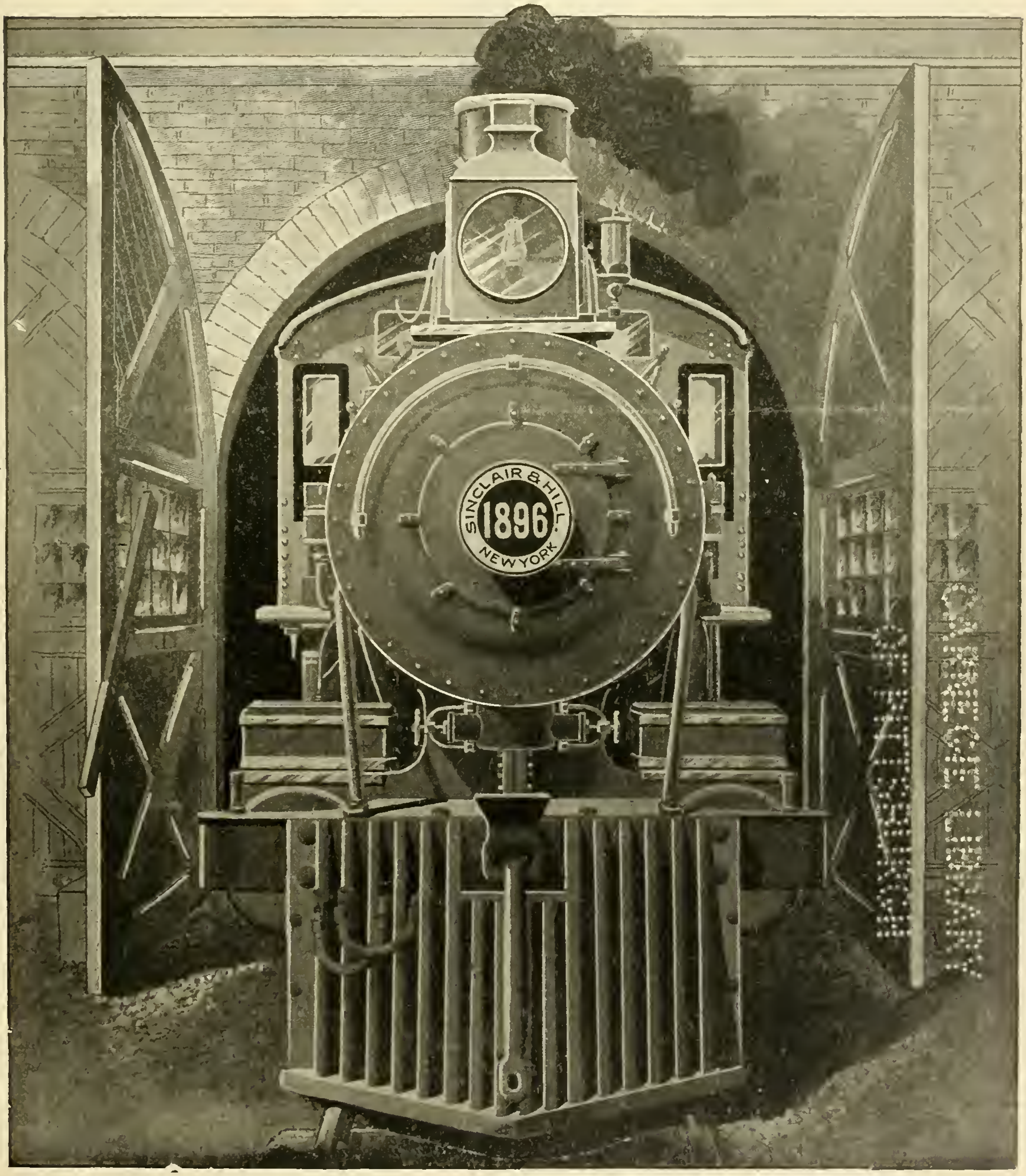
TECHNICAL INDEX, VOL. 9, 1896.

LOCOMOTIVE ENGINEERING

A PRACTICAL JOURNAL of RAILWAY MOTIVE POWER AND ROLLING STOCK.

Trade Mark Registered
256 BROADWAY, NEW YORK.



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TECHNICAL INDEX TO VOLUME IX, 1896.

**Illustrated Articles. Where figures occur in brackets, they refer to No. of Question on page following, thus (97), 106.*

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BOOK DEPARTMENT

Cash must accompany order. No books sent C. O. D. Give name of book and author, and we can furnish any book wanted. The list below is especially recommended for mechanical readers. All books sent by mail free for price named, unless otherwise stated.

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Progressive Examinations of Locomotive Engineers and Firemen. Hill 1893. Three hundred questions, and answers to them, on firing and running. Standard form of examination on several roads. Contains colored plates of standard train and engine signals. Every fireman should have this book.......................................50c.

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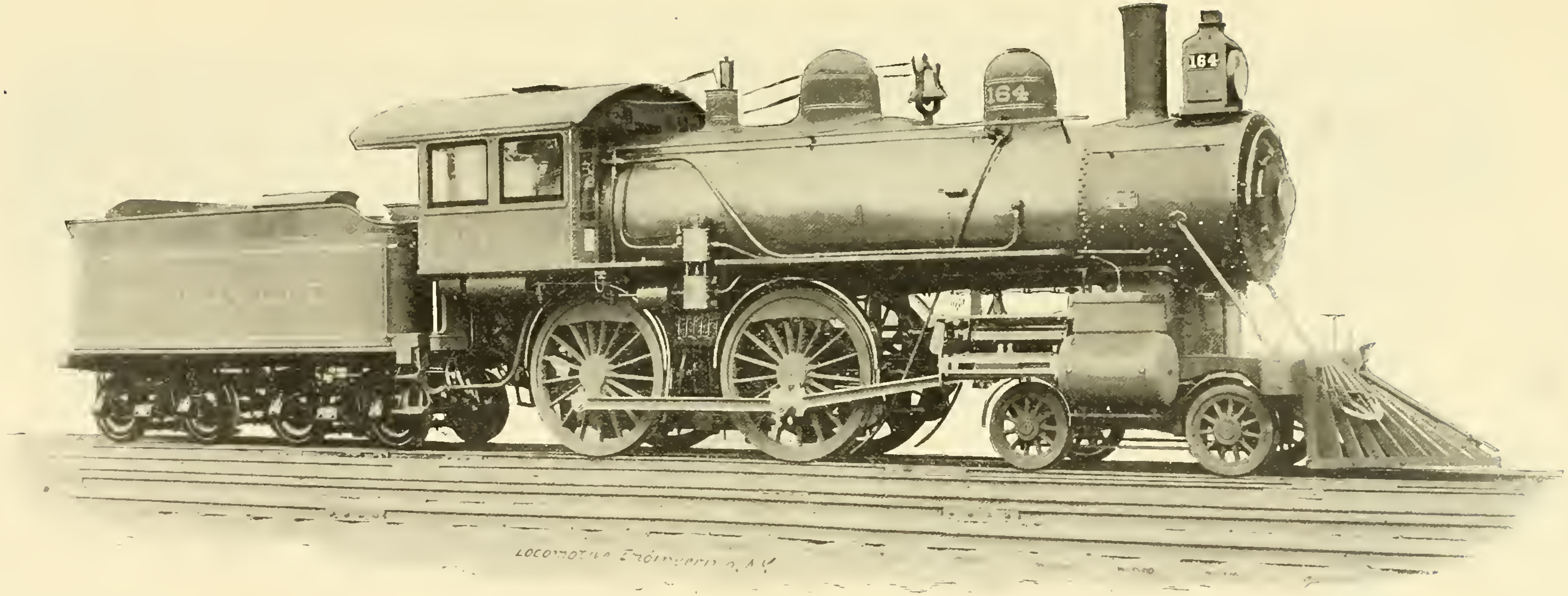
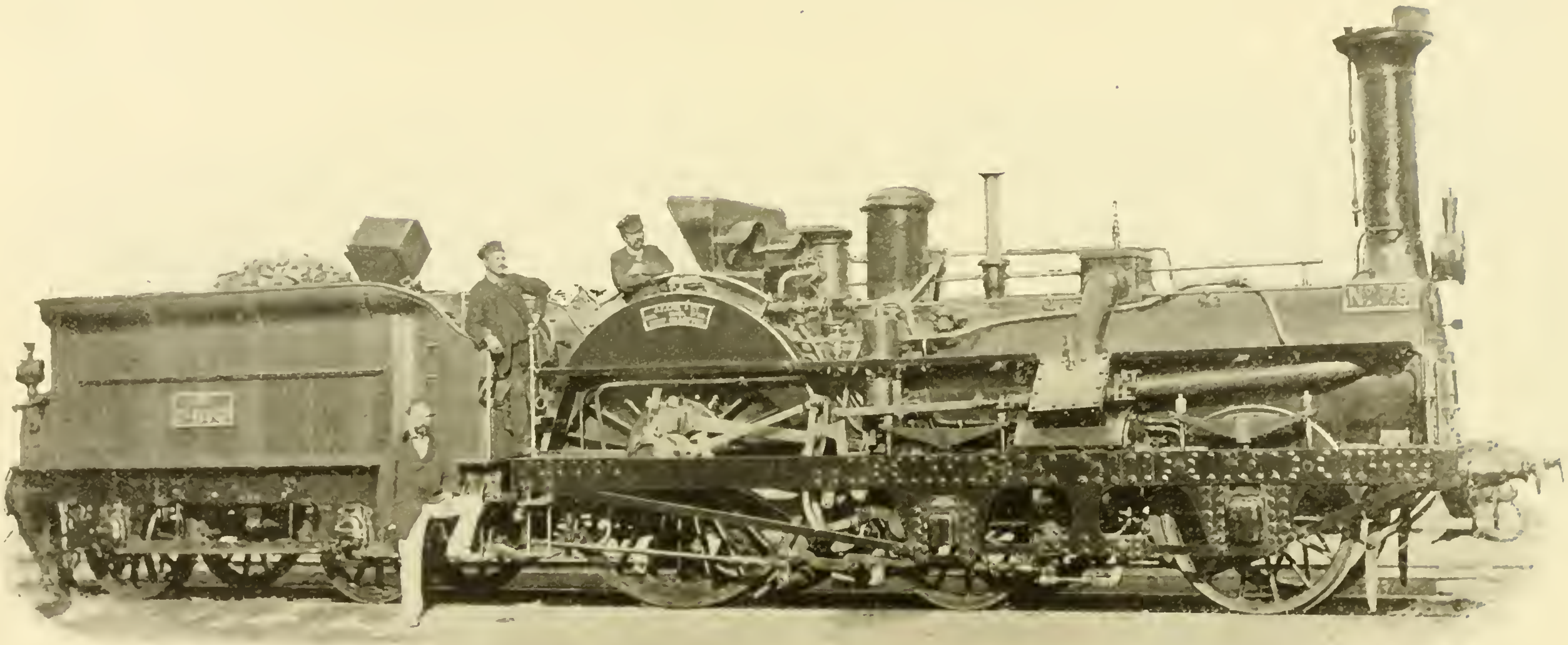


LATEST DEVELOPMENT OF THE AMERICAN LOCOMOTIVE.



Locomotive Engineering. N.Y.

A CRAMPTON LOCOMOTIVE. EASTERN RAILWAY OF FRANCE.

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Vol. IX. 256 BROADWAY, NEW YORK. No. 1.

The Latest Development of the American Locomotive.

The handsome half-tone on the first page shows the latest form of the American 8-wheeler—no radical change in the design, but a wonderful improvement ot details.

This particular locomotive has 20x24-inch cylinders; drivers 73 inches in diameter; extended wagon-top boiler, 62 inches in diameter; firebox 9 feet in length by 40 inches in width, and 320 tubes 12 feet in length; working pressure of boiler 190 pounds per square inch. The weight of the locomotive is as follows: weight on drivers, 84,500 pounds; weight on truck, 44,700 pounds; total weight, 129,200. Steel crossheads; connecting rods and driving-wheel centers were used with very much reduced sections, corresponding with the latest practice.

The weights of revolving and reciprocating parts are as follows:

Piston	420 pounds.
Crosshead	157 "
Main rod	470 "
Side rod	287 "
Main crankpin	125 "
Back crankpin	117 "

The saving in weight by use of cast steel driving-wheel centers over cast iron alone is 3,000 pounds.

These engines are handling heavy fast trains of the Vandalia line between St. Louis and Indianapolis.

This shows where the builders are seeking to make the most improvement—big boilers and lighter reciprocating and revolving parts.

The "164" is a handsome machine. There must be something wrong with a man that couldn't love an engine like that next best to his wife and babies.

A "Crampton."

Most of our readers have heard of "Crampton" locomotives; until a few years ago it was the only kind of locomotive shown in Webster's Dictionary, but there are few of our readers who have any idea that there are any of them still in existence. Here is the picture of a real, live one; still doing duty on the Eastern Railway of France.

You will note that she has the ear marks of the last two decades—air pump, injectors, etc.

Crampton was an English designer who, in the early days, found more friends for his system in France than at home, and Crampton engines became the standard of several lines there.

The leading feature of all his engines was the use of a large single driver behind the boiler, and in carrying the most of the weight on two pair of independent wheels ahead of drivers.

The early designs of Norris, in this country, were of the Crampton order, and he was often called the American Crampton.

There are some things about this picture that will interest Yankee railroaders. For instance the hod on tender for carrying the clothes box; the throttle-box and steam pipes, and the large and comfortable cab.

Blueprint Paper, and How to Prepare It.

We are so frequently asked about the relative merits of the prepared blue process paper and the paper prepared by the user, and also what are the best proportions of chemicals to use and how to apply them to the paper, that we will go into the details of these questions as viewed from a practical standpoint, and handle the same as we have found them in the drawing office.

To the first question the answer must be that there is no difference in the quality of prints when made on the best samples of both papers; they will each give uniformly good results if properly prepared and kept excluded from the light. But there is one other important consideration that should be kept in the mental foreground; and that is—"Will it pay to prepare our paper?" A reply can be easily framed from one's own knowledge of any particular situation.

If a man must be employed to do this, then it will plainly be an expensive investment; if it can be done by some one who can handle it in connection with other duties—say the blue-printing, for example—then the cost can be brought down to a figure closely approaching that of the commercial article; and below that, if the supplies are bought in quantities large enough to realize a discount on; but the question of quality will still be a factor in the problem, for it requires long practice to prepare paper for blue-printing that will be as even in good results as that purchased.

Then there are accessories to be bought that are necessary to do the work properly, namely, a mortar and pestle, a 16-oz. glass graduate and a 6-inch camel hair brush. Their uses are: The mortar to pulverize the crystals of red prussiate of potash, the graduate to measure the water used, and the brush to apply the prepared solution to the paper.

Leaving a choice of the two systems to those interested, we will give a brief explanation of the preparation of the sensitizing solution.

Take 1¼ ounces of red prussiate of potash, and pulverizing it to the consistency of flour, place it in a large-mouthed glass jar containing 10 ounces of clean water; take 2½ ounces of citrate of iron and ammonium and place it in a glass jar similar to the first, also containing 10 ounces of water. When the solids in each jar are thoroughly dissolved, their contents are to be poured into one vessel and well shaken, when it will be ready for use.

To sensitize the paper, it should be secured to a frame gotten up like a bill-board, if the space can be spared to do so, for then both sides of the board can be utilized for paper, and thus reduce the dimensions of the mounting board, which for ordinary use can be 30 x 60 inches; this will allow eight pieces of paper 18 x 30 to be sensitized at one operation.

The paper should then be secured to the board by two drawing tacks through the upper corners only, leaving it to expand when wet.

To apply the solution, pour it into a deep dish, and, taking a full brush of it, begin at the top and left hand side of a sheet, going from the top to the bottom, and so continuing until sheet is covered; after this is done, repeat the operation across the sheet, and it will be found to be quite evenly covered with the solution, as it must be to produce good results; an uneven application will always show in streaks on the print.

The sensitizing can be done in a moderate light, but it is best to do it in the weakest light possible, and take no chances for injury to the paper. Leave the paper on the board to dry, and afterward place in a dark, dry room, ready for use.

John Chinaman's Little Play Railroad.

There is in China one of the smallest railroads in the world.

Here is a photographic reproduction of one of the engines, built by Dubs & Co., at Glasgow, Scotland. The gage is only 1 foot 11⅝ inches, the cylinders are 5x10 inches, the drivers 24 inches diameter and the water tank holds 90 gallons.

If this was the standard sized engine in this country hardware stores would keep them, same as they do sausage-cutters. Railroad managers would order them by the gross, and locomotive engineers would be thicker than fleas in a dog kennel.

JOHN CHINAMAN AND HIS LITTLE PLAY RAILROAD.

There is a certain kind of merchant bar on the market, made from old steel rails, that is real pretty to look at, but no good for average blacksmith work. We find that some makers work in a few rods of this in every bundle or two of good iron. Will this pay?

Bound volumes of 1894 on hand.

No Dummy Couplers.

The C. B. & Q. have not only abandoned the practice of putting dummy couplers on the ends of all cars, but are actually taking them off.

It was found that in a majority of cases the couplers were not used, and the hose hung open anyway. Again, when hung up the hook alone was often used instead of the whole dummy, and the end of hook chafed and destroyed the gasket.

They are having no trouble at all in letting the hose hang; if this becomes epidemic the M. C. B. Association will have to modify the rules of interchange, for some of the strict inspectors will reject cars now that are short a dummy coupling.

Some engineers in one section of the country have objected to our advocacy of the Brown system of discipline. All we have to say is that a man who would rather be "suspended pending investigation," and afterward laid off from ten to thirty days for infractions of rules, instead of being talked to quietly and alone by the proper official and allowed to go to work at once, is a hard man to please; and reminds us of Artemus Ward's old saying: "It taks a lot of kurios kritters to make a menagery."

A bushel of bituminous coal weighs 76 pounds.

Master Mechanics of the Central Railway of Brazil.

We are indebted to Mr. Lewis Gleason, of the Brooks Locomotive Works, who has recently returned from Brazil, for photographs reproduced herewith, accompanied by the following comments on same:

It is well known to the readers of "Locomotive Engineering" that the United States can justly claim to have within its borders some good-looking master mechanics—brainy men, whose mechanical ability and their never-ceasing quests after labor-saving devices is not excelled and seldom approached by like officials in any country in the world.

That the Republic of Brazil has its full quota of good-looking master mechanics (Chefos do Depositos) is fully vouched for by the group which appears in this number of "Locomotive Engineering".

First in the group, commencing from the left, is Mr. Antonio Gomes dos Passos Perdigód, a "Rio Grandense," or native of the State of Rio Grande do Sul, Brazil. Mr. Perdigód served his apprenticeship in the Navy Yard shops in Rio de Janeiro, at the expiration of which he was transferred to the Government railway shops at Engenho de Dentro. He has had charge of the shops at San Paulo and Lafayette. At present he is master mechanic of the shops at San Diego, Rio de Janeiro.

Next in order is Mr. Arnaud Gustavo Bión, a native of France, but for many years with the Central Railway of Brazil. Mr. Bión's first employment with the road was as a machinist, afterwards as locomotive engineer, and for twenty years was master mechanic at San Diego; recently he was appointed general inspector of all shops in the system.

During Mr. Bión's career as an engineer he was detailed to pull the first train equipped with air brakes, in connection with which he tells the following story: "The day of the trial trip was looked forward to with much eagerness, to prove the practical working of the new idea. Dom Pedro II (the late Emperor of Brazil), accompanied by his Ministers, occupied the state coach which was attached to the train, the other cars had as occupants many principal officers of the government, mechanical engineers, etc.

"My orders were to make the best possible time, after city limits were passed, and when the Emperor was satisfied with the speed he was to pull the bell cord as a signal for me to apply the brakes. I carried out my instructions, and when I got the engine running at a high rate of speed, I anxiously waited for the signal. It did not come, however, but something else came which answered the purpose, for after rounding a curve and getting on to a straight piece of track, it almost made my hair stand on an end to see, at a short distance ahead of me, a large rock between the rails. I instantly applied the brake and reversed the engine (there was no driver brake at that time), the train came to a stop just as the tip of the pilot got to the rock; the many valuable lives I had saved made me feel almost certain of a decoration of some kind, but, on going forward to remove the rock, judge of my surprise to find it was only a skillful imitation made of paper, and placed there by Emperor Dom Pedro's orders, to better test the efficacy of the brake in sudden emergencies. It served its purpose, and made the air brake a permanent fixture."

The third of the group is Mr. Joaquin Jose de Loura, master mechanic at Entre Rios. This gentleman is also a graduate of the system, a Brazilian, and a clever man.

Picture No. 4 is Mr. Antonio Lopez Ferras, master mechanic at Burra de Pirahy. Mr. Ferras is a Brazilian who has been with the road since boyhood, gradually advancing until he attained his present position.

The fifth, and last is Mr. Alexander Robau, born in France, but for many years with the Central of Brazil. He resigned his position as master mechanic at San Paulo some months ago to go into business, and is now at the head of a flourishing engineering establishment in San Paulo.

Taken as a whole they are a courteous, intelligent and good-looking body of men.

The first man to properly get at the true weight of coal used by his engines was Geo. S. Griggs, on the Boston & Providence, nearly forty years ago. He weighed engine and tender before and after taking coal. The N. Y. Central are just commencing that practice. The Wisconsin Central use a spring scale on their coal buckets. Most of the other roads are guessing at it.

THE MASTER MECHANICS OF THE CENTRAL RAILWAY OF BRAZIL.

The Boys Named 'Em.

A long time ago an engineer on the Fall Brook road made a fast run down several bad grades with a coal train, and the superintendent heard of it. He not only called the engineer upon the carpet, but he put up boards at the head of all stiff grades, stating just how many minutes freight trains must use in getting to the bottom.

The engineers dubbed the new signs "McCoy's time-cards," and they are known as such even to this day.

Stack Black.

Claude Ayers, the hustler of the Ft. Worth & Denver City road, at Clarendon, Tex., has a famous receipt for stack black that saves time and makes a handsome job, that Claude says, "Has the right of track over everything on the road." The receipt is as follows: Asphaltum, 8 pounds, and fuse in an iron kettle; then add 5 gallons of linseed oil, 1 pound of litharge, ½ pound of sulphate of zinc (add these slowly or it will foam over). Boil three hours, and then add 1½ pounds of dark gum amber and boil 2 hours longer, or until the mass becomes quite thick, when cool. After this it should be thinned to a proper consistency with turpentine.

How do you fasten collars or chafing plates on hubs of driver boxes? Some use brass in halves put on with copper patch bolts riveted—expensive. Many use babbitt metal on hub and box—cheap and good. On the Fall Brook they use plain cast rings, loose; they are put on new as well as old work and are a success.

The "Novelty."

An Experimental Locomotive of the '40's Reminiscences of Her Engineer.

In looking over the stock of old locomotive pictures in the hands of Mr. F. Moore, of London, Eng., we ran across the picture here reproduced, marked "An Old B. & O. Engine." This photograph was evidently made from a daguerreotype.

"Locomotive Engineering" got the photograph and submitted it to the officials of the B. & O. for some data from the archives of the road—there were none. No one on the B. & O. had ever heard of such a locomotive.

Someone, however, remembered that the Reading road built a locomotive with a separate boiler many years before. We wrote Mr. L. B. Paxson, superintendent of motive power, about it and got a clew at once, as the following extract from his letter will show:

"* * * I duly received your favor, with proof of photo engraving of the engine 'Novelty.'

"I would state for your information that this engine was invented and patented by G. A. Nichols, somewheres along about 1846 or 1847, and was built in the Reading shops and ran on the Reading Railroad for a short time. My recollection of the matter is that the engine was thrown out of service in 1848. I remember the engine very well, and it was run for a portion of the time by Mr. David Clark, who was lately master mechanic of the Lehigh Valley, at Hazleton, Pa., who could give you, probably, a more correct history of the engine than I can. I am going to hold on to the proof of this engine, unless you desire it sent back, as I am free to say that it is a very interesting one to me. I was not aware that there was anything like as full a picture of it as is shown on this photograph. You, of course, understand that in addition to this the tender for carrying water was attached to the car that carried the boiler. * * *"

We then sent a proof, and a request for data, to Mr. Clark, who replied as follows:

"* * * The locomotive 'Novelty' was built by the P. & R. R. R. Co. in 1846-'47. I worked in the Reading shop during the building of the locomotive, and I had charge of some of the principal work on this engine, and when completed was sent with it as a traveling machinist to keep it in repair. It was but a short time after that the engine was turned over to me as its engineer.

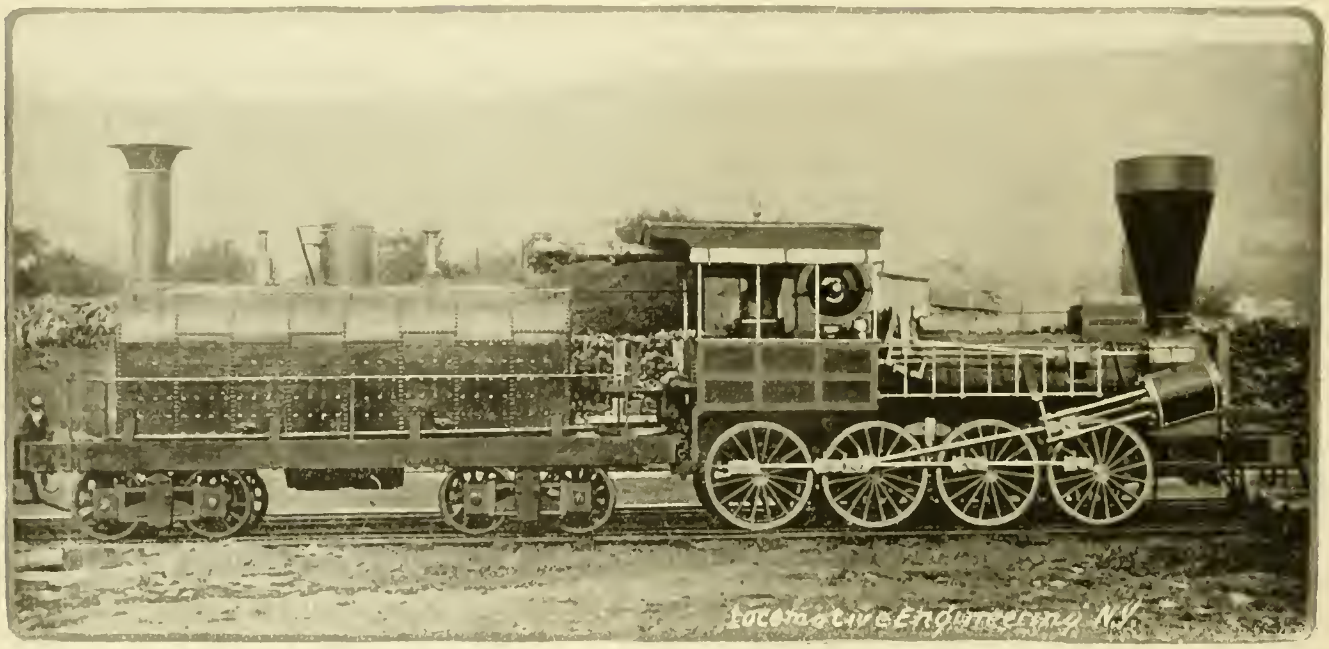
"* * * The engine was an eight-wheeled engine, boiler on two 4-wheel trucks, and tender run behind the boiler on two 4 wheel trucks. The machinery of the engine was attached to a plain cylindrical boiler which was used as a reservoir. The exhaust steam was conveyed through this water, in pipes, as a heater, thence up the stack.

"The engine was first turned out with pump underneath, driven with eccentrics on forward axle. The water was pumped through universal-jointed pipes similar to the steam pipes connecting the boiler with the engine. This arrangement was soon abandoned, and a steam pump placed on the frame of the boiler near the fan, which was used to force the fire. You ask how the valves of the engine were operated. Eccentrics were on the axles of third pair of driving wheels. The eccentric rods were connected to a bell crank, with an upright connecting rod to rock shaft on top, running up through what would be called the boiler. The upright rods were in water-tight passages through the boiler.

"One of the causes of failure was the distance the steam had to travel before reaching the cylinders. Another was that the fire would not last from one station to another, as we had to stop the fan to replenish the fire. Consequently the engine was a complete failure.

"I have thought since, if we had put a jet of steam in the stack it would have been quite an improvement; but steam jets were not thought of at that time. The idea of this kind of engine was that a boiler large enough to burn anthracite coal successfully on the same wheels of the engine would be too heavy for the road.

"About the time this engine was built, Ross Winans, of Baltimore, built three engines for the P. & R. R. R. They were eight-wheel connected engines, horizontal cylinders, with a long, overhanging firebox, to compete with the 'Novelty.' These engines were delivered at Reading about the time the 'Novelty' was finished. On account of the long overhanging firebox, they were not allowed to run on the road, on account of too much weight on back wheels. Mr. Winans then put a steam cylinder on the back end of each side of the firebox and a pair of pony wheels under the back end of firebox, the piston rods resting on the journal boxes. Steam was admitted on top of the pistons; the pressure on the piston took some of the overhanging weight off the back end of the engine, and they were allowed to go into service. I ran one of these engines some time, and they were much better than the 'Novelty.'"



EXPERIMENTAL LOCOMOTIVE "NOVELTY," READING RY., 1846-47.

* * *

We are out of copies of June, October and November, 1895.

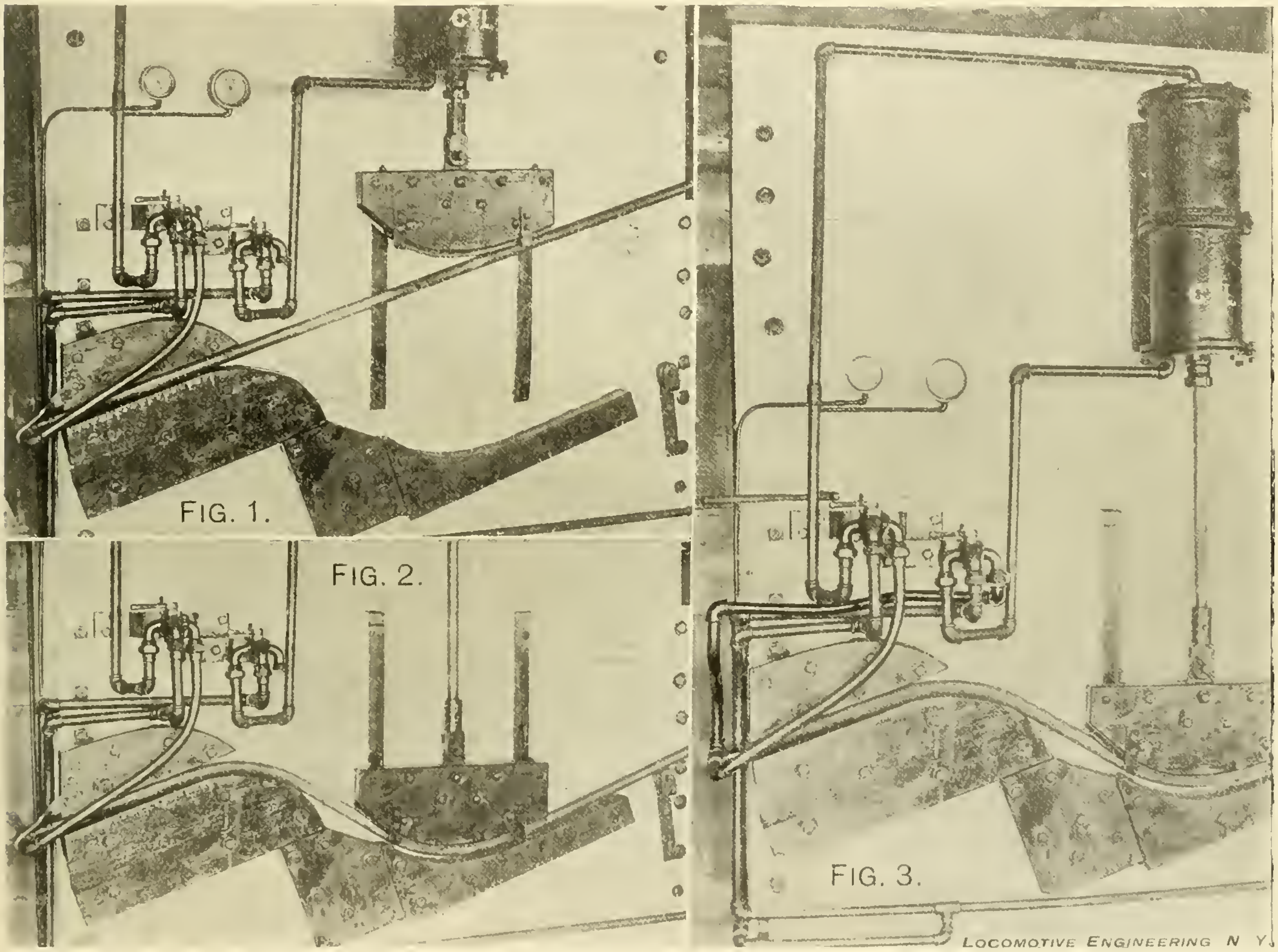
Device for Bending and Cleaning Out Air-Brake Pipe.

At the Aurora shops of the Burlington road they have rigged up an efficient and simple device for bending brake pipes for cars.

The equipment of many freight cars required the bending of lots of pipe, and, with hand work, this was a slow process and no two pipes were exactly alike. This device consists of wooden formers of the shape necessary to bend the pipe, bolted to planking on the wall of the stock shed in freight car repair yard, a cylinder and head with suitable valves.

The first effect of the ram is to bend the pipe down; this brings the free end upon the grooved bearing wheel, shown at the end of the lower former; then the pipe is drawn back as the second bend is made. Fig. 1 shows the parts when the pipe is in position to be bent; Fig. 2, after the pipe is bent, and Fig. 3, the whole apparatus, including the cylinder. It also shows a means of piping the exhaust from both three-way valves, so as to do more effective blowing out of the pipe.

This machine bends the pipe to uniform shape as fast as a man can put the piping in and take it out, and is one of those handy kinks that save a lot of time, bother and money. It was gotten up jointly by Mr. J. H. Hubbard, foreman of the car machine shop, and Mr. J. R. Cuthbert, foreman of air brake repairs under freight equipment.



AIR PIPE BENDING MACHINE, C., B. & Q. SHOPS, AURORA, ILL.

The ram or head is made of hard wood shod with metal. This ram is operated by an air piston, and a stroke of 26 inches is gotten ingeniously by putting two old 10-inch air cylinders together. The piston is controlled by two old three-way cocks, one being used to force piston down and the other to raise it.

The best part of the whole scheme is the piping of the exhaust air from the three-way cock to a nipple that forms the end stop for the pipe; this blows the pipe out after it is bent, and it is wonderful the amount of scale, dirt and rust that comes out. In ordinary practice this scale finds its way to the triples and causes trouble.

All the talk and all the resolutions about standard trucks for freight cars amount to nothing. The railroad men of America never did and never will build diamond trucks alike—or any other kind of truck. A standard form will only be reached by the general purchase from a manufacturer of a superior article.

A somewhat seasonable question presented for discussion at the last meeting of the American Society of Mechanical Engineers was, "Has any one found it to pay to exhibit in recent international expositions, where to do so entails a cost of attendance, transportation, and other heavy charges?" Exhibiting goods at expositions is an enterprising and expensive form of advertising. In rare cases it brings satisfactory returns, but in most cases the outlay has to be regarded as a compliment to the country or districts where the expositions are held. We have talked to a great many manufacturers who have been in the habit of making displays of their goods at expositions, and the general conclusion is that it does not pay.

At the Aurora shops of the C. B. & Q. they make up enough car brasses in the fall to last them through the winter. This work is done in a shed outside of the regular brass foundry. A Tabor molding machine is used, and two men put up the flasks for 640 brasses in a day. The brasses are all lead lined on the spot, and the two men working at it are experts; they make good wages and still line brasses for less than a dollar a hundred.

Notes from the Union Pacific Shops at Omaha—Some New Air Tools.

It is generally conceded that the Omaha shops of the U. P. have more air tools in use, and that more air devices are originated there, than in any other railroad shop in the country. I believe this is true.

The air for the plant is furnished by three large compressors, located in a separate power house and driven by a battery of boilers of their own. But, big as these compressors are, they are unequal to the demands upon them, and a very large compressor is half finished in the shop.

When Mr. Joseph McConnell, the genial superintendent of motive power, starts out to show you the shop, the first air tool you notice is in the back office he takes you through, and consists of an air cylinder on the copy press in place of the old screw. It does the work of the large press well, and much quicker than could be done by screw and wheel.

AIR ON TRANSFER TABLE.

By carrying hose on a long, swinging crane, air is taken to the transfer table and drives it through the medium of a Westinghouse engine. The table is reversed by throwing gearing out and in. This requires no attendant, as any mechanic can stop and start it with ease and safety.

A MONSTER PUNCH.

The largest air tool around the place is a monstrous punch, located out of doors and at the end of the boiler shop.

Our illustration will give some idea of the size of this tool. The cylinder is 40 inches in diameter, and the housings large enough to allow the largest boiler sheet—238 x 96½ inches—to be swung between them.

A large special crane, not shown in this photograph, serves the punch. It will pick up and handle the largest sheets. All sheets are laid out here and punched flat before they ever go into the shop at all.

Shear blades are substituted for the punch, and a coupon cut off every sheet and sent to the laboratory.

As will be seen, this press is a home-made one; the anvil, or die block, is the end of an old driving axle, and the wheel center was left on it to form an ample base. The details of construction will be plain from the engraving.

BOILER SHEET RECORD.

While on the subject, I might as well mention that a chemical and physical analysis is made of a coupon cut from every sheet used; the sheet is numbered, and a record book tells just what part of what boiler it becomes, and subsequent records show what it does. In time this record is going to be of the greatest value, not only to the U. P. road but to American railroads as well, for it does not record that Shoenberger, or Carbon, or Otis steel was used in a certain place, but steel of such and such analysis. Perhaps from this record a new set of specifications may be made up that will amount to something.

AIR ON FLANGE FORMER.

There are too many sizes and shapes on a road like the U. P. to make it pay to buy and use a flanging press. Hand-flanging is done, but they use air to hold the hot plate on the former and make it "stay put." Our picture shows how this is done: A long cylinder, fixed by a ball joint to a flat plate, is used to hold down the hot plate while being worked on. This cylinder is entirely out of the way of workmen, exposes the entire edge of the plate in position to work on, and makes it possible for more men to work at once. When out of use the platen and piston are lifted high enough to give a clear floor space in the shop.

PUNCH OUT OLD STAY-BOLTS.

When a firebox is cut out of an old shell, it leaves the said shell full of stay-bolt ends screwed in and riveted on the outside. The usual plan is to drill them out or cut them out with a hand tool. Here they sling the boiler up on the big riveter, using air instead of hydraulic power, and the stay-bolt ends are punched out. This strips the thread, of course, but by any process the holes must be re-tapped, and these are in better shape for it than are those on a boiler where the bolts have been drilled or cut out, and the saving of time is something wonderful.

TAP AND REAM WITH AIR.

All tapping, reaming and turning in of stay-bolts is done by air motors attached directly on the tool. For turning in stay bolts they use a

STAY-BOLT CHUCK,

which is shown in detail herewith. This is a simple little affair that does the business to the Queen's taste. No square end

HEAVY TEN-WHEELER, FOR TRANSCONTINENTAL EXPRESS, U. P. RY.

is required for the bolt; this chuck takes hold of the threaded or blank end and forces it home, driven by the ever-ready and active little motor behind it.

COPPER FIREBOXES.

For the past eighteen months they have been using copper for side and door sheets of fireboxes in some of their bad-water districts. Results, so far, have been good.

GOOD BOILER WORK.

Especial care is taken in boiler work. Hollow stays are used exclusively. The sheets are as large as can be used, and all seams avoided where possible. A single sheet forms the barrel, and a single sheet forms the shell around the firebox end. There are no side seams. Crown bars are used exclusively. Boilers are all lagged with magnesia blocks fitted to them exactly, even the front end is covered and jacketed.

A POWER FLUE-SWAGING MACHINE.

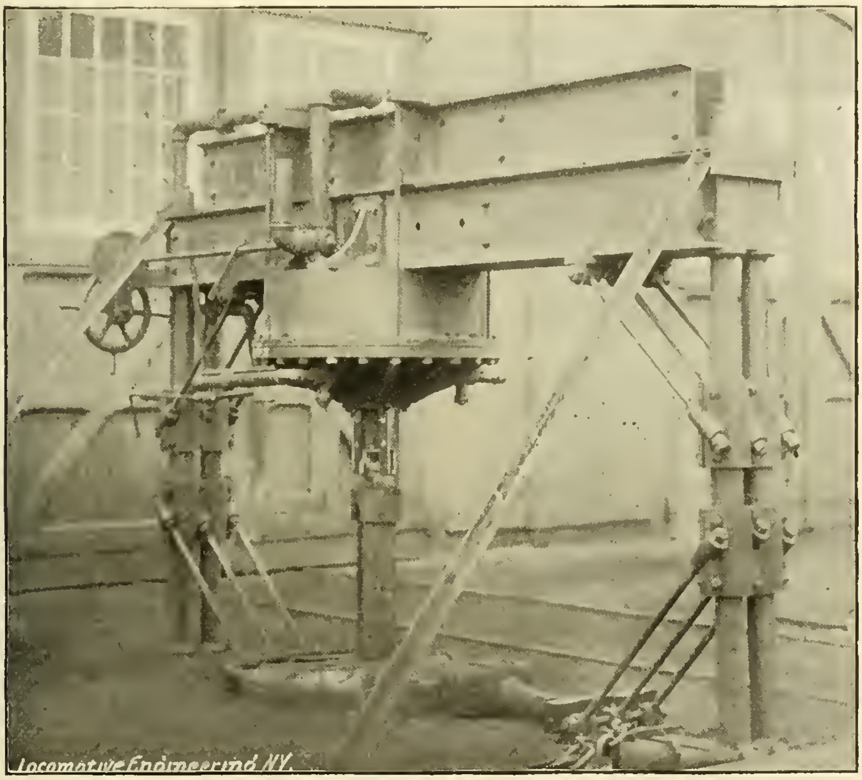
In a little room off the boiler shop they do the flue work—and there is lots of it. They have recently put into use here a swaging machine that is a good one and almost as simple as the taper hole in a piece of iron, that is yet used almost universally to pound flues into, and by courtesy called a swager.

Our picture shows the machine. Its dies are made of heavy plate, perhaps ¾ of an inch thick, the lower one fast in the frame and the upper one having a movement vertically of about half an inch, imparted by the eccentrics on the shaft. The eccentric rods are adjustable in the straps, and may be set to vary the size of opening of dies.

In swaging down flues for copper ferrules, the dies are adjusted just right, a chalk mark made over the die used, and the swaging done as fast as the flues can be handled by two men, there being a fire each side of the machine. There are six different openings in the die block, covering all sizes of flues and arch pipe used on the road. On the right hand upright of the machine is shown a small air hose, used to clean the scale off the work.

HOISTS AND ELEVATORS

throughout the shop are handled by air, and almost every tool has its hoist ever ready to do the heavy lifting.



FORTY-INCH AIR PUNCH AND SHEAR.

FINISHING THE INSIDE OF WROUGHT PIPE FOR AIR CYLINDERS.

Like most shops, they are obliged to make their own hoists if they get any, and as many of their hoists are large and made of wrought pipe, I was anxious to know how they finished the interior—by grinding or boring. They do neither. Large and long cylinders are finished by shoving through them a steel die that cleans them out and trues them up in good shape. This die is a flat piece of steel with a sharp square corner, and is forced through the pipe by the big wheel press.

POLISHING A BELL.

It has been found that turning up the outside of a locomotive bell changes the tone—and never improves it. To avoid breaking the outside skin of the casting, new bells are polished in a new way. They are packed in a small wooden box with lathe turnings around them and "tumbled" for a day or so in an old lathe. This cleans and polishes them, and it is claimed, makes a better sounding bell, besides being cheaper than turning.

BABBITTED ECCENTRICS.

They have gotten over all serious annoyance with eccentrics, and the cure has been babbitt metal. All eccentric sheaves are turned up true, with the proper amount of throw, the straps are bored out half an inch too large and with the face recess dovetailed; then the babbitt metal is poured into the strap on the eccentric itself; the strap is then taken down, and the soft metal scraped up a little, the fins taken off, and oil holes opened.

With feeder cups, these eccentric straps run a very long time without wear, and they have never yet had one hot enough to throw the babbitt.

No work is ever done on the straps, not even to close them, and as they are not subject to wear they are a permanent job. When straps need closing they re-babbitt them.

FLANGE PLATE HOLDER.

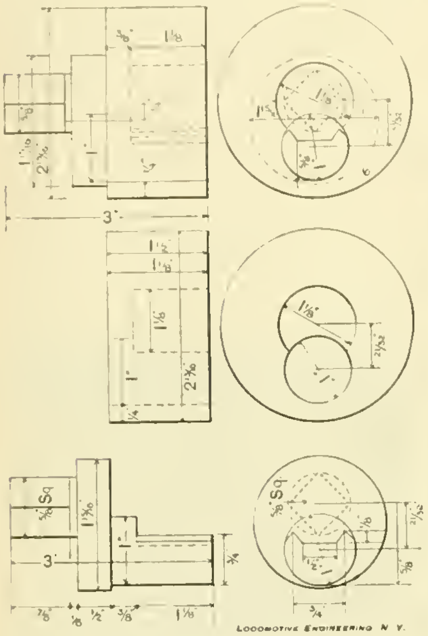
SOFT METAL ON DRIVING BOXES.

The sides of driving boxes are bored out, or recessed, to hold babbitt metal, and all side motion is taken up in this way. New driving boxes are cored out to receive the soft metal without machine work.

HEAT TRAINS WITH EXHAUST OF AIR PUMP.

In anything but blizzard weather their

ordinary sized passenger trains are heated with the exhaust from the air pump. This is controlled by the valve shown herewith. This valve is located in the exhaust pipe of the pump. When set as shown in our engraving, it automatically takes care of the steam supply. The exhaust steam, entering the valve at the top opening, cannot go to the stack direct, but is free to pass back to the steam-heater pipes, until the pressure there is great enough to overcome the spring



STAY-BOLT CHUCK.

shown in right side of casing. This allows the check valve to rise and steam to flow through the by-pass to the open exhaust in the stack. The plug of this three-way valve may be turned to force all the exhaust to the stack, but cannot be set so that the exhaust must go to the heater pipes only.

This kind of an arrangement may be hard on a pump, but it certainly saves lots of steam, as the ordinary air pump exhausts when its cylinder pressure is the highest.

Only in the coldest weather do they need to supplement the pump exhaust with live steam.

SUSPENSION OF TANK RIVETER.

In the tank shop, as may be supposed, every rivet is driven by air. The riveter is suspended on an overhead track; but instead of the usual traveler and rail, requiring the constant moving of the riveter and the swinging and pulling usually done, they have a simpler plan. The track overhead is exactly the size and shape of their standard tank. The tank is set up if a new one is to be built, or located in a fixed position if an old one is repaired, and directly under the track. The riveter follows around the outside of the tank shape and into the U of coal space, the workman simply moving it forward.

AIR ON NUT TAPPER.

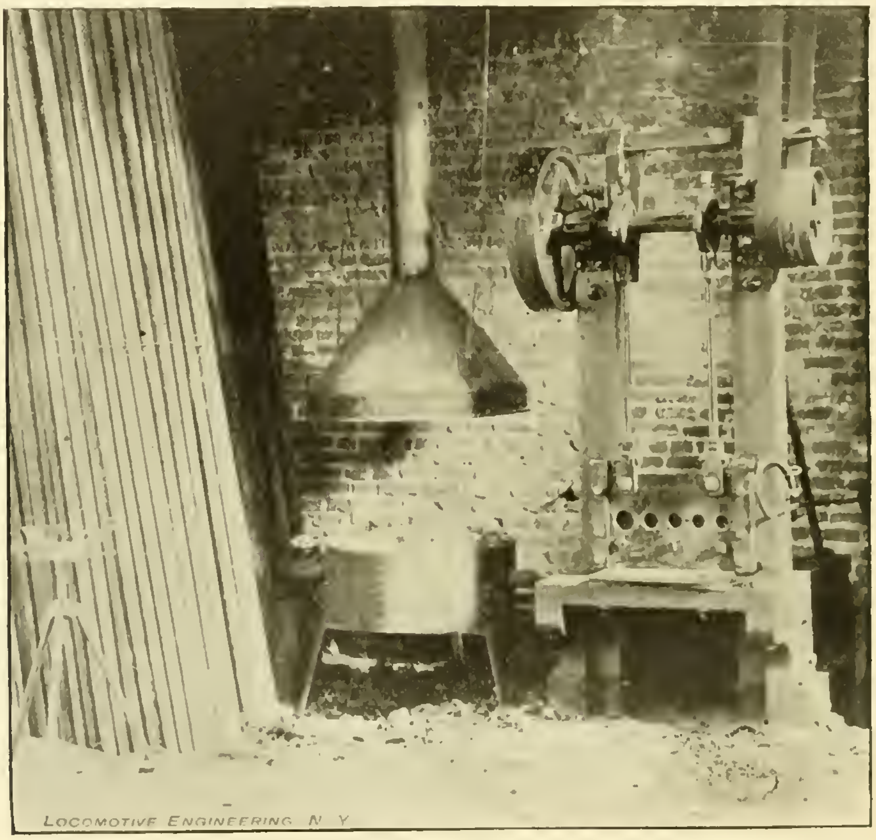
They use a multiple-spindle nut tapper, one of the kind in which the taps stand upright and are driven from below, and in which the operator drops the nut on the tap by hand, places a double-handled socket wrench over it to prevent turning and starts the tap into it by holding down a lever that forces the nut upon the tap. Here, as elsewhere, the oldest men in the shop are put on the nut tappers, and it is hard work hanging on the levers all the time, besides it is slow work. They made neat little cylinders, over each tap, out of $1\frac{1}{2}$-inch copper pipe, and put a piston in them. Now the artist touches a tiny tap, and air pushes the piston down, forcing the nut on the tap; while the next nut is being placed in position, the air in the cylinder last used has done its work. This saves hard work for the men, and lots of time for the company.

SAND-PAPERING MACHINE.

One of the most ingenious and useful air tools about the place is the sand-papering machine used in the car shop. This is an air motor carrying a disk on the end of its shaft, upon which is fixed a piece of sandpaper.

Our photographic reproduction shows the tool at work. The supply hose is on the right of the operator; the larger hose, of cotton duck, is the exhaust; this is conducted almost to the floor, and serves to carry off the dust, the machine being cased up to keep the latter from flying. By keeping the floor very wet, most of the dust is kept down. The machine is suspended by an air hoist, having a cylinder of 2-inch copper pipe some 8 or 10 feet long. The maximum air pressure in the shop system on this piston just balances the weight of the machine, and it can be raised and lowered with a very slight effort on the part of the operator—a counterbalance weight was tried, but without success. This tool does as much sandpapering as six carpenters formerly did, and does it better, for it makes an absolutely uniform surface all over the side of the car.

Our outline drawings will explain the details of construction. The motor itself is very similar to the motors used about the shop for various other purposes.



POWER FLUE SWAGING MACHINE.

As will be seen, the air and exhaust ports are located in the heads of the cylinder. The adjusting screw on top is to lower the sand paper wheel just the right amount below the wooden blocks that rest on side of car—if too low, the tool "chatters" and digs ridges in the work. A sixty-foot mail car is sandpapered in a day and a half by two men, going over the work first with a coarse paper and then with a fine grade.

ROD STRAIGHTENER.

Outside of the freight car repair shop is located a simple set of heavy, short rolls, used for straightening out bent rods. There is always a tangle of bent truss rods, deformed brake rods, and the leavings of wrecks and fires, that are so crooked that a cord of 'em makes a carload. A laborer can straighten these rods by means of the rolls so that they can be handled and gotten back into service.

CHANGING WHEELS.

They have increased the size of drivers on many of their freight engines with good results, and many half-worn tires of the smaller size are piled up waiting to be worn out by the quill-wheels still in service.

FREQUENCY OF REPAIRS.

For their service Mr. McConnell thinks they get better results and the engines earn most money when they are kept at the maximum of their efficiency. He does not believe that it is a good business policy to run an engine when she is not capable of doing first-class work, when the condition of her boiler requires the expenditure of more fuel to generate a given amount of steam than it would if it were clean, and when defects in her machinery, due to wear, prevent her from being economical. Therefore, they take in freight engines for thorough repairs after a mileage of from 38,000 to 40,000 miles, instead of operating them to the failure point. The result of this policy is that their record board shows most of the power either in "good order" or "in shop," and mighty few as "fair" or "bad."

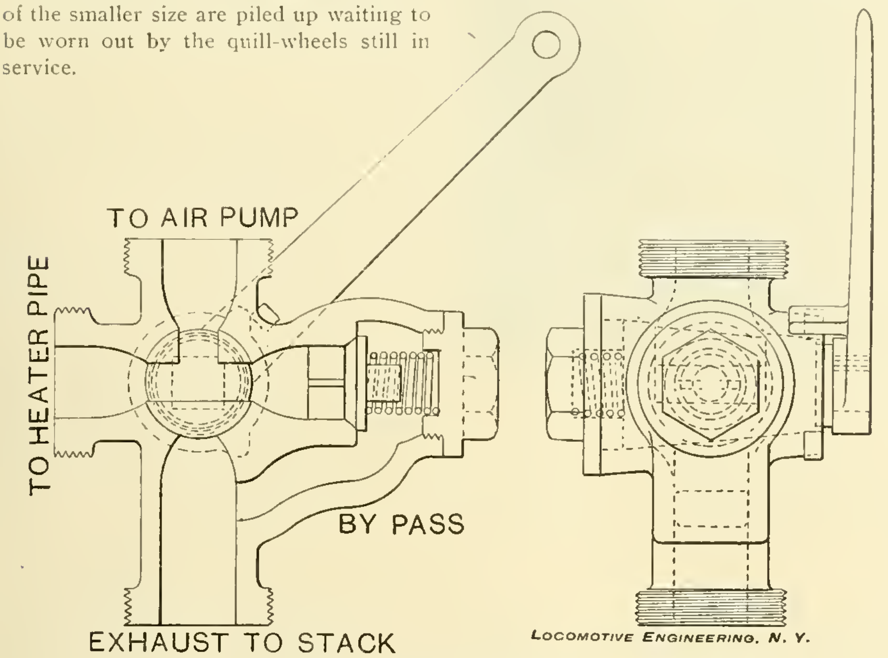
THE NEW TRANSCONTINENTAL TRAIN.

The first train of the new Pacific flyer to run from Chicago to San Francisco in 76 hours, was in the shop being painted and varnished while I was there. The new color for passenger equipment is "Van Dyke brown," which is so near black that there is no difference to the average observer. It looks splendid, and shows up the simple gold leaf ornamentation to good advantage. The engines are painted to match the train, and the splendid 10-wheelers look like business.

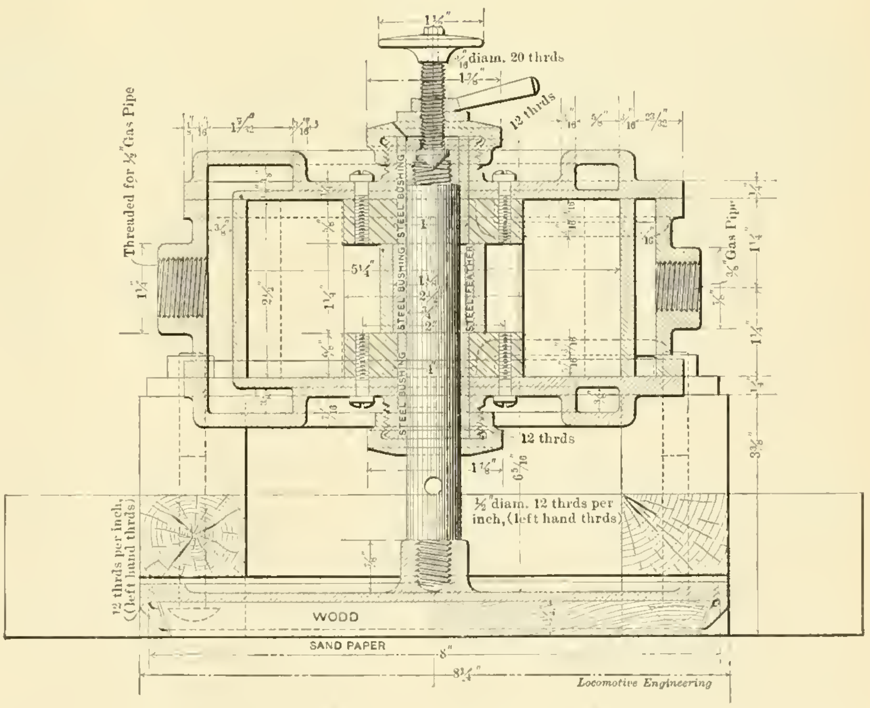
THE "1800"

is a sample of one of the engines built at Omaha. They are put up to stay and are modern and up to date in every way.

Perhaps the U. P. is the only trunk line of any size in this country using a short smokebox and diamond stack. Certainly



AUTOMATIC CONTROLLING VALVE FOR HEATING TRAINS WITH EXHAUST FROM AIR PUMP.

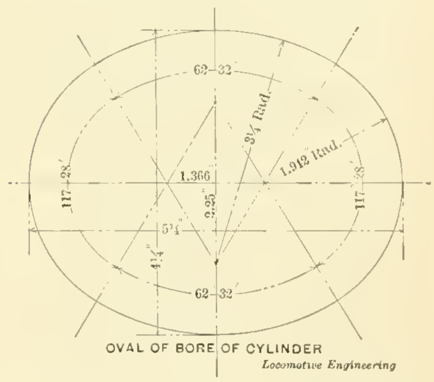


SECTIONAL VIEW, SAND PAPERING MACHINE.

it is the only one that ever discarded extension fronts to go back to diamond stacks. But, it should be remembered, it is also the only one burning a light coal with only 24 per cent. of carbon, and running through a dry country where fires are disastrous, and doing work with a fuel record second to few.

FRONT ENDS.

The standard front end has a petticoat pipe that is adjustable from the outside, the handles coming up each side of the stack and being secured by set screws. No pet changes are now made to suit the whims of engineers to make their engines steam. When the engine is in good condition, and steam cannot be had by adjustment of the front end, an improve-



ment is always made by changing engineer or fireman.

APPLYING AIR BRAKES.

Most of the modern equipment of the U. P. has air, and old equipment is being supplied at the rate of 300 sets per month.

PUNCH AND PRESS TINWARE.

In the tin shop all tops, bottoms, handles and other parts of standard tinware are cut and formed by air-operated presses.

A HISTORICAL RELIC.

Out in the coach yard stands the battered hulk of what was once the car used by President Lincoln during the war. In the loft over the upholstering shop there remains, carefully covered over, a large arm-chair and one of the old-fashioned settees used in the state room of this car. In another place is preserved the pictured panels that once adorned the free-story. This old relic, or some part of it, would seem to be worth preserving in the Field Railroad Museum, at Chicago.

A SENSIBLE WAY TO INCREASE THE OUTPUT.

The Omaha shops, like many others, are small for the work they have to do. The machine shop is especially small and crowded. When it was proposed, some time since, to increase the force and the output, Mr. McConnell asked for a less increase of men but the privilege to work nights in the machine shop.

The day force do all the machine work they can, and a day force prepare work for all the machine tools to work on at night, so that every machine is cutting metal night and day and really keeping up to a very large force of men in the other departments.

These shops and yards are in the cleanest and most orderly condition I have ever seen them, and I have visited them when under five different managements.

There are many good practices and good kinks here that I have not told you about. Mr. McConnell and his hustling master mechanic, Mr. Manning, are prolific in expedients—and I want something left for another time.

I have not tried to tell you of all the air tools in use—they are everywhere—but only of some new ones recently brought out there.

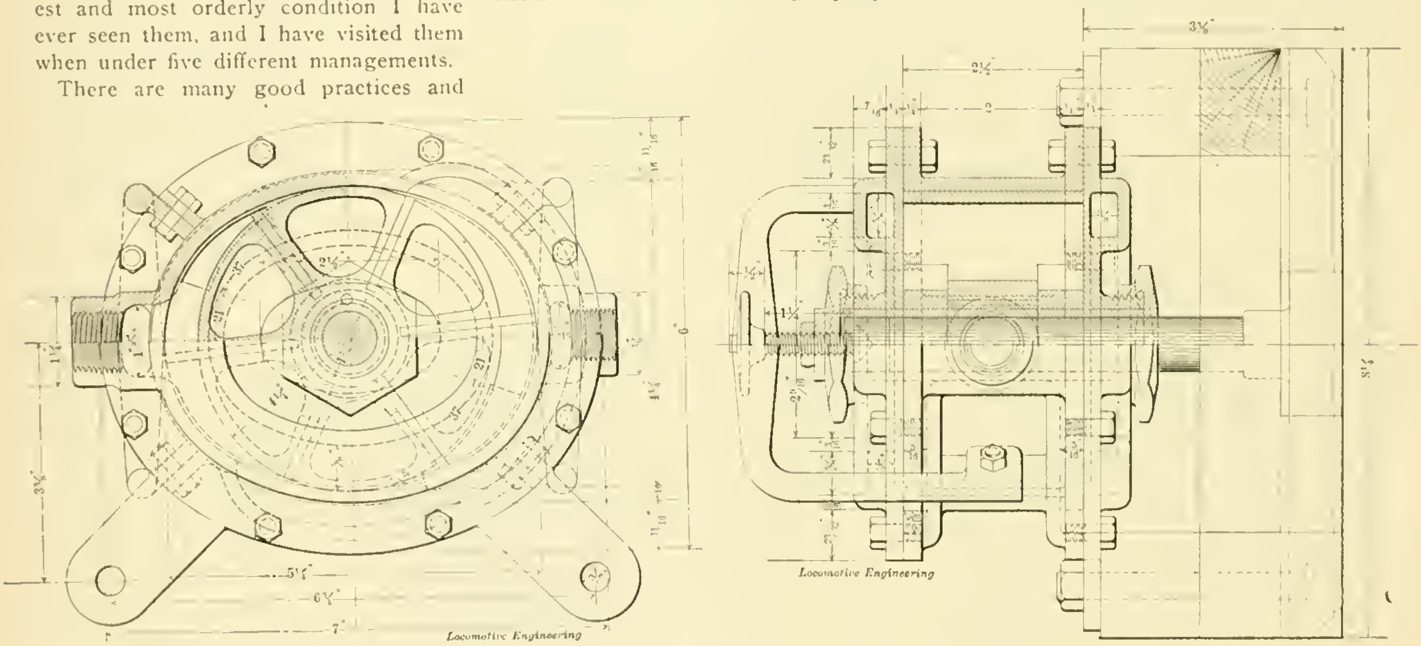
If any railroad man wants to put in a pleasant, interesting and instructive day, let him put some fifteen-cent cigars in his pocket and go visit Mr. McConnell and the Omaha shops. J. A. H.

Please mention "Locomotive Engineering" when writing to advertisers.

If one inch air hose is large enough for one and a quarter train pipe—on the other fellows' cars—why not on all? Some roads are using the smaller size for replacements.

SAND-PAPERING MACHINE.

The number of tons (2,000 pounds) of rails required per mile is approximately one and a third times the weight per yard.



DETAILS OF PNEUMATIC SAND-PAPERING MACHINE.

The new model of the Smillie coupler, with face knuckle and square shank, is meeting with marked success. This coupler is being placed on the five hundred 60,000-lb. new coal cars of the Central Railroad of New Jersey, and a large number of the cars of other lines.

Did you ever notice a spot chafed on top of air hose, just under the end of the curved handle? It is quite common. Is there any use of the handle being so long?

Don't clean outside while engine is running. What does it profit a man if he gain the whole world if his wife is a widow?

Extension of the Brown System of Discipline.

Last March the general manager of the L. & N. appointed a committee to investigate the system of discipline in use on the Indianapolis division of the P., C., C. & St. L. Ry.. That committee made a very favorable report, and the general manager ordered the introduction of the system on the L. C. & L., and the Kentucky Central divisions, to go into effect June first.

The plan has been successful, and now the superintendent of transportation has issued a pamphlet describing the system and its operation.

We notice on the first page that no reference is made to the author of this system, but that it might be inferred that Supt. Darlington, of the Panhandle, might be the originator.

Mr. Brown had the courage of his convictions; introduced his system and improved it year by year, and had it in successful use for twelve years before the outside railroad world heard of it through "Locomotive Engineering."

The least that can be done by the railroads profiting by his efforts is to give credit where credit is due.

We hope every road using it will designate it as the "Brown System of Discipline."

A copy of this paper is sent to all the operative railroad officials on earth.

We will pay for sketches and descriptions of bulldozer dies to do other work than shown in article on that subject.

The articles on signals will end in the March number. They will then be issued in book form.

Some Interesting Things to be Found in the Rock Island Railroad Shops at Chicago.

Long ago I gave up the practice of "writing up" shops—one has to say so many of the same things of them all. Going into generalities about the size, equipment and practice of one American railroad shop, as compared with another, is a good deal like comparing two copies of the Koran—a good deal alike, only one is dirtier than the other.

My readers have borne with a great deal of this sort of thing in the past, and now, like myself, have outgrown it.

I only try to pick out the things that are most interesting in any shop. What's the use of using so much whey, when there's cream to be had for the skimming?

On a recent trip to the West, I visited the Rock Island shops, at Chicago, and spent a pleasant day there.

Mr. George W. Wilson, Superintendent of M. P., is always an interesting talker, and a good listener is sure to pick up something useful in a visit, even though he never sees the inside of the shop.

STEAM HEATING TRAINS.

When I was there, Mr. Wilson was doing some figuring on steam heat, and he let drop some remarks on the subject that so nearly accorded with my own ideas that I believed Mr. Wilson a great thinker. Thinkers flock by themselves.

Mr. Wilson is one of those mechanics who don't believe that you can get something for nothing. He does not agree that steam can be taken from the boiler of the locomotive to heat an ordinary passenger train, and "not make any difference that you can notice" on the steam supply.

Last winter they found that it was practically impossible to heat some of their through trains at all until they put storm windows on the coaches.

Traps are another abomination that are yet to be improved. The traps that will take care of the condensation, and not waste steam, and not freeze up when the car is thrown out in zero weather without attendance, are like hens' teeth—few and far between.

Heater systems that depend on the attention of trainmen for the regulation of heat and draining of system, when out of service, are born to trouble from the start.

A thoroughly automatic steam trap that tends to business in prosperity, and does a little better in adversity, is one of the crying needs.

The fairy stories about the slight pressure required on steam heat system, at engine, to force steam through an eight or ten-car train is not taken as law and gospel here, either.

Steam heat is all right; it has come to stay; it's a grand improvement over stoves, and all of that; but it takes coal. Some people profess to believe that it don't.

THE OIL KINDLER.

Mr. Wilson says that their oil fire kindler is the best investment that the road ever made in shop equipment, and that it is saving, over wood fires, $1,400 per month.

CAST TUMBLING SHAFTS.

Several years ago I mentioned the first cast-steel tumbling, or lifting, shafts used in this country, and applied to R. I. engines. I am informed that not one of these has ever given a bit of trouble. Both arms and the reach-rod lever are cast in one piece with the shaft.

NO ENGINES WAITING SHOP.

Last summer, when most of the roads were squeezing down the last item of expense in the shape of men, the Rock Island put all their power into first-class shape—when they had long, light days. The result of this policy was that, when the grain and cattle rush came on this fall, they had about seventy-five locomotives that were just out of shops after general repairs, white-leaded and ready to throw into service.

EXTENDED USE OF AIR.

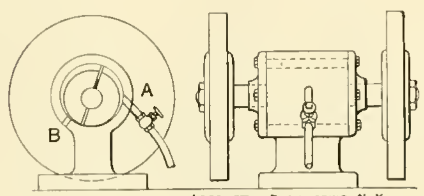
Out in the shop, I fell into the hands of Mr. J. W. Fitzgibbon, division master mechanic, who steered me toward the engine room.

The extended use of air called for a more plentiful supply than a whole string of brake pumps could pound up. A compressor was built and attached to the cylinder head of the main engine, and the piston rod extended to do the work. This job was done by the builders of the engine, E. P. Allis & Co., and is a workmanlike job, though, in my estimation, not the best way to arrange a compressor.

A very ingenious governing device is used, so arranged that when the maximum pressure is reached valves are opened that allow the air piston to move back and forth in the cylinder without doing work.

AN IDEAL EMERY-WHEEL DRIVER.

No shop manager, who has air in his place, will ever put up another counter-



AIR DRIVEN EMERY WHEEL.

shaft and belt to run an emery wheel after seeing the advantages of the air-driven one shown here.

The cut, made from a sketch, tells the whole story. The ones in the R. I. shop were made from odd pieces. The stand and cylinder were made from a casting for a tumbling-shaft box. The form of motor is the simplest. The speed is entirely in control of the user, he can regulate it at will by the amount of air admitted, and when speeded up they fairly sing. A belted emery wheel runs at one speed all the time, regardless of the work or conditions.

SIZE OF CYLINDERS.

Experience has proven here that the average air drill has had too much cylinder. A cylinder 2½ inches in diameter and 3 inches long, made as shown in sketch, with the shaft plug 1⅝ inch diameter and set ⅝ inch off the center, giving an opening of ⅞ inch for piston strip when in center, will do a lot of work with 60 pounds of air and making from 600 to 1,800 revolutions a minute. This sized cylinder, easily held in the hand, will drill stay-bolts as fast as a man can handle it. One neat improvement was made by piping exhaust to the drill, to cool it.

They use these tools here for wood boring in the car shops. In putting up a coal car, for instance, they put up the side stakes and bore them after they are in place, side planks and all.

All the tools in the boiler shop use air. It is also used in the tin shop to press out forms. And, of course, all the heavy lifting is done by it.

UNIQUE USE OF AIR.

The transfer table is operated by a steam engine, and an engineer is in charge. By slightly enlarging his house, and rigging up a brake cylinder for press, they have gotten up an ingenious punch for cutting out rubber gaskets and washers. The exhaust from the pump is piped to the punch in such a way that the rubber gasket is blown out of the punch as the tool lifts, as is also the center, or punching—this latter being used for another size, down to the smallest.

This rig is ingenious, and I thought it a good thing—the labor costing nothing, and the work done being good and uniform—but on investigation, I find that ready-cut gaskets are about as cheap per pound as sheet rubber. If the R. I. get their gaskets cut for nothing, the manufacturer gets his material for nothing, for scraps are worked up for gaskets.

TRUCK SPRING COMPRESSOR FOR TAKING DOWN HANGERS.

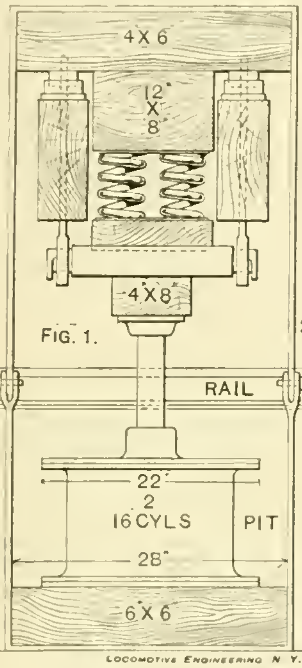
They have here a device for quickly releasing swing hangers on both passenger and freight trucks. It is so rapid in its work that one minute and forty seconds is the regulation time to free the hangers and drop bolster, springs and spring plank.

This rig consists of two air cylinders 16 inches in diameter, placed side by side across a pit of the car shop, and resting on a foundation of 6 x 6-inch oak blocks. On the top end of pistons is a 4 x 8-inch oak block, 4 feet 7 inches long, which forms a part of the flooring over pit when the pistons are down, and is raised up to the spring plank of truck when compressing the springs.

Two other oak blocks, 4 x 6 inches, having ½ x 2½-inch U-shaped straps secured to them, are used in this combination; these blocks being placed on top of the truck bolster when the straps pass down, and engage with like straps provided with jaws and pins, rising from the foundation blocks.

This whole thing being a permanent fixture, the truck to be operated on is placed over the cylinders, the upper blocks are put in their proper position, and the straps are connected, as shown in sketch, ready to do business.

This view shows the bolster, the transoms and the spring plank in section; cutting out all other parts of the truck not



TRUCK SPRING COMPRESSOR.

involved in action with the subject in hand.

The results accomplished by this home-made squeezer, as stated above, are not dress parade figures, but are always obtained without preparation. They are arranging to build one of these "squeezers" on a truck of its own and running on a narrow track in a pit, then they will move the tool to the truck intead of the truck to the tool.

LEAD-LINED BRASSES.

The road has recently gone back to the manufacture of their own journal brasses; these are lined with lead or babbitt. The soft metal is poured on a vertical former, as usual, but the burr of soft metal at the ends is cut off and trued up very nicely on a revolving cutter, like a milling tool, mounted on the arbor of an old lathe, and projecting through an iron table; it is quicker and better than chipping by hand.

SOLID ROD CUPS.

All new rods have the oil cups forged on the rod or strap. On old ones they make a solid wrought-iron cup, the body round all the way down; this is screwed into the rod to stay, with a heavy pipe wrench, and forever after treated as a solid cup, and it is hard to tell that it is not one.

THE SMITH SHOP

is especially interesting; but as we have a special article on their bulldozer forms in this issue, and expect to publish a similar one on the uses of the helve hammer, I shall refrain from long-winded descriptions here.

I went to the Horton, Kan., shops of the same road, and picked up some valuable pointers there; but to save making this article any longer than a head brakeman's dream, I will give it to you under another heading. J. A. H.

Some Handy Shop Tools at the Rock Island Shops, Horton, Kan.

Horton, Kansas, is one of those places that was going to be the center of the universe once, and is disappointed because the center was finally located somewhere else.

Horton lies in a splendid farming country, but the road has built so many cuts-off and cross-overs throughout that section that it is no longer the important location it once was.

The shops are large and substantial brick buildings, and there are lots of them.

Mr. Harry Monkhouse, assistant superintendent of motive power and machinery, is located here, and that alone makes Horton worthy of a visit from a railroad man.

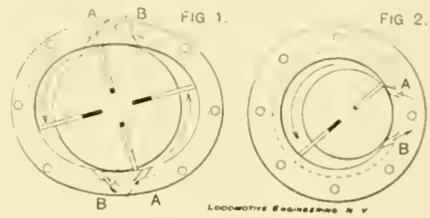
I don't know that all the unique tools I saw at Horton originated there. That is where I saw them, anyway.

THE COMPRESSORS.

The first thing I noticed was a big pop valve, on an air storage tank outside one of the buildings, making a fuss, and inquiry showed that this was the only means of relief when the compressor had pumped up the maximum pressure of air. The compressors are home-made, are attached to stationary engines at car shop and machine shop, and driven by an extension of the piston rod through the head.

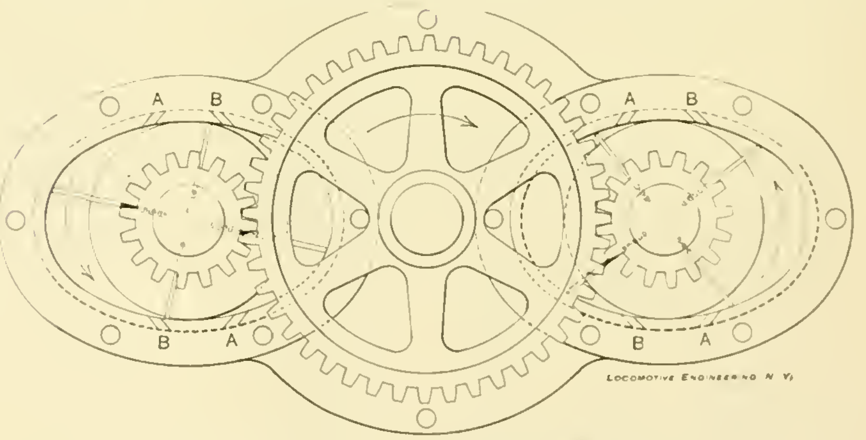
GOOD AIR MOTORS.

They have designed and built here the steadiest running air engines I have seen. Instead of the usual device of a plug set out of the center of a cylinder, with packing strips, the cylinders are bored out in the form of an ellipse, the plug revolves in the center, and there are four or six



AIR MOTORS.

packing strips, one taking air on each side of the plug at the same time. This form of motor is largely minus the elegant "wobble" given to the eccentric plug affair. The people at Horton have made one that has two of these elliptical cylinders, and the shaft of each plug—I call it that for want of a better name—carries a small pinion that meshes into the opposite sides of a large gear, journaled between the cylinders and encased in the head. The shaft of this large gear carries the drill chuck, tap or reamer. The motors are run at high speed, and the drill runs slower; there being no jerk at all, no breaking of small drills in stay-bolt work.



DOUBLE CYLINDER GEARED MOTOR.

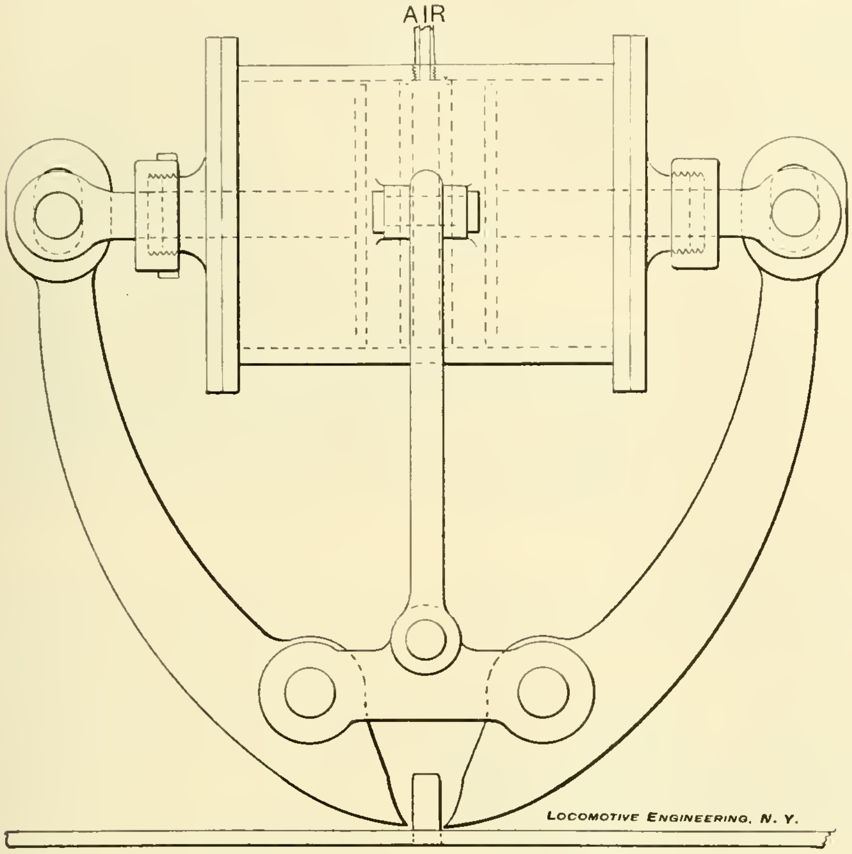
This tool is worth building for the market.

STAY-BOLT CUTTER.

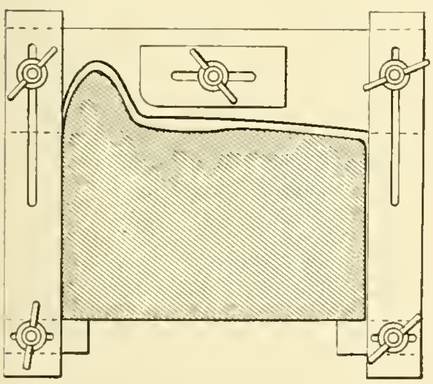
They cut off stay bolts with a double piston affair, the construction of which will be plain from the sketch shown herewith. Air is admitted between the pistons of a 16 or 18-inch cylinder to do the work; the shear being hung up by a balancing yoke reaching from the side of the cylinder to the fulcrum piece between the jaws, near the cutting edge. This tool is smaller than many used for similar work.

A TIRE GAGE.

A very neat and efficient tire gage is used here, that I hope my sketch may make plain. The two adjustable pieces, at bottom of the legs or sides, are to set the gage snugly up to tire—side and bottom. Then the top piece, which is a standard tire gage, is lowered until it strikes the tire, and the wear is at once apparent, be it where it may. The adjustable piece in the center is used to measure the wear; it can be set to show the tread wear or flange wear; and if, then, the gage is moved around the wheel uneven wear is not hard to detect.



PNEUMATIC STAY-BOLT CUTTER.

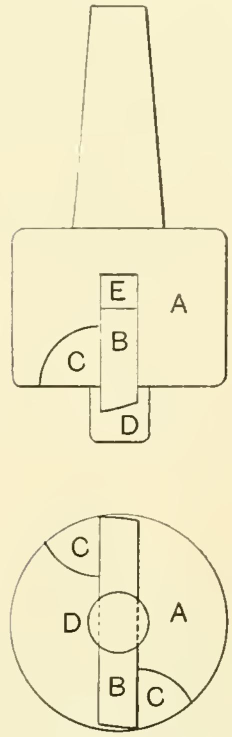


TIRE GAGE.

A FLUE-HOLE CUTTER.

Almost all flue-hole cutters have bent tools, that in cutting out the hole save some stock—that is, cut a washer.

They use one at Horton that beats any I have seen. It is made of solid steel, much as shown by sketch; A is the body of the tool, having a taper shank for driving. B is the cutter, a straight piece of tool steel fitting a slot, through the head entirely and cutting at each side, and supported within a sixteenth of an inch of the cutting edge by the solid head. E is a wedge that holds the cutter in place. C is clearance space for chips, and D the projection that enters the punched hole in sheet to guide the cutter. When this tool is cutting a sheet, a good honest bite is taken, and the metal cut out easier than with a bent tool. When nearly through the sheet it acts as a punch, takes out the bottom and leaves a clean, true hole.



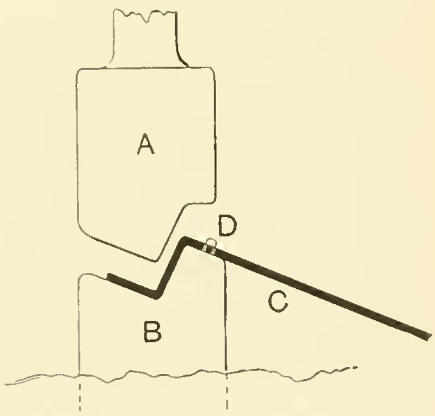
FLUE HOLE CUTTER.

STEAM-HAMMER DIE FOR FORMING ENDS OF BODY BOLSTER.

Out in the blacksmith shop I noticed an ingenious rig for forming the ends of the top member of wrought-iron body bolsters. The metal is cut to the right length, and punched while yet flat.

The ends are heated and formed under a steam hammer, with special head and die, as shown at A and B. A pin, D, enters one of the holes in the bar, and insures the bend being put in exactly the right place.

In order to get the right angle to the piece C, which is quite long, a pit is used for the lower end.



HAMMER DIE FOR FORMING ENDS OF BODY BOLSTERS.

HEATING RIVETS RIGHT.

In the boiler shop I noticed a neat scheme for heating rivets evenly, and keeping them out of the fuel. A hollow fire was used on an ordinary forge, and fuel piled up well around it; over this lay a piece of boiler iron punched full of holes, and through these holes the rivets were dropped, hanging by the head. The right part of the rivet gets hot, they are easy to handle and the boy always knows when his stock is running short. This may be 180 years old, but it was new to me.

IMPROVING A SHORT DROP TABLE.

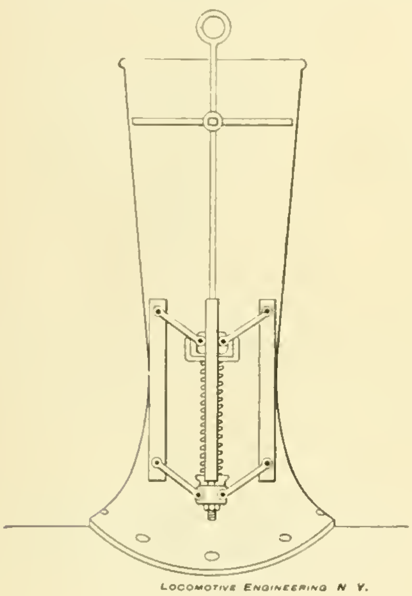
The drop table here was put in when it was thought that an eight-wheeler was big enough for anything. The big ten-wheelers will go on the table, but they could not roll the three pair of driving wheels out from under them—had to raise and lower the table three times, once for each pair of wheels. They got around this by dropping all three pair at once, and rigging up a big air lift over rear of table that lifts out one pair at a time.

A STACK LIFTER.

Clamps and ice-tongs and half-hitches are usually used to lift and handle stacks. The device used here is a simple affair that, as they say in the West, is "onto its job." It consists of a long rod with ring in top, to lift by; a spider, or cross, near top enters stack and keeps rod central, and on the bottom are hinged, with links, as shown, four wooden blocks about two inches in diameter by a foot long. A light spring prevents these pieces from hanging down. When shoved down a stack, until these pieces are at or below the throat, and the stem pulled up, the arms force the blocks out and grip the sides of the stack; the harder they pull on the rod the harder the lifter bites.

A STACK CRANE.

While on the subject of stacks, I want to mention their stack crane, the simplest and best one I have seen. Most stack cranes have a fork on the jib that goes



STACK LIFTER.

each side of the stack near the base, with a rod running from outer end of jib to top of stack. This is all right for steam chest or cylinder borer lifting, but cannot be used over the head-light or boiler.

No use to waste words in describing their crane. The sketch does the business.

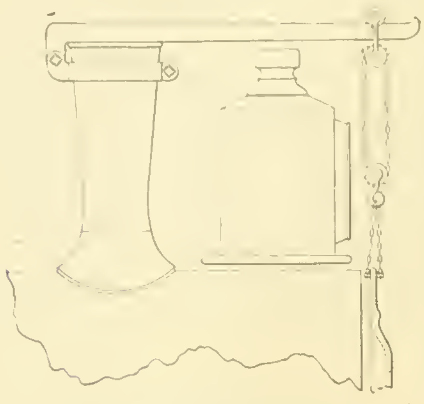
A collar in halves and a flat bar for jib, resting over top of stack. This is used here largely for putting up and taking down front ends. It will work anywhere around the stack.

HOW THEY INSPECT ARCH TUBES.

Noticing a pile of old arch tubes, I asked if they had many failures. "Never had a failure," was the reply, "we inspect very carefully." I knew where they had repeated failures in spite of inspection, and asked how they did it, and was told that they always look for a damp spot at lower bend, next the tube sheet, when boiler is cold. When they begin to get thin there, the damp spot shows up, and the tube is at once taken out. Long tubes are cut off and re-bent for smaller fire-boxes. Nearly the whole yard is piped for air with old arch tubes, the ends being reduced for standard fitting.

AIR LIFTS FOR CARS.

In the freight repair yard an ingenious air lift has been rigged up, for bodily



STACK CRANE.

lifting freight cars while the trucks are taken out for repairs. This is so arranged that a car body can be turned on its side or entirely over, by air, to facilitate repairs.

TRANSFER-TABLE ENGINEER MOUNTS HOSE.

The engineer of the transfer table mounts all hose, steam and air. He has an air-operated rig fitted up for the purpose. He has plenty of time, and keeps tools on hand for mounting and dismounting all the fittings used. I have recently heard rubber men declare that any air-operated machine would cause the fittings to tear the lining of the hose—this is not true. The reason for the fracture of lining was found to be caused by clamping the hose too close to the end—the fitting and the clamp form the jaws of a pair of pincers that rupture the lining. Clamping further away admits of just as good work and prevents all trouble.

PIPE CHECKS AND SELF-CLOSING ANGLE VALVES AT BOILER.

They use non-lifting injectors almost exclusively, and instead of a check at boiler use a regular pipe check, located in branch pipe midway between injector and boiler connection. At boiler an angle valve is used, with self-closing valve for emergencies. This angle valve can be closed at any time, and repairs or renewals made at check. They have no trouble at all with checks, and report this arrangement cheaper and more satisfactory than the old boiler check.

BRONZED RODS.

The main and side rods of all home-made engines are simply good forgings painted. They are using for rods, rockers, valve rods, etc., a silver bronze, or aluminum bronze, that looks at a little distance like finished iron and stands well.

ANNEAL ALL WROUGHT PARTS.

When an engine comes in for general repairs, all her rods, eccentric blades and other wrought-iron working parts are put into an old boiler shell, outside the shop, packed around with shavings, fired and allowed to get red hot and cool off slowly. All cracks and other flaws show up then, and are cared for. The heat is found not to affect the fits at all.

A CUSHION WHIPPER.

In a shed beside the coach yard, a shaft with arms and whip lashes is rigged to pound the dirt out of a coach cushion with a vim and alacrity that doubly discounts the most energetic galvanizer.

A PIPE SHAFTING.

A neat line of shafting was rigged up, over the ends of the pits in erecting shop, some years ago, to drive flexible shafts, boring bars, etc. This is idle now, and the "flexibles" are peacefully coiled in the tool room. Air motors on every kind of portable tool.

APPRENTICES GALORE.

There are more bright boys running machine tools and doing floor work here than I ever saw in three shops of its size. It is somewhat isolated here, and it has been found that mechanics "native and to the manner born" do better and stay longer than the average tourist.

J. A. H.

The Boston & Albany have just one of the famous old Eddy "clocks" still in service. They ought to put her on a pedestal at Springfield as a monument. They were better than they looked, and, in their day, hard engines to beat—save the last one as a relic.

Our little notice about watch-charm steam gages flooded the Utica Steam Gage Co. with requests for them, and the company have already sent out some thousands. They have been obliged to stop giving them away, and are now sending one for eight 2-cent stamps.

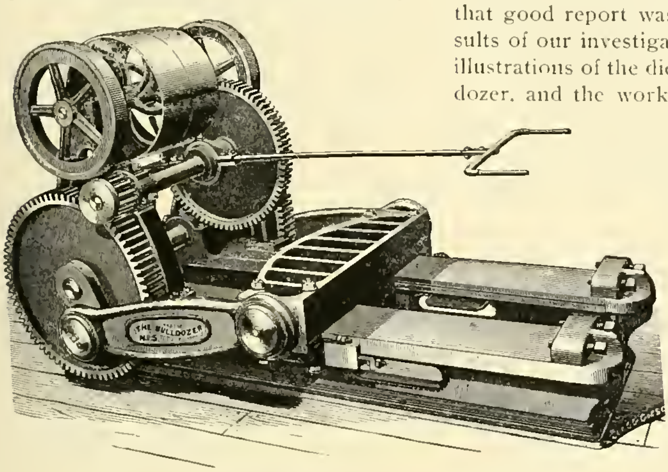
Mr. E. C. Boyer, of Dayton, Ohio, manufacturer of screw and ratchet jacks, has issued a catalogue in the Spanish language. Mr. Boyer recognizes the fact that all the Latin-American countries south of us should be supplied with American tools, and proposes to say so in a language they can understand.

We cannot supply complete sets of papers for 1895 except in bound volumes. Order at once, we are short of these.

This is a pretty healthy looking paper for a beginning of our ninth year.

How to Save Money with the "Bull-dozer," or Horizontal Forging Press.

Visit almost any railroad shop, and you will find a belted and geared forging press in the blacksmith shop. The enterprise and hustle of one maker of these tools has made the device known almost exclusively by their trade mark, as the "Bulldozer."



THE "BULLDOZER."

Often, in visiting shops, we mention to the foreman blacksmith or master mechanic that he has a good tool there, and the reply is almost always that it's a good thing, but they don't have enough for it to do. A glance at their dies shows that there are few of them, the foreman or other officers not being very inventive.

In order to help all who have bulldozers to save money with them, we present herewith a lot of drawings, with all sizes plainly marked, of some ingenious dies, made in a shop where they pay great attention to the economical production of duplicate parts in the blacksmith department.

No responsible officer can afford to let his men do hand work at great expense, when much better work and much more of it can be done for less money on a simple machine.

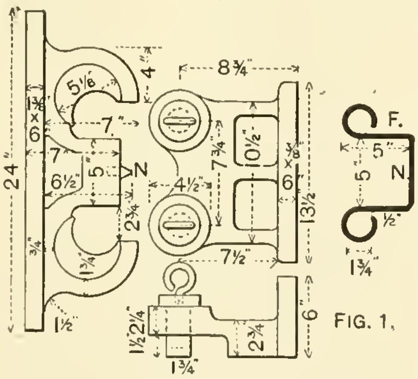
There may be some of our readers who are not familiar with the bulldozer, and we present herewith an engraving of the machine, without dies. It needs no description. As will be seen, it is geared about seventy-five to one, and is powerful enough to shape with ease the heaviest parts used in car and locomotive construction that are bent or formed.

Through the courtesy of Mr. Geo. W. Wilson, superintendent of motive power, machinery and rolling stock of the Chicago, Rock Island & Pacific Ry., we are enabled to present some facts and figures concerning rapid and good work, as done in his smith shop at the Chicago plant of the above company.

Foreman Blacksmith Geo. Tutbury, of the C., R. I. & P. shops, Chicago. In charge of the shop where these tools were made and are used.

The reputation of this shop for labor-saving methods is more than local, and we have been at no little pains to find what that good report was based on. The results of our investigation are given in the illustrations of the dies as used in the bulldozer, and the work performed by them under the management of Mr. Geo. Tutbury, the foreman.

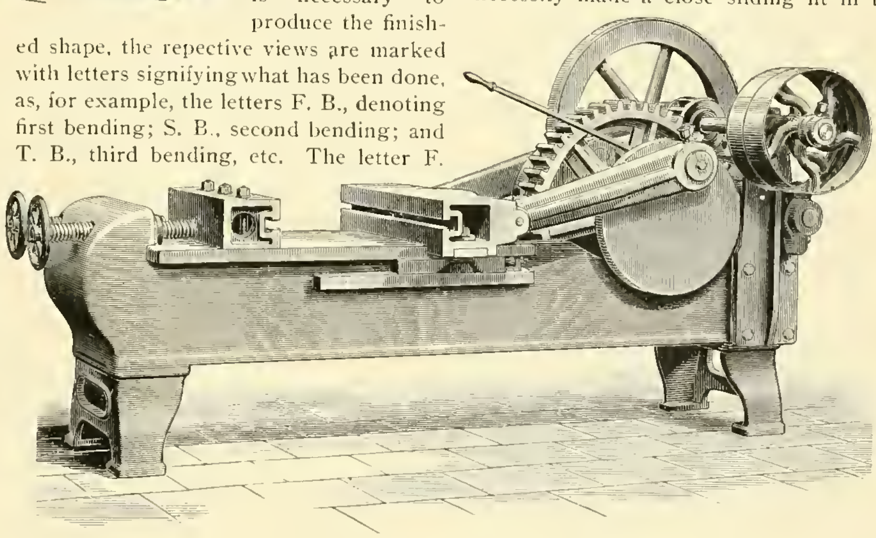
For convenient reference, the illustrations of the dies and the work done by them have been numbered, and in cases where more than one operation is necessary to produce the finished shape, the repective views are marked with letters signifying what has been done, as, for example, the letters F. B., denoting first bending; S. B., second bending; and T. B., third bending, etc. The letter F. alone in the views indicates the finished part. The dies are cast iron, and made as light as possible, having ribs to give the necessary strength—the cores be-



tween ribs forming pockets, which are filled with water when dies get too warm. There is no machine work done, except to plane the back where fitting the angle plate on the machine, and on the bottom where resting on the platen, unless in some particular case, where extreme nicety of fit is required, when the working faces are machined.

Fig. 1 is a pair of dies for forming brake-pipe hangers out of 1¼ x ⅜-inch iron, bending two hangers from the same piece of material at one stroke of the machine, and nicking the piece at the center at the same time, at the part which does duty as the foot when the hanger is in use.

These dies are more complicated to make than is usually the case for this class of work, all owing to the peculiarity of the shape produced; on this account it was necessary to machine them in two places; but this extra outlay is more than repaid by the increased efficiency of the machine. The movable die seen at the left of the illustration, is counterbored on the top face for two revolving half discs, which are forced to change their position when the piece to be bent is entered by the stationary die, they revolving in a horizontal plane about the pins and bending the iron into shape. The pins are of necessity made a close sliding fit in the stationary die, so as to be removed and thus release the hanger after bending; they are provided with eye bolts on their heads for this purpose.



FORGING PRESS.

The nicking of the hanger is done by a piece of steel dovetailed into the movable die. The output is two pieces, or four hangers, per minute, the machine making six strokes in that time.

Fig. 2 is a pair of dies for bending the protective sheathing used on the edges of gang planks. This sheathing, as made here, is of No. 14 steel, 36 inches long, and 14 inches wide; it is V shaped when finished. When this forming was done by hand in the boiler shop, the cost was 50 cents for each piece; the present cost is one cent per piece. The bending is done cold and in one movement of the dies, leaving a smooth, true job that cannot be equalled by hand work.

Dies Fig. 3, for freight draw-bar followers, are the outgrowth of a want that made their use imperative. These dies have a cast iron backing faced with tool steel 1½ inches thick, the facing is secured with tapped bolts having slotted heads. This construction makes it possible to replace the old cutting faces with new or bring them up by planing the faces at any time,

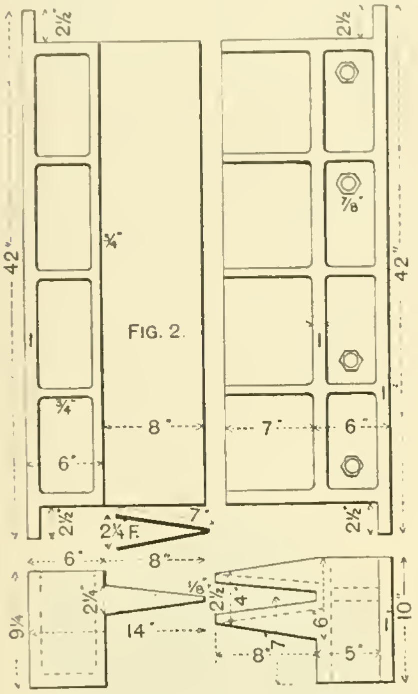


FIG. 2.

but it has not been found necessary to renew the dies thus far, for the reason that the followers are punched at a white heat, and the dies, being kept cool, preserve their cutting edges.

The passenger followers are punched out of the solid in the same kind of a die, but, of course, larger; the work turned out by these dies is remarkably clean, considering that the material is 1½ inches thick.

Numerous dies to suit the various sizes of followers are made to fit the same castings. We have shown one size each for freight and passenger. Capacity of machine on this work is 500 per day.

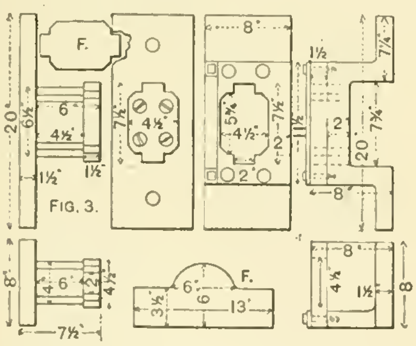


FIG. 3.

Fig. 4 shows the dies for the hook end of a freight brake hanger. This piece is of 1-inch round iron, and is bent in a plain hook on one end, in lots of a hundred, when the dies are replaced by others to form the lower, or stirrup, end of the hanger, which is made of ⅝-inch round iron.

These dies are arranged at the center of their length to bend two pieces at a time into a U-shaped blank, as shown; and at each end of the dies is a block which is in contour the shape of the stirrup end of the hanger when completed; after the first bending into U-form, the blanks are transferred to these end dies, which are duplicates, and the second bending completed there. It is seen that four pieces can be operated on at once, two in the first bend, and two in the second bend.

After the forming is completed in the dies, the hook and stirrup ends are welded to length, producing the finished hanger, as shown in the detail. These dies paid for themselves in the saving on the first lot of hangers made by them.

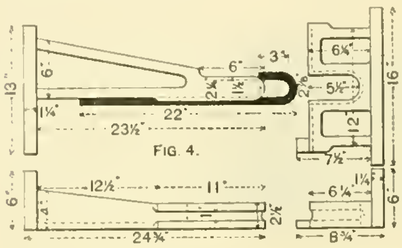
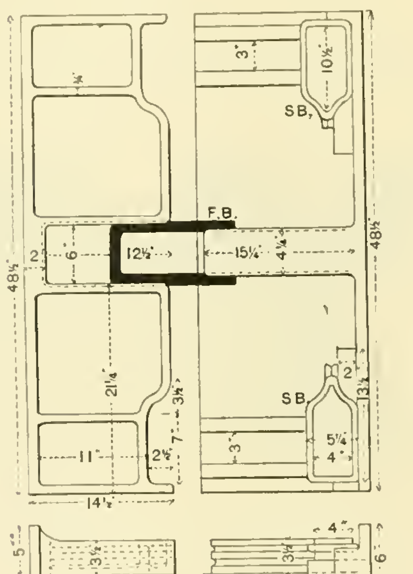
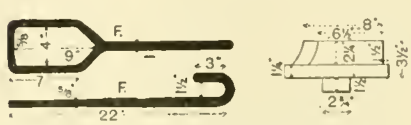


FIG. 4.





Die Fig. 5 is a well-devised means to an end, and tells of the gains that must follow the use of special tools for special uses. These dies are used for making rail braces out of old fish plates; a species of scrap that piles up on every road for the want of a purchaser. There are two sets of dies, the first bringing the brace to shape from the straight piece, in lots of a thousand at a time; after which they are placed in the second or finishing dies on the machine, and the end is bent at right angles to the base, finishing the brace at a cost of 2½ cents, against 12½ cents for the purchased article.

The dies for the second bending have their working faces covered with steel plates, secured with countersunk screws. The stationary dies are held open by two coiled springs of No. 10 steel wire, so that when the movable die recedes, the brace is free to be removed. The thought

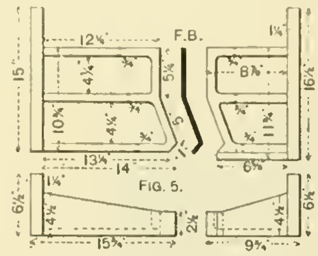
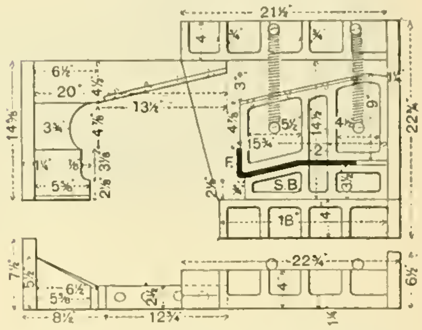


FIG. 5.



and first cost put into these dies show good returns, in the cords of rail braces piled up for use.

Draw bar yokes are formed in dies Fig. 6, at the rate of 500 per day. The old hand process would produce but 50 in the same time, and then only by the liveliest work. The work turned out by the two processes is not at all comparable, as the dies always insure a true job, and the yokes are absolute duplicates.

Fig. 7 represents the dies used to form safety hangers for brake beams. Two sets of dies are used to bring the piece into shape; the first operation bending it

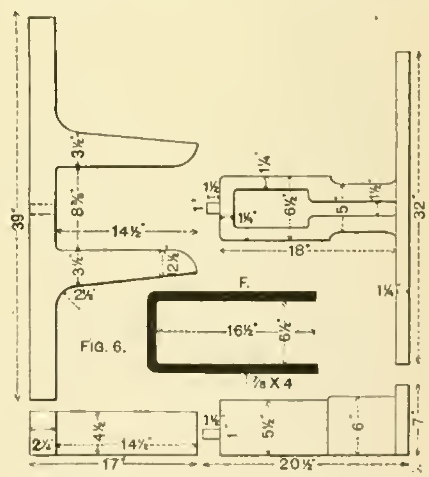


FIG. 6.

into three sides of a parallelogram, and the second set of dies completes the bending, which is done cold at the rate of one per minute, on material ¼ x 2 inches. The pieces as formed by both operations are shown with the dies.

Passenger brake hangers are also bent in two sets of dies, as shown in Fig. 8; the first bending producing a U-shaped piece, which is transferred to second set of dies and bent into a link, open at one side.

The stationary die in the second operation has an adjustable block on which the

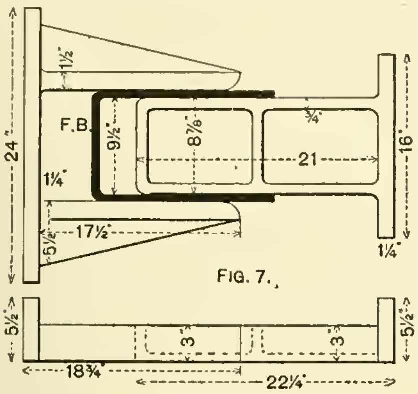
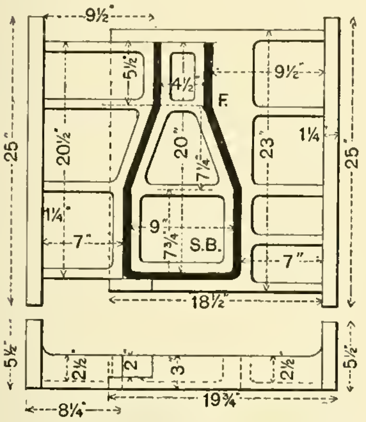


FIG. 7.



half formed blank is laid, holding it in position to receive the pressure from the moving die. These hangers are bent hot, it having been found that commercial bars over ¾-inch diameter would not bend

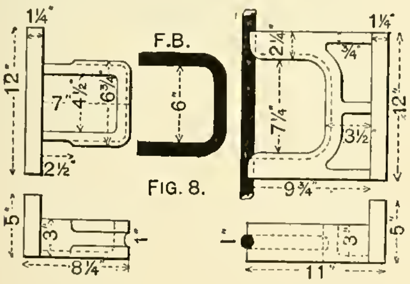
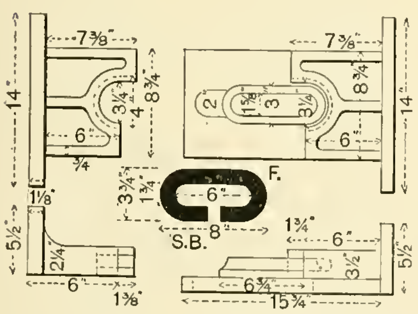


FIG. 8.



cold in all cases without fracture. Five hundred is the rate per day for these dies.

Eye-bolts from ½ to 1⅛-inch iron are formed by using two sets of dies, placed side by side on the machine table; the first operation in Fig. 9 leaves the proper amount of material to complete the eye in the second dies, where it is formed around a removable pin of the correct diameter for the purpose. The blank is taken from the first die when the moving head recedes, and placed in second die in time to be operated on upon the return stroke. The capacity of machine for this work is only limited by the number of strokes per minute.

A truck equalizer is justly regarded as

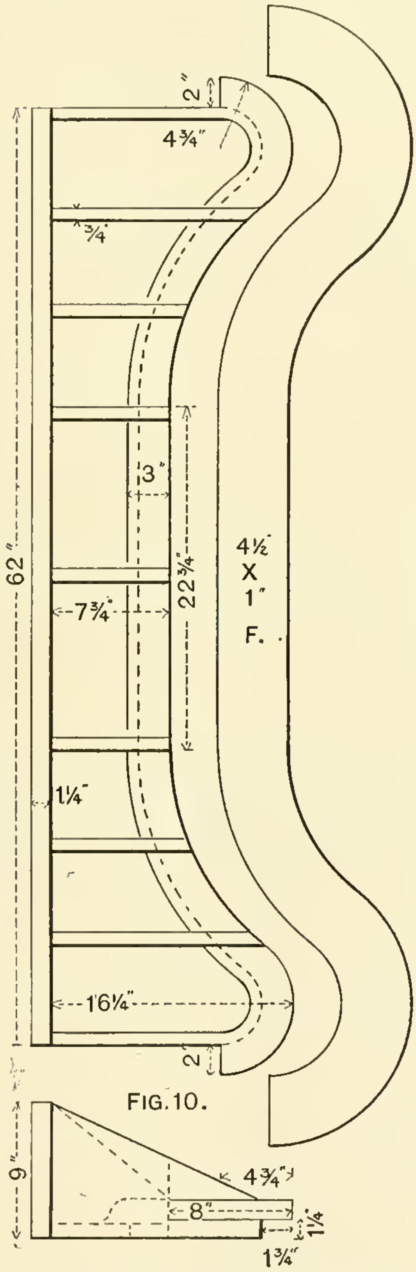


FIG. 10.

a hard form to produce at the anvil. Of the two well-known shapes, we have taken the one that represents the most work to make, although it is not in general use at the present time. Fig. 10 shows the die for this equalizer, the movable die only being sketched, on account of the size of the whole combination. This 4½ x 1 inch material is brought to form on the bulldozer with no more fuss than would be made over lighter stuff.

All hangers for auxiliary reservoirs are made in dies shown in Fig. 11. The advantage of this method over the hand process for hangers, lies in the uniformity of the work; each one being a duplicate of its mate where made by the same dies.

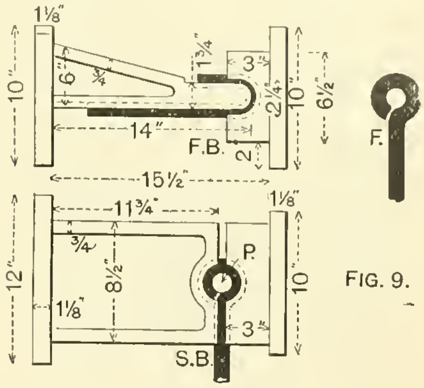


FIG. 9.

This is a feature of more importance than a hasty glance would show, for the reason that it is no simple job to get a hanger just the right size without some cut and try when made by hand; but with the dies made correct at the start, for a given size, it is always right, and the hanger will be certain to have the proper amount of draw when holding up the auxiliary to its place.

Dies Fig. 12 bend the pieces of ⅝ x 3 inch iron for tender truck braces. The correct duplication of these pieces would make the dies almost indispensable, even if the cost was greater than by the old method at the anvil.

This is one of the jobs that deceives by its apparent simplicity, while it is really a difficult thing to shape and bring the ends to the proper angle, without more or less fitting when done by hand. The dies turn out these parts ready to be assembled without any further work whatever, they going to place and fitting properly at once, when the dies are of correct shape to produce this result. The out-

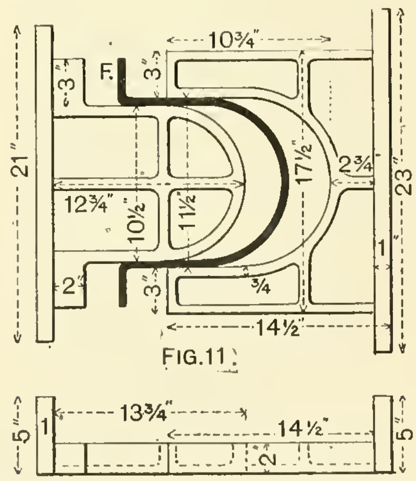


FIG. 11.

put is only limited by the strokes of the machine per minute.

Dies Fig. 13 make switch stand cranks, a job of smithing that requires, when done by hand, what is known in shop parlance as a good man. With the dies, the personal equation of the operator is eliminated entirely in every instance, making uniformity in results a certainty, and this is of the greatest importance with the job in consideration as affecting the throw of

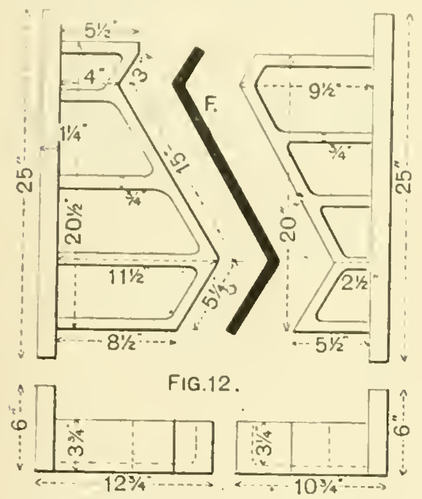


FIG. 12.

the crank, the one point at which accuracy is wanted. Hand car cranks are also turned out by similar dies designed for the proper throw and size of material,

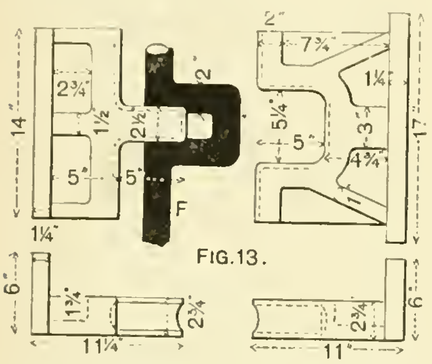


FIG. 13.

being counterparts of Fig. 13 in all particulars, except dimensions of the male and female parts of the dies. Comparative time of the hand and machine pro-

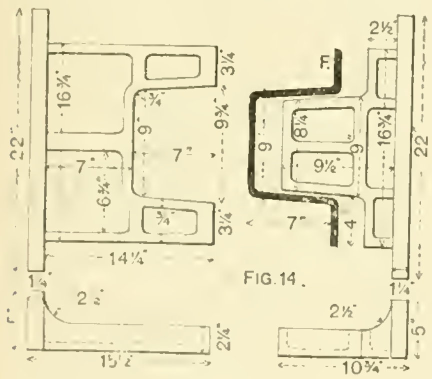


FIG. 14.

cesses has not been obtainable, so figures cannot be given; but if known it would only serve to emphasize the value of dies on this work.

Fig. 14 shows the dies for sill steps on freight cars, another job of simple outline that takes time to do by hand; but the machine turns out the finished article of ⅜ x 2-inch material at one stroke, and that means six steps per minute; or, if there are two sets of dies on the machine, twelve steps per minute on a rush order.

Dies Fig. 15 are an ingenious creation for bending train hooks. The bars of 1⅜-inch square iron, of which the hooks are made, are first drawn out and the eye formed, leaving bending in the machine for the last operation. The stationary die, which is the important part of this combination, is made up of three pieces—the backing piece or frame, and two movable jaws; these jaws have flat backs and curved heels, and around the latter bearings, each jaw can move through a small arc, so that when the male die is advancing they may have sufficient movement to admit the die and the blank; after

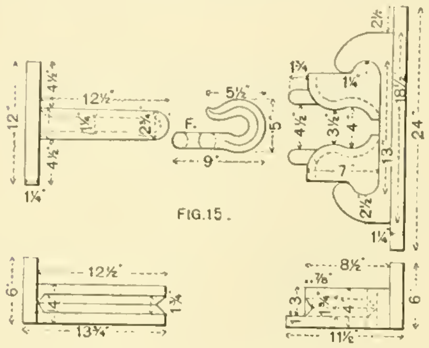


FIG. 15.

this admission any further movement serves to close the jaws on the work and bring the hook to the form intended by the contour of the dies. This scheme has proved highly satisfactory for bending hooks of all sizes.

Dies for bending the 2½-inch angle

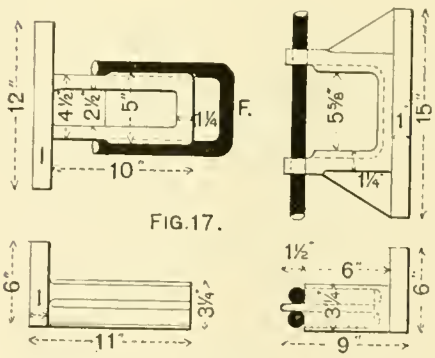


FIG. 17.

irons used on the under side of locomotive boilers are shown in Fig. 16, with a sample of their work. The angle shown is one to which the guide yoke is secured, and freedom from wind and kinks is the condition demanded from, and met by, the die process, to a degree that is hard to approach by hand bending.

Curves of greater or lesser radius to fit larger or smaller boilers can be made in these same dies, by using shims of the proper thickness—one set answering for all boilers.

Stake pocket U-bolts require uniformity in size and a reasonably good fit at the pockets; this is obtained by the use of dies, as shown in Fig. 17, in which the dies are arranged to bend two bolts at one movement. It is seen that the capacity of the dies could be increased to four or more if the necessities of the case demanded a greater output, but as four bolts per minute are turned out by the

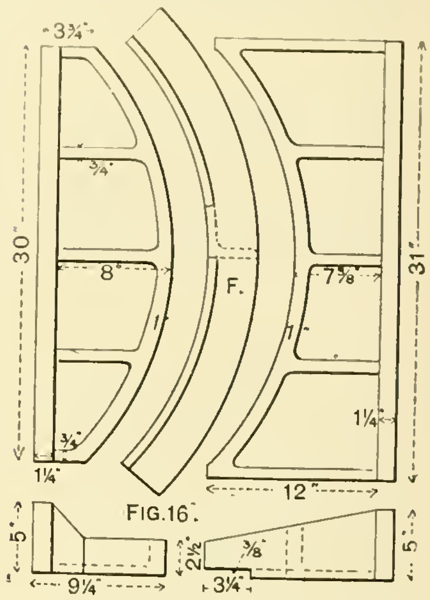


FIG. 16.

dies, as shown, all ordinary calls are easily filled.

The dies shown in Fig. 18 are for brake-lever guides, made of ⅝ x 2½-inch iron, and by separate operations—the lower member formed in one die, and the upper one, or clamp, formed in another. No

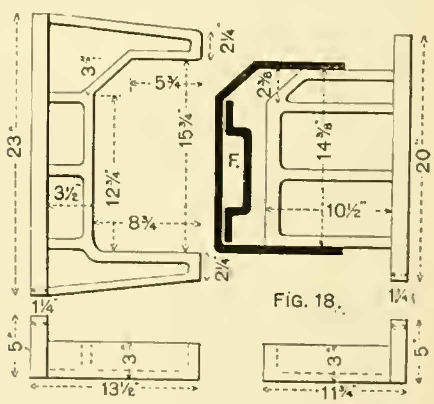
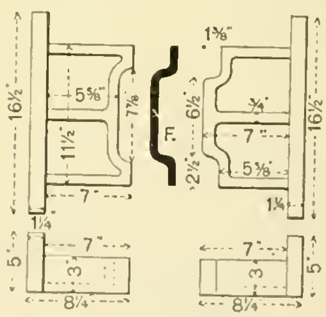


FIG. 18.



fitting whatever is necessary on these guides, they being applied to the car just as leaving the dies. The cut shows the guide as completed.

Corner plates for freight cars are bent in dies Fig. 19, which show a plate ¼ x 3 x 9 inches as used at the girth and plate of a box car. All corner plates are bent in these dies at the rate of six per minute, the corner being brought up square and true without breaking the fiber of the material.

Dies Fig. 20, for uncoupling levers, bend the same with such facility that the rush for the application of vertical plane

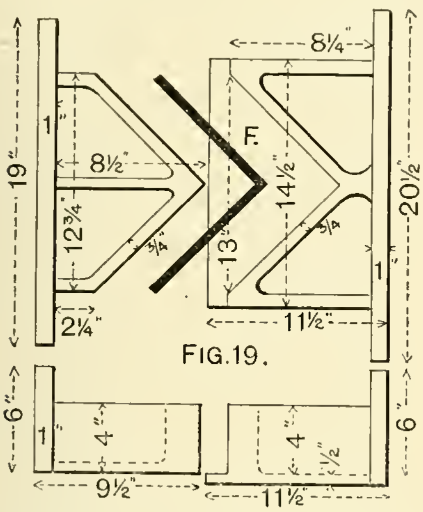


FIG. 19.

couplers was scarcely felt in the shop where these dies were sketched—four per minute being turned out when hurried.

Fig. 21 shows the dies for bending the

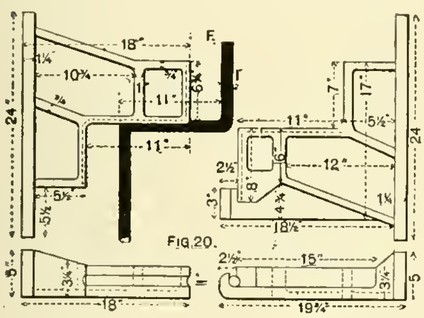


FIG. 20.

hook ends of tie rods. Four sizes of these hooks are provided for in one set of dies: ½, ⅝, ¾ and ⅞-inch iron, all of which can be made at one stroke of the machine.

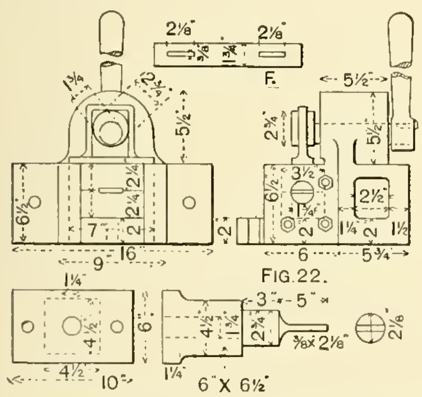


FIG. 22.

The neat character of the work turned out by these dies, in bringing up corners, makes hand work on hooks a thing of the past.

The dies for key ways, shown in Fig. 22, bear evidence of mechanical thought, and the work done by them is a witness that wool-gathering was not disturbing the mental faculties of the designer. This little rig comprises a pair of steel dies, the lower of which is secured permanently to the cast-iron holder which carries them, and the upper one movable in a vertical plane, being actuated by an eccentric which passes through a yoke on the upper face of die. These dies are pierced on their parting line, and in the direction of their length, with a hole slightly smaller than the iron to be operated on, in these dies it is 1¾-inch diameter. At right

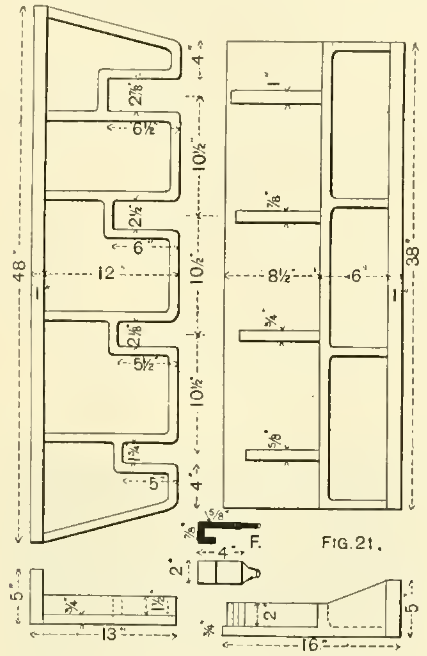


FIG. 21.

angles to this hole is a rectangular slot, ⅜ x 2⅛ inches, passing through the dies, also on the parting line; this slot receiving the punch on the movable die. The

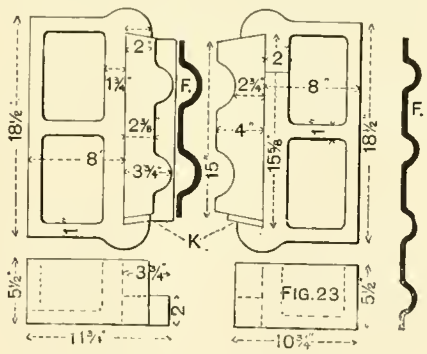


FIG. 23.

punch has a tapered shank fitting into a boss on the movable die, and made short enough to have requisite stiffness to stand up to the work. In operation the bolt or pin is passed into the gripping dies, and the eccentric is turned by means of the lever, to which it is secured, until the piece is clamped so as to prevent turning in the dies. The advancing punch then enters the slot and cuts a smooth, clean key way, with no accompanying enlargement of the material around it. These holders are arranged to receive dies and punches for all sizes of key ways in use, so that when key ways are in order it is only necessary to remove one set and apply another while the holders are on the machine.

The bending of pipe clamps, so as to secure an even spacing of pipes, is made an easy matter by the use of dies Fig. 23, in which the dies are separate from the holders and keyed into place. This

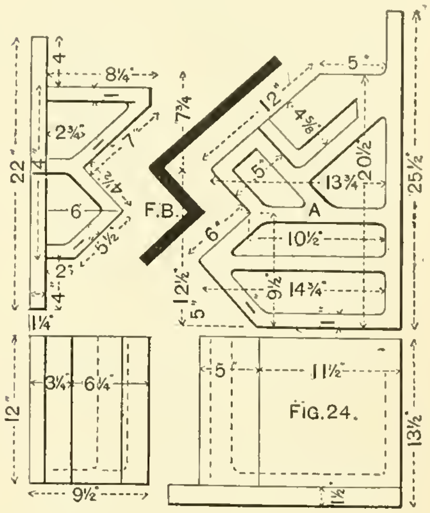
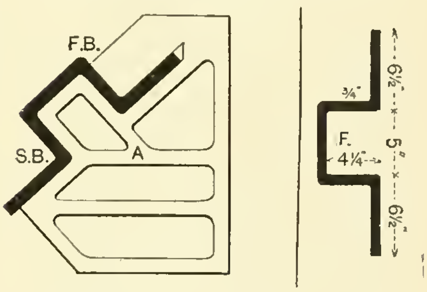
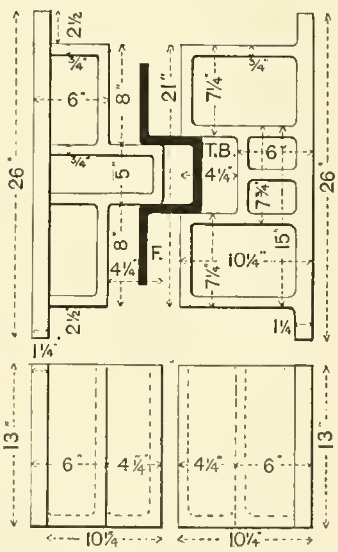


FIG. 24.





method, where practicable, is a good thing for the reason that dies are adjusted to position with greater facility, and have the added advantage that they can be removed and other dies introduced without removing the holders from the machine.

Frame buckles are formed on dies Fig. 24 in three bendings, two of which are made in one die, bringing the buckle roughly to shape, after which it is finished in the second dies, so that no machine work is required in so far as the frame fit is concerned. The blank of the right length for the buckle is placed in dies and bent on one end only; it is then reversed, and the end first bent is placed in the slotted end of die, while the blank is bent at the open end. This gives the buckle the proper form, and it is then placed in the finishing dies and given the correct dimensions to fit the upper frame.

The buckles for lower section of frame are made in the same dies, and examples of both are shown in the illustrations. It will be remembered that it is not common practice to put up buckles without more or less fitting after leaving the smith's shop; and the saving effected by the method shown is at once apparent, as it must have been also in the examples of work done preceding this, but which do not comprise all the possibilities in this direction by any means. Enough has been shown, however, to satisfy the most skeptical that the bulldozer can be made one of the largest factors in reducing blacksmith shop expenses.

In addition to the dies we have illustrated, there are many others in commission here that are equally as useful as those shown. On account of their general similarity in design we will only mention the work they do: Brake staff guide, brake staff carry iron, brake beam hanger, ends for dead lever rods, spring hangers, all brake rod jaws, draft timber braces, draft timber straps, draw bar carry irons, running board braces, end door slides, arch bars, body bolster plates, clips for wrecking frogs, release springs for brake beams, balance springs, axle guards, lug irons for Miller draw bars, door post plates, reverse lever sectors, crown bars, crown bar washers, chafing plates for trucks, spring pockets, tender steps.

This comprises a very complete outfit, but it is being added to whenever occasion arises, and if there are any other shops that can approach this in point of thoroughness in the way of specialties for cheapening the cost of work, we would like to know where they can be found, for it is our mission to put the best processes for doing work before our readers.

One English Engineering Opinion.

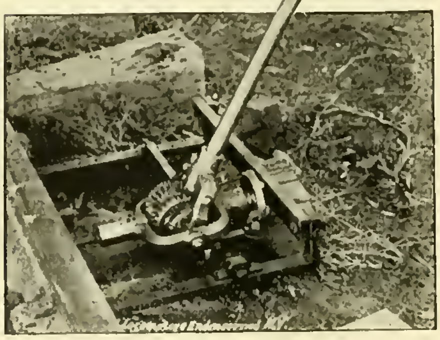
There is a journal published in London, called the "Engineer," which makes abuse of everything American its weekly theme. The crank whose daily labor is finding new excuses for slandering our people, our industrial productions and our engineering practices, has become unusually rabid over the fast run made on the Lake Shore & Michigan Southern by the Brooks ten-wheeler. He wastes an array of figures to prove that the record made was an impossibility. To aid in proving this, he makes the astounding assertion that it has been shown by experiments in the United States that not more than one-half of the power developed by a locomotive is available for hauling the train. Think of a paper pretending to be a guide and mentor of engineering thought permitting a statement of this kind to be made seriously in its columns. It is well known that the internal resistance or friction of our locomotives is less than those used in England, and the resistance of their engines is seldom more than six per cent. The "Engineer" was unusually polite in its assertion that the fast run referred to was an impossibility; its usual mode of expression is "Some more Yankee lies."

A Continuous Feed Track Drill.

Our illustration represents a new track drill recently put on the market by the Bignall & Keeler Mfg. Co., St. Louis, Mo.

By means of the double bevel gears and ratchet the feed is made continuous — the drill advancing with every movement of the lever, be it in either direction.

A detailed description of the tool is not necessary, the cut tells the



story. The frame or "old man" is of steel, and, therefore, light to carry around, and one of the greatest advantages is that the whole thing is entirely out of the way of passing trains.

The New York Central people are determined to keep up the reputation they have secured by running the fastest regular train in the world. At the beginning of last month they shortened the time of the Empire State Express 25 minutes in the run from New York to Buffalo. The time consumed in the run of 440 miles is now 8¼ hours, which makes an average speed of 53.33 miles per hour. This is a very high average speed, but there is no fear but it will be made regularly. A curious thing about the Empire State Express is that it gets to the journey's end on time more regularly than any train we know of. It is said that the shortening of the time was done to surpass the speed of a train on the East Coast route of Great Britain, which has lately been accelerated to make an average speed of 52.46 miles an hour between London and Edinburgh.

"Discipline Without Suspension."*

By Geo. R. Brown,

General Superintendent, Fall Brook Railway.

The usual penalty for a serious violation of rules on American railroads is dismissal from the service. Minor infractions are usually punished by depriving the offender of employment for a fixed time—ten, thirty or sixty days; a few roads have adopted the European practice of direct fines. In my estimation, as a rule, these forms of punishment are as unjust and inhuman as they are unnecessary.

It is a well understood principle in jurisprudence that a law without a penalty for its violation partakes more of the nature of advice than of law.

The rules and regulations governing the running of trains on a railroad are laws, and should be so considered, and penalties for their violation are not wanting.

The responsible officer or officers of a railroad must act as judges, try every case, make every decision and punish every violator. It is not only their right, but their duty, to be strict in maintaining discipline. They have no right to excuse one offender and punish another, but must try every case on the calendar.

Penalties are imposed for two purposes: First, to uphold the law and prevent its further violation; and, second, to reform the violator.

Punishment inflicted indirectly benefits thousands who do not violate the law as well as the one who does.

It often occurs that the disgrace and injury occasioned by a strict enforcement of a sentence does more to ruin the guilty than anything else, and a wise provision has been made allowing courts to use their judgment as to carrying out punishments; this is known as "suspending sentence." If the some-time offender does better, and is not guilty of the same or other offences, the judge conveniently forgets the indictment hanging over him, but should he go on committing one misdemeanor after another, his "record" rises up to condemn him.

I believe in the practice "suspending sentence" with railroad employés.

Officers of railroads differ from Judges of the law, in that they make the law and enforce it, while the Judge administers the law as he finds it. If the people are dissatisfied with the laws they change them, but there is no appeal from the decision of the railway official who performs the functions of Judge, jury and executioner.

Railroad officials who hire, discipline

* Under the caption "Discipline Without Punishment," Mr. Brown contributed an article similar to this to the February, 1894, edition of LOCOMOTIVE ENGINEERING. Several roads have adopted this plan, now known as the Brown System, and the operative officials of America have been deeply interested in the subject, discussing it at their meetings, etc. The demand for the paper setting forth the plan long ago exhausted the edition, and Mr. Brown has consented to revise his article and again explain his plan in this paper, as much to avoid writing long letters on the subject as anything else.—EDITORS.

and discharge employés cannot be too careful in exercising their authority, and no honest one can afford to decide on a single case without first "putting himself in the other man's place." In other words, treat him as he himself would consider just and honorable if the sentence was to be pronounced on him, and the decision should be made impassionately, impartially, and giving him the benefit of all doubts.

Accidents have happened on railroads since the starting of the "Puffing Billy" until to-day, and are likely to happen as long as railroads are operated.

Every wreck, every accident, every mistake, every loss has taught its lesson, and these are of no less value to the railroads and to railroad men than the successes. I practice making every mishap a lesson to every man on the road.

It often happens that an accident, or a "close shave" for one, is the best kind of a lesson to the man who could be blamed; and if he is retained in the service, he is a more valuable man than he would otherwise be or who could be hired to take his place.

I am afraid that it would do me no good, and would do me harm, to lay me off for thirty days for any offense; and I am sure I would do no better, when reinstated, than if I had been allowed to continue in the service. I should feel as if I had been ill-treated, as if my family had been deprived of the necessaries and comforts that my earnings afford them, and that they were the innocent victims of an injustice.

In order to make every accident and incident happening on the road a lesson to all the trainmen, I established twelve years ago a Miscellaneous Bulletin Board.

On this we post up brief accounts of mishaps and other occurrences on the line, pointing out how such trouble could be avoided, etc. This board is closely scrutinized. We do not mention names, but, of course, the men know "who's who" in most cases. This board has done much to keep the men on their guard, prevented many accidents, and shows them how headquarters look at every case, instead of letting them discuss every accident around the roundhouse and caboose stoves and form their own conclusions—no two of which will be alike.

To show the class of notices posted, I inclose a few that have appeared. We usually leave a notice up for ten days.

A train was derailed at Hammond. They had five cars of through freight, which they failed to give to train 84, which passed them at that station, making various excuses for not doing so, none of which are valid. These cars were all delayed at Corning, and two of them were twenty-four hours late arriving at Chicago on this account.

Please remember there are no exceptions to the rule, unless you have a written order to that effect, which will not be granted under ordinary circumstances.

This is a matter of record.

Trainmen will please discontinue throwing water at each other on the road. The party receiving the water is liable to slip or fall and injure themselves, perhaps very seriously. The stormy weather will afford the brakemen all the outside application of water that is necessary.

Please report any violation of this order to me.

I regret to announce that 13 out of 46 freight and coal train conductors who have worked the full year ending with May 31, 1895, have lost their $60 premium. Last year there were but three out of 47 who lost it.

We believe it is possible, and we hope that the coming year every conductor in the employ of the Company will be entitled to this premium, ending with May 31, 1896.

Please remember that it remains entirely with yourselves whether you get it or not. The original notice stated that your services must be entirely satisfactory for the full year in order to insure it. Please make diligent effort, each and every one of you, to procure this $60 with your May pay for 1896.

Caboose No. 27 had to have a new set of springs put under it on account of being loaded too heavy with links, pins, etc. There was taken out of this caboose 2,020 pounds of unnecessary material.

Conductors will only allow such material in their cabooses as may be actually necessary, and not load the boxes down for the purpose of making the springs ride easier; and it is unnecessary to haul a ton of this material around month after month.

I understand that recently, at a night telegraph office, the semaphore light had gone out and the blade was wrong when a train arrived at the station. This was not reported to Corning office by the train so finding it, and should have been done from the next telegraph station. All conductors and engineers will please report any violations of this kind at once.

Please remember that employés' lives are jeopardized when operators do not strictly comply with rules and regulations, and parties who know and do not report these things will be considered as guilty of negligence as the operators themselves.

Train 86 met train 69 at Cooks. The side track did not hold 69. The man on the rear gave signal to go ahead. This was construed by the man on the head end as a signal to stop. They took it that the train was in the side track and covered up their headlight. A brakeman in the center of the train comprehended the situation and flagged 86.

Investigating, we find that men are very careless about giving signals. When a go-ahead signal is given at arm's length by their side, instead of being raised and lowered vertically, it makes a part of a circle, which might be construed for a signal to stop.

In future, in giving a go-ahead signal please hold the lantern directly in front of you and raise and lower it vertically, and under no circumstances attempt to give a go-ahead signal at arm's length by your side. Conductors and engineers will please watch this very carefully. As an extra precaution, the brakeman on the head end should have gone out on the main track or bank, until he could have seen down the main track and have known personally whether the caboose was in or out of the side track. This should have been done in addition to all signals, as the engine was around the curve where the caboose could not be seen plainly.

A car billed from Port Allegany to Ulysses, via Ansonia, was taken by a south-bound train to Newberry Junction. This is a matter of record.

A south-bound coal train overtook the way freight at Reading Center, and was nearly stopped when the way freight started. After the way freight passed the station the semaphore was raised, and the engineer of the coal train pulled slowly by the depot the engine and several car lengths, and within six or eight rods on the caboose of the freight.

Two ladies attempted to cross the track after the freight passed, and their horse was scared, and were unable to do so. They were turned around in the street, and a man caught the horse before any damage was done. The engine of the coal train was behind the depot, where the ladies could not see it, and they claim they understood that trains were to run five minutes apart. This is correct, and should have been done. We learn from this:

1st. That the way freight is holding coal trains; which is prohibited.

2d. That trains are following each other too closely; which is prohibited.

3d. That this train passed the semaphore when it was up; which is prohibited.

Under no circumstances must the pilot of a locomotive pass the semaphore pole until the blade is dropped.

A north-bound train had some cars derailed at the south end of Level Corners' siding about 5:17 A. M. The cars ran up the main track far enough so that trains could have passed through the side track had not the frog been injured. The trainmen reported that it was necessary for a wrecking crew, which we ordered of the Beech Creek Co. Instead of taking their engine and going to the section house near Larry's Creek, getting the sectionmen out and telling them what was required to make the side track ready for passing trains, they remained at the wreck, and the wrecking train had orders to stop and get the sectionmen, where they found them surfacing the track, at nearly 8 o'clock in the morning. When they arrived at the wreck they had to go back to the toolhouse for the necessary material and tools to take out the frog and put in a piece of rail—and it was about five hours after the derailment before trains could pass. Had they taken their engine and went immediately for the sectionmen the track could have been made ready in not to exceed one and a half hours, thereby saving delay to all other trains of at least three and a half hours.

Conductors and engineers should always look the situation over carefully and work with a view of getting trains around the wreck at the earliest possible moment, leaving the wreck to be cleaned up later on.

Flags used on locomotives and cabooses in many cases are badly faded. In some cases the faded green flags look very much like dirty white ones. When flags are dirty or faded, new flags must be procured in their places.

Conductors and engineers, please give this your careful attention, remembering that the safety of employés and trains largely depends upon it.

I am credibly informed that engineers, more particularly passenger, find fault with flagmen on account of being flagged, even when it is absolutely necessary that the train should be stopped.

If engineers have any criticisms to make about when they should or should not be flagged, they will please make them at the office, and not take the matter up with the flagmen personally.

Engines Nos. 6 and 21 collided near the water-tank in shop yard; damage, about $80. No. 21 was going to the shops after coming in on passenger train. When the yard engine first saw No. 21 they were in one of the shop tracks, and should have remained there until No. 21 passed. Instead of doing this, they backed out on the main track, and continued to back until they saw that No. 21 was not liable to stop.

Yard engines must under no circumstances detain road engines going to or from the shops or their trains.

There is little doubt but what engine No. 21 was making too high speed around the curve, and both engineers are more or less to blame, but particularly the engineer on engine No. 6.

A coal train arrived at the "Y" without any man on the rear end. Investigating, we find that the conductor went over to the engine at Angus; a brakeman got off at Angus to close the switch, and he claims the train ran so fast he could not overhaul it; the flagman got off at Earles to close the switch, and he also claims the train was moving so fast he could not overtake it. There was, therefore, no man on the rear end of the train from Earles to the "Y." Had the train been obliged to stop, no flag would have been sent out, and had it broken in two there would have been no one to control it or prevent a wreck.

1st. The conductor had no business that required him to be on the locomotive.

2d. The engineer should not have left Angus for Earles until he got a signal from a man standing on the rear cars and not on the ground. The flagman should have given a signal to stop the train until the brakeman overhauled it at Angus.

Notwithstanding there is a telegraph office at Earles, not one of these men reported this occurrence to Corning office or to the following train, which shows lack of judgment on their part. Fortunately nothing unusual occurred to cause a wreck.

A brakeman was posted to go on train No. 85. Instead of going, he arranged with another who was not an employé of the company to go in his place, without permission from the office. When called in the office to explain, he said he had been here about two years and did not know that he had to get permission under these circumstances.

For the information of all other brakemen, will say, that the man who went in his place will not receive any pay for the trip, as he was not employed by the company to perform such service, and the brakeman who was posted has been discharged for this and other offences.

The conductor is not responsible, for he supposed this man was an extra man until going down Pine Creek, he asked him his name, at which time he asked the conductor to put the other man's name on the time-slip and he would get his pay from him, as the other man had been here about two years and was entitled to $1.75, where he was a new man and only entitled to $1.62½ per day.

If we have any more brakemen who are so ignorant of the rules, and do not know they must receive permission from the office when they desire to lay off or procure a man in their place, it is high time that they do know it, and this notice is posted for their information.

We don't always give the boys left-handed compliments. Here is a right-handed one from a farmer.

Wedgewood, N. Y., July 31, 1893.

Mr. G. R. Brown, Gen'l. Supt., Corning, N. Y.:

Dear Sir—Yesterday morning, as train No. 85, drawn by engine 56, was approaching this station, your employés on same discovered a portion of a flock of sheep on the track, and instead of dashing into and over them, by which a number of them must have been killed, they slowed down and used all their efforts, and so managed that not a sheep was injured. I mention this, deeming it worthy of your notice, that the men on train 85 should receive your commendation as making the extra effort in the interest of your company, even if in the line of duty.

We put up a notice that at the end of the year we will pay a cash premium of $60 to every freight conductor whose services have been entirely satisfactory. It speaks well for the men, when our report shows that forty-five out of fifty-six conductors were awarded premiums for the year ending May 31st, 1892. The reasons the other eleven failed are given below, which shows that some of them lost it through no fault of their service.

1. Brought car of freight for Newberry Junction to Corning as an empty car.

2. Absent on vacation about a half year.

3. Stood in Billsboro side track to switch car in spur; set one brake back of car to be switched. Rear end ran down and collided with car going in spur.

4. Only worked part of year; resigned.

5. High speed, Beaver Dams to Watkins, and from Log City to Long Point.

6. Violation of rules. He supposed engineer had sent flagman.

7. Put two cars off end of side track at Dresden by giving back-up signal without receiving same from man on rear end of the train. Broke telegraph wires. Did not report it until next day.

8. Ran double-header to Beaver Dams, and only took cars that one engine should haul. (Since discharged for drinking. Now proprietor of saloon in Corning.)

9. Allowed 3d 70 to pass Cooks less than ten minutes behind; the second section overtook them south of Presho and collided.

10. Left car of horses at Himrod's Junction that were shipped for Watkins. Man in charge told him it was an error on bill. Left car without asking for instructions.

11. Engine "John" (pony engine used by officers of company) found train south of Earles; his flagman not out proper distance; conductor in caboose, and could see flagman plainly.

For the year ending May 31st, 1893, but three conductors lost the premium, for the following reasons, viz.:

1. Ran into truck loaded with steel rails. Section flag out 20 telegraph poles. Had 62 cars, running too fast; no brakeman in center of train.

2. Backed train out of south end of Four Mile Run side track without sending flagman to protect his train.

3. Left cars on farm crossing in Hilborn storage track; also left tin box at Lyons containing way-bills.

We also pay premiums to section foremen for the best kept track. Three premiums on each Division, $40, $20 and $10 respectively. The benefits derived are even more than expected. The condition of the track is at least 25 per cent. better, and the track pay-rolls for the year ending October 31st, 1893, was $37,199.66, and for the year of 1894 $41,842.46 less than the average for the eight years before premiums were given.

For the trainmen we keep a record book. This book is never shown to any employé, except that page which is his personal record.

In it I write down a brief statement of every irregularity for which a man is responsible; this record takes the place of the "lay off," and is dreaded fully as much; the man goes to work at once, and no one but himself suffers, and he only in reputation at headquarters.

We are very careful in the selection of our men; promote all our own engineers and conductors, and in a few months or a year or two our record tells us whether they are adapted for the business or not. We have engineers who have been running here more than twenty-five years without a scratch of the pen against them; while others, who have been running as many months, have quite a page full of irregular circumstances; but down near the bottom of such a page can generally be found the words "Discharged—incompetent."

When a man commences to make a record (in the book), we call him in and talk with him. He is reminded that, if this gets too long, we shall have to consider him a failure for our service, show him his weakness, and give him another chance. But he understands that it will not be entirely for the last offense that he is dismissed—the "suspended sentence" cases are against him.

With this system the good men are retained, developed, benefited and encouraged, and the culls are got rid of to the betterment of the service all around.

It is well understood that we do not wish to retain in the service men who deliberately deceive us about mishaps on the road; we want the "straight" of every matter, and we want it at first hands. It would be a very lively detective who could get to my office sooner than some of the men who are responsible for the accidents. If it is not serious enough for dismissal, the matter is overlooked or made a matter of record, and the man goes out on his regular run. Then the "Miscellaneous Board" has another object lesson on it.

If there is anything that will stimulate a good man, who has become careless enough to make a lapse of duty that "gets him in the book," more than that simple record, I do not know what it is; but when the record is made and the victim warned to look out and attend to business in future, and to take his run out in the morning, he goes away with a mental vow that he will try and make his services satisfactory in future. On the contrary, if he reasons that the record is an easy way out of his trouble, makes light of it, and is frequently called on to explain irregularities, it is the best of evidence that he should not be retained in the service any longer. Some of the records are years apart. In some cases a memorandum is made, and never an occasion given for a second one.

Good men who have made some little mistake, are less likely to do so again than men who have not yet tried the responsibilities of running trains and engines, or men who are not familiar with our road or work. If the responsible officer takes such an offender into his office, talks the matter over dispassionately, and tells him that he is considered too good a man to be discharged for incompetency; that the accident has cost so much, which the company will stand "this time," but perhaps not the next; tell him that this is a matter of record against him, and if he desires to remain in the service these irregularities must not occur, this has a tendency to make better and more successful railroad men of the ones that are naturally adapted to railroad work—and the "next time" comes only too soon to the man out of his sphere.

There is nothing in this to disgrace him among his fellows, nothing to make him feel revengeful or maltreated; but everything to make him feel as though he was encouraged and helped, and that his final success depended solely upon himself. Can as much be said of the plan that disgraces a man among his fellows; that takes the comforts, and, perhaps, the necessaries, from his home; that makes him a loafer for thirty or sixty days, and puts him in way of temptations that he would not find at his work, and that leaves him, in many cases, in debt to the dealers who furnish his family with supplies?

On many roads there is a great want of cordiality or confidence between the men and the officials immediately over them. In too many cases a suggestion from a trainman to an officer would be resented as an unwarranted interference. It seems to me this is not in the interest of the railroad company, however much it may enhance the dignity of the official—who is himself only "one of the hired hands" with a little more responsibility.

I have found suggestions from the men of vital importance in matters of detail, and every man in the service knows that the rule and motto at headquarters is, "Suggestions are always in order."

Train and enginemen see and know things about the road that an operative officer could never find out in his office. At their suggestion, we have frequently made minor changes in time-tables, etc., and every change has been an improvement. A laborer on a section may suggest something that will save the Company hundreds of dollars, and besides this, it encourages men to think and become more interested in their work, and feel at liberty to offer other suggestions.

When a suggestion is made that is considered impracticable, the reason that it is so is pointed out, and both the man and the manager have learned something. I am sure that this rule makes and keeps up a friendly feeling between the men who plan the work and those who execute it.

Roads that can afford to let one department fight another, who can afford to have hundreds of employés disinterested and dissatisfied with their work, who can afford to have the officers "out" with the men, and the men glad to see any hoped-for improvement a failure, are few and far between.

The suggestions set forth in this article may not be practicable everywhere, but on a moderate sized road (Fall Brook has 257 miles all single track, with an average tonnage of about 6,000,000 yearly) where the superintendent knows all the men, or most of them, it has worked so well for years that I have an abiding faith that it will work anywhere and in every case in the interest of better service.

A Stud Wrench.

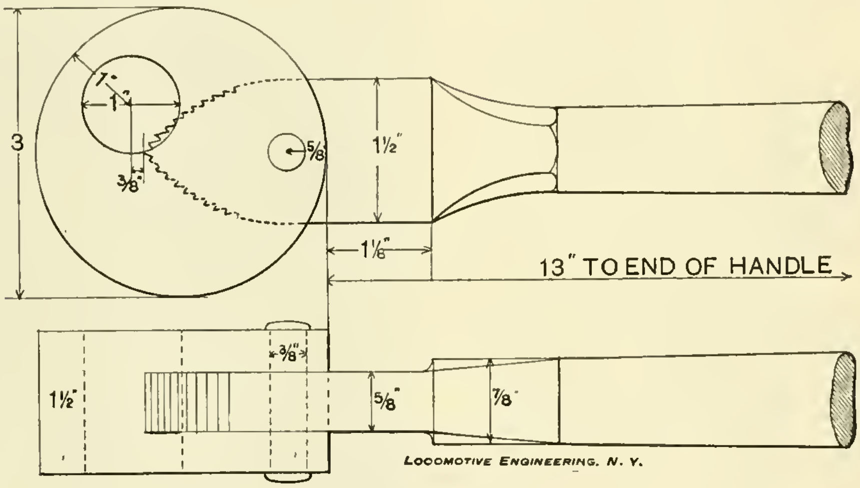
While on an exploring trip through the One Hundred and Forty-fifth street shops of the Manhattan Elevated Railway a few days ago, we were shown a well-ordered little tool-room that bore every evidence of being conducted on business principles by a mechanic who builded for the future as well as for to-day.

The tools arrayed in their respective racks looked much like the display of a machinery supply house—so clean and bright.

Among several creations of this place we noticed the stud wrench shown in our illustration, which looks like a combination of the sleeve and alligator features of other wrenches; but it stands alone, distinctively original, consisting of a disk-like sleeve which is slotted to receive the toothed gripping head forming an extension of the handle.

The disk is pivoted to the handle, so as to move freely. The serrated part of the wrench is made elliptic in form, and the two edges are toothed, so that when the sleeve is slipped over a stud the teeth in either edge may engage with the stud at will, depending only on the way it is desired to turn the stud—out or in.

Having had several falls taken out of us during our shop experience by dallying with a slippery alligator, we were ready to admire the tenacious grip of this little tool, that can give points to even the octopus in staying power, for it is absolutely impossible for this wrench to slip, its action being that of a cam.



STUD WRENCH.

The Moran flexible joint used on the P. R. R. big compound "1515" has been in use now for over three years, giving good service and no trouble. This joint does away with leaky hose, insures the full opening all the time—hose kinks up—and is not affected by the heat, by ashes or bad water. It is a question if the time has not come when a flexible metallic connection must be used between engine and tender, at least on steam heat and water supply, if not on air.

Every railroad man and every traveler will be interested in a verdict lately rendered by a court in Brooklyn, N. Y. In New York State a constitutional provision changed the iniquitous law which made $5,000 the limit of damages for causing the death of any person. The wife of a citizen of Brooklyn was killed by a trolley car, and he sued the company for $50,000 damages. A verdict for $7,500 was given. The trolley company appeal to find out if the constitutional change cannot be overruled.

The Santa Fé fast train is hauled over the Southern California by oil-burning locomotives. The Southern Pacific are equipping two of their engines with Booth oil-burners, at their Los Angeles shops.

Notes on English Railways.

By J. W. Thomas, Jr.,
Assistant General Manager, N. C. & St. L. Ry.

PERMANENT WAY.

The track is up to a remarkable degree of perfection. Stone, gravel and furnace slag is used for ballast. Ties are spaced rather close. They are generally 8 feet 11 inches long, 10 inches wide and 5 inches thick; are creosoted, and last about seventeen years where chairs or tie plates are used. After doing service in the track, they are sawed into 2½-inch plank and used for fencing, facing for platforms, surface drains, etc., etc.

Rails weigh from 60 to 90 pounds per yard, 30 and 32 feet being about the usual lengths. The London & Northwestern Railway is laying some 90-pound rail, 60 feet long. Rails are laid with even joints, and as a rule are supported in cast-iron chairs and secured in the chairs by wooden wedges driven between rail and side of chair. Chairs are fastened to the ties by bolts or lag screws. In some of the tunnels felt is put between the chairs and ties to reduce the noise. Where chairs are used, rails have a narrow base or are of the double-headed pattern. Noticed that chair wears a depression in the lower head of the double head rails, and when the rails are turned tracks ride badly and trains make a lot of fuss. The depressions are a trifle longer than the length of the rail bearing and are as much as 1-16-inch deep. The American pattern of rail is used to some extent, and is either placed directly on the ties or on tie-plates.

Angle bars as well as plain splices are used. They are not over 18 or 20 inches long. Four 7-8-inch bolts to the joint. Bolt holes in rails are oblong. No spring rail frogs. The keyed frog seems to be in favor. Split switches have but two tie bars.

Right-of-way of all trunk lines is fenced throughout, hedges being used quite extensively. Many miles of iron fencing. The absence of grade crossings is very striking.

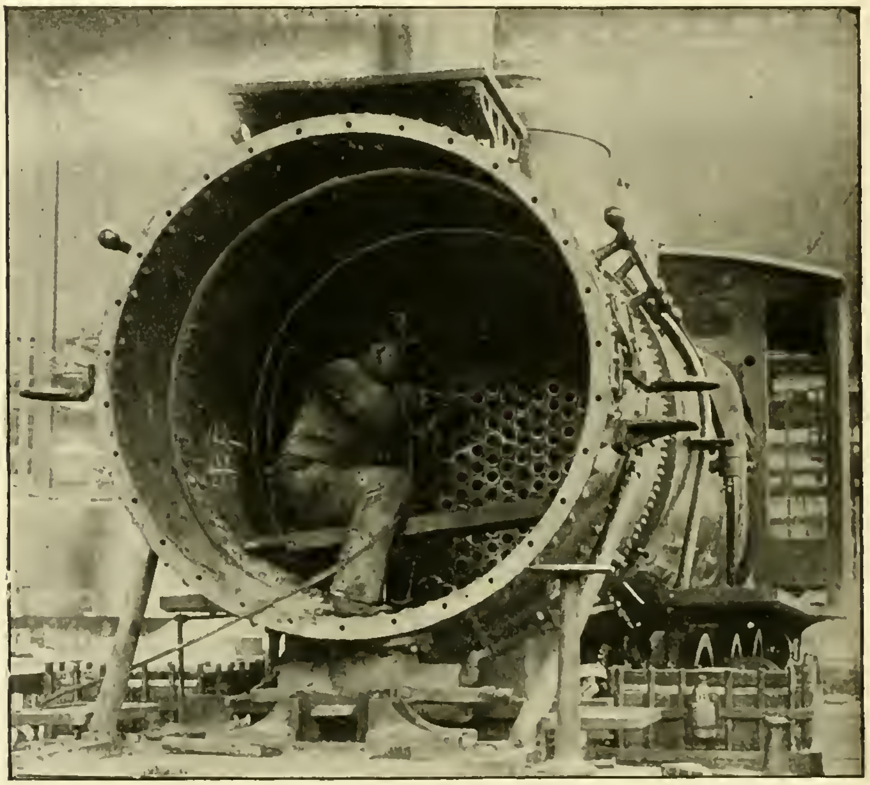
Few bridges to be seen, viaducts of stone or brick being the rule. All bridges coming under my observation were so constructed as to admit of ballast and road ties being used upon them. Do not remember of seeing but one wooden trestle on any of the main lines; this was on the approach to the docks at Dover.

In some localities, in addition to the mile posts, quarter, half and three-quarter posts are erected. Quite a number of roads mark change of grade with a post having arms extending parallel with the track, and on them is stenciled the number of feet in which track ascends or descends one foot, as "1 in 200," "1 in 1,270," etc., etc. If grade changes from ascending to descending, the left arm is inclined upward, the right downward. If grade changes from ascending to level, the left arm extends upward and the right arm is horizontal, and so on.

CARRIAGES.

The standard carriage is about 30 feet long, and, with the exception of a few excursion and special cars, is divided into compartments, the seats running crossways the car. Three pairs of wheels, one pair at either end and one pair in the center.

Corridor cars vary in length from 40 to 65 feet. Where aisle is in center of car, the seats on one side accommodate two persons and on the other side one person. This arrangement is necessary from



BEADING FLUES WITH PNEUMATIC HAMMER.
BURNSIDE SHOP, ILL. CENTRAL.

the fact that the cars are only 8 feet 6 inches wide. The shorter cars of this class have three pairs of wheels. The longer ones are carried on two 4 or 6-wheel trucks.

What few sleeping cars I saw were 42 feet long, divided into four compartments, and accommodate only eight persons. Two brass bedsteads, each of which are a little narrower than a single bed, in each compartment; no upper berths; $1.25 per berth; by paying for both berths passenger can have entire compartment. Although windows are provided with curtains, a large curtain, quite thick, is hung over the windows. Aisle on one side of car; lavatories at each end.

Passenger trains are equipped with continuous brakes of the Westinghouse or automatic vacuum pattern. Some of the carriages are equipped with both. Iron brake beams. Every beam tested before being put in service. Steel and iron are used quite extensively for side and intermediate sills. The body of carriage is bolted to sills pretty much as we bolt our tenders to the tender frames, and in some instances about as insecurely.

All slack is taken up by the screw couplings.

Mansell wheels are used almost exclusively under passenger equipment. These wheels have cast hubs, steel tires and wood filling.

Many of the cars are illuminated with compressed oil gas. Oil lamps are used in large numbers, however. Where oil is used, lamp is put in position through a trap door in the roof and must be lighted from the roof.

Some few dining and sleeping cars are heated with hot water, oil gas being used to heat the water. Ranges in dining cars are heated with gas. As a rule foot warmers are used. Saw a pile of twenty thousand of them at the carriage works of the L. & N. W. Railway. They are made of heavy tin, 2 feet long, about 12 inches wide and 4 inches thick, are charged with acetate of soda and put in a tank of boiling water previous to going in the carriage. There is a cast iron ball in the can, and after water cools and soda begins to reform into crystals the heater is shaken and the ball breaks up the crystals, thus reheating the water to some extent, and warmer is good for about two hours longer, after which it must be reboiled.

Passenger trains have either ordinary

bell cord, running outside the carriage and underneath the eaves of the roof, or an electric signaling apparatus.

Cars are poorly ventilated. Very few raised roofs. Those coming under my observation were not over 5 or 6 inches high.

A small per cent of the carriages have lavatories in them. The number of cars so equipped is gradually on the increase. No urinals. Hoppers have double lids and are self-flushing.

Water coolers seem to be the exception rather than the rule. Drinking water is kept in small water bottles; one bottle in each lavatory. No ice is provided.

A few carriages have reversible cushions; the cushion being lined with leather on one side for summer use and with cloth on the other side for winter use. Some of the corridor cars have counterbalanced windows.

Some of the roads side the carriages up with ½-inch mahogany. Carriages are given eighteen coats of paint. At the carriage works of the L. & N. W. saw thousands of feet of this siding, some of it having been in stock and under cover for four years. Their paint shop has track room for 300 carriages. One new carriage is erected per day.

If a meal is to be served en route, and you have seat in corridor car, you need not go to the dining car, as meal is served at your seat. Meals are served in courses and are first class.

WAGONS

Except in special cases, wagons, as all freight cars are called, have two pairs of wrought-iron spoke wheels and are from 4 to 8 tons capacity. They are from 15 to 18 or 20 feet long, with sides about 12 inches high, the lading being covered with tarpaulins. Box cars form a very small per cent of the freight equipment. In many cases the roofs of box cars are cut away opposite the doors; this space is covered with a tarpaulin. Made inquiry, but failed to ascertain why this was done. Many of the coal cars have side doors. Sides are about 30 inches high. Wagons for transporting rails, long timbers, etc., have a false bolster, the bolster being pivoted in the center, and the loads resting on those bolsters so as to permit the cars to curve. Noticed several tank cars with body bolsters riveted to the tank itself, the bolsters being either steel or iron.

Wagons are not equipped with continuous brakes. Brake generally applied to one wheel only, but never to more than two, and when this is the case the two wheels on same side of wagon are braked. No brake beam. Brake lever is on one side of car, is about 6 or 8 feet long and cannot be manipulated except when train is moving slow enough to allow trainmen to run alongside of car and shove it down. About the only brakes that can be applied when train is running is the one on the engine and the one on the brake van.

The 5-link coupling is gradually disappearing, a 3-link coupling being substituted. It is not necessary to go between the wagons to couple or uncouple, nor is it necessary to couple them as they come together. In coupling and uncoupling a "shunter's stick" about five feet long with a hook in the end to engage the chain is used, the buffer being used as a fulcrum to assist the shunter in raising the chain and throwing it over the hook of the next car, or to disengage the chain from the coupling hook. A good deal of slack in freight trains. When train is stretched the buffers are from 7 to 12 inches apart.

LOCOMOTIVES.

While the English locomotive looks plainer, and the casual observer would think they had fewer parts than the American locomotive, I believe the inside-connected engines, as used in England, have more parts, and if run under the same conditions would cost more for repairs than the American type of locomotives of the same general proportions.

As in America, the tendency is to increase the steam pressure. Engines steam freely. In the first place they have splendid fuel, and in the second place draft is not obstructed by netting and draft sheets. No extension fronts. The engines have a much lighter exhaust than ours, and throw very few sparks. No headlights, pilots, bells nor seat boxes. Cabs are coming into use, but are not long enough to furnish the protection they should. Saw several shunting engines without even a wind-guard. Simple engines, both passenger and goods, usually have 18-inch cylinders. Express passenger engines have drivers varying in diameter from 5 to 8 feet. Goods engines usually have 5-foot drivers; those of heavy mineral engines are generally 4 feet or 4 feet 6 inches in diameter. Driving wheels are either of wrought iron or cast steel. Many companies are putting four-wheel trucks under their locomotives. Some few roads are using iron or steel tubes and fireboxes. Copper is preferred. Nearly all locomotives have screw-reversing gear. I believe most of the engines on the Caledonian Railway have reverse levers. Engineers stand on left side. Engineers run by water-gage glass; most engines have two gage cocks, but no gage-cock drip pans. No steps on front or rear of shunting engines. Jackets are painted, each road using a different color. Fire doors open inward and upward. Passenger engines have power brakes on both tender and driving wheels. Goods and shunting engines have hand brakes on drivers and tenders.

Water space of tenders extends under coal bin. Coal boards are sheet iron with small trap door at the floor. Tank boxes are made of sheet iron or steel. In some instances the circular ends of water legs of tenders are used as tool and oil boxes, the water space being shortened about 18 inches. Track tank scoops are sometimes handled by air or vacuum.

SIGNALS.

With few exceptions, the railways of Great Britain and Ireland are fully interlocked. For instance, at Kenmare, Ireland, where there are only three trains in and three trains out every 24 hours, the interlocking is as complete as though 500 trains were worked in and out of the station per day. Ninety per cent of main line switches are handled from interlocking machines.

Passenger traffic is worked under absolute block system. Permissive block working is admissible on goods lines. Single track lines are either worked with the staff or the staff-and-ticket system. Where business justifies it, signalmen look after staff machine; otherwise the guard performs this duty. Communication between the towers is had by a code of bell signals, train describers, telephone or telegraph. In some instances there are two or three means of communication between the same towers.

As a rule signals are in very poor adjustment. From my observation, if blades are inclined anywhere from 30 to 70 degrees, safety is indicated. As far as practicable, signals are placed on left side of track they govern, with the blade pointed to the left; top arm applies to the line to the left, etc. Each home signal has its distance signal. Some distance signals are handled more than a mile; 1,200 yards is the average. Signals are handled by a single wire. If necessary, signals are put as high as 40 or 45 feet above the rail, in order to get sky background.

Many signals have repeating blades, i. e., a blade placed below the running blade and about 10 feet above the rail. This is done to enable the driver to see the position of the blade in foggy weather.

Some roads use what is termed a "calling on" signal. It is a short blade about two feet long, placed just below the running blade. When the lower blade is pulled it indicates that the train may draw on slowly to the next signal.

When signals are located so they cannot be seen from the tower electric repeaters are used.

Some roads use red for danger, green for safety; others use red for danger, white for safety. As a rule, back light shows white when signal is at danger and obscured when signal is at safety.

Where slow running tracks are parallel to fast running tracks, signals for the former are designated by a sheet iron ring fastened to the blade.

Most companies manufacture their own interlocking apparatus. Very few machines have preliminary locking. Tappets are usually coupled directly to the levers. Channel iron and not pipe is used for connecting rods for handling switches. It is claimed that pipe buckles too easily. Detector bars are placed on the inside of the rail. The bar itself is either T or L iron. Many switches other than those on main tracks, are not provided with detector bars.

Saw no selectors. Facing point switches are rarely ever handled more than 540 feet from the tower. Bolt locks are termed detector locks. On some roads sidings leading to the main line are equipped with catch points. In some instances catch points are introduced in the main line to derail wagons running in the wrong direction.

A novel method of stopping runaway wagons in gravity yards consists of a hook with 14 or 16-inch radius, attached to a piece of heavy cable chain about 50 or 60 feet long. The chain is coiled up in a pit between the rails. The hook is placed in the center of the track and engages with the axle of the runaway wagon. The force necessary to drag the chain out of the pit and the friction of the chain on the ties and ballast stops the wagon. It is so arranged that the hook can be lowered out of the way of passing trains.

The interlocking machine at Euston Station, London, is, I believe, the largest in the world. There are 240 working levers, the levers being in two banks. The train director told me that at times the fog was so thick the man operating the levers at one end of the machine could not see the man at the other end for hours. The tower is located in the center of the yard. During fogs the shunters use bugles to signal to the drivers and to the men in the tower; the bugles used on one side of the yard being different in tone from those used on the other side. A much-used crossover, about 500 feet from the tower, has a man stationed at it while fogs are on, the duty of this man being to notify the levermen by ringing a mechanical gong located just outside of the tower, when trains are clear of the cross-over, or when a train moving towards the tower wants to use the crossover.

I notice that the English roads make the same mistake that a great many of us are guilty of, in that they do not provide a signal for every move.

MISCELLANEOUS.

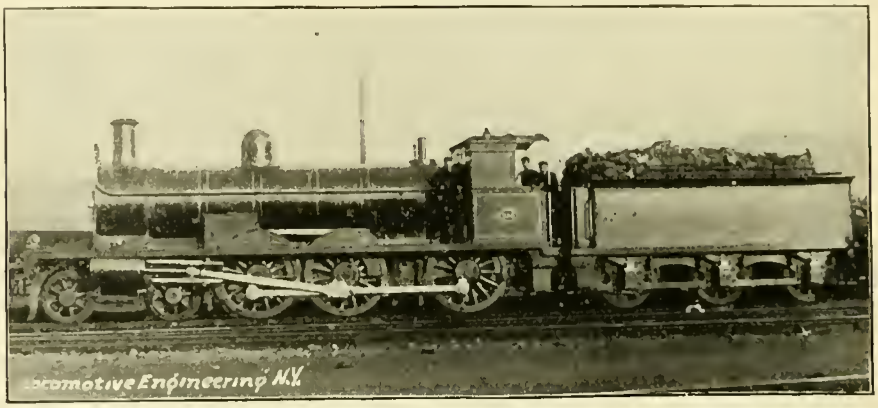
In the larger cities each railway has several freight stations. In cities and many of the villages store door delivery is in vogue. The railway companies also have their trucks, and haul merchandise from the stores to the stations. Where consignee unloads freight a demurrage of 3s. per day on wagons and 6d. on tarpaulins is charged. Don't remember just how long after arrival and placing of wagons demurrage begins. Private wagons are charged siding rent.

Horses, turntables and capstans are used for shunting purposes quite extensively, but all new yards are so arranged that locomotives can do the work. Capstans are generally handled hydraulically or electrically. Cranes for loading and unloading heavy articles are stationed at convenient points about the yards. Many of the freight stations have lifts for placing wagons on the different floors of the warehouse.

The larger roads manufacture most of their material and supplies. At the locomotive shops of the L. & N. W. Railway, at Crewe, I not only saw them making 6-penny nails, but rolling 90-pound steel rails, 60 feet long. They were not only building locomotives, but had a department for the manufacture of artificial limbs. There are 8,000 men, women and boys employed in this shop alone.

The First Ten-Wheelers in Great Britain.

We are indebted to Mr. Samuel A. Forbes, of Perth, Scotland, for a photograph of one of the first ten-wheelers put into service in the British Isles.



FIRST TEN-WHEELERS IN GREAT BRITAIN.

This engine is one of the fifteen recently designed and put into service by Mr. D. Jones, locomotive superintendent of the Highland Railway, at Inverness. They were built by Sharp, Stewart & Co., at Glasgow.

These are claimed to be the most powerful engines in Great Britain. They have cylinders 20x26 inches with 5-foot drivers, 1,520 square feet of heating surface.

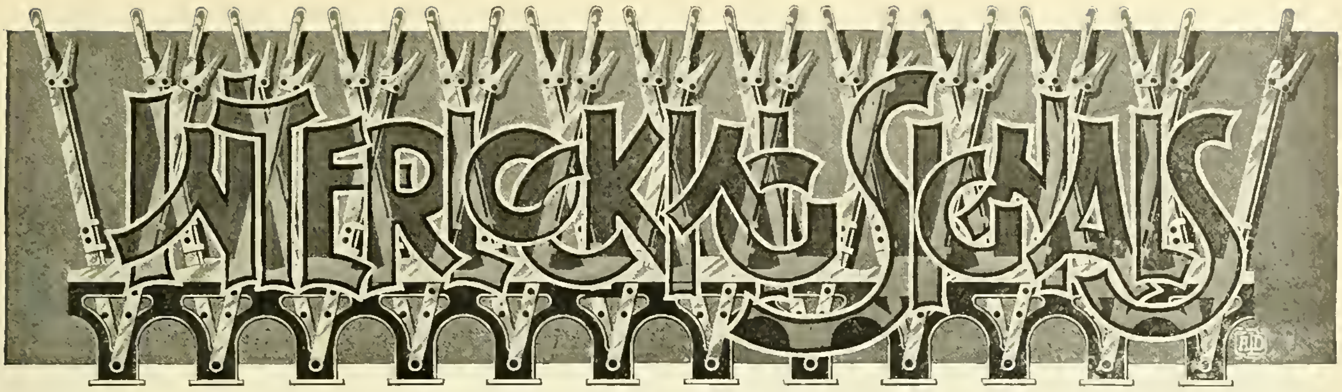
Running Engines Without Cylinder Oil.

At the annual convention of the American Society of Mechanical Engineers, held in New York City last month, an experienced engineer made the statement that engines could get along without cylinder oil. He said that some of the big steamships use no oil in the cylinders of their engines. The steam acts as a lubricant, and, when nothing else is used, the rubbing surfaces become glass-like in smoothness and extremely hard. This is, no doubt, a fact; but we should not advise our locomotive men to try the experiment on their engines. We have had considerable experience with locomotives that had no means provided for oiling the valves and cylinders. In some cases the rubbing surfaces became very smooth, but, as a rule, they came to look like a miniature corduroy road.

There has been at different times considerable discussion among railroad men as to which gives the greater mileage, a hard or a soft tire. The mechanical department of the Great Eastern Railway of England have been keeping a close record of the wear of tires of six coupled suburban engines, and hard tires were shown to be much superior to soft ones. Tires with a tensile strength of 40 tons gave a service of only 2,197 miles to 1-32 inch of wear, and tires with a tensile strength of 48 tons ran 5,892 miles per 1-32 inch wear. This was considered as being conclusive evidence that hard tires were more economical than soft ones. We do not feel entirely certain that the Great Eastern people have made a valuable discovery. Records of tire wear are not worth much, as a rule. If the same tires had been used on some other road, the chances are that the soft tires would have made the better record. At least, this is the experience of people who have interested themselves in the records on this continent.

The daily papers are entertainers in some things and educators in others, but they show up at their worst when they tackle a technical subject, especially a break-down on a locomotive. A few days ago one of the little giants on the "Elevated" broke a side rod, which resulted in a slight detention. The "Press" touched it up in their usual pleasing style, and rung all the changes on a broken "pitman."

The Hilles & Jones Co., of Wilmington, Del., are issuing their catalogues in parts, each part containing cuts of the tools used in particular trades. The latest one is especially devoted to machines for working on structural shapes of iron and steel.



By W. H. ELLIOTT, Signal Engineer, C., M. & St. P. R.R.

The Westinghouse Electro-Pneumatic and the Gibbs Electric Street Railway Systems.

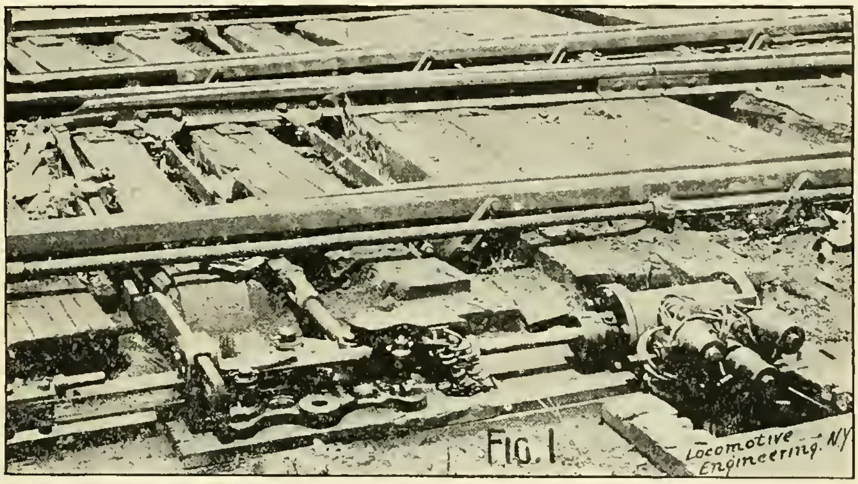
[THIRTEENTH PAPER.]

Many attempts have been and are now being made to operate the switches and signals of an interlocking plant by some power other than that of a human being, invention having passed successively from the first pneumatic machine put in service in 1876, to a hydraulic machine used in 1880, to a combination of these or a hydro-pneumatic machine in 1884 and to the electro-pneumatic in 1891. Of these, the electro-pneumatic is the only one that can be considered a success, the few plants in this country that are now operated by means of air, water or electricity having as yet not been in service long enough to demonstrate that they are anything more than an experiment.

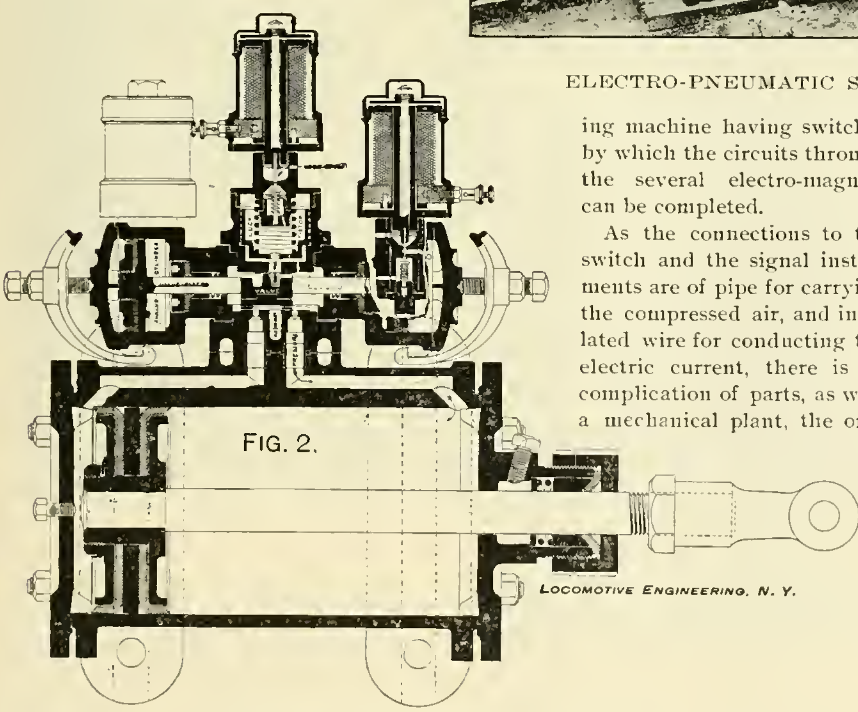
As the several inventions along the lines named have been made principally by Mr. Geo. Westinghouse, Jr., the system that is in use to-day is one that bears his name. With the electro-pneumatic system the power to move a switch or clear a signal is obtained by the use of compressed air, the action of this power being controlled by a valve worked by an electro-magnet, the electric current to energize the magnet being in turn controlled by an interlocking machine having switches by which the circuits through the several electro-magnets can be completed.

As the connections to the switch and the signal instruments are of pipe for carrying the compressed air, and insulated wire for conducting the electric current, there is no complication of parts, as with a mechanical plant, the only apparatus used outside of the tower being such as is required at the switch or signal. For the same reason there is no limit to the distance that the different movements can be placed from the tower, other than what it would be safe for a man in the tower to operate. A description of the valve and cylinder for operating a semaphore signal has already been given in the article on "Automatic Electric Block Signals," that appeared in the May issue of LOCOMOTIVE ENGINEERING, the same arrangement being used at an interlocking plant.

To briefly describe the action of the valve: When the lever of the interlocking machine which works the electric switch is turned, the circuit through the magnet of the signal instrument is closed, energizing the magnet, causing it to attract the armature and open the valve admitting air to the cylinder, at the same time closing the exhaust passage by which the compressed air is permitted to escape. As soon as the compressed air is admitted to the cylinder, the piston is forced through the length of its stroke, the movement being transmitted by means of a balance lever and connecting rod to the signal, which is moved to the position indicating safety. When the lever is returned to its normal position, the circuit is broken and the magnet loses its power, allowing the valve to be pressed up by the force of a spring, the passage by which air is admitted to the cylinder being closed and the one releasing the air being opened, the piston in consequence being pressed up and the signal returned to danger by the force of gravity.

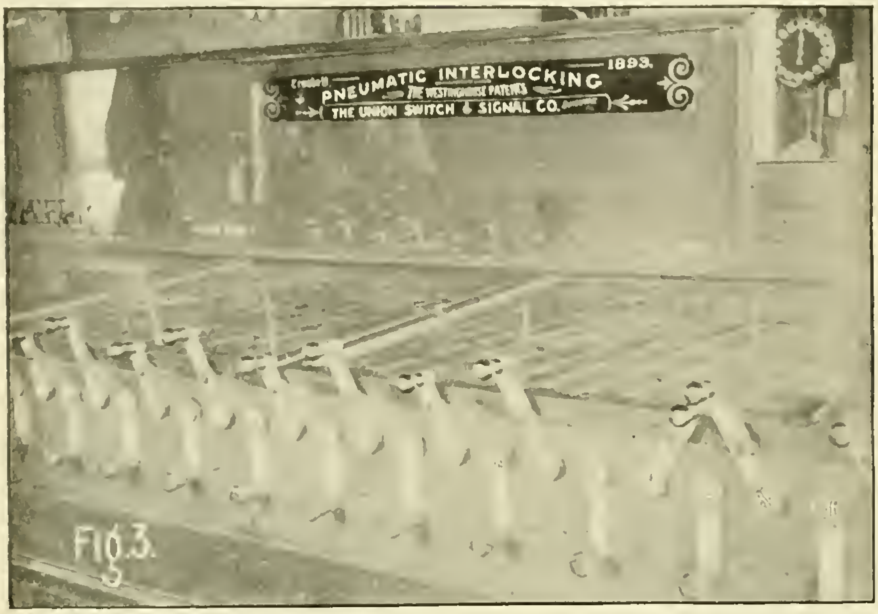


ELECTRO-PNEUMATIC SWITCH AND LOCK MOVEMENT.



DETAIL OF VALVE AND CYLINDER.

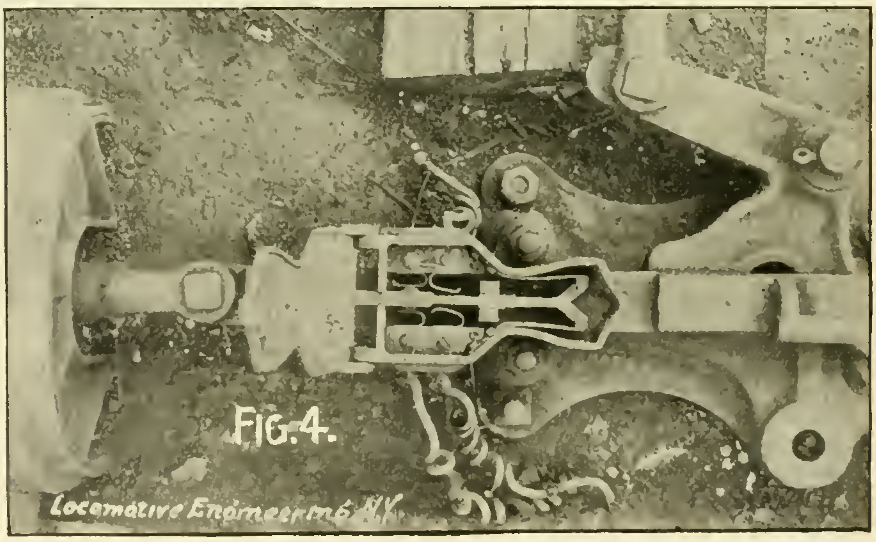
The arrangement used for operating a switch is shown in Fig. 1, and consists of the switch-and-lock movement used with a mechanical plant and a cylinder, the piston of which is made to work the movement the same as if it were connected to the lever of an interlocking machine. The connections to the switch points, the lock bar and the detector bar being made in the same way as with a mechanically operated plant, the same certainty of action and protection is afforded as if it were operated by mechanical connections instead of by compressed air.



ELECTRO-PNEUMATIC INTERLOCKING MACHINE.

The construction of the valve and cylinder by which the necessary movement of the piston is obtained, is shown in Fig. 2. The valve used is of the ordinary slide-valve pattern, passages to the cylinder and to the exhaust being arranged in the same way as on a locomotive. To work the valve, two small pistons are fastened to each end of a yoke, which is made to fit over the valve, the small cylinders in which these pistons work being known as valve cylinders. Admission of air to the valve cylinder to move the piston, and with it the valve, is controlled by a magnet of the same construction as the signal magnet, air being admitted behind the piston when the magnet is energized by the electric current sent out from the interlocking machine.

As a check upon the performance of the admission valve, a lock pin is provided which fits in a socket in the back of the valve and locks it in either of the two positions it should occupy. This locking pin is riveted to a piston which is held down by means of a coiled spring placed on the opposite side from the valve. To lift the lock pin and release the valve so that it can be moved, a magnet is provided, the armature of which, when attracted, is made to open an exhaust passage to the atmosphere and allow the air on top of the lock piston to escape. The pressure of the air on the other side of the piston overcomes the pressure of the spring, raising the piston and with it the lock pin, thus leaving the valve free to be moved. When the current through the lock magnet ceases, the armature is released, closing the exhaust passage and allowing air to accumulate on that side of the piston, once more restoring the equilibrium, when the pressure of the spring will force the piston back to its normal position again and lock the valve.



INDICATION SWITCH BOX.

The operation of the valve admitting air to the cylinder, by which motion is imparted to the piston in the cylinder and the switch-and-lock movement worked, is as follows, the lever of the interlocking machine being in the normal position with the circuit closed through one of the valve magnets: With the first movement of the lever, an electric circuit is formed through the lock magnet, which, when energized, opens the lock exhaust and permits the pressure of the air to raise the piston, and with it the lock pin from its seat. A further movement of the lever breaks the circuit through one of the valve magnets, permitting the pressure to escape from the cylinder controlled by that valve, and energizes the other valve magnet, admitting air to that valve cylinder. This forces the valve piston, and with it the valve, to the other position in which air is admitted to one end of the cylinder and opened to the exhaust on the other, the compressed air forcing the piston through the cylinder and performing the movements desired.

When the movement of the lever is completed, the circuit through the lock magnet is broken and the magnet de-energized; the armature, being released, closes the exhaust passage, allowing the coiled spring to force the piston back, seating the pin upon the other side of the valve and locking it, until the whole process is repeated in the other direction. In this way the valve is locked open, to one end of the cylinder or the other, at all times, the pressure being kept upon the piston to prevent any accidental movement of the switch.

The construction of the interlocking machine is very different from that of the machines used in operating a mechanical plant, as the levers, instead of transmitting the mechanical force necessary to work the different parts, have only to change the several electric switches controlling the movement that it is desired to make. The general appearance of the machine is shown in Fig. 3, the upper row of levers, called the switch levers, being used to make and break the circuits that connect the main battery with the switch valves, the lower levers being called signal levers, as they are used to make and break the circuits to the signal valves. Each of these levers is attached to a shaft carrying a rubber roller, on which are fastened small brass strips with which the connections are made between the two springs bearing against the roller, when the roller is turned to the proper position, the circuit between the two springs—which are the two poles of the circuit—being thus completed. By arranging these strips so that the several circuits are completed in the proper order, the movement desired is

TOWER HOUSE FOR ELECTRO-PNEUMATIC.

made by merely turning the lever. So, also, if all the levers are not in the proper position to safely perform the movement, contacts would not be made on the roller of the lever improperly set and no current would be sent out from the machine, the levers being thus electrically interlocked.

To prevent the levers controlling conflicting routes from being reversed (if such it may be called) at the same time, locking bars driven by mitre gears on the shaft are arranged, by which it is made impossible to turn the levers that clear any two routes that may lead to a collision. The locking is of the improved Saxby & Farmer type, arranged in a manner similar to that shown with the mechanical machine.

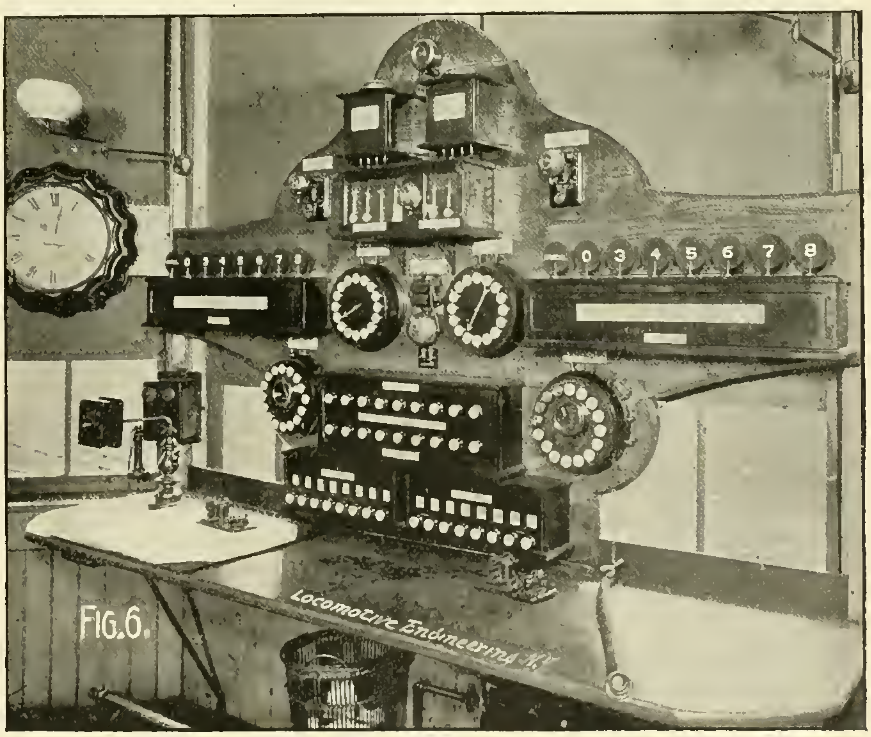
As a still further check, there is placed at each signal and switch movement a circuit breaker, from which wires are run to magnets placed on the machine, the armatures of which are made to operate latches controlling the levers, so as to delay the completion of the movement until after the signal or switch has completed its movement, the object of this being to prevent any other lever from being moved until the switch or signal that is being operated has completed its movement; for until the lever has been moved to its extreme position, the locking will not permit any other levers to be moved. The electric switch by which the indication is sent to the machine, that the movement of the switch has been completed, is to be seen placed on top of the switch-and-lock movement, a photograph showing its construction being shown in Fig. 4.

It is thus seen that a double check is had upon all the movements of the levers, and that the possibility of a mistake being made by an ignorant or careless operator is well guarded against. And, to quote from a recent technical paper, "the sequence of movements, by virtue of which a clear signal cannot be given until the route has been prepared for it by setting the switches in their proper position, is absolutely secured by the order in which the several electric circuits are closed."

With this system, owing to the amount of work the magnet has to perform, the current has to be of a comparatively high voltage, and as the current is used at all times, whether a movement is being made or not, it has been found necessary, or rather more economical, to generate the electricity by means of a dynamo, more especially as a power plant has to be provided to furnish the compressed air. It is also customary to use storage batteries, keeping them charged, so that in case of a shut-down of the dynamo, the batteries will furnish the current to operate the plant. At small plants where the current is generated simply for the interlocking, it is usual to run the dynamo only during the day—the storage batteries that were charged when the dynamo was running, furnishing the necessary current at night.

In the operation of an electro-pneumatic plant, the facility with which the different movements are made reduces, to a great extent, the number of men required to do the work. While in most cases one man is required to move the levers, another as a train director, and other men have to be employed to run the engine, the number required at a mechanical plant having one hundred or more levers, is so large that the cost of operation of the electro-pneumatic is not any greater and, in many cases, is much less. More especially is this the case where, as at terminals, a plant for generating electricity has been put in for other purposes, the only expense then being the cost of the additional power expended to provide the current used to work the plant and for furnishing compressed air.

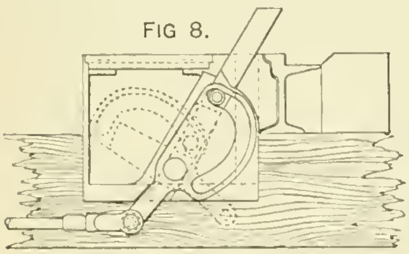
Owing to there being no mechanical connections from the machine in the tower to each of the different movements, this sys-



ELECTRICAL ANNUNCIATOR AND INDICATOR INSTRUMENTS IN P. R. R.

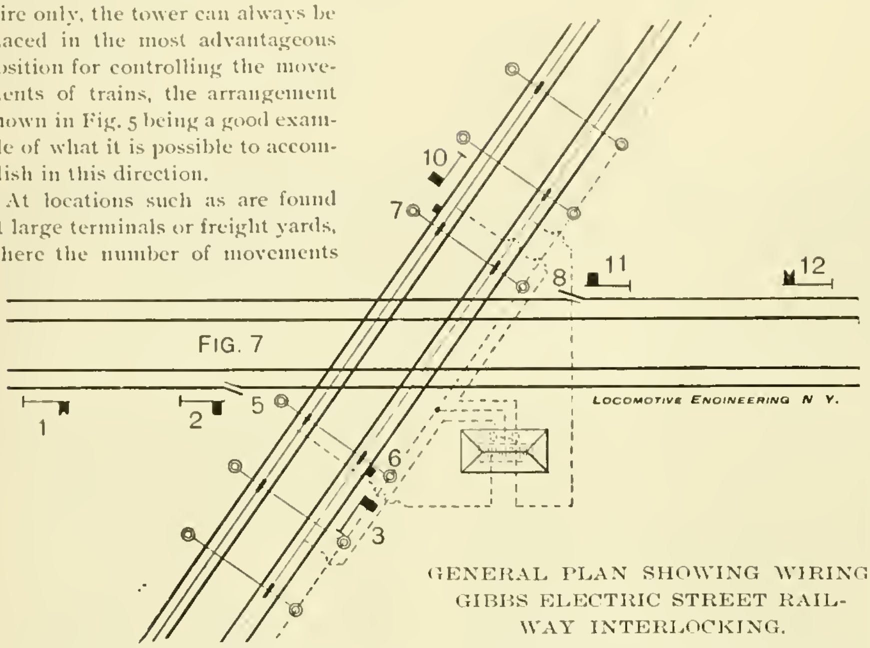
tem lends itself most readily to all applications where there are many and complicated sets of switches, sharp curves, or to places where it would be almost impossible to operate a mechanically connected plant. The connections from the tower being of wire only, the tower can always be placed in the most advantageous position for controlling the movements of trains, the arrangement shown in Fig. 5 being a good example of what it is possible to accomplish in this direction.

At locations such as are found at large terminals or freight yards, where the number of movements to be made is large and the number of switches and signals to be worked is very great, the dispatch and safety with which every movement can be made warrants the use of such a system, even if the first cost is greater. At all such locations it is usual to equip the tower with such electrical devices as will aid the train director in his work, enabling him to keep himself informed as to the movements of trains, the condition of the tracks and the position of the signals. The view shown in Fig. 6 well illustrates this, being a photograph of the instruments in a tower on the Pennsylvania road, and kindly furnished by the Union Switch & Signal Co.



DETAILS OF "SCOTCH" BLOCK.

The several instruments shown comprise train describers, by which information is signaled as to what train is coming; disk and semaphore indicators to inform the operator when a track is occupied; drop annunciators to give information regarding the starting of trains on certain tracks; telegraph instruments, telephones and electric bells. In addition to these a miniature model of the tracks operated is provided as a part of each interlocking machine, the switches being movable and mechanically connected to the levers, so that the model will accurately represent the position of the switches on the ground. This is a great help in the operation of the machine, as the operator can see at a glance the position of all the switches, and not have to look at each lever to see what position it is in.



GENERAL PLAN SHOWING WIRING, GIBBS ELECTRIC STREET RAILWAY INTERLOCKING.

Incandescent electric lamps can also be used with great success, instead of oil, at an electro-pneumatic plant; for while the cost will be about the same, the service will be very much better.

The cost of an electro-pneumatic plant for small installations is greatly in excess of one mechanically connected, but when the number of levers is large, or the tracks very complicated, the cost will, at most, be the same—and may be somewhat less. As there is hardly any limit to the number of movements that can be put upon a single lever, a very much smaller machine can be used, the cost in consequence being very much reduced.

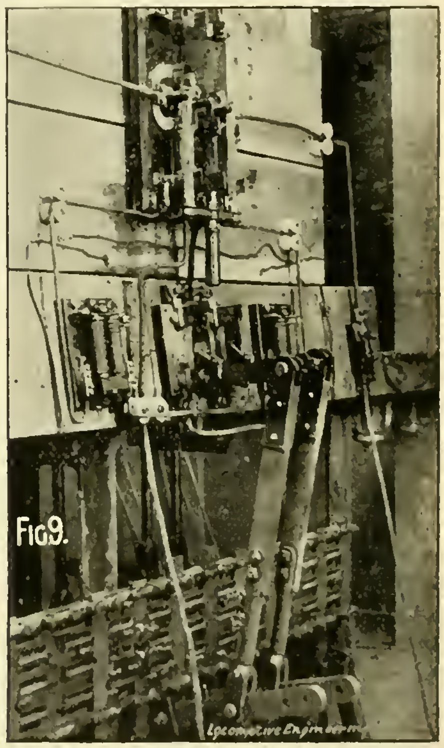
As an instance of this kind, at the Stewart avenue plant, Chicago, there are but 48 working levers in the machine, occupying a space 5 x 24 feet, to work 84 signals, 37 switches, 22 double slips and 22 movable frogs; while with a mechanical machine, according to American practice, 187 working levers, occupying a space 14 x 77 feet—and to English practice, 243 levers, occupying a space 17 x 93 feet—would be required.

If the plant has been properly installed, the repairs will be no greater than with a mechanical plant and it will be much easier to keep in working order. In winter, trouble will be experienced from freezing up of the valves and pipes, unless proper precautions are taken to get rid of the water of condensation formed in compressing the air. The contacts at the different movements must also be kept free from snow and ice, or else a contact will not be made, and it will not be possible to entirely reverse the lever.

An interlocking device which has come into use in the last two years, for the protection of a crossing of an electric road with a steam or with another electric road, and which promises, with the rapid increase in the use of electricity for street railroads, and their extension consequent upon the same, to be quite extensively introduced, has been patented by Mr. George Gibbs, Mechanical Engineer of the Chicago, Milwaukee & St. Paul Railway.

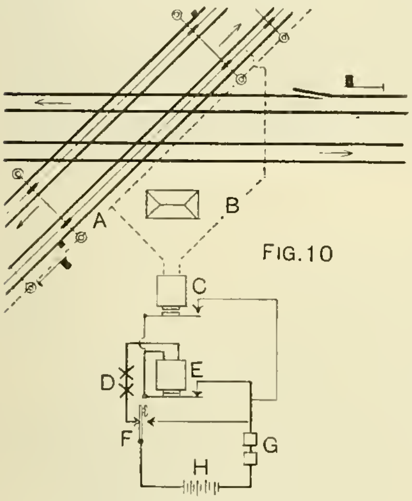
At any street crossing, when a change is made to electricity as a motive power, the danger of using the crossing is very much enhanced, owing to the increased speed with which the cars approach the crossing, their great weight and consequent inertia, and the liability of failure of their source of power, due to a shut-down at the power house, blowing out of fuses, or jumping off of the trolley wheel when the car is on the crossing. "There seems to be no good reason," to use the words of Mr. Charles Hansel, C. E., "why the statute of the State of Illinois, which requires all new crossings of steam railroads at the same level to be protected by a suitable system of signals, derails, etc., should not include the crossings at grade of all railroads or railways which carry human freight, for it cannot be regarded as unreasonable that street railways should comply with the requirements of public safety in the same manner and in the same measure as is required of steam roads.

"In cities where such grade crossings occur, the police regulations generally require the railroads to keep a flagman posted at the crossing to signal traffic. This practice gives but a small measure of protection, while the charge to the rail-



ELECTRIC CUT-OUT SWITCHES AND CONNECTIONS TO INTERLOCKING MACHINE.

roads for operating is the same as if this flagman had physical control of the crossing. Considering the subject from a financial point of view only, it appears that if we can construct a system of signaling to be controlled by a single man in a tower overlooking the crossing, with mechanism so arranged as to make it impossible for trains or cars on the steam railroad and the electric railway to reach the crossing at the same time, we have invested well; for with such a device the danger of crossing is eliminated, and the operation of either line is the same as regards safety as if no such crossing existed, and both roads are relieved of the constant danger to life and property and consequent payment of damages. The saving in rates of insurance to the electric line where such protection is provided, is alone sufficient to pay the fixed charges on the investment."



LOCOMOTIVE ENGINEERING N. Y.

ELECTRIC LOCKING CIRCUITS FOR ONE TRACK ONLY OF A DOUBLE TRACK ELECTRIC RAILWAY INTERLOCKING.

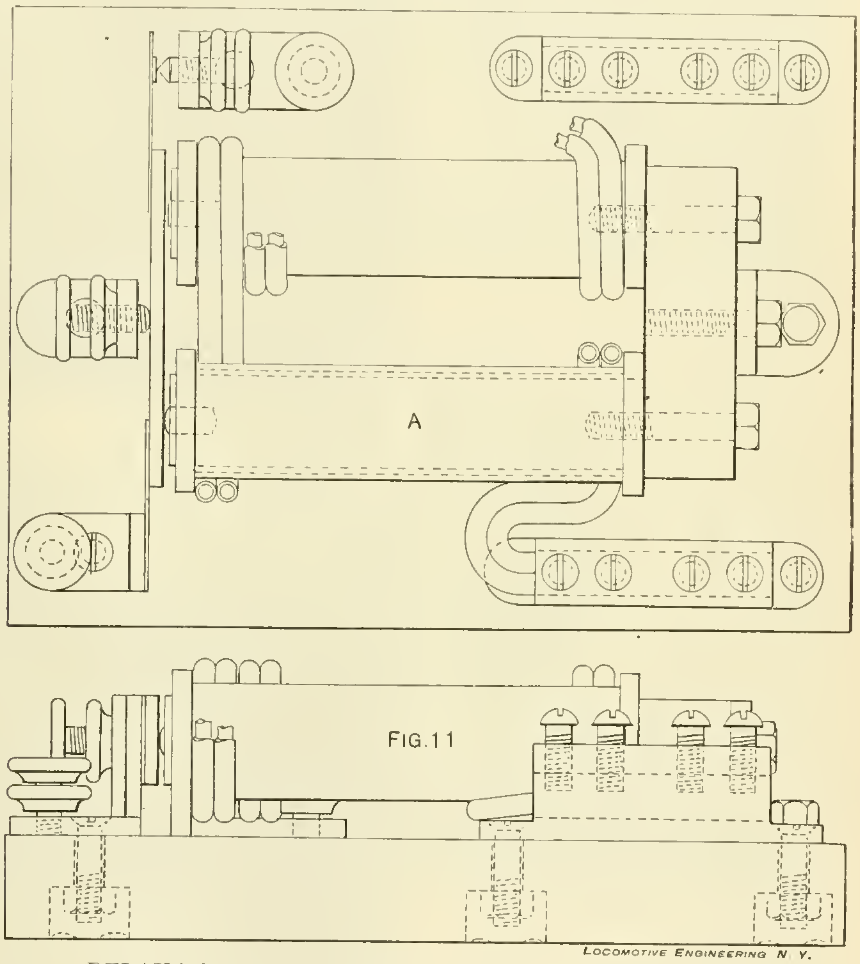
A, supply wire; *B*, wire to insulated section of trolley; *C*, releasing relay; *D*, circuit breakers; *E*, locking relay; *F*, hand releasing switch; *G*, locks; *H*, battery.

The principal features of the apparatus used by Mr. Gibbs are the cutting off of the current from an insulated section of the trolley line, making it impossible to move cars when it is desired to block the line, and in the use of a derailing device to be operated in paved streets, to prevent cars from rolling on or over the crossing, when the current is cut off from the trolley. These devices are connected to and operated by any of the usual forms of interlocking machines, the derailing device or "scotch block" being connected to the same lever that works the switch and cuts the current off from the trolley wire.

A general plan of the arrangement, as applied to a double-track crossing of a steam and electric road, is shown in Fig. 7, the trolley lines in which sections about 800 to 1,000 feet, according to grade, are insulated, being shown in the center of the tracks of the electric road. These insulated sections extend to within about 50 feet of the crossing, but never over it, and in this way make it impossible for the current to be taken away from a car at a place where it would be liable to be hit by a train on the other road. A feed wire connects the insulated section with the electric switches on the machine, which, in turn, are connected to the supply wire from the power house, the insulated section, when the switch is closed by the reversal of the lever of the interlocking machine, becoming a "live" wire and delivering current to any car that may be in the section.

The construction of the scotch block is shown in Fig. 8. It consists of a strong cast-iron box, which is placed outside of the rails, a groove being cast in the box in which an iron block 2 x 4 inches in size is raised or lowered whenever the cam lever is moved by the lever of the interlocking machine to which it is connected. When the block is down the top is flush with the top of the box, but when it has been raised, owing to the line of motion being inclined to the axis of the rail, it will project out from the box and over the head of the rail. The block is raised and lowered by means of a roller and pin working in the slot of the cam, but when in either of its extreme positions a solid bearing almost the size of the block is made on the cam and directly in line with the axis of the cam and the cam shaft. In this way the thrust of a wheel, whether of a car or heavy wagon, will be taken by the shaft and not transmitted to the pipe line and lever. The block, when raised, projects about 4 inches above the top of the rail, sufficient, it has been found, to either derail the car or to practically bring it to a stop. The block does not project entirely over the head of the rail, and so does not interfere with wagons or other vehicles which are continually running in the flangeway of the street road. This is an important feature in its design and one that has a great deal to do with the success of its application.

In Fig. 9 are shown the electric switches and the connections to the levers of the machine by which they are worked. The levers to which they are connected are the ones that work the scotch blocks, the current being always cut off from the insulated section of trolley wire when the block is raised. Placed on each side of the two electric switches, relays are to be seen through which the current to each insulated trolley section is made to pass. Either of these relays, when energized by the current used by a car in the insulated section, is made to complete a local circuit and work a bell to inform the operator



LOCOMOTIVE ENGINEERING N. Y.

RELAY FOR HEAVY CURRENTS USED BY MOTOR CARS.

A, core wound with two strands No. 8 double cotton-covered magnet wire wrapped with Okonite taping $\frac{1}{16}$ inch thick and paper well shellaced.

when a car has entered the section. A small electric switch worked by the signal lever breaks this local circuit and stops the bell as soon as the signal is cleared, the operator's attention, in this way, being more forcibly attracted to the fact that the signal had not been cleared.

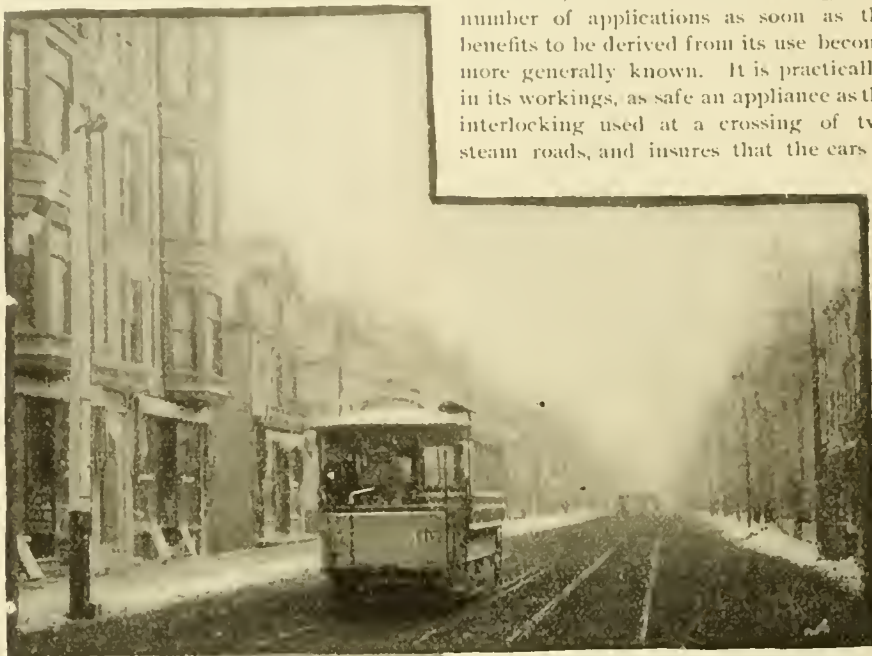
It will be noticed, by examining the figure, that a large three-way reversible switch, to which the supply wire is run before being connected to the two cut-out switches, is placed on the frame-work immediately below the switches. This is used to cut out the switches and relays in case any accidental short circuit should be made, or any of the parts get broken, the trolley wire being in this way energized so as not to block the electric road.

An additional feature which experience has demonstrated to be of great value in the safe operation of the plant, and one which has also been patented by Mr. Gibbs, is an arrangement of locks and releasing circuits whereby the levers of the machine are locked up after the signal has once been cleared for a car on the electric road until after the car has passed over the crossing. The circuits used are shown in Fig. 10, the locks, relays and circuit breakers being connected in the same manner as was shown in a previous article, where electric locking was applied to the levers controlling a simple crossing, except that when the releasing relay (the upper one shown in the figure) is energized the current is made to pass through the locks, releasing them as soon as the circuit is completed instead of around the locks in the shunt circuit, when they would not release the levers until after the releasing circuit had been broken. To obtain a current with which to energize the releasing relay, a short section of the trolley wire on the further side of the crossing is insulated in the same manner as the cut-out section and is connected to the supply wire through the coils of the releasing relay.

When the car has passed over the crossing and the trolley runs on the insulated section, the relay is energized, lifting its armature and completing the circuit through the locks, lifting them and also restoring the circuit through the locking relay, causing the circuit to be maintained and the locks held up after the car has passed off the releasing section. As the current which passes through the releasing relay is the one used to propel the car, it is at times a very heavy one, amounting to seventy-five amperes at 500 volts, or about fifty horse-power. A relay to carry such a current as this is constructed of very different proportions from the relays ordinarily used for the currents generated by a battery, and, for this reason, its design may be of interest to those who are not familiar with such things.

This relay is shown in Fig. 11, the core pieces being 1 inch in diameter and 4 inches long, arranged in the usual horseshoe form and wound with a single layer of two No. 8 cotton-covered magnet wires, which are soldered together where they enter the binding posts. The iron core pieces are covered with $\frac{1}{8}$ inch insulating material to prevent the current, the voltage of which is very greatly increased during thunder storms, from breaking through the insulation, and by reaching the locking circuits, burning out the locks and relays. To prevent, if possible, any damage being done in case the insulation should break down, the wires of the locking circuits are connected to the relay with a piece of $\frac{1}{2}$-ampere fuse wire, 6 inches long, which will burn out and prevent the current from grounding through the locks.

This system is now in use at seventeen crossings of electric with steam railroads in the city of Chicago and one in the State of New York, and is destined to have a greater number of applications as soon as the benefits to be derived from its use become more generally known. It is practically, in its workings, as safe an appliance as the interlocking used at a crossing of two steam roads, and insures that the cars of the electric road will have the same protection afforded them in using the crossing that is given to the trains on the other road.



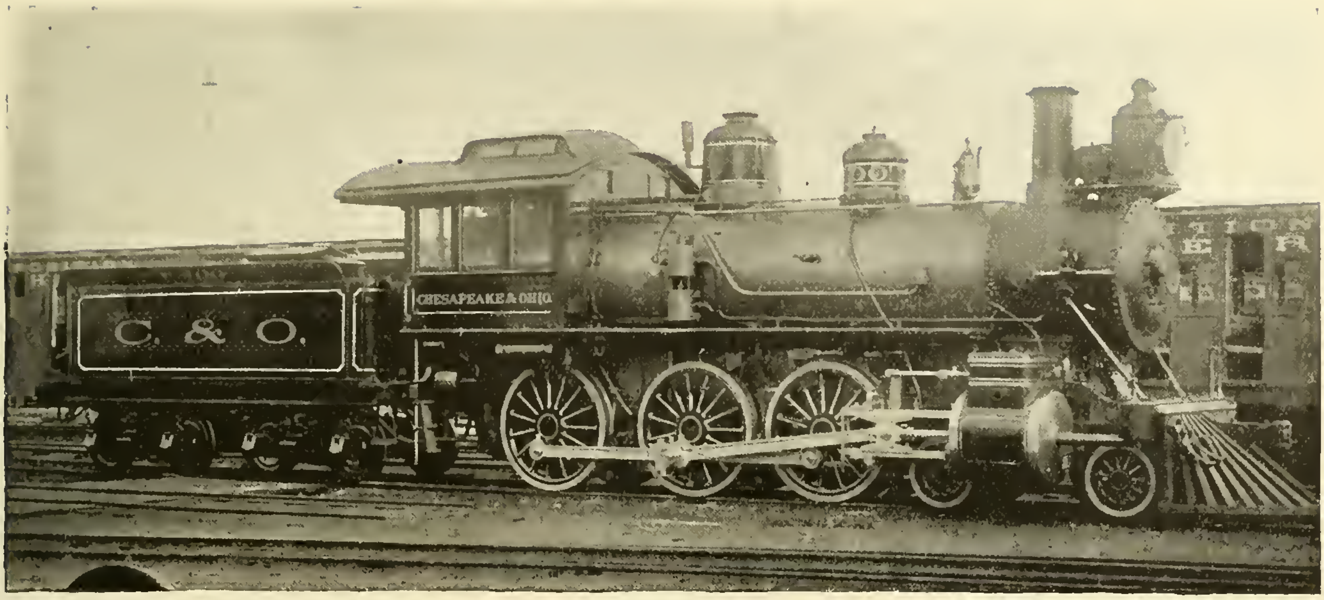
GIBBS ELECTRIC SIGNALS FOR STREET CARS.

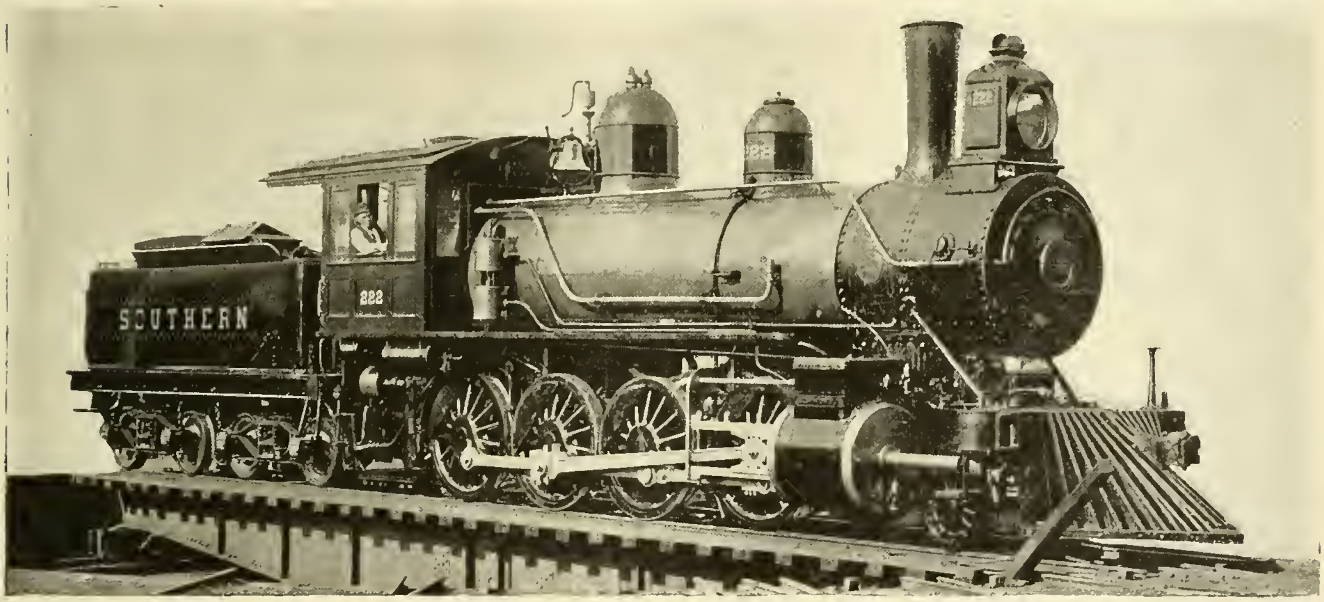
SCOTCH BLOCK.

The American naval service, which is about the most aristocratic in the world, has always treated the engineering department as if it consisted of a lot of greasy fellows, who had no right to aspire to be held in the same esteem as the men trained to handle the ships. The consequence has been that the naval cadets have displayed unwillingness to enter the engineering department. On account of this Senator Squire has introduced a bill into Congress making the graduates of outside engineering schools eligible for appointment as cadets in the engineering department of the navy. Other changes are proposed which will tend to make the position of naval engineer more acceptable to ambitious men.

Commencing January 1, 1896, Mr. Lewis R. Pomeroy, late of Coolbaugh & Pomeroy, will have charge of the railway sales department of the Cambria Iron Co. and the Latrobe Steel Co. His office will be at 33 Wall street, New York.

After much weary travail the New York, Lake Erie & Western Railroad Company emerged from the hands of the receivers on the first of last month, and the property is recognized under the name of the Erie Railroad Company. The same officials remain in charge.





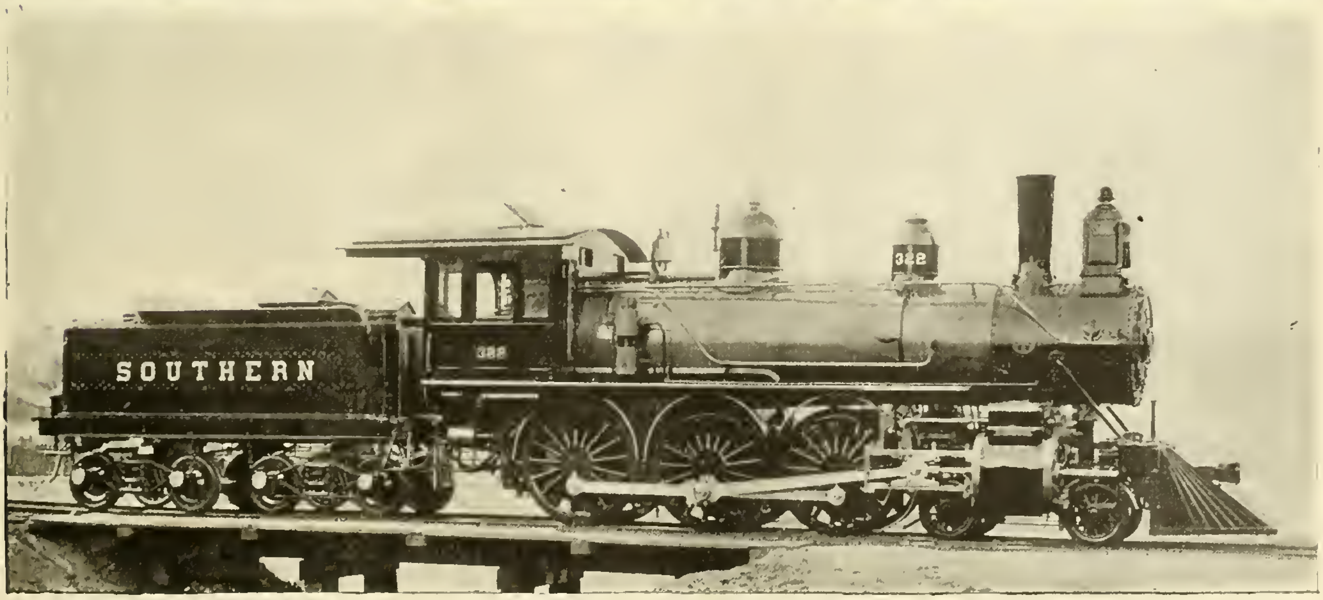


EXHIBIT OF THE RICHMOND LOCOMOTIVE WORKS AT THE ATLANTA EXPOSITION.

LOCOMOTIVE ENGINEERING
A PRACTICAL JOURNAL of RAILWAY MOTIVE POWER AND ROLLING STOCK.

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Defective Freight-Car Brakes.

In the course of a paper by Mr. A. M. Waitt, general master car builder of the Lake Shore & Michigan Southern, at the Western Railway Club, on "Air-Brake Equipment for Freight Cars," attention was directed in a forcible manner to the existing carelessness in the maintenance of air brakes on that class of cars. Owing to this and to the practice of depending upon a few cars to do the braking of freight trains, Mr. Waitt alleges that instead of being a source of safety, the air brake in its existing condition is increasing the number of accidents to freight trains. No statistics are given to substantiate the position taken, but we presume that the conclusions were based on reliable data.

Those who are in the habit of lingering around freight yards and car repair tracks, do not require outside testimony to convince them that the condition of the air brake on the average car is a disgrace to the railroad companies which permit them to remain in service. We had supposed that the inefficient condition of air brakes on so many freight cars was due to utter neglect of equipment that was originally in good order, but Mr. Waitt testified differently. He asserted that in the building of new cars, but few companies seem to have their inspectors give much attention to how the brakes are put together or inspected. It is a most common occurrence to find newly-built cars with leaky joints in the pipes, or with the hose nipples screwed into the angle-cock casting so as to hold by only two or three threads, or with air cylinder so located as to prevent removal of front head for oiling and cleaning, or with the pipe clamps merely acting as a loose support for the pipes instead of holding them tight in their place, thereby preventing rattling and consequent tendency to leaky joints. It is also frequently found that the strainer is filled with scale, greasy dirt, red lead and other obstructive matter, showing that the pipes have not been blown out with steam before being put up. A triple case or a hose coupling is often discovered with sand holes—another testimony to want of proper inspection.

The essential part of air-brake gear designing was said to be as bad as the inspection. The braking power of the light car is only 70 per cent., which is very low for heavily-loaded cars; but by ignorance, design and carelessness in arranging levers the braking power is frequently as low as 40 per cent. of the light car. Among the defects mentioned as reducing the efficiency of brakes from lack of attention, after they have gone into service, are—the inside of the cylinders becoming a bed of rust, and the packing getting so dry and hard that the air will blow through the packing without moving the piston. Dry cylinders, gummed triple valves, torn hose and defective gaskets, all have their share in impairing the usefulness of the air brake on freight cars.

Neglect of the air hose was severely censured. "Perhaps," said the author, "there is no part of the air-brake system more neglected, and at the same time more important, than the short pieces of hose that connect our main lines of pipe between the cars. A neglected inspection and renewal of this seemingly insignificant part has been the direct cause of more wrecks and loss of property on freight trains, during two years past, than any other cause or causes. With ordinary careful inspection, well-instructed engineers and properly equipped locomotives, we have had air hose burst in trains—not simply in tens, but by fifties in a month, and it is reasonable to expect that other railroad companies are having similar experience."

That is rather a discouraging condition of affairs, and it means to us that the air hose of brakes are kept in service after their season of usefulness is over. First class air hose has a fairly uniform life. When it has been in service about its allotted time, a rigid inspection ought to be made to ascertain its condition. The fact is, however, that there are too many inferior hose on air brakes, because the railroad purchasing departments are too much influenced to purchase cheap articles, no matter how inferior they may be. This may not be the policy followed by the Lake Shore & Michigan Southern, but it is nevertheless a policy largely pursued, and we have no doubt that many of the expensive wrecks to freight trains have resulted from this species of dear cheapness.

The principal remedy recommended by Mr. Waitt, to cure the prevailing maladies of air brakes, is thorough and systematic inspection. He also wants the train crews to be provided with the tools necessary for putting defective air brakes in order. As a means of increasing the efficiency of the air brake, he recommends the use of instruction cars and schools, where train men and others may acquire proficiency in the handling of air brakes. This is all in the right direction, but we submit that enginemen and trainmen, as a rule, are quite proficient enough in knowledge of the air brake if they only have a brake in fit condition to be handled. Nearly all railroad companies examine their train men, to test their knowledge of the air brake, and the practice is rapidly increasing; but the movement to provide systematic means for repairing defects of brakes on freight cars moves slower than the mill of the gods; but it is starting, and will eventually do some fine grinding upon those who act as if their responsibility for the condition of air brakes ended when the car left the shop.

A curious feature of this miserable condition of air brakes on freight cars is, that it prevails mostly on cars belonging to railroads east of the Mississippi. Western roads have learned how to inspect their freight-car brakes and keep them in working order. That proves that brakes that go far from the home road can be kept in good order, and it is true that the railroads in other parts of the country are doing likewise. There are inspection plants at various interchange points, east of the Mississippi, for finding out the condition of brakes; but they are used principally to reject cars. There is grievous absence of the spirit that moves, not to make a rejection, but to effect an improvement. A rule exists on all well-managed roads that the engineer must try his brakes when the engine is coupled to a train. A rule equally binding ought to be enforced that no air-brake car should pass an interchange point or making up yard without the brake being tested, and no car with a defective brake should be permitted to go upon the road. This policy would be a little troublesome at first, but it would pay railroad companies the cost many times over, in the prevention of wrecks and delays from brake failures.

The Fastest of Fast Runs.

The Brooks Locomotive Works, Dunkirk, N. Y., have published a pamphlet giving full particulars of the extraordinary fast run made from Chicago to Buffalo on the Lake Shore & Michigan Southern Railway on October 24th. The pamphlet contains a table giving leading particulars of the fast record-breaking runs made by the London & Northwestern and Caledonian Railways; the New York Central, and the Lake Shore &

Michigan Southern Railway. Fine halftone cuts of engines "599" and "564," of the Lake Shore are given, and a variety of press comments upon the run are quoted. This pamphlet will be a very convenient reference to those interested in high train speeds, as it contains official figures of the three fastest runs on record. Any one interested in fast speed can obtain a copy of the pamphlet on applying to the Brooks Locomotive Works, Dunkirk, N. Y.

The builders have sent us the following facts concerning the fuel and water used by Brooks engine "564" which made the run of 86 miles in 70 minutes and 46 seconds, an average speed of 72.92 miles per hour:

Distance run	86 miles.
Coal used, total	3,250 lbs.
Coal used per mile	37.79 lbs.
Water evaporated	3,700 gals.
Water evaporated	30,833.33 lbs.
Water evaporated, per lb. of coal	9.48 lbs.

These figures present facts which make the record more surprising than ever. The engine has 28 square feet of heating surface, and burned coal at the rate of 2,746 pounds an hour, which is close on 100 pounds to the foot of grate area. The prevailing doctrine and belief is, that fuel burned under such conditions must result in great waste of heat, yet this engine's boiler evaporated 9.48 pounds of water to the pound of coal, very good performance for a well-designed stationary boiler. It is evident that there are still a good many things about the economical rate of combustion that have not yet been satisfactorily settled by the engineering world.

Increase of Heating Surface.

During a discussion on Wide Fireboxes at the Western Railroad Club, Mr. William Forsyth, mechanical engineer of the Chicago, Burlington & Quincy, made the point that locomotive designers are not increasing the area of heating surface of their boilers so fast as they are increasing the grate area. An examination of the designs of new locomotives built in the last few years, will show that the tendency has been to exercise ingenuity in making the grate area larger, while no effort worth mentioning has been devoted to making the heating surface greater. Unless some radical change is effected on our design of boilers, the American locomotive as seen on some roads has reached the limit of its capacity. The driving wheels limit the width, and the bridges, to say nothing of a dangerous high center of gravity, limit the height of the boiler; there is no advantage gained in making the boiler longer, and so we find that boilers as large as can be carried are in use on different roads.

Mr. Forsyth advocates a radical change, in the adoption of a special form of water-tube boiler which has proved superior to the locomotive boiler as a steam maker for the engines of fast torpedo boats. Mr. Yarrow, the famous English shipbuilder, has been very successful in the designing of water-tube boilers for torpedo boats, and his types are employed in various navies, where large steam making capacity is needed in small space. The design of a locomotive boiler that would have both water tubes and ordinary flues was presented by Mr. Forsyth. The firebox and boiler appear to be about the same size as the firebox and boiler of the C., B. & Q. locomotive illustrated on page 748 of the December number of "Locomotive Engineering." While the firebox shown in the engraving referred to has 187.4 square feet of heating surface, the firebox with the water tubes would have 579 square feet. A change of this kind might entail troubles that are not experienced with the common firebox; but it is a proposed improvement which is worthy of a trial. Various forms of water-tube boilers have been tried for locomotives with very unsatisfactory results, but that is no reason why a good, practical water-tube boiler may not yet be made a success.

Prospects of Using Oil as Fuel.

Railroad officers are frequently importuned by inventors of oil-burning appliances to adopt their devices and burn oil in locomotive fireboxes, great claims of saving being made. There are circumstances under which liquid fuel is cheaper than coal, but they are very rare. At the last meeting of the American Society of Mechanical Engineers the subject was discussed with a result that brings no comfort to the oil advocates. The question was submitted: Are there any conditions under which oil fuel is cheaper than coal for generating steam at points on the Atlantic seaboard?

The answers given to this question were to the effect that if a man owned an oil well and a coal mine, the oil would be the cheaper fuel; but, under existing conditions, the companies controlling the oil wells keep the price of oil so high that coal is the cheaper fuel. There is no difficulty in using oil fuel in a locomotive, but the supply is not nearly equal to provide fuel for one-tenth the locomotives running in this country. In fact, it is estimated that the locomotives in use on the Pennsylvania Railroad alone would use half the oil production of this continent if they were all burning oil.

How Throttling Superheats Steam.

A question in connection with steam which many engineers find hard to understand is, "Why does throttling the steam cause superheating?" The impression among many people is, that the superheating results from the friction of the steam in passing through the restricted opening. This is not correct. The superheating consists of the extra heat that was in the steam when it was at the higher pressure. For instance, we have a boiler carrying 180 pounds pressure, and the throttle opening is kept so restricted that the steam entering the dry pipe is reduced to 140 pounds pressure. The heat in steam at 180 pounds pressure above the atmosphere is 379.4 degrees Fah., while the heat of saturated steam at 140 pounds pressure is 360.6 degrees Fah. When the steam descends to the lower pressure, without doing work, it has, therefore, nearly 20 degrees more heat than what is required to keep it in a gaseous condition. The reason that economy sometimes results from throttling steam down to a lower pressure is, that the gas is able to give out some heat to the cylinders before any water is formed. Steam passing from the boiler without reduction of pressure is always at the dew point, so to speak, always ready to turn into water on the least amount of heat being abstracted from it. During the whole journey from the dry pipe to the atmosphere, the steam is meeting something that robs it of heat and turns it into a misty vapor. The bad effects of this vapor inside of the cylinder are cumulative, for it carries off heat without doing any work, and every drop formed helps to condense more steam. It is to restrain this action that appliances for superheating the steam are used in connection with some steam engines.

Effect of Throttling.

Steam engineers have been so long accustomed to believe that waste of heat results from throttling steam in its way to the steam chest, that it is hard for them to admit that there may be exceptions to the rule in favor of a full open throttle. About a year ago Mr. Charles T. Porter, one of the most celebrated mechanical engineers in the country, described, in a paper read before an engineering society, experiments which he had made to find out the exact effects of throttling steam, and asserted that under certain circumstances throttling resulted in saving steam. For a locomotive, the time when throttling might prove beneficial would be when the engine was working so very light that the reverse lever might be kept in the center notch or very close to it. Before Porter published his discovery many locomotive engineers claimed that they used less fuel at short cut-offs, when the steam was throttled, but that was generally considered a prejudiced view in favor of a bad practice.

During the past year, since we published an account of what Porter's experiments had demonstrated, several of our friends have been making tests and observations of the effect of throttling, and they unite in saying that a locomotive cannot be operated economically with a cut-off shorter than 25 per cent. In certain cases it has been found economical to advance the reverse lever a notch ahead of the 6-inch cut-off, and reduce the admission of steam by throttling. Compound locomotives appear to waste steam when they are worked closely hooked up. In a letter to the "Railroad Gazette" Mr. J. H. Symington, mechanical expert for the Richmond Locomotive Works, says: "I believe that few men realize that a light throttle is often the most economical throttle to use. With our high boilers and short domes there is great difficulty in getting dry steam.* * * On all engines there is a certain throttle opening which conduces to a maximum efficiency by superheating the steam sufficiently in its passage through the contracted opening to insure dry steam in the cylinders, and at the same time maintain a good initial pressure in the steam chests." He then tells that in his experience with the "Tramp" compound he found throttling an advantage when running light.

It is well known that locomotives, and all engines having cylinders exposed to the weather, lose a great proportion of the steam by cylinder condensation. The range of temperature of the cylinder is so great that the initial steam finds the cylinder acting as a condenser, since its metal has to be heated up from the temperature of the exhaust steam to the temperature of the ingoing steam. The reduction of pressure due to throttling superheats the steam, and it contains a certain amount of heat that can be taken away by the cylinders without turning the steam into water. This appears to justify to some extent the practice of the old fogy engineer who prefers to run with the throttle partly closed.

BOOK REVIEWS.

"Seventh Annual Report on the Statistics of Railways in the United States." For the year ending June 30, 1894. By the Statistician of the Interstate Commerce Commission. Government Printing Office, Washington, D. C.

This is the usual elaborate report, with tables giving full information on almost every subject concerning railroads. Although the data is over a year old, it is in the main correct, and should be used instead of floating statements in the newspapers, as a basis of information on American transportation matters. You can get a copy free by making request through your Congressman.

"Catalogue of the Hopkins Railway Library, at Palo Alto, Colo." By F. J. Teggert, Asst. Librarian. Price $1.50.

This is a very large and complete catalogue of almost everything ever printed about railroads. It seems to be the largest collection of railroad books and pamphlets in America. If there is a better we do not know of it.

"Poor's Directory of Railway Officials and Manual of Street Railways." By H. V. and H. W. Poor, New York.

This is the usual list of officials of railroads, both under the heading of the road and classified. There is also a mass of tables and other data published for the information of investors, and a lot of advertising. This is as good an official list as it is possible to make an annual publication. The changes of officials on American railroads amount to some thousands in a year, thus largely destroying the usefulness of such a list. The recent issue of a monthly correction list, by one of the annually published lists, has done more than anything else to show the weakness of any list compiled at so wide an interval as one year.

"Sketch Portfolio of Railroad Stations and Kindred Structures." By Bradford Lee Gilbert. Published by the "Railroad Gazette," New York.

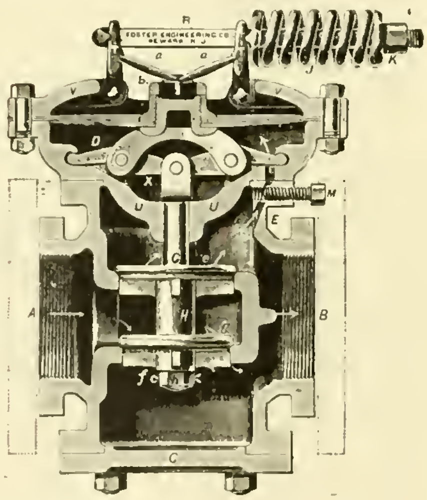
This book is portfolio shaped, about 10⅛x13⅛ inches, and containing half-tone and line sketches of many railroad stations in this country and other buildings of a public and private nature. It is a handsome and useful book for any railroad architect. There is no text, simply the pictures with briefest possible descriptions. No price is given.

Useless Loss of Life.

On the morning of December 18th, a steam valve or pipe connection in the engine room of the American Liner "St. Paul" burst, scalding to death nine men of the engineer's crew.

Only a couple of weeks before a similar accident, but with fewer fatalities, occurred in the engine room of the Olympia Theatre, in this city.

Long and large steam pipes are always



subject to dangerous strains, that are apt to cause a rupture.

Our engraving shows the details of construction of a valve made by the Foster Engineering Co., of Newark, N. J., that is intended to guard against just such risks. This safety device, if placed in a steam-pipe system anywhere, will shut off the supply of steam from the boiler the moment there is a rupture. The valve is automatic, costs little and insures much.

The Pennsylvania employs 47,000 men, and pays out annually to them $36,000,000; the Panhandle lines employ 8,600 men, and the wages paid annually are $8,000,000; the Pittsburg, Fort Wayne & Chicago employs 10,000 men, and pays them annually $6,300,000.

PERSONAL.

La Mott Ames has resigned as master mechanic of the Beech Creek R. R.

Mr. John D. Campbell has resigned the position of master mechanic of the Buffalo & Susquehanna R. R.

Mr. G. W. Seidel has been appointed master mechanic of the Baltimore & Lehigh, with headquarters at Baltimore, Md.

Mr. W. W. Wilson has been appointed general manager of the Gulf Beaumont & Kansas City, with headquarters at Beaumont, Tex.

Mr. F. N. Hibbits, master mechanic of the Rochester division of the Erie, has been appointed train master of the Eastern division.

Mr. W. J. Parker has been appointed superintendent of the Western Railway of Guatemala, with headquarters at San Felipe, Guatemala.

Mr. T. S. Inge has been appointed master mechanic of the Southern, with headquarters at Burlington, N. C.

Mr. R. L. Herbert has been appointed master mechanic of the Southern Pacific, with headquarters at Victoria, Tex.

Mr. R. H. Garland has been promoted from general car inspector to be general foreman of the Pennsylvania shops at West Philadelphia.

Mr. Henry C. Robinson has been appointed assistant superintendent of the southern division of the Boston & Maine, with headquarters at Boston, Mass.

The headquarters of Mr. S. A. Sheppard, master mechanic of the Carrabelle, Tallahassee & Georgia, have been removed from Carrabelle to Lanark, Fla.

Mr. Adolfo Magar has been elected director general of the Western Railway of Guatemala. He is spoken of as a most enterprising and successful railroad manager.

Mr. J. Shigemachi Fujita, assistant locomotive superintendent of the Nippon Railway, at Tokio, Japan, is traveling in this country, examining our railway machinery.

Mr. Patrick Sterling, head of the mechanical department of the Great Northern, of England, and one of the ablest men of his age, died on the 11th of November, aged 76.

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. F. J. Cole, mechanical engineer of the B. & O., has resigned that position to accept a similar one with the Rogers Locomotive Co. The B. & O. are in need of a man to fill his place.

Mr. Richard Durborrow has been promoted from the position of general foreman to that of master mechanic of the

Pennsylvania, at West Philadelphia, in place of Mr. Garrett, retired.

Mr. A. E. Brown has been appointed general foreman of the shops at Somerset, Ky., of the Cincinnati, New Orleans & Texas Pacific. He was formerly a locomotive engineer on the road.

Mr. J. W. Evans has been appointed trainmaster of the Choctaw, Oklahoma & Gulf, with headquarters at South McAlester, I. T., to succeed Mr. F. L. Moeller, superintendent of transportation, resigned.

Mr. Ira C. Hubbell has been appointed purchasing agent of the Kansas City, Pittsburg & Gulf, Texarkana & Fort Smith and Kansas City & Independent Air Line, with headquarters at Kansas City, Mo.

Mr. J. P. Boyle, trainmaster of the Keokuk & Western, has been appointed superintendent of that road, with headquarters at Keokuk, Iowa, and will also have jurisdiction over the Des Moines & Kansas City.

Mr. A. K. Stone, of Glasgow, Mont., has been appointed assistant superintendent of the Fergus Falls division of the Great Northern, with headquarters at Melrose, Minn., in place of Mr. C. C. Ponsonby, resigned.

Mr. G. F. Huggins has been appointed general superintendent and engineer of the Choctaw, Oklahoma & Gulf, with headquarters at South McAlester, I. T., to succeed Mr. J. D. Bradford, superintendent, resigned.

Mr. H. A. Ivatt has been appointed locomotive superintendent of the Great Northern Railway of England, to fill the vacancy made by the death of Mr. Patrick Sterling. Mr. Ivatt was formerly locomotive engineer of the Great Southern & Western of England.

Mr. S. B. Fisher has been appointed assistant chief engineer of the Missouri, Kansas & Texas, with headquarters at Parsons, Kan. He was formerly chief engineer of the Milwaukee & Northern and afterward chief engineer and superintendent of the Everett & Monte Cristo.

Mr. W. Augustus, master mechanic of the Keokuk & Western, has taken charge of the machinery of the Des Moines & Kansas City, which has been absorbed by the Keokuk & Western. He holds the title of superintendent of motive power, with headquarters at Centerville, Iowa.

Mr. Frank Toumey has been appointed master mechanic of the Rochester division of the Erie, with headquarters at Rochester, N. Y., to succeed Mr. F. N. Hibbits, appointed trainmaster of the eastern division. Mr. Toumey was formerly foreman of the shops at West Newburgh, N. Y.

Among our visitors last month was Mr. J. B. Elwell, master mechanic of the East Louisiana. He came north to look after the purchase of some locomotives and cars. Mr. Elwell is a Boston man, but he has been in the South for twenty-one years, and this is his first visit to the North in that time.

Mr. T. A. Mackinnon, general manager of the Boston & Maine, has been made first vice president of the road, with authority over the operative and construction departments. Mr. Mackinnon is one of the best-known railroad men in New England, and is making a fine record on the Boston & Maine.

Mr. Thomas W. Adams has been appointed superintendent of car department of the New England Railroad, with headquarters at Norwood, Mass. Mr. Adams is a son of Mr. F. D. Adams, superintendent of the car department of the Boston & Albany, and was for years foreman of the principal car shops of the Boston & Albany.

Mr. George F. Evans, superintendent of the southern division of the Boston & Maine, has been appointed assistant general manager of that road, with headquarters at Boston, Mass. Mr. Evans has been superintendent of the southern division since March, 1892, and was formery general manager of the Louisville, Evansville & St. Louis.

Mr. M. A. Miles has been appointed traveling engineer of the Madison division of the Chicago & Northwestern. He has been for some time a passenger engineer on the same division. A correspondent writing about the appointment says that the engine men are all highly pleased about the appointment, and consider that he will be the right man in the right place.

Mr. William G. Bean, assistant division superintendent of the Boston & Maine at Concord, N. H., has been appointed superintendent of the southern division of that road, with headquarters at Boston, Mass., to succeed Mr. George F. Evans, promoted. Mr. Bean was superintendent of the southern division of the Concord & Montreal before that road was absorbed by the Boston & Maine.

Mr. P. H. Schreiber has been appointed master mechanic of the entire Chattanooga division of the Cincinnati, New Orleans & Texas Pacific. Mr. Schreiber has been master mechanic of the second district for the past six years, and his jurisdiction has now been extended to cover the territory which was formerly in charge of Mr. I. W. Fowle, who has resigned to go into other business. Headquarters at Chattanooga.

Mr. William Apps, master mechanic of the Illinois Central, has been appointed master car builder of the Canadian Pacific, with headquarters at Montreal, to succeed Mr. J. Higginson, resigned. Mr. Apps has been master mechanic of the Illinois Central shops at Chicago since October, 1891, and was master car builder of the Chicago & Eastern Illinois from June to September, 1891. From May, 1881, to 1887, he was general foreman of the car department of the St. Paul, Minneapolis & Manitoba, and from October, 1887, to May, 1891, was master car builder of the Western Railway of Alabama.

In the course of a series of visits to the general offices of various Western railroads lately, the writer heard many comments about the reorganization of the Atchison, Topeka & Santa Fé, and, with scarcely an exception, regrets were expressed that Mr. D. B. Robinson was not made president. There seemed to be no objection to Mr. Ripley, but railroad men generally seemed to be enthused in favor of Mr. Robinson, whose personality seems to bind many friends in his favor. The talk was that he had labored so vigorously and so successfully to bring up the condition of the Santa Fé property that his work deserved the recognition that would have been accorded had he been elected president.

Mr. Chas. E. Schaff, assistant general manager of the Cleveland, Cincinnati, Chicago & St. Louis, has been advanced to position of general manager of the road, with headquarters at Cincinnati, Ohio. Mr. Schaff has risen through the train service of railroads to the high position which he has now attained. Twenty-four years ago he began work as brakeman on the Pittsburg, Cincinnati & St. Louis, and advanced through the positions of fireman, conductor, yard master, train master, to the position of general superintendent. He went from the Peoria & Pekin Union to be assistant general manager of the Big Four. His advancement gives general satisfaction throughout the system.

The following were elected officers of the reorganized Erie railroad at a meeting of the directors, November 14: E. B. Thomas, president; Andrew Donaldson, third vice president; G. G. Cochran, fourth vice president; Stetson, Tracy, Jennings and Russell, general counsel; J. A. Middleton, secretary; Edward White, treasurer; J. T. Wann, auditor. The following appointments are made: C. R. Fitch, general superintendent, Erie Railroad division; A. M. Tucker, general manager, N. Y., P. & O. R. R.; A. E. Mitchell, superintendent of motive power; W. Lavery, assistant superintendent of motive power; C. W. Buchholz, chief engineer; A. Mordecai, assistant chief engineer; D. I. Roberts, general passenger agent; E. B. Sheffer, purchasing agent. General Superintendent Fitch, General Manager Tucker, of the N. Y., P. & O.; Fourth Vice President Cochran, and General Passenger Agent Roberts announce that all officers and employés in their respective departments will be retained, unless otherwise specifically ordered.

One of the most interesting men we have met for a long time is Mr. J. W. Thomas, Jr., assistant general manager of the Nashville, Chattanooga & St. Louis, who contributes an article on European railways to this issue of "Locomotive Engineering." We do not think there is a railroad officer in this country who has more intimate acquaintance with the whole operating departments than Mr. Thomas, who is a slim, wiry, sandy-haired gentleman, whose abounding energy and vim keep his bones clothed with little else besides skin and muscle. His father, president and general manager of the road, held the same position during his son's rise into manhood, and after graduating from college the junior got the choice of working in any department of the service to which inclination drew him. At one time he is said to have worked on the track, and one of the men in the shop, speaking about him, said, "Why, Mr. Thomas knows more about track work than any road master in Tennessee." He learned the machinist trade in the shops, and while there got the engine fever and wanted to go running. His father was opposed to this, and as persuasion did not avail, got him assigned to an engine on a hard local run, where there were long hours, hard work and very little enjoyment. He held on to that job for a year, and then his father decided that the youth was in earnest, and gave him an engine on a decent run. He ran an engine five or six years. Then he had a turn as conductor. At one time he was a telegraph operator, and the first move of promotion was being made train master. The road is run very much on paternal lines, and Mr. Thomas knows the good and bad points of every man in the service. When it becomes necessary to discipline a man, his mind is constantly on those who are dependent on the culprit, and many a man has got off easy from serious scapes because punishment would be hard on his wife and children. One time Mr. Thomas went North to negotiate with the president of a signal company to put in a signal system upon certain portions of his road. The price asked for the signals seemed very high, and Mr. Thomas said that he would rather devise a signal system for himself than pay that price. "Why," the president replied, "there is not a man south of the Ohio River with brains enough to devise a signal system." "We shall see," said Mr. Thomas, and he returned home and designed one of the best signal systems that has ever been used on a railroad. The employés say that Mr. Thomas has a very alarming bark, but he does not bite. With his men he seems to be the hero of the business. According to the sentiment that prevails among the trainmen on the whole line, there may be other managers who know something about railroading, but if they want to get down to the more artistic points, they had better come and talk with Mr. Thomas.

EQUIPMENT NOTES.

The Big Four are in the market for six passenger cars.

The Grand Trunk are in the market for four passenger cars.

The Chattanooga Southern have placed an order for 100 cars.

The Mexican Central are reported to be in the market for freight cars.

The Long Island Railroad people are asking bids for fifty gondola cars.

The Denver & Rio Grande have ordered 550 freight cars, of 60,000 pounds capacity.

The Illinois Central have ordered 200 more freight cars, increasing a large order placed some time ago.

The Midland Terminal of Colorado are in the market for ten passenger cars and 100 freight cars and five consolidation locomotives.

The Boston & Maine are in the market for 100 platform cars. They have just placed an order with Rhode Island for twenty locomotives, and expect to order five more.

The Boston & Albany are about to order more of the eight-wheel passenger engines of the Schenectady type, illustrated in "Locomotive Engineering," September last.

The latest news from Jim Skeevers is to the effect that the grief committee and the old man have him cornered upstairs in the general office. We expect to hear from him for next month's paper.

The New York, New Haven & Hartford gave some of their men an unusual cause to feel merry at Christmas. The wages of firemen was raised from $2.00 to $2.10 a day, and the pay of freight brakemen was advanced from $1.90 to $2.00.

At the December meeting of the New York Railroad Club, Mr. John A. Hill, an editor of this paper, who has been secretary for the past four years, declined to serve longer in that position, and Mr. W. G. Wattson, superintendent of the West Shore Railroad, was appointed to take his place.

The Pennsylvania Railroad people have been put to great expense and inconvenience lately for want of water at Altoona. For months they have been hauling about a million gallons a day. When the cold snap came about the middle of December, there was so much difficulty experienced in transferring the water from the portable tanks that they were compelled to shut down the works.

The Manhattan Railroad Company are seriously considering proposals to change from steam locomotives to electric motors. Those who claim to be familiar with the inside affairs of the management say that President Gould is in favor of proceeding to make the change at once, but that Mr. Russell Sage, one of the largest stock holders of the property, is strongly opposed to making any change.

The students of the Stevens Institute of Technology holding the Railway Master Mechanics scholarships appear to take an active part in the literary work of the institution. We notice that Mr. W. D. Ennis, son of Mr. W. C. Ennis, master mechanic of the New York, Susquehanna & Western, is one of the editors of "Stevens Life," and Mr. W. H. Jennings, son of Mr. William Jennings, superintendent of motive power of the Mexican International, is a special correspondent for the same lively journal.

A material called "Mannocitin" has lately been introduced into this market from Germany, which is said to be an absolute remover and preventative of rust. It is used largely in Germany, and is reported to have taken the place of tallow, white lead and other mixtures formerly used to protect bright metal work. We commend it to the attention of those who are responsible for keeping polished rods and other bright work free from rust. A sample of the material will be sent by Otto Goetze, 25 Whitehall street, New York, to any of our readers on application.

The Siemens & Halske Electric Co., which are now proprietors of the Grant Locomotive Works, of Chicago, have recently finished twelve 10-wheel locomotives that were commenced by the old company. The engines are fine looking machines and have the appearance of first class work and material. The cylinders are 19x24 inches, and driving wheels 62 inches diameter. The boiler is straight, Belpaire firebox, the whole giving 1,845 square feet of heating surface. The weight of the engines in working order is 128,000 pounds. The engines are for sale.

There are several roads using rattled scrap for crank pins and piston rods, among which may be mentioned the Chicago, Rock Island & Pacific and Chicago & Northwestern. There seems to be a revival in respect of the material of these two details, after having lain dormant for some time, and choice selected scrap is again being put into these parts. The matter of kind of scrap is covered by the word "selected," it will be noticed, and is vague enough; but, with the best of care in this regard, the results must be unsatisfactory, unless more attention is given to the working it than has been done in too many cases that we can recall.

The Northwestern's Locomotive Testing Machine.

Almost every reading railroad man has heard in the past year of the plant erected at Chicago by the Northwestern Railway Company for the purpose of testing their locomotives as they come out of the shop. Instead of running them around the yard, they go upon the tester and are "broken in."

Breaking in engines was not the original aim sought by Mr. Robert Quayle, the superintendent of motive power, and his able assistant, Mr. E. M. Herr, but to provide means for carrying out inexpensive experiments that would show where the efficiency of their engines could be improved.

Mr. Quayle built a testing machine at South Kaukauna, Wis., when he was master mechanic of the Milwaukee & Lake Shore road, and knew pretty well what was needed in his new plant.

Our large engraving shows one of the Northwestern's latest passenger engines on the plant ready for testing.

As will be seen, her tank stands beside her—the tester occupies one stall of the roundhouse—and a platform is built between its deck and the foot board, so that coal may be taken off the tank, as well as water, if it is found desirable.

Simply stated, the plant consists of a set of supporting wheels set in a pit in such a way that the drivers of a locomotive may be made to rest upon them; brake wheels on these supporting shafts, and automatic means of controlling the brakes upon them, and means to prevent the engine leaving the supporting wheels.

Without going into elaborate detail of sizes, etc., we will try to make the construction of this plant clear.

Fig. 1 is a sectional side view of the pit and machine. The pit is 28 feet 3 inches long, 15 feet wide, and 7 feet 2 inches deep inside the brick walls.

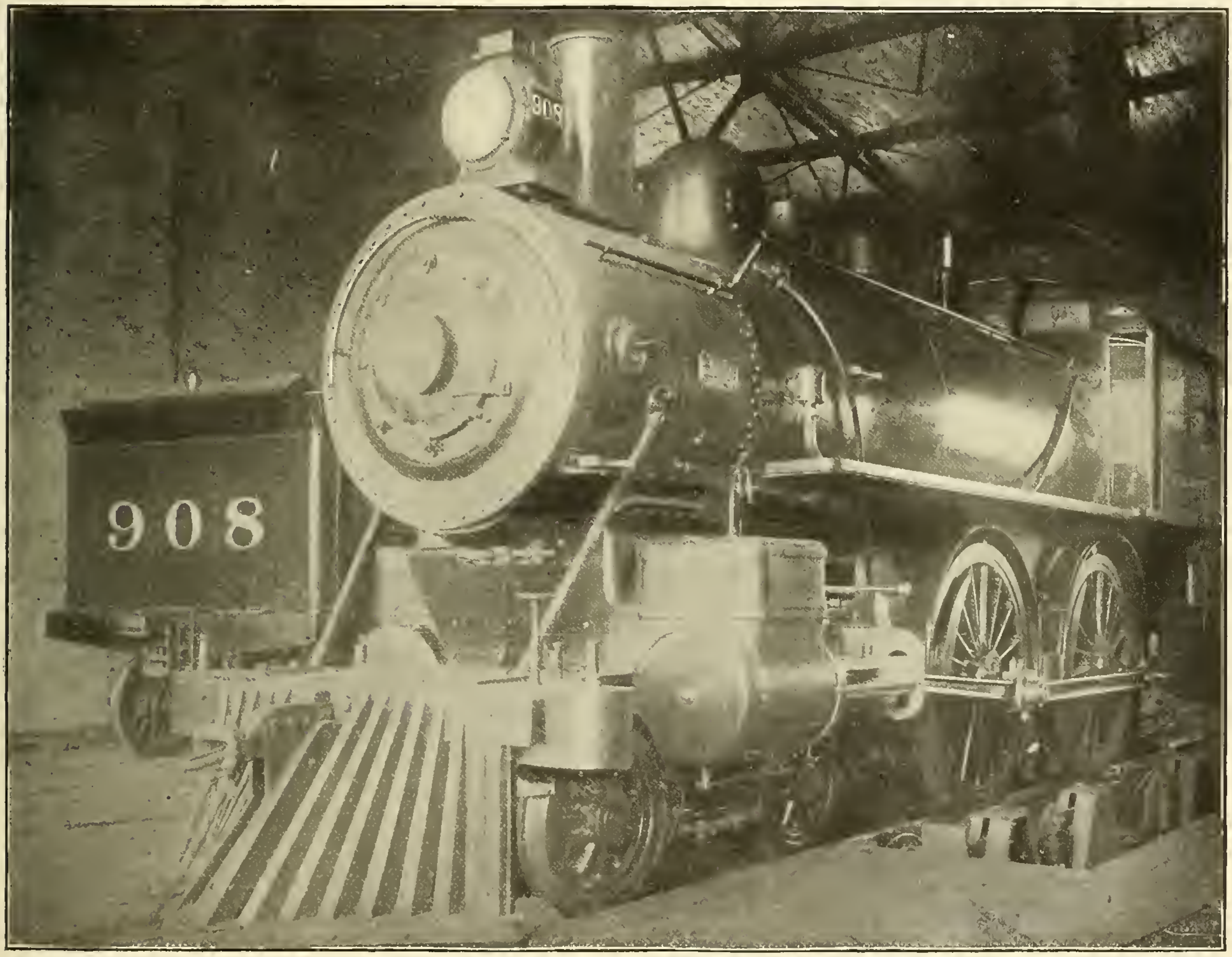
The boxes of the carrying axles rest on heavy cast iron rails or bed plates, which in turn are supported on heavy longitudinal timbers resting on ties. These iron rails have T slots and a rack in them, and there are pinions on each set of housings, or boxes, that permit of their being moved along the base, so as to admit of setting the carrying wheels to the same centers as any locomotive's drivers they may wish to test.

The heavily braced and anchored framing at rear of pit supports the drawbar and stands the strain of the pulling of the locomotive that is being tested.

Fig. 3 is an end section of pit, supports, and one pair of supporting wheels. The supporting wheels are old drivers, with steel-tired wheels, turned off so as to take the drivers on—all of them are 56 inches in diameter. The carrying axles are 10 feet 5½ inches long, and have on their outer ends cast iron brake wheels 33 inches in diameter, with 5½-inch faces, chilled.

Around these brake wheels there are arranged 21 small brake shoes (half this number twice as large would have done as well) on a steel band, the ends of which are attached by lugs to the bell-crank shown in Fig. 4. One arm of this crank is extended, and is fulcrumed to the piston of a 6-inch air cylinder. There is one of these brake wheels and brakes on each end of each axle.

Around each of these brake wheels, and its prony brake, there is arranged a sheet steel casing shown in Figs. 4, 5 and 6. This has a water-tight joint at the axle and is kept filled with water up to the top



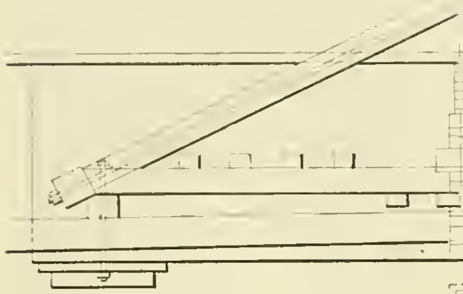
LOCOMOTIVE ON TESTING PLANT, NORTHWESTERN SHOPS, CHICAGO.

of the brake wheel. The water is taken in at the bottom, as shown in Fig. 6, and runs out at the top from hose nipple shown at left in Figs. 4 and 5. This prevents heating and insures uniform braking effect. These water connections are all by hose, so that changing the position of carrying wheels does not affect them.

Air from a common connection is taken under the pistons of all the 6-inch governing cylinders, the supply of air being taken from the regular shop supply.

An ingenious device consisting of a combination of an I section rail and U-shaped cap rail, with legs that rest directly on the axles of the carrying wheels, is used to get the engines upon the machine. They are so made that when en-

FIG. 1.



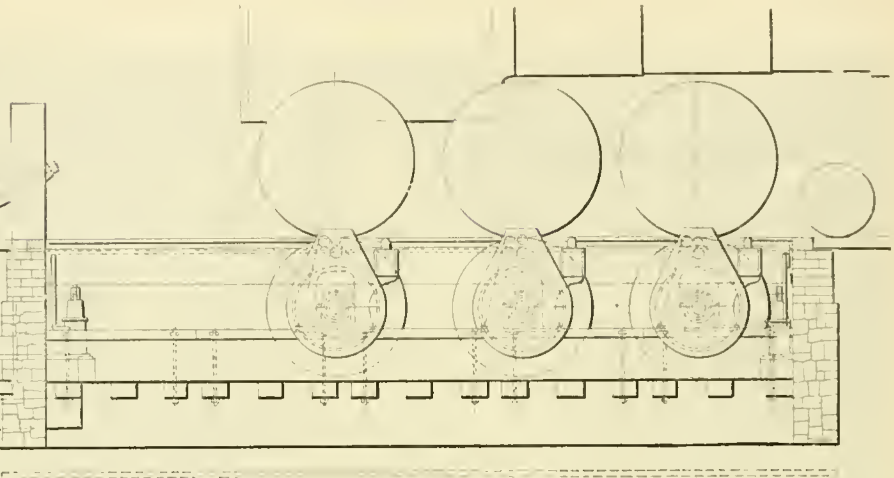
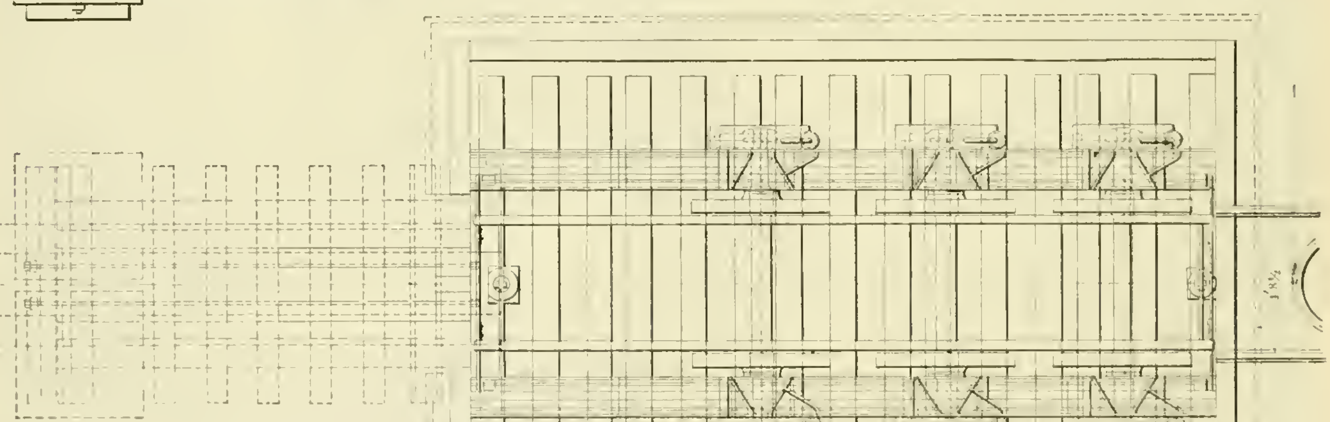


FIG. 2.



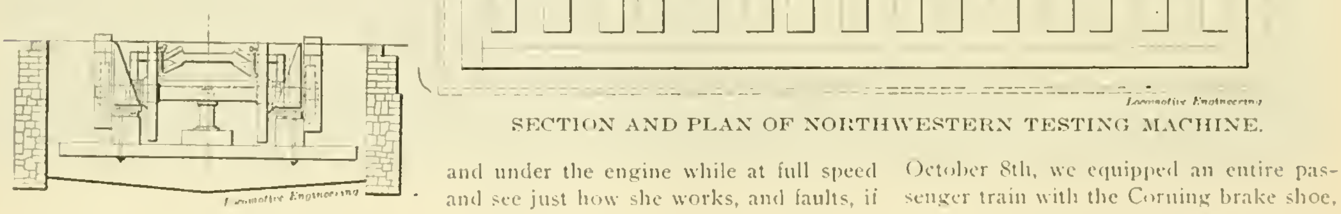


FIG. 3. END SECTION.

SECTION AND PLAN OF NORTHWESTERN TESTING MACHINE.

gine reaches the crown of wheels, the rails are free to be lifted out of the way.

On the axle of the back pair of carrying wheels they clamp a wooden pulley, made in halves, and from it runs a round belt to the pulley of a common ball governor, and this governor controls the amount of air that is admitted to the brake cylinders. So, you see, it is perfectly easy, by changing the size of pulleys, to arrange to let a locomotive run at any given speed. The governor is very sensitive, and will hold the speed within a very few revolutions of what is wanted.

Indicator cards taken from an engine on this plant, under any and all conditions, will prove something. Many things now in doubt will be settled by experiments here.

When they get their dynamometer on the drawbar to register the exact pull, they can tell better and easier what engines are doing.

With self-recording gages on the brake cylinders, the power developed can be figured out now.

The beauty of this plant is, for breaking in engines, that you can crawl all over and under the engine while at full speed and see just how she works, and faults, if there are any.

So far, the principal thing done on the plant has been to note the effects of different proportions of valves and arrangements of valve motion—the result being that on almost all their engines they have cut out inside lap.

When one of these big passenger locomotives is making a sixty-mile an hour gait on the tester with her nose ten feet from the door she looks reckless, and makes a man wonder what she would do if the drawbar broke.

This device has only been in use since August, and all the useful things that may be found out there have not yet been tried. It is very likely that some of the Master Mechanics' Committees this year may try some original experiments on it that will be of benefit to all railroads.

❦ ❦ ❦

The Corning brake shoe, which has chilled pieces that press upon the parts of the tread not worn by the rail, is meeting with extraordinary success on the roads where it is in use. Mr. G. R. Brown writes:

"Replying to your inquiry concerning the Corning brake shoe, as used on the Fall Brook Railway, I have to say that, on October 8th, we equipped an entire passenger train with the Corning brake shoe, and they have run continuously since that date, making 9,000 miles and 3,550 stops.

"From a personal examination, I find the shoes have worn a scant 3-16 of an inch, there being no visible wearing or cutting of the tires.

"From the engineer who has charge of the train I learn that the adhesive effectiveness of the Corning brake shoe is all that we desire, being, I should judge, 25 per cent. greater than the shoes we have been using.

"I look upon the economy and durability of the Corning brake shoe with such favor that on December 7th, 1895, the Fall Brook Railway Company adopted it as their standard shoe."

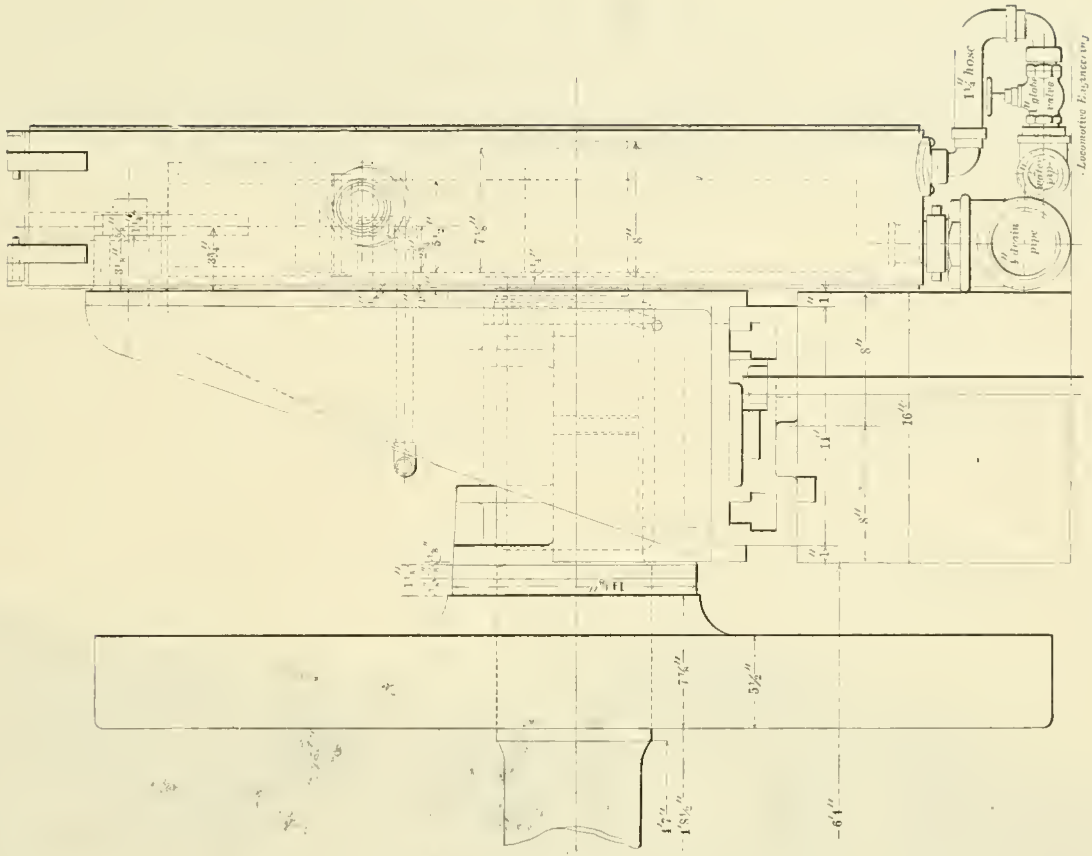


FIG. 6. CARRYING WHEEL, BOX AND WATER JACKET.

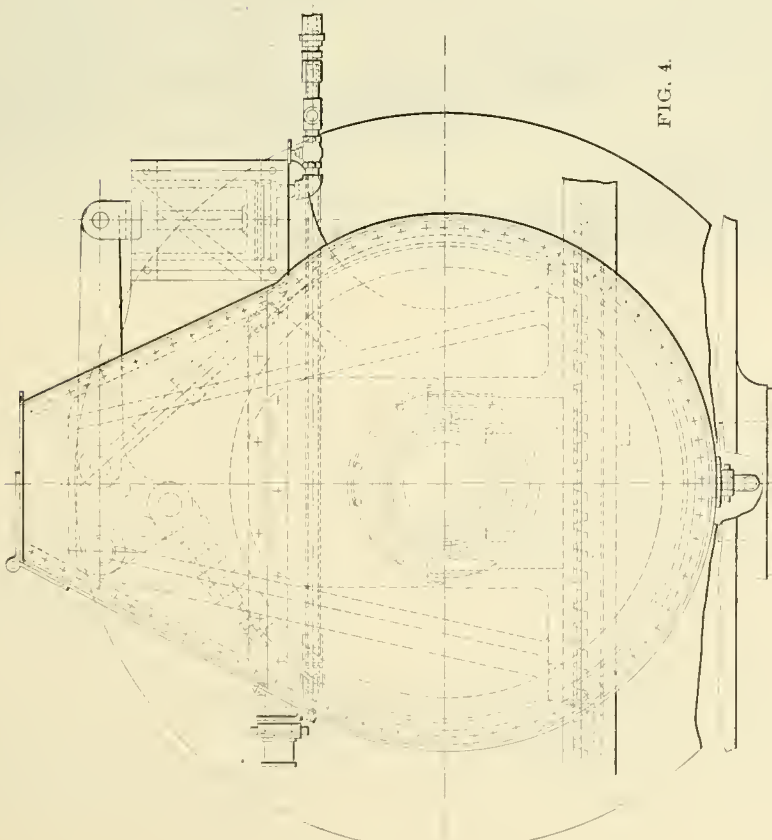


FIG. 4.

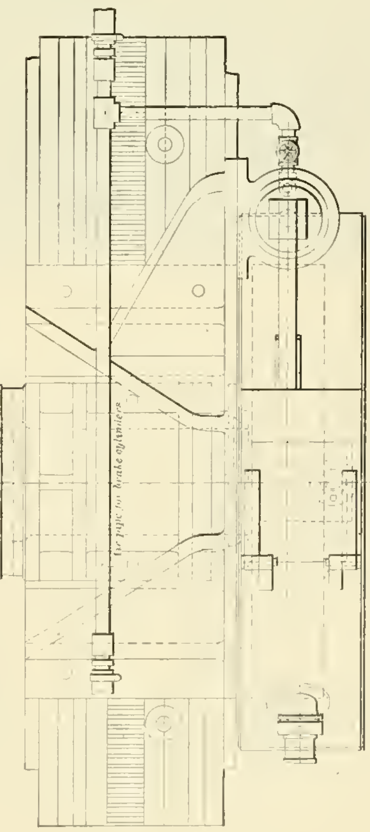


FIG. 5. ARRANGEMENT OF BRAKE WHEEL AND WATER JACKET.

Our New Year's Issue.

We are proud of the magnificent number of "Locomotive Engineering" for the first month of 1896. It is a specimen of what the paper will be every succeeding month, only that we expect to make it a little better every time. Every month we are spreading the net a little wider, which catches good things for our reading pages, and we can assure our readers that little will escape that is worth putting before them.

Readers will find the advertising pages well worthy of being carefully examined. For artistic effect this department will bear favorable comparison with anything ever done in advertising. These pages this month constitute condensed catalogues of all the important railroad supply manufacturers on this continent. Purchasing agents, heads of mechanical departments and other officials interested in ordering supplies, will find the buyers' finding list in this paper a very convenient book of reference, when anything is wanted. We have provided the means of hanging up the paper, and submit the request that it be given a prominent place within reach of the buyer.

Car Knuckles Are Protected by Coupler Patents.

There have been several lawsuits against car-coupler companies for infringement of certain parts decided lately, which indicate that there are features about some couplers which can be defended in the courts—an idea that many people have come to consider doubtful. The most important decision was given by the United States Circuit Court at St. Louis, holding that outside parties were liable for infringement if they manufactured knuckles without the consent of the patentee. Owing to a decision of the courts, given years ago, that it was legal to make, for repairs, cutters of a reaping machine without permission of the patentee, many manufacturers have assumed that they were at liberty to make and sell any part of a patented article, so long as the parts so made were to be used for renewal or repair. There are few parts of standard railway appliances that are not made and sold by unauthorized parties under this claim. Besides car-couplers, air-brake mechanism, parts of signaling apparatus, parts of safety valves, lubricators, and a great many other things have been made by parties having no interest in the patents. The decision on knuckles is likely to exert a wholesome effect upon this line of industry.

Among the railroad changes of the month has been the purchase of the Des Moines & Kansas City by the Keokuk & Western. The D. M. & K. C. was a 3-foot gage line 112 miles long, with nine locomotives and 217 cars. It traverses a fine agricultural country in Iowa

A New Disease.

The New York "World" recently described the cause of delay to the steamship "Paris," as follows:

"The eleventh boiler was incapacitated. Oil or grease got into the water and 'churned' so the water was inconvertible into steam. This boiler will be thrown out of service."

A good thing to carry under the hat is a knowledge of the fact that a given weight of water when evaporated to steam in a vessel that is tight enough to prevent its escape, will leave a weight of steam equal to that of the water from which it was evaporated, or, one pound of water will make one pound of steam. This will be one pound weight and not one pound pressure, and a proper understanding of this fact will divest the subject of its murky features at the start.

The handsomest calendar for 1896 we have received or seen, is sent out by the Ajax Metal Co. (Inc.), Philadelphia, Pa. You can get one by writing for it.

Formulas are a good thing to have, when they are correct, but how many who use them every day know whether they are following false prophets or not? Fortunate is the man who can build his own formulas.

THE OLDEST ROLLING STOCK IN ENGLAND, BODMIN & WADEBRIDGE BRANCH, LONDON & SOUTHWESTERN RY. IN USE FOR FIFTY YEARS.

Wear of Tires in India.

Editors:

In reference to the curious wear on driving-wheel tires in India, these six-wheel coupled "goods" are engines perhaps of English build, and years ago the equalizer was an unknown quantity in their engines, and I believe is not generally used even at the present. In engines of this class, as you well know, it is next to impossible to distribute the weight exactly, as a weak or strong spring, or the length of hangers, makes a great difference, as there is no equalizing medium; and if so, this particular driver may be the slighted one, thus causing the wheel to be virtually overbalanced, viz., the balance weight, for equalizing the centrifugal and reciprocating parts, especially when running fast, is greater than weight on this driver. Why it should be on the left driver is hard to account for without it is a mountain road and curves in one direction; say running shut off, where the momentum of the different parts has no steadying medium and the left wheel is on the elevated side of track on the outer rail.

I remember a goods engine built at the Swindon Works of the G.W.R.R. of England, and put in service on the Wolverhampton division; they had similar trouble with it, and they found it was owing to not having weight enough on that driver; the balance weight to overcome, say, 1-3 or ½ of reciprocation, and the centrifugal balance, was too much; after the weight was distributed she was all right.

In the case mentioned by me both drivers were in the same boat; we had no mountains.

GEO. SMART.

Edgemont, So. Dak.

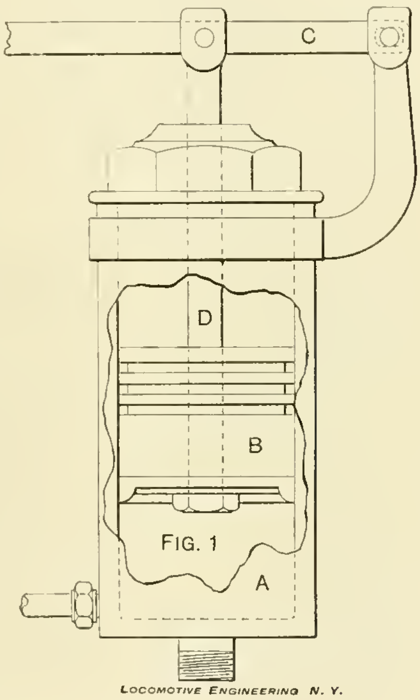
A Water-Pump Governor.

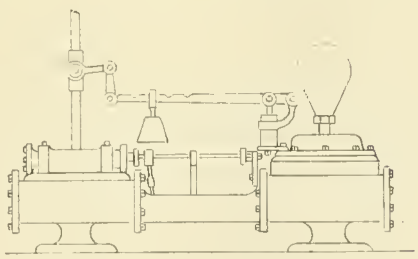
Editors:

For the benefit of any readers of "Locomotive Engineering" who use a force pump for washing boilers, and who would like a good governor for same, I would like to describe one used at this place.

They use here a common No. 4 Knowles pump, situated in the stationary engine room, quite a distance from the roundhouse. A signal bell near the pump was formerly used to notify the engineer when to increase or decrease the speed of the pump. Now, a great difficulty encountered in this manner of working was, that in order to signal the engineer the boiler washer had to frequently go some distance to the handle connected to the bell, and was oftentimes compelled to go to the engine room and regulate speed of pump himself. This was very annoying, as well as expensive.

The foreman of shop tools and machin-





ery noticing this fact, set his wits to work to devise means for overcoming the difficulty, and met with success by thinking out a simple and cheap governor, which I will try and describe. He made this of stick brass:

Cylinder A, Fig. 1, being 2x4 inches inside; into this is fitted piston B, the lower end of which carries a common leather packing such as is used in the Westinghouse air-brake cylinders. The upper end of piston has three square grooves which form a water packing.

Around the outside of the cylinder, near the top end, is shrunk a wrought iron band with a lug attached, as shown, the lug forming a fulcrum for lever C, to which piston rod D is connected; the long end of lever C being attached to the handle of a simple circular cut-off valve in the steam pipe.

The application of governor is shown in Fig. 2; the base to which the cylinder is fastened being a small piece of tank steel, which in turn is secured to the pump by one of the nuts holding the discharge valve chamber cap in place. As pressure is generated in this chamber, it is transmitted to cylinder A through pipe E, and forces piston B upward, raising lever C, which closes cut-off valve in steam pipe.

To render the governor more positive in its action, the lever C has its upper edge notched and weight F hung therefrom. When the governor was first tried, it was found that it opened the steam valve too quickly, causing the pump to jump. To obviate this, a brass connection, with a thin brass button in it having a 1-16-inch hole through its center, was placed in pipe E; this prevented the water from either entering or escaping from cylinder A too quickly. After this was done, the governor worked perfectly. It is now regulating two pumps, which are placed side by side, and will govern either one or both of them nicely. About the only fault which, perchance, might be found with it is that if applied to a very large pump it might prove rather unwieldy; but for small pumps it gives entire satisfaction, maintaining an even pressure at all times.

L. C. HITCHCOCK.

Los Angeles, Cal.

A Case of Cracked Firebox.

Editors:

I have been very much interested in reading the valuable correspondence of late in "Locomotive Engineering," in reference to above important subject, and as I have had quite a little trouble where I have been employed in the above line, I would like to give you a little of my experience.

We had frequently small cracks take place in sheet, invariably at top and bottom of stay-bolt head; these generally appear after boiler is washed out, and if they do not take up, and leak bad, we have to pull fire and cool her off, and boiler-maker goes in and puts in a copper plug or two and hammers up stay bolt. This will keep tight until boiler is washed out again—or about one month. When it is washed again, it is found that the crack has extended so that it is necessary to put in two or three more plugs; this state of things went on for a little longer, when boiler-maker informed me that he would have to cut the piece out and put on a patch, which I allowed him to do, and he proceeded to cut out the piece, which took in four stay-bolts, under side of patch being about 3 inches from mud ring. After he cut out piece he proceeded to get patch fitted and drilled, and got into firebox to bolt patch on temporarily. In doing so, the side sheet gave a noise like a pistol and cracked itself upwards along the line of stay-bolts for a distance of 17 inches.

On examination of the fracture I found that the sheet had separated where fracture started, a distance of 3-32 inch, showing that it had been either too short or had been pressed apart by stay-bolts being too tight in holes. As this happened about six weeks ago, and weather was warm, and boiler had been empty for two days, I could not account for it by uneven temperature.

Can it be that this was caused by stay-bolts being put in a good fit—what we might call nearly steam tight—and then subjected to an unnecessary hammering which would result in making head and part of stay-bolt in hole similar to that cruel tool called a boilermakers's drift pin? Then, when the fire heated the head of stay-bolt, heat would pass in some distance, which would cause bolt to expand, but hole would not allow it without fracturing the sheet. I have also a theory which I would like to give in relation to sheets cracking vertically instead of horizontally. I have noticed often that the stay-bolts get more hammering on the top and horizontal sides of the heads than they do on the bottom side; this happens because the man doing the work cannot get such a handy blow on the bottom as he can on the sides. This hammering down on the side horizontally has the effect of making the stay-bolts a powerful wedge which exerts its force to split the sheet vertically.

I would like to ask any of the numerous and talented correspondents who have had experience with the hollow stay-bolt, if the sheet shows cracks when it is used, just the same as when the solid stay-bolt is used. I have never had any experience with hollow stay-bolts, and would like this information.

W. S. Hughes.

Providence, R. I.

Was It Luck?—An Incident of Old-Time Railroading.

Editors:

In the summer of '73 I was running a "Manchester" on one of our great Western trunk lines pulling what was then known as the "night express," and it was while on the road with this train that I met with perhaps the most peculiar chain of entirely unusual incidents during my long experience running an engine, and in the absence of any one of them a disastrous head-end collision would have occurred.

We were west-bound with No. 1, and should have met No. 12 freight and No. 2 at A——. We reached there on time, and headed into a siding, permitting No. 2 to pass. Following the departure of this train, we backed out and pulled up to the station, making our regular stop. The signal was displayed denoting telegraph orders, which, when delivered to the engine, found us thirteen minutes late. While standing at the station, I observed that the relief valve in main reservoir was not operating properly—it was in the days of "straight air"—and the 70 pounds we were supposed to carry had increased to about 90. This higher pressure would give no more than a safe brake force, so far as wheel sliding was concerned; for at that time the low braking force employed was so much superior to hand brakes that maximum efficiency was not a ruling consideration.

From A—— to T—— was a distance of nine miles, the first three miles being down a grade of 70 feet to the mile, the remaining six miles being level, with numerous curves among the bluffs. A half mile from the foot of the grade was a water tank, where, with seven cars, it was our invariable practice to stop for water; but on the night in question, while standing at A——, the fireman reported sufficient water to make M——, fifteen miles away. It should here be remarked that this trip was the only one we ever made, with seven cars, without taking water at this tank.

One and a half miles east of T—— was a lane crossing seldom used by vehicles, and it was not a practice to whistle at this point, particularly at night.

In approaching T——, the track began curving at the whistling post a half mile east of the station, continuing through and past the station grounds. T—— was simply a passing point having a siding some sixty rods in length and a depot, located about midway between the switches. In approaching from the east, the switch and depot were obscured from view by a bluff just east of the switch. On the opposite side of track, parallel to it and about twenty rods away woods skirted the right of way. The only resident of the "town" was the station agent, who occupied a portion of the depot.

Upon leaving A——, we attained a high rate of speed, in descending the grade, which was kept up across the "bottom."

As we approached the lane, for some reason which I cannot explain, I sounded the whistle and shortly after the station signal at the whistling post. About this time I noticed the reflection of a light on the woods, and my first impression was that No. 12 had left its head light uncovered, denoting that the main line was not clear; next the thought occurred that Den. F. was conductor of the freight, and, contrary to the general practice, he always sent a flagman out at stations, as well as elsewhere.

These thoughts passed my mind in an instant, and I applied the brakes. This had partially reduced the speed when I saw a headlight rounding the bluff. "Over she went" on two pipes of sand, and the occupants of the cab located themselves on the steps preparatory to alighting among the stumps along the way.

Seeing the prospects were fair for stopping, we remained on the engine, finally stopping on a trestle 20 feet in height, and the two engines so close together that in going from one to the other—the bridge was too narrow to pass along their side—I stepped from one pilot to the other.

The station agent had company that night and was sitting in the telegraph office with his guest, a lantern furnishing the light. He heard No. 12 whistle for the station, followed shortly after by our whistle for the lane crossing, and, noticing by the sound of the former, coming through the dense wood, that they were not going to take the siding, he ran out with his lantern and flagged them.

Now to recapitulate. Had not the relief valve stuck, giving us an excessive pressure of air, 20 pounds more than we usually carried; had we stopped for water at the tank; had I neglected to whistle for the lane; had I not known of the flagging habit of Conductor F., or had the station agent been in bed, where that hour usually found him, those trains would inevitably have come together with dire results, from lap orders.

Is it any wonder that in retrospecting on old-time railroading, in thinking of the circumstances as above related, I oftentimes wonder "Was it luck?"

S. J. Kidder.

Chicago, Ill.

Wide Fireboxes.

Editors:

There are so many "ink marks" which refer to me, not only on page 760 of your December issue, but also on pages 746 and 761, that I accept with pleasure your implied invitation to reply. Under pressure of limitation of time, as well as out of consideration for readers who may not be interested, I will endeavor to be brief.

Acknowledging, with thanks, your very complimentary expressions in your editorial, "Does Large Grate Area Promote Fuel Economy?" as to the merit, from a historical point of view, of my paper on "Wide Firebox Locomotive Boilers," read before the Western Railway Club, it seems to me that your article, by clear implication, makes me, first, an advocate of "the use of inordinately large grates," and, second, to hold that the grate area of a locomotive cannot be made "too large for the economical use "of fuel," neither of which positions I have assumed, either in the paper referred to or elsewhere.

The quotation from John C. Hoadley's paper was undoubtedly taken by me as a text for my own, and I assumed that the facts which prove "the advantages that result from the use of a large firebox and the evils that flow from small grate areas" were so familiar to railroad men as not to need recital. That the ordinary small grate will not give steam for the normal working of the engine under load, without a nozzle so cramped as to throw about 10 or 15 per cent. of coal out of the stack, and involve unnecessary and expensive work in pushing the steam out of the cylinders, I maintain to be both a fact and an evil. That a wide firebox can be worked with a much lighter exhaust, with an inferior grade of fuel, and with abundance of steam for maximum requirements, I know to be a fact, and unless these, and whatever other results it develops, are advantages, and decided advantages, I am unable to understand why it has been continued in service over eighteen years, why between eleven and twelve hundred are in use to-day, and why roads of the standing of the Philadelphia & Reading, the Delaware, Lackawanna & Western, the New York, Ontario & Western, and the Lehigh Valley, make it their standard, and put it on their latest and highest-class engines.

I do not pretend to say just how many pounds of coal per square foot of grate per hour is most economical, and I do not think that to-day anyone else can do so with absolute accuracy. Neither do I, for a moment, maintain that as large a grate is necessary for bituminous coal as for anthracite, or that some of the present wide fireboxes used with anthracite are not larger than they should be. I am, however, perfectly certain that wide fireboxes, of proper area, will give as good results with good bituminous coal as they have given and are giving with good anthracite, buckwheat, pea, slack, lignite, or any other mineral which is combustible. That they have done so in a long period of service with bituminous coal is within my personal knowledge, and for the proof that they will continue to do so in regular service, under the highest requirements, I shall have to ask you to await the record of the new C., B. & Q. engine, No. 590.

Your position that an excess of air is drawn through a thin fire when the engine is working light, is not, I hope, intended to encourage the evil practice of carrying heavy fires with a sharp exhaust to pull the air through them. As I read it, it is an acknowledgment of the necessity of a variable exhaust, and, if so, I am heartily with you. Again, you are entirely in the fashion in suggesting that the grate area may be made too large. This is the stereotyped expression of some high authorities who run in the narrow firebox rut, apparently because they have always been running in it, and with them any grate is too large which extends beyond the outside of the frames. Very naturally, they cannot find firemen who can keep steam, day in and day out, with a narrow grate ten or eleven feet long, but they never try the experiment with the same or a greater area in a short and wide grate. A wide firebox is not necessarily an "inordinately large" firebox, and one of its chief merits is that all the grate area required, be it much or little more than that of a narrow firebox, may be provided without using an inordinately long grate.

As to "Over-Cylindered or Under-Boilered," you misunderstood me as repudiating "over-cylindered" and recommending "boiler not large enough" as more correct. Engines have often been "over-cylindered" and probably still oftener "under-boilered." I merely quoted the expression of a gentleman in whose case the latter expression happened to be unquestionably the more correct one. The boilers on his road were too small, but the cylinders were not too large, and when the boilers were made "large enough" the cylinders were proper for them and for the duty of the engines.

Finally, your correspondent on "Early Wide Fireboxes" (page 746) is wrong as to the Dripps engines. The firebox of the "Monster" of 1835 was not above the frames, because "there was no frame; the jaws or pedestal for each box was riveted to the boiler itself" ("Locomotive Engineer," Volume III., page 21). The engines of "Vancleve & Co.," of 1852, referred to, were, doubtless, the later "Monsters" of Vancleve & Dripps, of about that time, and there is no evidence that they differed from the first one in this particular. Unless something more definite than this can be shown, I insist on my claim that Milholland first put a firebox above the frame in the "Vera Cruz," in 1857.

J. SNOWDEN BELL.

Pittsburgh, Pa.

The Japanese government have determined to build their own locomotives, as far as practicable, and there is an official in the United States at present investigating our methods of building rolling stock. A competitive test was made some time ago between a British-built locomotive and one built in Japan. The gage of the road is 3 feet 6 inches. Both were tank engines. The British engine had cylinders 14 x 20 inches and a total weight of 35 tons. The cost on shipboard, with freight and insurance, was $8,560. The Japanese engine was compound, with cylinders 15 and 22½ x 20 inches. In the test, the Japanese engine hauled a train of 122 tons with a coal expenditure of 22.2 pounds to the mile; and the British engine, with a train of 118.6 tons, used 24.8 pounds of coal per mile. The Japanese engine cost $8,960. It seems to us that American builders could supply these engines at considerably less money.

Some experiments in train lighting by electricity are going on on the London, Tilbury & Southend Railway. The system combines the use of a storage battery and a dynamo. The battery and dynamo are suspended below the frame of the car. The generator, which only absorbs about 1-3 of a horse power, is driven by a link belt from an 18-inch pulley on the axle, and by a simple and ingenious device its speed of rotation and the difference of potential at its terminals are kept practically constant through a wide range of train speed. When the train is slacking up, the dynamo has to be cut out of circuit, which is done automatically.

Reports were current a month ago that a large sale of steel rails, for delivery in California, had been effected by the proprietors of an English rolling mill. The report elicited some warm protection speeches from politicians. It turned out to be another case of much ado about nothing. The Carnegie Co., Pittsburg, got the order, and the steel will be rolled from iron made from ore mined by American workmen.

Periodically the link is called upon to stand a comparison with some new scheme that is guaranteed to tip over all the old records in the way of economical steam distribution; but the old thing seems to wiggle out of all pits digged for it, and evaporates as many pounds of water per pound of coal as any other device controlling the slide valves of a locomotive.

There is a small, illustrated catalogue of perforated sheet metal, published by A. J. Beckley & Co., Meriden, Conn., which every boiler-maker ought to have in his pocket. It is full of useful information about sheet iron and other things in which boiler-makers are directly interested.

Two committees of the Master Mechanics' Association have sent out circulars of investigation lately. One calls for information concerning slide valves, and the other calls for facts about driving-box wedges. It may not be out of place to remind the members of the Master Mechanics' Association that the season for answering these circulars is at hand.

There is a well-defined sentiment cropping out among the more advanced roads against the use of truck check chains. Those arguing in the negative seem to have the best of it.

AIR BRAKE DEPARTMENT

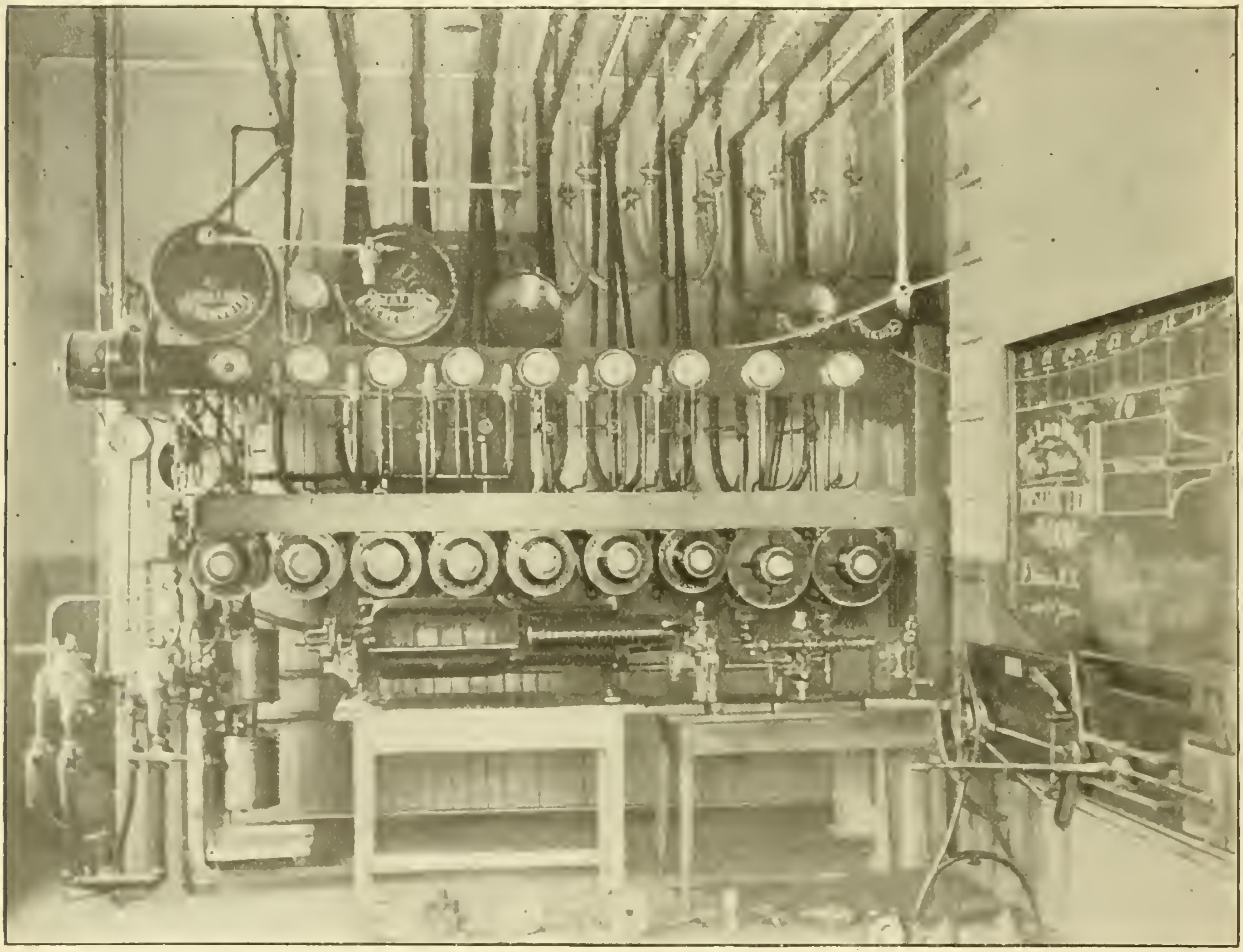
Conducted by F. M. NELLIS.

The Elmira Air-Brake and Technical Club.

The Elmira Air-Brake and Technical Club, of which T. H. Gonware is President and Chas. Twiss is Secretary and Treasurer, was organized some little time ago, and has been brought up to the front rank, abreast of the other technical railroad clubs, by the methodical management and active interest of its officers and members.

The air-brake instruction room, in which the club holds its regular meetings the second Tuesday and fourth Friday of each month, is splendidly equipped for the purpose, as is shown in the accompanying illustration. It is ideal in design and arrangement, well lighted, of ample proportions and neatly finished. A staunch rack supports the working equipment, and gives easy access to all of the parts. An eight-inch pump furnishes the pressure and pumps into the first main reservoir, which delivers clean, fresh air to the second one. Two brake valves, the plate D5 and E6, are located within easy reach, and by proper cut out cocks either valve may be used at the option of the instructor. A sectional plain triple, direct-connected, works tandem with the driver-brake triple, and makes easy to the beginner that principle of the greater pressure governing the lesser.

The piping for the brakes on engine, tender, four freight and two passenger cars, and for six cars of air signaling apparatus, is neatly arranged and suspended overhead. Pressure gages are plentifully supplied to make clearer to the student the demonstrations of the instructor. A blackboard is conveniently located on the right side wall, and assists the gages in carrying conviction to the doubting mind. A sectional freight-car equipment is mounted on a substantial table, and, with the sectional parts scattered about on the floor, admits of thorough investigation of the air-brake system by the student. Below the blackboard is a handsome valve-motion model, whereby the mysteries of "cut-off," "lead" and



AIR BRAKE INSTRUCTION ROOM, D., L. & W. RY. SHOPS, ELMIRA, N. Y.

"lap" are made clear, and teaches the engineer, in case of break-downs, just what parts should be disconnected, and tells him how to avoid the humiliation of being towed in with the greater part of the running gear of his engine loaded upon the back end of the tender.

Surely such worthy ambitions which lead to higher education in railway matters and the consequent formation of clubs of this nature are commendable, and deserve the hearty support and substantial encouragement of the railway officials. Higher-grade men will thereby be made, and their intelligent service will prove its superiority over that had from machine-made men.

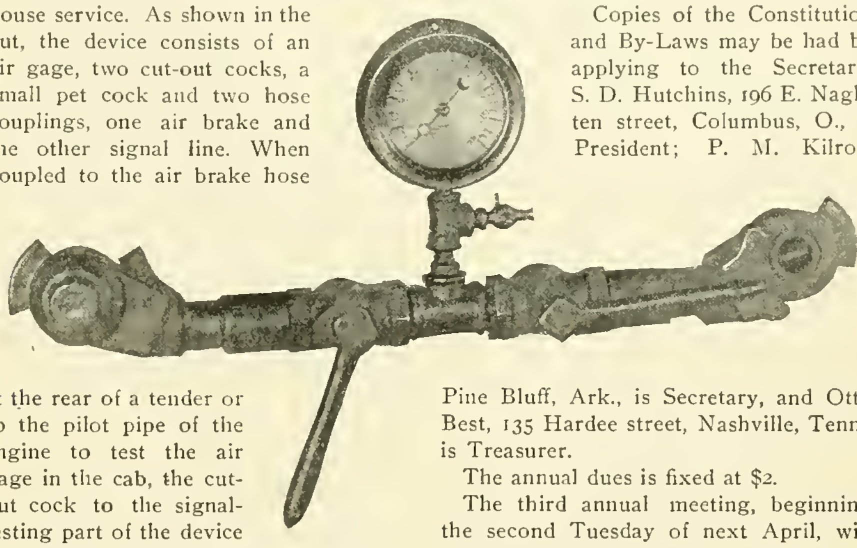
Better Location for Angle Cocks on Tenders.

Anyone who will take the trouble to look at the location given angle cocks on tenders of our different railways, will be forcibly impressed with the absence of method employed in numerous instances. That more care should be taken in locating angle cocks to insure against accidental closing, is evidenced by the following from a correspondent, who writes:

"I notice in your December number a cut of a curious railway accident on a western railway in France, and that the engineer claimed that the Westinghouse automatic brake worked all right till he went to stop at the station; but this was disproven, because the brakes worked "O. K." just as the train stood in the station, and all blame, of course, falls on the engineer. Now, I have had two cases that might have been just as disastrous if the conditions had been the same. The brake on a four-car train had been working all right until I applied it to stop for a railroad crossing. I knew by sound of exhaust from valve that there was something wrong and that I had but the tender brake (there being no driver brake on engine). I called for brakes and reversed engine at once; fortunately, the train crew, assisted by a couple of line repairers, responded at once, and we stopped with front end of engine against crossing gate, doing no damage. On investigation I found angle cock at rear end of tender shut off. A few months later I had the same thing happen coming into a small station, but I had a clear track and there was no damage done this time. The angle cock was under tender and I have reason to believe it was struck by something. In either case had the conductor applied his emergency brake it would have worked, but if an accident had occurred and the rear end of tender been destroyed, as is generally the case, it would then have been a case of the engineer frittering away air in numerous slight applications, or, what is more likely, forgetting to apply the air till too late."

Air Gage and Signal-Testing Device.

An effective device for locating troubles in the air-signaling apparatus, and also for testing air gages without removing them from the locomotive, is shown in the accompanying illustration. Mr. Fred. Hain, general air-brake inspector of the W. N. Y. & P R. R., at Buffalo, is the designer, and speaks highly of it for roundhouse service. As shown in the cut, the device consists of an air gage, two cut-out cocks, a small pet cock and two hose couplings, one air brake and the other signal line. When coupled to the air brake hose at the rear of a tender or to the pilot pipe of the engine to test the air gage in the cab, the cut-out cock to the signal-testing part of the device must be closed. When testing the signal apparatus, the air-brake part, of course must be closed. This is a device which all roundhouse air-brake men should have, as it will show surprising discrepancies in air gages, and will prove an able "detective" in discovering "crooked work" in the workings of the signal apparatus.



The Air-Brake Association.

In response to numerous queries of correspondents desiring information regarding the requirements for membership in the Association of Railroad Air Brake Men, the following extract from their Constitution is given.

ARTICLE III.

Membership.

Sec. 1. There shall be two classes of members, Active and Associate. Each member must sign the Constitution or authorize the Secretary to sign it for him.

Sec. 2. Any person having a general knowledge of the operation or construction of air brakes in any branch of the service in which he may be employed, and in the employ of a railroad corporation, may become an active member.

Sec. 3. Any person having a general knowledge of the operation and construction of air brakes, and otherwise employed, may become an associate member; and be entitled to all the privileges of an active member, except holding office.

ARTICLE IV.

Application for Membership.

Any person desiring membership in this association, and possessing qualification provided for in Sec. 2 and 3 of Article III., shall make application to the Secretary, his application to be signed by two members of the Association in good standing, be recommended by the Superintendent of Motive Power, Master Mechanic or Master Car Builder of the road upon which he is employed; and by paying the necessary fee of $3 the Secretary will enröll his name.

Copies of the Constitution and By-Laws may be had by applying to the Secretary. S. D. Hutchins, 196 E. Naghten street, Columbus, O., is President; P. M. Kilroy, Pine Bluff, Ark., is Secretary, and Otto Best, 135 Hardee street, Nashville, Tenn., is Treasurer.

The annual dues is fixed at $2.

The third annual meeting, beginning the second Tuesday of next April, will be held in Boston, Mass.

The advertisements in this issue speak for themselves, and are so artistically displayed as to require no supplementary puff.

All the special advertisements occupying one-quarter page or more in "Locomotive Engineering" are arranged by our department of illustration, in charge of A. Leighton Donnell.

The first turntables used for turning locomotives in New England were six feet in diameter. That was for engines carried on four wheels. The introduction of the leading truck made these short tables useless, and Payne Aldrich, of Worcester, Mass., began building turntables, 34 feet diameter, which were considered immense articles in those days, early in the sixties. His table became the standard type of America, and continued to monopolize favor until superseded by the simpler form of iron and steel turntables.

We notice in the December 12th issue of the "American Engineer and Railroad Journal" the announcement of the absorption of the "National Car and Locomotive Builder." The new paper will be known as the "American Engineer, Car Builder and Railroad Journal," and on January 1st a transformation will be made in its appearance, and the price reduced to $2 per year. Mr. M. N. Forney will be in charge of the editorial department. Our prediction of short life for the twice-a-month paper came true sooner than we expected.

CORRESPONDENCE.

A German's Experience with "Fresh" Air Brakes.

Mister Yeditor:

Ef you vill ust alowe me von letdle sphase in dot "Locomotion Enjineering," I vould ligke to say me a coople verds aboud lodts of vailures ofe dese are bragkes. Some dimes I dink me dot idt vos der vault ofe der Mans vat pulls der stchring ef he vould somedimes reed dere bapers dot lehrn him der puisness, he vould findt me out dot dere is no vailure ofe der Bragkes ef you ust ledt him pe ven you tondt kno somedinks aboud him. I vant to told you som leetdle dings vot hepbens som dimes a vile past ago.

I vas Bragkmans on der thrain dot I vas sphoken aboudt. Vee hedt er mans for Enjinehr vots name vas Lum, undt I vant to dolt you he vas one schmart fellohs; vat he tont kno aboud der Enjine undt der are Bragks vould magke von letdle boock. Now vee sthart out von tay mit von big drain ofe cole, undt fhrate, undt som gars lodedt mit are on der hed endt. Everydings vent aroundt schwiming undil der hill vee coom on top. Dis is vere der puisness goomense dot I esk me som gwestions aboudt. Ven vee sthops der hill top oup der Enjinehrs, he say, "Bagker (dot's my name), magke dot englie coockse ophen undt ledt out der are," undt he sthop dose pumb ofe der Are Bragkes on der enjine, undt blose der vind all avay; den Lum, he say, "Bagker, glose dose englie cookse," undt den he schtart der pumb som aghain. I say me to der Enjinehr, "Lum, vot for you do dot; der oder mens tondt do dese vay?" Den Lum he say, "Bagker, ef you vant von gloss beer vould you traw him in der morning to trink in der efternoon?" undt I say, " No, he voult pe sthale." Den Lum he say, "Dot's idt, der are vas sthale;" undt he say der Bragkes mounst hef frishare, so dey vork goot. Dis vas der segret of der Are Bragkes. Den he say dose oder fellohs vas von big fools. I magke me der sthudy of dis puisness, undt findt dot dose Are vas gombosed of geses, und he say someding aboud oxeerjen undt highderjen, dwenty-tree (23) undt siventy-siven (77) barts, respegdfuly; undt he say der oxerjen vas der lightest, undt efter idt vas gonfindt so long voult be on top vere dose piphes coom der are droom oudt. Ven der bragkes vas aplied der lidte are cooms oudt fehrst undt vas to veak to do der vork. Dese is der reesen vee rede som quite a leetdle aboud bragke vailurs. He vas also eggsblane der levferige undt piston trevel ven der Conducther coom ahedt und schware som purty hardt Den vee schtart der hill down mit dose bragkes charget oup mit frish are, undt dey vorket so goot dot der fierst apblegation put der bull-eye oudt in der gaboose, upsedt der sthoie undt madte a jenny coopler bloush midte shame. Undt now ven Lum pass by der poys say, "Dere goes frishare!" I dink, Mr. Yediter, I vill sighn me my names mit der biler magker for dose "Locomotive Enjineering," undt sthudy me dese are Bragke gwestions, undt findt me myself oudt.

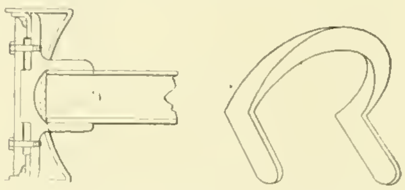
JACOB BAKER.

Elmira, N. Y.

Handy Tool for Entering Brake Pistons.

Editors:

I inclose herewith a rough sketch of a very simple and handy device for compressing the packing expander and leather of brake-cylinder piston, preparatory to replacing piston in cylinder The one I use is made of ½x3-16-inch bar steel, bent flatwise and to a circle large enough to clear release spring and reach midway of piston. The ends are turned at right angles to a height of 1½ inches.



The distance between these uprights is same as diameter of piston head.

The expander of an 8-inch brake cylinder is generally very stiff and difficult to compress by hand. By pulling this device over the packing midway of piston head, it compresses expander and holds packing leather close up to the follower plate. When piston is entered in to the cylinder the device will push off readily.

I would say in connection, that by filing off the sharp corners of brake cylinder there will be no danger of cutting packing leather.

J. A. JESSON.

Nashville, Tenn.

Unite Theory and Practice.

Editors:

The recent article by S. D. Hutchins in October number of "Locomotive Engineering" is very opportune; for though a greater interest in the brake is being daily manifested, one of the weakest points yet is the inability of the men handling and caring for it to locate defects readily and correctly that same may be properly reported or repaired. As stated in the paper on "Instruction," and contained in the Proceedings of the First Annual Convention of the Association of Railroad Air-Brake Men, "any defect intelligently reported is as good as half repaired already."

The following is related as showing how much unnecessary trouble and expense occasionally results through lack of this necessary knowledge, even though the will to do well exists.

Recently I rode with an engineer hauling a heavy passenger train. He complained that for over two weeks his tank and driver brakes would release after each reduction when making a stop, and though he had frequently reported it, the roundhouse people seemed unable to remedy the trouble. In fact, he said, they seemed to doubt that it existed, as both brakes worked all right with the light engine. Noticing that when brake-valve handle was moved to "service" the gage hand would drop very rapidly, and that on returning handle to "lap" that gage hand would raise quickly and train-pipe exhaust close abruptly, he was asked if brake valve had not been working badly. He said he had noticed it did not work quite right, but, as he was able to make the stops without trouble, did not intend to report it until the tender and driver brake had been fixed. Many readers will recognize the cause of the trouble, as the valve was a W. A. B. Co.'s Plate D-8 pattern.

A gasket was cut for the joint where the equalizing reservoir couples to the valve, and inserted during a stop at which there were a couple of minutes to spare. As a result, the trouble with the brake valve was remedied, and, as well, that with the driver and tender brake. The old gasket had been compressed until the opening through it was very small (there being no lip at the joint to prevent) and acted as a choke, causing the trouble as described.

One of the first principles of "operation," as taught by most, if not all air-brake instructors, is that to cause the release of a brake through the triple valve the train-pipe pressure must be made higher than that in the auxiliary reservoir. Also, that with a train of any considerable length the exhaust from the train pipe must be closed gradually, else a rise at point of discharge will result and some adjacent brakes likely be released; that to prevent this is the object of the equalizing discharge valve.

If the engineer and repairman had borne these points in mind, and, noticing the incorrect action of gage, done a little reasoning from cause to effect instead of going blindly at the work, much valuable time (which means money) would have been saved and the service bettered.

This might be termed one of "Skeevers'" object lessons; at any rate, it was effectual, for the engineer remarked at parting, "Well! there is one trouble that will never catch me again."

Without in the least decrying the utility of an instruction car or plant, it is urged that the instructor should not confine himself to either alone; but, instead, improve every opportunity to examine the condition of brakes on cars and engines in service, and where same are found faulty, to explain to the train, engine or car man what the trouble is, how located and the manner in which same should be reported or repaired.

Watching the roundhouse repair book and, where same is used, the air-brake defect card or sheet, will frequently indicate to the instructor where and what information is needed.

It should ever be borne in mind that the end sought by instruction is not to assist the student in passing a good examination, but, instead, that he may be enabled to operate and care for the brake in the most economical and excellent manner.

In many cases where the air-brake student can locate a trouble when the symptoms are given him by the instructor, in practice he is unable to do as well through inability to recognize the symptoms. Thus is demonstrated the need of a closer association or blending of "theory" and "practice," that the knowledge of construction and operation gained in the instruction car or room may be applied and its usefulness thus demonstrated.

Such work, as indicated, will also raise the instructor in the opinions of the men, because they will see he is "practical" as well as "theoretical," and that the ultimate use and benefit of the knowledge gained is not merely to pass an examination or to discourse wisely before a crowd on the subject of air brakes.

F. B. Farmer.

St. Paul, Minn.

Answer to Conger's Problem.

Editors:

When brakes were set with full service application, the coach brake having the longest piston travel equalized at a lower pressure than the engine and tender brakes, and consequently released first when train pipe was slowly recharged. When set with the emergency application, the coach brake equalized nearly ten pounds higher than engine and tender brakes, and therefore had to let go last.

C. B. Conger.

Grand Rapids, Mich.

Cumming's Solution of Conger's Problem.

Editors:

Referring to "Conger's Problem," in December issue, I would be pleased to give the following as the reason the brakes released as they did. When we expand air from the auxiliary reservoirs into the brake cylinders in full service or emergency application, the cylinders with the longer piston travel are charged at a lower pressure; therefore, in slowly recharging the train pipe, the low-pressure triple acts first. Now, in the emergency application in this case it is different, as the engine and tender had the old-style triple and the coach had the quick-acting triple. The engine and tender brake cylinders were not charged any higher in the emergency application than they were in the service application, but the coach brake cylinder was charged higher by the additional 20 per cent. pressure coming from the train pipe. In making the slow release it would take longer for the pressure to start the coach triple than to start triples on engine and tender; therefore the difference in time of release of the three brakes as mentioned.

H. Cummings.

Meadville, Pa.

Synnestvedt's Solution of Conger's Problem.

Editors:

In your last issue, Air-Brake Department, I noticed a problem inserted by Mr. Conger, of which I beg leave to offer the following solution.

In general I would say that the different pressure at which the engine, tender and coach brakes released was due to the difference in the equalized pressures, resulting from variations in the proportionate capacities between the respective reservoirs and cylinders with the unequal piston travels. The reason there was a different result in case of emergency application from that obtained in service is because in emergency application the coach had a higher equalized pressure than either the engine or tender, due to the fact that it was provided with a quick-action brake, while the triples on the engine and tender were undoubtedly of the plain type. When the emergency valve on the coach opened, pressure from the train pipe as well as from the reservoir was vented to the brake cylinder, while the engine and tender cylinders did not receive any such augmented brake pressure, but in both service and emergency applications equalized at practically the same ultimate pressure.

To consider it more in detail, let us take, first, the case of a service application. Approximately, the equalized pressures in the three cylinders with the piston travels given (presuming, of course, that the proper size reservoirs were used) would be somewhere near this: Engine 51, tender 52 and coach 50. Now, when the train-pipe pressure was gradually restored, as is stated to have been the case (the engineer's valve having been put around to only service position), the coach, having only 50 pounds to overcome, released first; the engine, being next lowest, 51 pounds, released next; and the tender, having the highest pressure, 52 pounds, of course, released last.

Looking next at the emergency application, we may safely assume that the pressures after full equalization were something as follows: Engine 51, tender 52 (these two being the same as before) and coach about 58, due to the additional pressure coming from the train pipe. Now, when the train-pipe pressure was gradually increased, the engine pressure (51 pounds), being lowest, released first; the tender (52 pounds), being next, was the next to release; and the car, having 58 pounds, would, of course, be the last to come off.

Paul Synnestvedt.

Chicago, Ill.

A Hint to Air-Brake Instructors.

The successful air-brake instructor is he who can make clear to the minds of his pupils the apparently mysterious actions of the brake, and who patiently and kindly smooths the way in such a manner that they cannot help understanding its construction and operation. Some instructors, through incompetency or design, represent the air brake system to be exceedingly intricate and almost impossible of comprehension by the ordinary man. Others burden their pupils with unnecessary and inopportune detail, and instead of clearing the pathway to an understanding of the brake, they only succeed in creating bewilderment which causes discouragement in him who, if properly handled, would, by giving better service, prove a valuable recommendation to his instructor.

Let an instructor be on his guard when he hears one of his pupils remark: "I wish I were as well posted on the air brake as you." A course of instruction which will call forth such a remark has not taken seed, and instead of imparting needed information to the pupil, it has fallen flat and resulted only in unhealthy praise for the instructor. It is a deplorable fact that some instructors seem to work for such praise. But the instructor may feel justly proud and happy when his instructions have been of a kind which causes his pupil to lose sight of class, instructor and all in his mental wrestle with valves, pressures and pipes, and impels him to say, "I have learned more from that man's instructions than I knew before." This is the highest and most flattering compliment the true instructor can receive. An instructor, if given proper support by his officials, will prove his competency by the high grade of air brake service furnished by his men. Verily a man is known by the company he keeps.

Hereafter correspondence over nom de plumes, and also that without signature, will be considered as anonymous communications and will not be published. The department has among its contributors the most prominent members of the Air Brake Association as well as other writers of ability and repute, and there is no reason why writers should object to attaching their signature for publication to any article which is worth the trouble of writing.

A gold mine has been opened up to the air-brake instructor who is sufficiently skillful to beguile his superior officers into a thorough understanding of the air-brake system.

QUESTIONS AND ANSWERS

On Air-Brake Subjects.

(1) A. J. A., Springfield, Mass., writes:

Please explain what is meant by total leverage on page 84 of the Proceedings of the Air-Brake Men's Second Annual Convention? A.—It is the leverage required to produce a certain pressure on the brake shoes, based on a certain cylinder pressure. For example: An eight-inch brake cylinder gives 3,000 pounds pressure, emergency action. A total leverage of seven would be required to give a brake force of 21,000 pounds to the brake shoes.

(2) H. A. R., Newark, N. J., writes:

Please give me some rule which will tell me whether the air pressure, which blows from the exhaust port of the triple valve when brake is off, comes from a leaky slide valve or a poor rubber-seated valve. A.—Charge the auxiliary reservoir, and then cut out the brake at the cock in the cross-over pipe. If the leakage at the exhaust port continues and the brake remains off, the escaping pressure comes from a badly-seated slide valve or other auxiliary reservoir fault. If the brake sets and the blow of escaping pressure ceases, the trouble lies in the rubber-seated valve. For further information, see report of Committee on Care of the Triple Valve and Brake Cylinder, in the Air Brake Men's First Annual Proceedings.

(3) D. R. A., Boston, Mass., asks:

1. What kind of leather is best for packings in air-brake cylinders on freight and passenger cars? I make my own packings from regular oak-tanned leather, but I am told that it is not as good as oil-tanned leather. 2. How long should a leather run in ordinary service? A.—1. The leather packings furnished by the air-brake manufacturer is vastly superior, as it is specially prepared with a view of giving longer and better service, and costs less than that cut from ordinary leather. 2. The conditions of service and care given it are such varying factors in this case that it would be impossible to say positively. Two or three years is considered a good term of service before renewing, although there are many cars in service which have not had such renewals in much longer time.

(4) J. R. B., Rochester, N. Y., asks:

1. Why does tapping the top head of the eight-inch pump with a hammer start it sometimes when it stops? 2. Would you recommend coal oil for cleaning the air cylinder of the pump? A.—1. Usually because the reversing piston and main steam valve have become dry, from lack of sufficient lubrication, and are, in consequence, unable to break loose from their high frictional contact with the sides of their cylinders. Proper care in keeping the lubricator filled and feeding, and not striving to make an oil record at the expense of the wear of the parts of the pump, will cause this trouble to disappear. Too tightly-fitted and badly-worn valve motion and steam cylinder parts greatly aggravate the trouble. 2. No; the low proof of coal oil, and its consequent tendency to explode from heat in air cylinder, disqualify it for this purpose. A pail of strong lye water, drawn in at the suction valves when pump is running slowly and afterwards drawn off at the main reservoir drain plug, is the most satisfactory cleaner. The lye water should be followed up with a rinse of clean water.

There are very few freight cars in Europe equipped with air brakes, but public sentiment in the more progressive countries is pushing railway companies to apply continuous brakes to every car run on steam railways. There have been several destructive accidents on British railways lately through heavy freight trains breaking in two on steep grades. The public trouble themselves very little about how much railway companies break up freight rolling stock through avoidable collisions, but when accidents of this kind menace the safety of passenger trains then there is a howl. That noise is on now.

If the human system, through neglect and abuse, be allowed to degenerate into a diseased condition, it cannot be expected to perform the work which that of a thoroughly conditioned athlete will do. So it is with the air brake. If allowed to drift into disuse, it will not be in satisfactory operative condition when wanted. Constant operation is as essential to it as regular exercise is to the human system. Switch all air brake cars ahead and keep them working.

A thorough knowledge of the construction and operation of the brake, a store of truly practical experience to draw upon, the patience of Job, and an angelic disposition generally, are invulnerable plates (without flaws and blow holes) in the armor of the successful air-brake instructor.

Considerable air brake matter which should appear in this month's issue has been laid over until next, on account of scarcity of space. Several correct solutions to Conger's problem have been received too late for publication.

Mummies.

That mummy is become merchandise, that Misraim cures wounds and Pharaoh is sold for balsams, has long been matter of current knowledge, but it is rather a new thing to "brace" a royal mummy for a first-class railway fare, and lay upon it an octroi duty at the city gates, as lately befell in the case of one of the sepulchered royalties discovered by Brugsch Bey and scheduled for transmission to the Museum of Alexandria. The discoverer would not trust his prize in the luggage van, and the railway guard insisted on collecting full fare upon it; at the gates of Cairo it encountered another obstacle. "What have you there?" queries the official. "Mummy? Ah, he pays." No ordinance was found governing the case, and the mute and unrepining object was entered as dried fish (duty, two piasters), its custodian no doubt exploding in paroxysms of early Egyptian profanity. Such are the steep and thorny ways of resurrection which await the unsepulchered Pharaohs, and it seems as if Great Britain, which now practically holds sway over their old dominion, might make them a little smoother. Even if it were held necessary to levy a municipal impost upon them, they ought to be properly classified and not put in the same category with red herrings or smoked Yarmouth bloaters. Brugsch Bey ought to make a serious row about it, and invoke the intervention of the Foreign Office as speedily as possible.—Ex.

The University of Minnesota, at Minneapolis, has instituted a department of locomotive engineering, which is in charge of Prof. H. Wade Hibbard, lately mechanical engineer of the Lehigh Valley Railroad, and a graduate of Cornell University. Students entering this department will receive very good instruction on everything relating to the design, construction, operation and maintenance of locomotives. The university has published a pamphlet, giving particulars of the instruction imparted in this direction, which they will gladly send to any one interested.

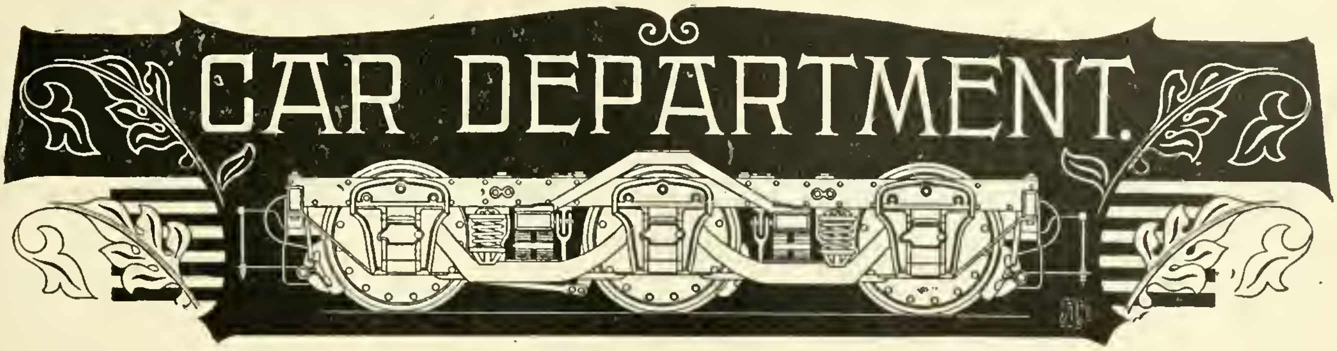
The Erie and the Southern roads have each put into service recently one or more Jones & Lamson flat turret lathes, to cheapen the cost of production of both pins, studs, etc. No live shop manager can afford to make small parts on a common lathe if they are needed in any considerable number.

The New York Central Railroad Co. have commenced issuing checks for carrying bicycles, the charge being about twenty-five cents per hundred miles. The officers of the company think that the owners of bicycles will be satisfied with the arrangement, as the check gives them the means of identifying their own bicycles at once.

There appear to be good prospects of a reorganization of the Reading Railroad property, a strong syndicate having proposed a plan that seems highly equitable to all the immense interests concerned. The small minority opposition that generally rears its head when any plan for settling the affairs of the company is proposed, is shouting no, but the cry against a settlement is not likely to carry much weight.

The Leland & Faulconer Mfg. Co., of Detroit, Mich., have recently put on the market a trimmer for patternmakers that is something new in this line, all parts being adjustable for wear without removing a single piece from the machine.

The Page Woven Wire Fence Co., of Adrian, Mich., have recently booked several orders for fence to be erected in Great Britain and other foreign countries.



Conducted by ORVILLE H. REYNOLDS, M. E.

Superstructure of Cars.

When the exceptionally heavy weights and generally questionable features of the lower part of a car can furnish a pretext for biting criticism from those whose opinions are not a merchantable article, any further comment from the same authority will not, of course, cause surprise.

The idea that a car must, of necessity, be put up on the lines of an armored cruiser, will not stand the probe of investigation, and this has been demonstrated so often that there would appear to be no opening for the old, time-worn fallacy to obtain a lodgement among intelligent builders; but the fact remains that it is still doing its deadly work; and always in places where a draftsman is regarded as an incumbrance, and where the officials never tire of calling attention to "our fine, strong cars."

The full import of this swelling-with-pride process dawns too vividly on the observer when sizing up the massive proportions of the details, when taking in the wealth of material used in their make-up.

It is not an unusual thing to find cars of 60,000 pounds capacity having posts, braces and plates of dimensions that are simply too heavy for any calls that can ever be made on them in resisting shocks due to shifting loads, or, in fact, any other cause. The racking effects of yard and road service, especially the former, are the evils to provide a remedy for, and when they are met, the problem is solved for that particular case. This proposition holds for any car, no matter what its capacity or service. Should the posts and braces of a car be increased, because its capacity is greater than former practice? We think not, for the reason that the shocks of service are precisely identical in all cars, and the effects must be similar. The position is therefore taken that the upper framing, found by experience to be correct for a 40,000-pound car, must also be sufficiently heavy for one of greater capacity.

This statement might have to be modified, if abnormally high cars were placed in the balance against those of ordinary height; since the height is the governing element to be considered as affecting the strength of the frame (it, of course, being weaker, and less ahle to resist shocks as the height is increased), but our tunnels and bridges name the extremes to which we may go, and this fact will bear us out, that there cannot be enough difference in height of cars to warrant such a disparity in dimensions of like parts.

The dimensions of posts seem to be chosen, in most cases coming under our observation, with no well defined idea of their duty; guess-work, or a blind groping after results, are too plainly responsible for the situation; this is apparent to the most casual onlooker when a two-foot rule is brought into action.

Corner posts range from 3¾ to 5 inches; door posts from 4 to 6 inches; intermediate posts from 2 to 3 inches. Braces are seen to be a plaything in the hands of the builder, running from 1¾ to 2½ inches; and as for side plates, they stand silent witnesses of the blunderer's art; they are found to be from 3½ x 6 to 4 x 8 inches.

These are frigid facts; no rioting of a diseased mind; just simply figures taken from cars of practically the same outside dimensions, and the lesson they carry is that dead weight will continue to reduce dividends, until these parts are designed for the work they are required to do.

These strange conditions can be accounted for by the fact that the later cars were constructed so that the upper framing would form a truss—and thus relieve the sills of a portion of the load, which would pass up the posts and down the braces, depositing itself at the bolsters; in other words, a bridge, in which the bolsters figure as the piers.

The various designers, while preserving the general idea of a truss, in form at least, seem to have gone wildly astray as to what constitutes the most economical type of same, with the resulting hopeless tangle of sizes for the parts under consideration. The province of these parts is to form a cover for the load, to either preserve it from the elements, or insure safety while in transit—the posts to support a roof, and the braces applied as stiffeners and to resist shocks. This was the original intent that has evoluted into dimensions demanding investigation, and limiting lines for the guidance of those who do not know when the boundary is reached.

The question forces itself to the front, Are not some of the committees overdue, who have been appointed to take action on car design? It would seem to be so, when from 2,000 to 3,000 pounds can be saved in weight in the upper framing of a freight car body, thus increasing its ratio of paying load to unit of dead weight—and therefore its earning capacity by just the number of pounds saved.

Overweight is inexcusable in any part of a car, and while it can be condoned when within reasonable limits in the case of sills, there can be no apology for it when found in the super-structure.

The present agitation of the car question cannot but result in good to all concerned in their design, if it does nothing else than to bring out a healthy discussion of it. Out of this will surely come prescribed lines for standards in construction.

Would it not be a good idea for the malleable iron people to spread their literature over the land, and have it carry glad tidings to points remote or near, where gray iron gods are still worshipped? A pictorial representation—a kind of "before and after," that will show both a gray and malleable casting of the same part, and the reduction in weight effected by the use of the latter, would, we think, do the business. If the weights were marked good and plain, it might bring conviction home to many who will not be convinced by the most voluble tongue.

The season is upon us when the hot-box will be in evidence again. Minus zero temperatures and lubricants never intended for frosty weather, are a combination that is sure to produce the easily recognized bouquet always accompanying the hot-box. The first condition it is impossible to avoid, but the second is one that can and should be provided against in a measure, by the use of a lubricant that will lubricate at a time when it is needed.

The weight of the coaches on the New York elevated roads is 26,000 pounds, and they have a seating capacity of 48 people. This is getting the dead weight per unit of paying load down to a business level.

A Steel Car.

The Pennock Bros. have designed and built at their car works, at Minerva, O., a steel flat car of 60,000 pounds' capacity, which is now in service in the yards of the Carnegie Steel Co., for whom it was constructed.

This car having no cast iron or wood among its component parts, stands alone as an example of advanced practice in the field of car work, not from the fact that it is of steel, but by reason of the form of that material, bringing out the greatest strength with a minimum weight, which is one of the best tests of the engineering ability of its designers.

The half-tones and section, kindly furnished us by the builders, will make unnecessary any lengthy description, showing, as they do, the new ideas so well worked out to a successful end. Fig. 1 is a sectional view of the sills, taken just forward of the body bolster, shown at the left side of illustration and at the cross-tie beams. It is seen that the sills are made up of seven channels 14½ inches wide and ¼ inch thick, with flanges 8 inches deep; the channels are placed side by side, extending the full length of car, and are tied by ⅞-inch rods passing across the car, close under the web of channels and through the struts of malleable iron that are shown fitted between and around the flanges of channels, and which also stiffen and support the webs.

The center channel is given the needed strength by the T-sections running full length of car and riveted to the flanges on under side of the channel, as shown at *B B*, Fig. 1. To these tees the draft rigging is secured, the inner flanges being cut away for a distance of 11 inches to receive the draft springs and followers, thus making a shoulder which forms a part of the draft lug; the followers are secured in position by guides spanning the 11-inch gap on under side of the tees.

The draft springs are double, and of 40,000 pounds' capacity at each end of car,

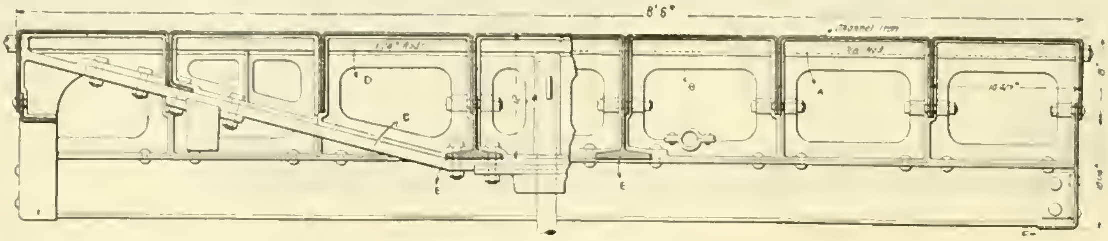


FIG. 1.

FIG. 2.

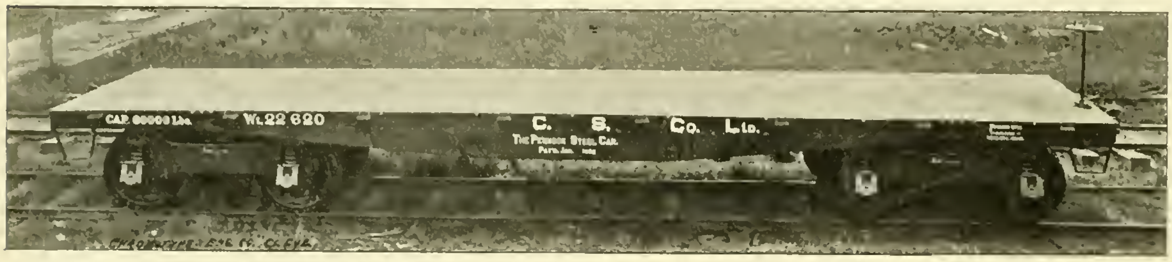


FIG. 3.

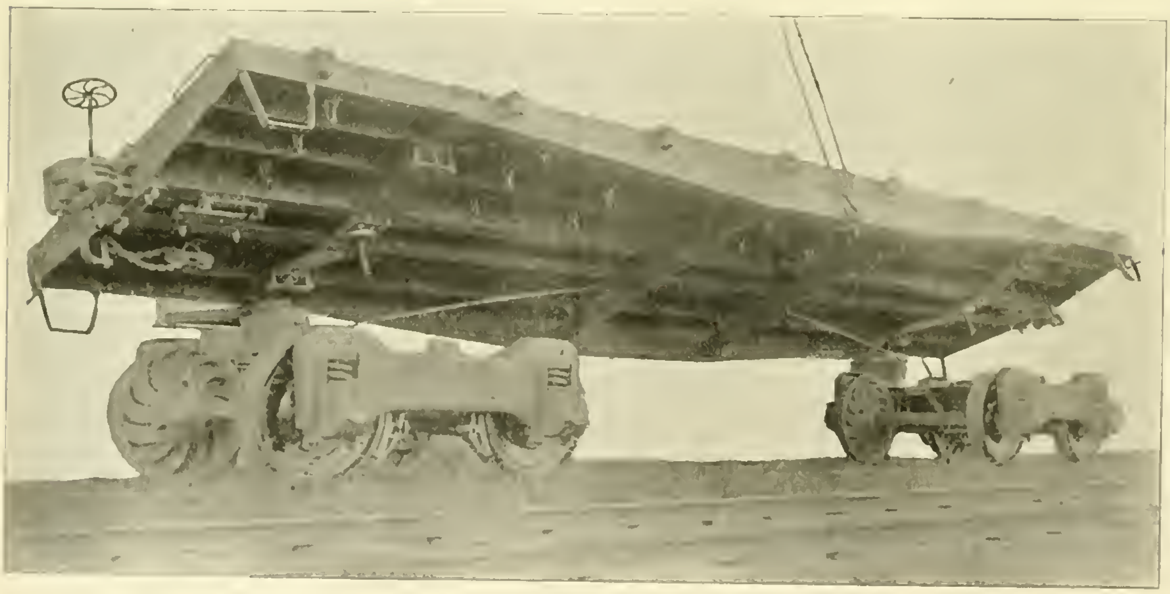


FIG. 4.

which is entirely in line with the needs of the time, and is notable because a large percentage of the newer equipment goes into commission with springs of only one-half that capacity.

At the outer flange of each outside channel is fitted an angle section extending down to the cross-tie beams, which rest on and are secured to the short leg of the angle. From the cross-ties the angles taper up to the body bolsters, giving a pleasing effect and added strength to the channels, the short leg of the angle being in tension.

The body bolsters are made up of a steel plate 1 x 10 inches for a compression member, and three 1¼-inch rods to take care of the tension; these rods also pass across the car just under the web of the channels.

The cross-ties, made of 6-inch I-beams, are found occupying their usual places, but entirely hidden by the drop of the outside angles, and the absence of longitudinal truss rods is not so marked in consequence.

A test of this car, made by the Carnegie Co., would seem to show that truss rods were not a necessity, as the car held up over ten pounds of load to one of body, the latter weighing 11,780 pounds, and the load 118,000 pounds. The deflection at center was ⅝ inch, and the sides or edges ½ inch, and no permanent set after standing forty-eight hours.

The estimated capacity of the body, at one-half the elastic limit of steel, is 104,000 pounds, and at the elastic limit 208,000 pounds, with a uniformly distributed load. A load of 60,000 pounds is therefore less than 30 per cent. of the elastic limit, and an 80,000-pound load is less than 39 per cent. of the elastic limit, which would appear to be safe enough for all contingencies of service. Fig. 2 shows how the car was loaded for the test.

Fig. 3 shows the car without load, exposing the channel floor; and Fig. 4 shows the body elevated, revealing the under side of framing and the light construction of an all-metal car.

The drawbar is seen to pass through the end sills, a construction that brings the car 6 inches lower than is possible with draft timbers, bringing the draft central, and at the same time eliminating one great source of grief from the car department by wiping out of existence the draft timbers.

It is claimed by the builders that the cost of maintenance of this car will be 25 per cent. less than for the average wooden car, leaving out in each case the wheels, axles, journal bearings, springs and couplers.

Patents have been granted the Pennock Bros., covering all kinds of cars, freight and passenger.

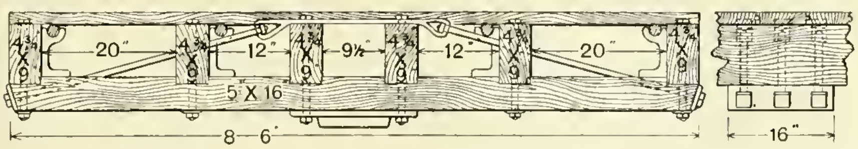
An Old Bolster in a New Light.

A few loaded freight cars which were making lots of fuss about going on a siding recently, attracted everybody's attention in the immediate vicinity. Having a few minutes to devote to just such cases as this, we proceeded at once to use them up.

The cause of the row was apparent at once—down on the side bearings—every one, except a car having trussed wooden body-bolsters; one of the old type, that is supposed to have outlived its usefulness years ago and fallen before the march of improvement in body-bolsters; but here it was, as proud as a king at having brought its load thus far without any sign of weakness; and the car, a new 60,000-pounder, was loaded, too.

Here was food for reflection—and having time for this also, we reflected, wondering what new surprise was in store for us, with what facility some smooth theories went to smash. Here is an obsolete form of construction elbowing its way to the front, and forcing recognition by worth alone, standing out prominently as the "noblest Roman of them all," simply because it don't lay down in the harness.

Among divers types and forms of metal and wood bolsters, a search of the train showed only one that had the requisite stiffness to hold the side bearings apart when loaded. To one who had passed through the wooden period, and had labored with the problem in metal, it was indeed a revelation to see a new car, of modern design in all its features, carried on a bolster that had come under the ban of almost every progressive car builder.



Who shall say there are no fads in car building as in other things? The wild race after an iron or steel bolster has much the appearance of a craze to one who has watched, and is conversant with, the barren results obtained in the greater number of cases.

Interest was awakened in this instance to the extent of making a sketch of the arrangement of the sills and bolsters, from which it is seen that both are of the lightest construction, and that the bolsters are no more nor less than the old friends of our youth stiffened up with heavier truss-rods. We present this sketch as an object lesson to any in need of it.

Impelled still further by curiosity, we made some few calculations to see about how much of a stress the rods were taking care of. The marked weight of car was 29,000 pounds, the load 60,000 pounds. Load and body equaled 77,000 pounds. Load on each bolster equaled 38,500 pounds, and stress on each rod was not less than 13,000 pounds per square inch. These figures, we must own, are better than we had expected to find them, and confirmed us in the belief that there were some things about these old-time schemes that might be well to perpetuate.

The stresses, as roughly calculated, are outside of the accepted limit of what is called good practice for anything except quiescent loads, but there was no stretch in these rods to any serious extent, and here again our theories were badly shocked.

The behavior of this trussed bolster in competition with some of the newer designs, places it on record as deserving of consideration on its merits, and is of sufficient moment to illustrate at this time, when so many heavier and more expensive creations are depending on side bearings to carry their loads.

The Large Car Problem.

The year 1895 is leaving, among some other orphans, a little red-faced weakling of an agitation for larger freight cars. Whether its squeaky cry will develop into the lusty howl of a well-nurtured infant will depend on the wet nurses of 1896, among whom there are friends who will sit up o'nights to give it the needed pap to fortify it against the ills of the long-clothes period.

This question will likely bloom into one of the most interesting issues ever brought before the M. C. B. Association for settlement, and the sparring over it in the attempt to strike a balance in the middle of the fence so as to avoid going on record for or against, will make some interesting reading.

It is plain from an examination of the situation that the large car partizans are chiefly found among the shippers, who are like the Chinaman when buying a pair of boots—they want all the leather they can get for their money—and they have been patted on the back so long that their request for larger cars now comes in the form of a demand. On the other hand, there are some roads that have a large car simply because a competitor happens to get some of the same kind, and do not like to be in the rear in point of size; still, again, there are some ambitious officials who want to be at the head of the class, and they order some samples built, with the object in view to eclipse all previous work in that line. These, we believe, are a few of the reasons for this stirring up of an issue that must be settled by a court of inquiry competent to deal with every phase of it.

Cars of 70,000 pounds' capacity are no longer regarded as a curiosity. So-called 80,000-pound cars are hauling freight, and it is fair to assume that the same influences that put these capacities in commission will ultimately bring out vehicles that will be marked for 100,000 pounds; but it is well not to lose sight of the fact that a paint brush cannot increase nor diminish the capacity of a car.

In our August issue of the current year we took the ground that "the volume of the inside of a car should be the index of its capacity," and "this once established for *average* ladings, it would be a long stride toward the goal of a standard;" we are confirmed in this position by the present attitude of some of the best authorities on the uses and abuses of the car.

It is generally understood to be the aim of the transportation department of railroads to have a car loaded to its full capacity in both directions of its haul; how often this is realized the layman will never know, but the fact is that they seldom have a full load one way even, except in case of rush in certain seasons, say the fall, when crops are moving, or on coal roads—in the latter case there is little cause for complaint about a full load one way—they always get it to the limit. These may be taken as the extremes in which a car gets a load near to its marked capacity; the inference, then, is that there must be a large part of the year when the rolling stock of most roads is running underloaded; indeed, we have many times had to face the lightly loaded train, when engaged in testing locomotives on one of the trunk lines, because the lading was away below the train's capacity, and had to be content with filling out with empties to get the tonnage up somewhere near to the engine's maximum hauling capacity, and this was in a comparatively busy season, when loads could be reasonably expected.

Whatever the causes for the light lading, it was an exceptional case to find a car of 40,000 pounds' capacity that would average a load of over 25,000 pounds, or 62.5 per cent. of what it was designed to carry. This may be accepted as a fair indication of what is still an active condition on most lines to-day, not excepting many that make a pretense of loading on the tonnage basis, which affords a solution of the particular evil under discussion.

This is the situation with which we are confronted, and it holds good for the 60,000-pound cars also. The wisdom of placing larger cars in commission to handle the same traffic, that is known to be more than provided for by the cars now in use, would seem to be called into question when viewed in the light of these facts, since the load cited above as an average one would, when hauled in a 60,000-pound car, be a less per cent. of the car's capacity than in the first case noted; for the reason that the light weight of these cars, as built, is about 30,000 pounds; then dividing the load by the rating of the car, we have 60,000÷25,000=42%, or less than half its capacity.

These figures show that a larger car will not afford relief, for it has been demonstrated that an increase of capacity brings in its train an increase of dead weight per unit of paying load, that must be carefully looked after and kept down, for its influence on the dividends is equally as deadly as the light load.

Following on these lines, with a 70,000-pound car having same load as before, we find it hauling only 36% of its capacity. When viewed from the standpoint of dead weight to paying load, and assuming the average load as before, the results are also unsatisfactory. The 40,000-pound car will weigh about 26,000 pounds, and 26,000÷25,000=1.06 pounds of dead weight per pound of paying load; if the car were loaded to its maximum we would have a ratio of 40,000÷26,000=0.65 to 1 between these values.

The 60,000-pound car with the assumed average load is found to have a ratio of 30,000÷25,000=1.2, and with a full load we have 60,000÷30,000=0.5 pounds of dead weight per unit of paying load. A 70,000-pound car we will assume to weigh about 35,000 pounds, until it is decided authoritatively what the volume of such a car shall be. This weight, it is seen, has the same ratio to paying load as the 60,000-pound car when both are loaded up to their capacity, but the bugbear of the average load still remains, and we find the relative values to be equal to 35,000÷25,000=1.4 pounds of dead weight to 1 pound paying load.

Summarizing briefly and reversing the values, the 40,000-pound car will haul 0.96 pounds of paying load for each pound of dead weight, while the actual capacity is equal to 1.53 pounds. The 60,000-pound car will carry 0.83 pounds, while the rate is 2 pounds, and for the 70,000-pound car we see that it has 0.72 pounds of paying load per pound of dead weight, against a capacity of two to one as in the case of the 60,000-pound car.

The lesson learned from these figures, as gathered from the facts of known practice, would seem to point to the average load as the vital factor to be considered in the design of a standard car. If this is taken as a correct view of the situation, our freight equipment should be lighter and smaller, rather than heavier and larger. Could the cars of high capacity be loaded at all times, then the problem would be easy of solution; but the law of averages is in force and must be considered, notwithstanding the tonnage basis of loading is supposed to govern.

In these deductions, drawn from facts that are plain to all, we have reached after only one important part of the theme. The matter of increased first cost, cost of maintenance, etc., has been left open for debate by those more directly interested; but enough has been said to convince all of the need of prompt action in arriving at a standard that will be based on the actual existing demands of traffic.

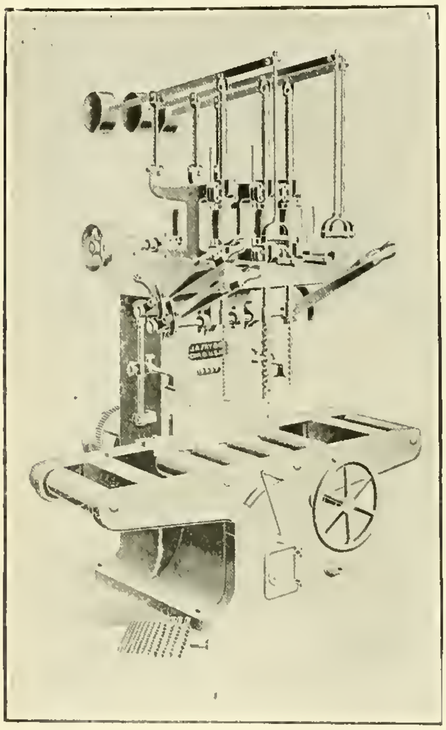
A very large percentage of the cars of the B. & O. are in bad order, so much so that they have to decline freight orders on account of the dearth of cars. Letting repairs go might have been economy last summer, but it is something else now.

New Style Large Three-Spindle Vertical Boring Machine for Car Work.

This is a very heavy machine, designed for railway car work. It will bore holes up to 3 inches in diameter in different work.

Its advantages are: The avoidance of so frequently changing augers, as in the single spindle machine; the convenience of all its parts to the operator, and the rapidity and ease of adjustment.

It is arranged for three augers, the spindles being separately adjustable, either across the work or vertically; the transverse adjustment being made by levers supplied with a friction lock, and under instant control of the operator. The vertical motion of the spindles is



CAR TIMBER BORING MACHINE.

produced by the movement of a counterbalanced lever.

The transverse movement of the spindles is 12 inches from center to center; their vertical motion is to bore through 14 inches of timber. They are furnished with stop collars for gaging the depth of the bore, and have different sized pulleys to vary the speed of the augers.

The countershaft is on the floor, attached to the back of the column, one belt from it conveying the power to all the boring spindles. Above the table, and attached to each side of the column, are adjustable stops to prevent the bits lifting the material from the table.

The table has a series of large rollers, the two outside ones being driven by chains, and the internal rolls being connected and driven by gearing on the countershaft that operates in either direction, moving the timber by power to the right or left by the movement of a lever in front of the table. A hand wheel and screw is connected to the rolls, in easy access to the operator, for moving the timbers laterally by hand.

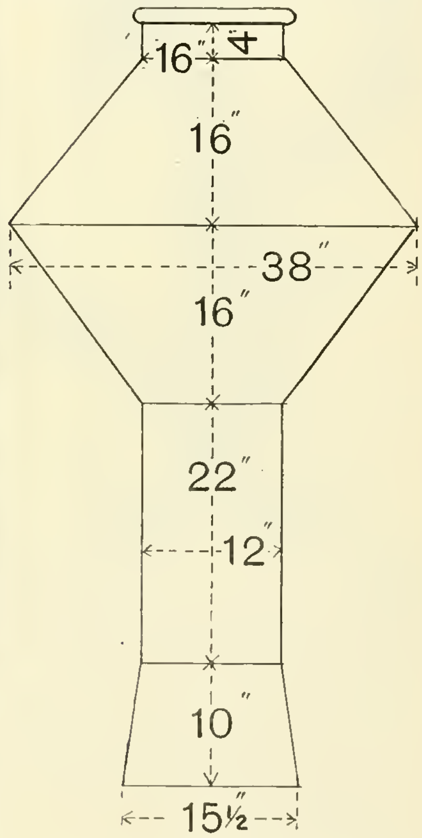
The carriages of the spindles are gibbed to a heavy frame, which with the tables and countershaft are all attached to a heavy column.

J. A. Fay & Co., 530 to 550 West Front street, Cincinnati, Ohio, are the makers of the machine. They should be written to for further particulars regarding it.

An Original Drawing by Geo. S. Griggs.

Some of our front end and stack experts, who have an idea that they are the inventors of the modern "choker," or reduction of size at base of stack—and there are many of them—may be interested in the drawing shown herewith.

This is one of George S. Griggs' famous



drawings—cut out of a piece of card board the exact shape of the outside, with the dimensions marked on.

This engraving was traced from the original card, now owned by Mr. Albert Griggs, a son of the designer of the famous old engines on the Boston & Providence. This drawing was made in 1857, and from it the first diamond stack was constructed. Had Mr. Griggs taken out a patent on the diamond stack he would have made a fortune.

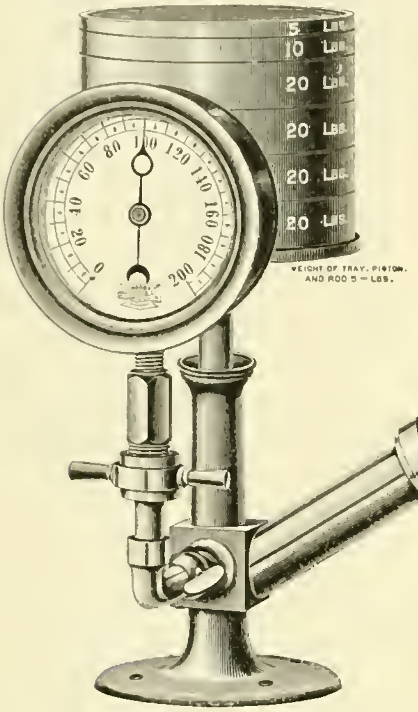
Mr. Griggs was also the first to use a brick arch.

This little "drawing," made partly with the shears and partly with ink, settles for good and all who it was that first contracted the base of the stack to increase the pull on the fire.

A Gage Tester That Tests.

The engraving shown herewith represents a Crosby weighted gage tester, and is at once the simplest tester we know of and one the least liable to get out of order.

The gage is not part of the device, but is the gage being tested. The instrument consists of a stand from which rises a cylinder, having accurately fitted into it a piston with an area of exactly one-fifth of a square inch, which moves freely up and down. Attached to the top of the piston rod is a disk for supporting the



weights; each weight is marked with the number of pounds pressure per square inch it will exert on the gage. From the bottom of the cylinder two tubes project; one forms a standard for holding the gage to be tested and is furnished with a coupling to connect it with a three-way cock; the other rises at an inclination and forms the reservoir for oil, having within it a screw plunger for forcing the oil inward or outward.

The weights for testing up to 300 pounds are brass cases filled with lead; the additional weights for testing up to 1,000 pounds are of iron. It is made by the Crosby Steam Gage and Valve Co., of Boston, Mass.

The locomotive boiler allows of a design that will give a liberal heating surface for a small diameter of shell, but a multitubular boiler must have a feed water that is free from mineral impurities, if it is to preserve its evaporative efficiency; and this fundamental proposition has probably caused as much unrest as any other one thing, to the operating officials of a road running through a district where coal is expensive and the water is loaded to the limit with scale-producing properties.

The Tool-Room.

The tool-room should have for one of its cardinal principles—and have it lived up to—that a tool should be kept in the best possible condition of efficiency to do work, in order to be a paying factor in economical operation of any shop.

A full recognition of this is always evidenced by the shelves and racks being well filled with taps, reamers, jigs for drilling, reaming and laying out of work, and also by the special tools that have their share in reducing shop expenses, simply because a man can do better work and more of it when he has the means to this end.

Time was when the tool-room was nothing but a place for the stowing away of alleged tools, covered thick with grease; some mud-plug taps held down in the corner by socket and "S" wrenches, and they, in turn, under a 24-inch jack, crowned by a lot of snoutless oil cans. In the darkest and most inaccessible hole, a torch was necessary to find anything. A tap or reamer spewed up from the depths of this place and put to work would be so dulled and unfit for use that their shrieks of protest would put to shame any picture of Inferno ever drawn by Dante. The echo of their wail can still be heard, but it is growing fainter with each succeeding generation of foremen, who have somehow learned that their ability to manage a plant is rightly measured by their success in keeping up tools and designing quick methods of doing work with antiquated machine tools that were far better in the scrap pile than in the tool-room.

Men without sense enough to grip a hammer are quick to see any indications of incompetency in a foreman, and quicker to take advantage of it to satisfy their yearning for rest. With such a foreman the "soldier" is in a veritable paradise, and at the same time the management is anxiously waiting for business to pick up.

A go-as-you-please ratchet drill, with a half-stripped screw and teeth that ought to be in the dentist's hands, is not the kind of a tool to do work with; neither is a straight edge that is not straight, nor a spirit level whose bulb is in a chronic state of unrest, and must be equated before it is in a condition to give an accurate reading; and the "big square," suffering from the effects of a fall in its younger days, and has to be gone over to see how much it's out before any confidence can be placed in it, is just as unreliable as the rest. These are all doing business in their way, in more than one shop in the country to-day, and would not be in the condition noted if they had a tool-room to call home.

The man who has pride enough to keep his overalls in a presentable condition of neatness will draw the line on a shop that knows no other and better way to keep up tools; and the outcome in all cases is, that the shop loses a good man, and his place is filled by the party without even a two-foot rule, who will revel in his greasy surroundings and prepare himself for a permanent stay. There is never any difficulty in keeping this kind of a shop filled with tourist talent.

The condition of a tool-room, and the methods carried out therein, have as much to do with the personnel of a shop as any other influence. It is among the first features referred to by the foreman, who is justly proud of his creation—if he has one worthy of the name—and the visitor to a shop can easily and accurately make an estimate of its standing in the line of progression by the manner in which he is escorted to or steered from the tool-room.

In the organization of the tool-room local conditions must govern to a large extent, although the experience and grief others have had in the direction is always a valuable guide, just as in every other pioneer move; but no matter what the conditions are, there is one essential element that must be considered as having more weight than all others, and that is *system;* whether poor or good, it is the keynote to the situation.

With a course of procedure outlined looking to a place for everything, and a criminal code to insure everything being in its place, the tool-room starts on its mission of usefulness, and before it is fairly under way, little avenues for improvement will suggest themselves. If the right man is in charge, these hints will be heeded and elaborated on to the fullest.

The next move is to put some machine tools in commission and have them located where the operator can see his work; the want of proper light will certainly render *nil* the best-laid plans for a tool-room. The tools required to make a start need be few, but the best of their kind: One 12-inch lathe, with taper attachment; one 16-inch drill, with sensitive attachment; one twist-drill grinder and two vises, one large and one small.

These tools will enable a mechanic to keep the tools of a good-sized plant up in shape, provided he is not obliged to pass tools through the wicket to a clamoring mob on the other side of the same, and is allowed to attend strictly to his legitimate duties. The price of a boy to do the handing out and taking in, keeping tab on every tool, and who is made responsible for the tools being placed in their racks properly, is a trivial expenditure when put in the balance against the time wasted by the one-man-for-all policy.

No stated or stereotyped arrangement of the tool racks and other conveniences can be spread thin enough to cover all conditions. The special needs of a case must be provided for by any arrangement that will best meet them. Press the brains and they will do the rest.

A tool-room started on these simple lines will, if managed half right, let a little light into many a place that never before knew what it was to have its hair combed.

In the *Engineering Magazine* of November there is an interesting article on the prevailing scarcity of skilled labor, a subject which is daily impressing itself more forcibly upon the employers of labor. It is a melancholy fact that the average American does not display much ambition to become highly proficient at the business he engages to learn, even though that business is to be depended on for a life's sustenance. The sentiment on this subject is much lower in our shops and factories than it is in Europe, and it is, no doubt, in a great measure due to the difference of sentiments that the difference in skill exists. We find, in visiting shops and factories, that a large proportion of the most skillful workers employed were born abroad. When a boy or girl goes into a shop or factory in Europe to learn a business the sentiment is found that those who turn out inferior workmen or workwomen are looked upon with contempt. This is a very great stimulant to make those learning a business strive to become first-class in every respect. There is very little of this kind of sentiment found in America. We are so intensely independent that it is considered the inherent right of a man or woman to remain an inferior hand if he or she sees fit. The growing practice of performing accurate operations by machinery is reducing, to a great extent, the necessity for close manipulation by workmen, and this to some extent reduces the incentive to acquire exceptional skill, but it has not such a deteriorating effect as the sentiment that it is no disgrace to be an inferior hand. We have heard a great many recommendations made these last few years for promoting the instruction of more highly skilled workmen, but we have never heard a word said about the sentiment which permits them to feel comfortable while looked upon as inferior hands. We believe that the first move towards a thorough remedy of the lamentable condition of affairs will be a crusade of education to change the existing sentiment.

The Webb C. Ball Co., Cleveland, O., manufacturers of standard railway timekeepers, have watch movements named for the several railway organizations, as "B. of L. E.," "B. of L. F.," "O. R. C.", and "B. of R. T." Mr. H. Walter Webb, the third vice president of the N. Y. C. & H. R. R., used the Ball watch in timing the record-breaking run of the "999," and it was also used on the L. S. & M. S. Ry. for the official timing of their recent fast run.

The Gould Balanced Valve.

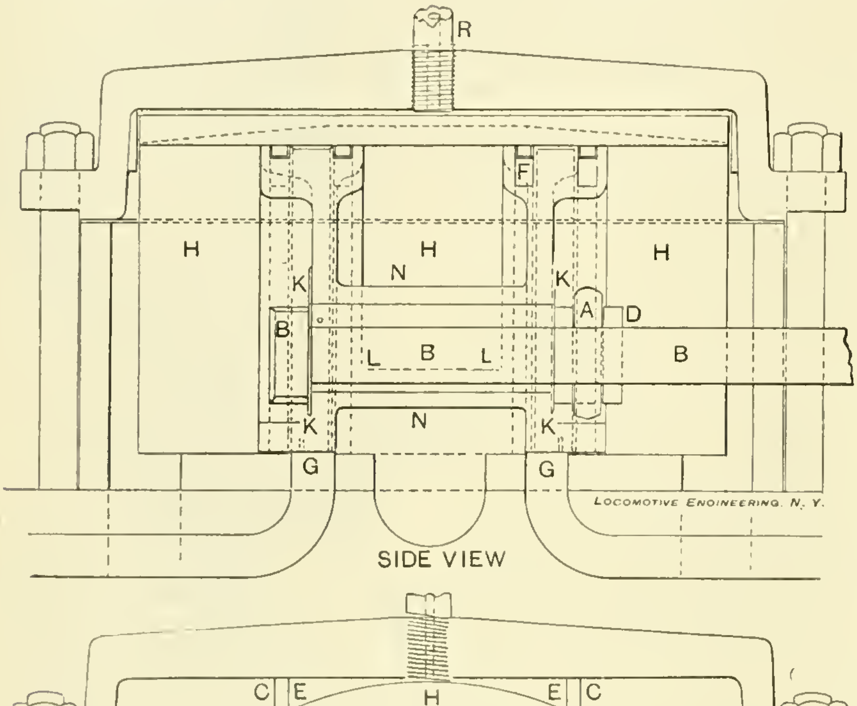
Something entirely new in balanced slide valves is shown in our illustration of the Gould device for this purpose. The aim of the inventor has been, evidently, to approach as closely as possible to the piston principle and still make it applicable to any slide valve.

The balancing is obtained by means of a semi-circular balance plate set into the steam chest; the top of the valve is of the same contour and has balance strips let into it, which bear against the balance plate in the usual manner.

In construction the two semi-circular

When the valves require facing, the same amount of metal is planed off the edges of the balance plates that is removed from the faces of the valves, and thus the relative positions of the valves and their plates are made to remain constant.

The letter *R* refers to the oil cup, reaching to within $\frac{1}{8}$ inch of balance plate *H*. *E* shows two small ribs on the top of *H* to carry the oil full length of plate. *C* are four small lugs on steam chest cover to prevent excessive longitudinal movement of plate *H*. *F* shows spring pockets for the helical springs holding the packing out against plate *H*.



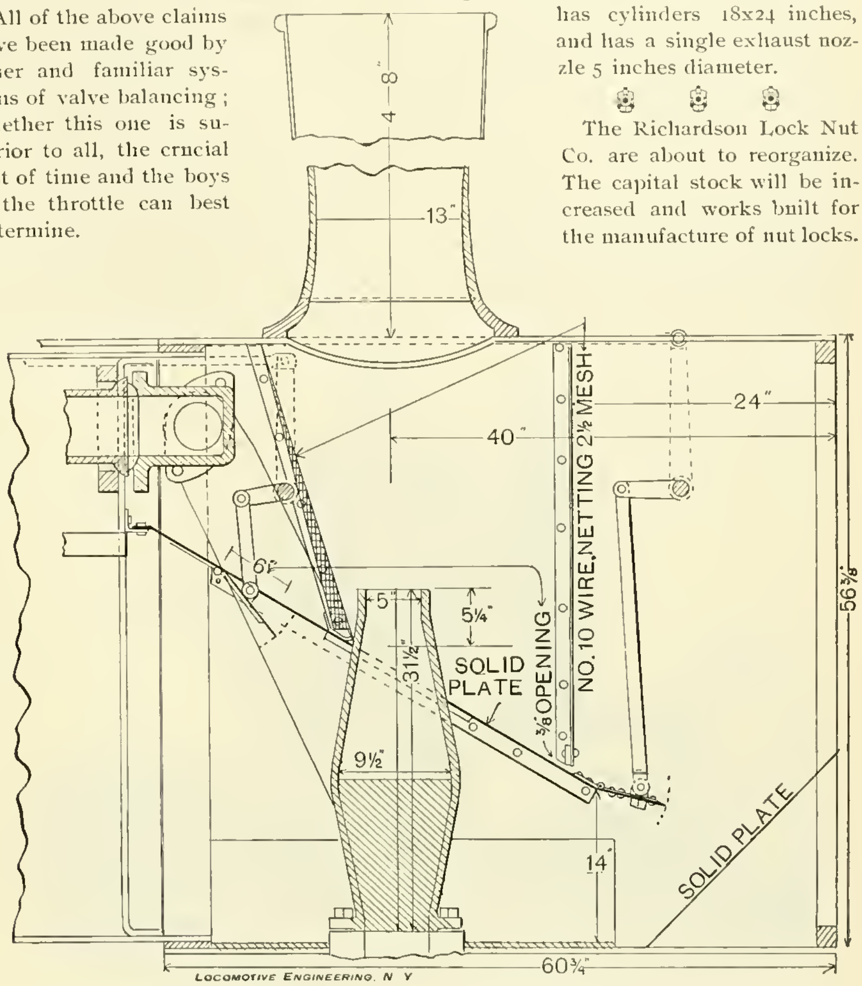
GOULD BALANCED VALVE.

plates for one engine are planed off on their longitudinal edges, clamped together to form a complete circle, and then placed in the lathe and bored out. The valves have their port faces planed, and are also clamped together and their backs turned into a complete circle slightly smaller than the balance plate, after which they are grooved for the balance strips. The strips are then turned to fit the grooves, and of a proper diameter to fit the plates, which, by the way, are made to fit loosely in the chests, and thus automatically adjust themselves to any inequalities due to wear of the valve.

There is a small steam port extending over the top of valve between the packing, or balance strips, at each end of valve, and connecting with the openings *G*, which allows the live steam from the port to come in contact with the back of valve in order to balance it against the cylinder pressure. These ports are located in the face of the valve, so that the steam from the port *G* equalizes the pressure to that acting on the piston.

The inventor states that an engine equipped with this balance has made 4,142 miles during the month of September, and more mileage in October, with no work done to the valves whatever up to date, the valves being perfectly tight and the reverse lever moving easily with one hand, with a full throttle and 130 pounds of steam.

All of the above claims have been made good by other and familiar systems of valve balancing; whether this one is superior to all, the crucial test of time and the boys at the throttle can best determine.



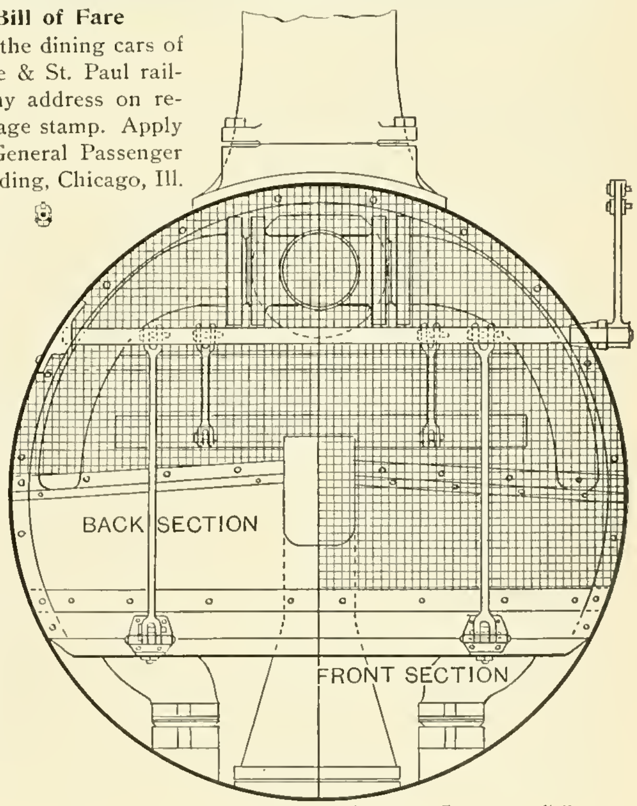
An Enigmatical Bill of Fare

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.

❀ ❀ ❀

Georgia Southern Extension Front.

A drawing from which the extension front shown in the annexed engraving was made was sent us by Mr. G. D. Harris, master mechanic of the Georgia Southern & Florida Railway. It has been applied to an engine on his road, and Mr. Harris says that the engine is making 65 miles to the ton of coal in passenger service, and is giving very great satisfaction. The engine has been running ten months, and none of the flues have stopped up, showing that there is a uniform draft throughout all the flues. The engine will steam against both injectors. She is very free from spark-throwing and keeps the smokebox clean. The engine has cylinders 18x24 inches, and has a single exhaust nozzle 5 inches diameter.



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The Richardson Lock Nut Co. are about to reorganize. The capital stock will be increased and works built for the manufacture of nut locks.

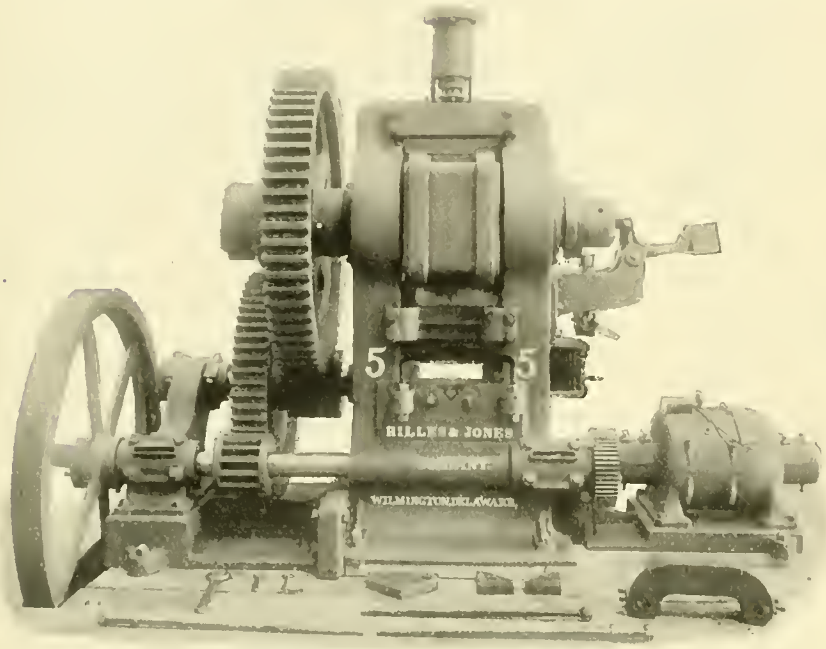
Electric Bar Shears.

The Hilles & Jones Co., of Wilmington, Del., recently furnished a well-known locomotive works a bar shear for cutting up heavy scrap, and we illustrate it to show the marked progress in this type of tool.

It is driven through a multipolar ironclad motor on the same foundation with the machine, and has a capacity for shearing flat or round bars up to 16 square inches of section.

The massive lines of the machine may be inferred from the spur gear which is 3½ inches pitch, and 10 inches face; the total weight of machine complete is about 45,000 pounds.

The starting rheostat is attached to the main frame in a convenient location, and a steam or compressed air cylinder is used for counterbalancing the weight of the sliding head. The machine is built to be driven either by belt, engine or motor, and of sizes to suit all classes of work.



ELECTRICALLY DRIVEN BAR SHEAR.

The Best Valve Motion.

The stove gang were discussing valve motion and telling lies about the smartness of engines that each of them had handled, when the question was put to an old timer for settlement. "Boys," said he, "the best valve motion I ever had hold of was a 17-inch cylinder engine with a boiler built for a 10-inch cylinder. I allus notice that an engine with a big boiler has a good valve motion."

In the course of a discussion at the Western Railway Club, Mr. J. Barr quoted the anecdote told by "Locomotive Engineering" about the fireman under examination who was asked what he would do if he saw a collision inevitable and answered, "Seize the valve oil can and jump off." Mr. Barr admitted that there was a tendency to expend superfluous effort in saving oil while the more important matter of saving fuel is neglected. It is strange that this fact is not more generally recognized. On roads where the engineers are practically persecuted into the saving of oil, we find glaring evidence that economy of coal is not urged upon those who could easily save more money by careful and intelligent methods of firing than the whole oil bill amounts to. It is all right to put some restraint upon the man who has fallen into the habit of pouring oil on every bearing every time he stops the train; but the simple injunction to the fireman to close the dampers when the engine is not working would save more money to railroad companies.

Ice gathered from goose ponds is unhealthy. Ice water itself is unhealthy. Unfiltered water is not as good as filtered water. It seems to us that any railroad can afford to use Major's filter. It is simply a porcelain covered steel bucket with a stone filter in the bottom, this sets loosely in the ordinary cooler. The ice and water are put into this vessel and the filtered water rises around the filter. The water is not as cold as ice water, but is pure and fit for use. The filters are a little extra—that are used to make a bad thing good. They are not of the kind of improvements that require throwing away a fairly good thing.

The Central Georgia have obtained control of the Macon & Northern, a line running from Athens to Macon, a distance of 107 miles. The purpose of the purchase was to give the Central Georgia a line to Macon, and shut out the Seaboard Air Line.

Weak Car Couplers.

Towards the end of November there were a series of coupler tests made at Atlanta, Ga., by the officials of Robert W. Hunt & Co., Chicago. A large number of couplers of various kinds were tested by a 1,640-pound drop, and the operations were witnessed by a large number of railroad officers, who displayed a very keen interest in the result. We have not yet received the official figures and cannot give detailed particulars, but we received some lessons from the tests that are not likely to be mentioned in the official report. Several of the couplers broke regularly under the first drop of three feet, and some of them did not seem capable of standing the shock that would result from the weight falling half that distance. One coupler, which has been notorious for its weakness, went to pieces under some of the drops, and its design and material, as seen when broken, gave convincing testimony that the coupler is dangerous when found on cars in trains that run faster than five miles an hour. With the wretched reputation this coupler has, it is a strange thing that railroad officers are still to be found purchasing a death trap of this kind and putting it upon their cars. The craze for cheap nastiness never descended lower.

The couplers not of steel were supposed to be made of malleable iron, but several of them did not show any of the traces of malleable iron in their fracture. They had the appearance of common cast iron. Some of those that broke most readily were badly made, the core not having been held central. Several of one make that broke under the first blow, had less than ¼ inch of metal on one side of the stem. Couplers that were made in what might be regarded as first-class malleable iron foundries stood very well. Those that broke most readily were made in small establishments where the art of making malleable iron is in the early progressive stage.

From what we saw of these tests, we would caution railroad men against purchasing couplers that do not have a good reputation. We would also advise purchasers to subject some of each lot of couplers to a drop test; and, lastly, we would say, Do not accept malleable iron couplers that are made in foundries where they scarcely know how to make decent cast iron.

The faculty of the University of Minnesota, Minn., are trying to make arrangements with one of the railroads with terminus in Minneapolis to fit up a testing plant for locomotives to be used by the students. The University people expect eventually to have a testing plant of their own similar to that at Purdue University, but in the meantime they will be satisfied with the use of an apparatus similar to that used by the Chicago & Northwestern Railway at Chicago.

WHAT YOU WANT TO KNOW.

Questions and Answers.

(1) J. H. N., Philadelphia, Pa., writes:

If 2 is ½ of 6, what is 1-3 of 9? Some people say 2, and some say 4½; will you please answer and oblige? A.—An answer would be out of place in these columns, and we would like to know how the above can find any possible connection between his question and locomotive engineering.

(2) Enquirer, Lowell, Mass., writes:

1. Why does an engine use more water when heated in the tank before being forced into the boiler, than when forced in cold, and how warm does it have to be before there is any perceptible difference? A.—An engine should not use more water in one case than in the other, to do a given amount of work, since a certain number of heat units must be put into the water to raise its temperature to that due to the pressure, no matter whether this is done to the water in the tank by the heater pipes, or in the boiler direct. 2. Does oxalic acid, used in cleaning the brass work of an engine, harden the brass? A.—There is a difference of opinion about this. We cannot say.

(3) Joe A., Temple, Texas, writes, repeating his question about getting an engine in without towing, if the left-hand link and right-hand main pin were broken, and asks if the unbroken link could not be used on the left side. A.—Theoretically the link on the right side can be transferred to the left side, and perform all its functions as well as though it were in its original place, but there are some practical reasons that might make this move impossible. In the first place the right hand link would require to have its ends reversed when placed on the left side, in order to bring the saddle and pin into proper relation with the lifter; if, now, the saddle is mid-length of the link, it will work all right, otherwise it might not; again, there is more than a passing chance that the saddle pin will not fit the lifter, or the rocker pin fit the block, or the eccentric rod pins fit the link, because there is not the same attention paid to duplication of parts on a small road as on one with a larger equipment; these, and other reasons, only aggravate a situation already overflowing with grief, therefore, our first answer: "Get ready to be towed in as soon as possible."

(4) J. H. S., Fort Worth, Texas, writes:

Please state in next issue of your very valuable journal, what is the best motion for a valve in a 17 or 18-inch 10-wheeled engine. The amount of lead, 1-10, 1-16 or 1-32-inch; outside lap, ⅞ or ¾ inch; inside lap, 1-32, 1-64, or line and line; also amount of lift throttle valve should have to supply boiler pressure at any point of cut-off and speed, and if, according to your opinion, it is better to use dowel pins in bull rings? These questions refer to an engine for freight service on a pretty hard division. A.—There are too many unknown quantities in these questions for us to give decisive figures; among the important omissions are travel of valves and diameter of wheels. Assuming the first to be 5 inches and the second to be 56 inches, we should say 1-32 inch or less for lead; ¾ inch for outside lap, and 1-16 inch for inside lap. It is impossible to state the amount of lift for throttle valve, under the conditions you name, because diameter of throttle pipe is not known, and even if it were, the information would be valueless. We would use dowel pins in the bull rings.

(5) J. L. B., Redburn, Pa., writes:

To settle a dispute we have agreed to leave it to you: 1. I claim that the valve travels faster when the reverse lever is in forward notch, than when it is hooked up close to the center, engine to be running at the same speed in both cases. A.—This can be answered by supposing the valve to have a travel equal to the stroke of piston, in which case the speed of valve and piston would be the same; since the travel of valve is affected by the position of reverse lever, the results are the same as would be had by changing the throw of eccentric; and if, now, the travel or throw be reduced to zero, or in other words, the center of axle and center of eccentric are co-incident, the valve will not move; it is plain then that since the travel is dependent on the position of the reverse lever, or what is the same thing for illustration, the throw of eccentric, the speed of the valve must increase as the travel or throw is increased. 2. I also claim that the crosshead travels faster while the pin is going over the top quarter than when it is going over the bottom quarter. Who is right? A.—You are wrong, there is no difference in the velocity of the crosshead when the pin is on the upper or lower quarter.

(6) F. S., Magnolia, Va., writes:

Please explain why an angle plate on a rail joint always cracks from the top, while an ordinary fish plate on the same joint will crack from the bottom? A.—This question was referred to Prof. P. H. Dudley, who kindly replies: "Your inquiry why an angle plate cracks at the top and a plain bar cracks at the bottom, while true for many conditions, is not true for all; for many angle bars fail from the bottom upward. A few years ago the majority so failed which were under my observation. When a wheel runs over a joint, the latter is depressed; the metal on the underside of the angle plate being in tension, while that of the top is in compression, but as the wheel rolls on until the joint is midway between a pair of wheels or drivers, the tendency for the ends of the rails is to rise, which is checked to some extent by the angle plates or plain bars; but the character of the stresses is reversed—the top now being in tension while the bottom of the bars or plates is in compression. If the stresses, either on the top or bottom of the bar, caused by the bending under the wheel loads, are near the elastic limit of the metal, it is only a matter of time when the bar will fail, either from the top or bottom according to the maximum stress. With the higher standard of tracks of the past few years, the stiffer rails and better designed angle plates, made of higher grades of steel, but few fail from either the top or bottom."

(7) J. H. H., Burbank, Col., writes:

Will you please answer these questions in your valuable paper: 1. What is the difference in the firebox, flue and front end arrangement, for burning bituminous coal and oil? A.—The firebox for bituminous coal usually has a brick arch extending crosswise and back from the flue sheet at an inclination, the front of arch being on line with lower row of tubes. A deflecting plate is used in the smokebox, passing from the upper row of tubes to a point near the bottom of arch, and having provision made for adjustment in lowering and raising so as to equalize the flow of gases through the tubes. There is also a wire netting placed across the smokebox, below the top of exhaust nozzles, to intercept the cinders on their way from the firebox to the smoke stack. A firebox for burning oil has (in the Urquhart system) its bottom portion lined with fire brick, and above this lining is an arch, which is closed at the front, and extending about half the length of the box. There is no difference in the arrangement of flues for the two fuels. 2. How is the oil fed to the burner; does it flow by gravity, or is it pumped? A.—The oil flows by gravity to an injector placed just above mud ring of firebox, where it is sprayed and forced under the brick arch by steam from the injector. 3. What is the principle of the Eames vacuum brake? A.—It is that of a vacuum on one side of a diaphragm, and a corresponding pressure of the atmosphere on the other side. The vacuum is produced by exhausting the air from the brake train pipe by the aid of an ejector; steam passing through this instrument causes an induced current of air from the pipe, and atmospheric pressure sets the brake with an intensity due to the vacuum produced.

In spite of the improvement in business, people who visit dealers in railway supplies still hear a great many complaints about the small volume of orders being placed by railroad companies. In this respect we have found one firm an exception, which is the Q. & C. Co., of Chicago. President Quincy is pushing things so vigorously that he is able to give the comforting assurance that business is first-rate, and his manner appears to sustain what he says. They have had a very lively demand for their various specialties—the Servis tie plate is meeting with increased demand, and the McKee brake adjuster is every month growing in popularity. Their car door has been applied to many of the cars now under construction, and their later specialty, Arborlineum, a material prepared to prevent decay of timber, is making a very promising record. Their metal sawing machine scarcely needs mention, as it does not have any rival.

The Lehigh Valley Railroad Company have made a contract with the Hall Signal Co. for the equipment of 186 miles of track. There are to be 186 block sections, each post having a home and a distance signal. The number of switches included in these blocks is 462, all of which will be equipped with indicators to prevent their being turned off from the main track when a train is approaching. When these signals are in place the Lehigh Valley will have 235 miles of track protected by Hall signals.

The Cooke Locomotive & Machine Co., Paterson, N. J., have a beautiful framed photograph of their latest record-breaker, which they will send to every superintendent of motive power in the world on application for it. The picture will be an attractive ornament to any office.

An Inkling of Maine Sport.

There seems to be an ever increasing inclination for our local huntsmen to hunt big game, and to them it is doubly delightful to know that a journey of a few short hours will carry them to a section of the Pine Tree State that is literally alive with fine specimens of moose, caribou, bear and other large game.

The following narrative, clipped from a recent issue of *Outing*, is an interesting and realistic description of the many exciting yet pleasing surroundings which attend a moose hunt:

"We started about 3 o'clock for a large barren, a mile or more away. Just as we struck the opening of the trail to the little lake, we saw on the opposite shore a bull moose. His antlers flashed in the sun with every motion, and his coat appeared almost as black as ink. Crouching at once in the friendly screen of the alders, we quickly made preparations to call.

"The bull was taking things in a most leisurely style, but at the first note of the challenge he became an active, fierce opponent. He was eager and ready for fight, and he started at once to come around the edge of the lagoon, giving with each step a short, sharp grunt, as much as to say, 'I'll cook your mutton, presently.'

"The distance he had to come was about a quarter of a mile, and he stopped every now and then to give forth a bellow in answer to our renewed invitation to 'come and have it out.'

"The sight of that great raging brute was one never to be forgotten.

"In all my previous experiences in hunting I had seen nothing to equal it, for it must be remembered that the bull was in full view for nearly two hours.

"The fear that some whiff of wind might carry the taint of our presence to his keen scent; the dread that some slight defect in the call would alarm his sensitive hearing; the necessity to remain as quiet as the grave in our hiding; his partial disappearance when the trail led around some large boulder, or a few yards into the forest, kept our excitement at fever heat.

"When he was within a hundred yards or so of us he halted. He was evidently stripping for work. Tossing his head, striking his horns against the saplings, pawing up the mud and moss, and throwing it over his back, he presented a sight rarely granted to the hunter. His stop troubled us, as he might fool about till dark.

"A whispered consultation was held. The feasibility of trying to creep nearer to him was discussed. We dreaded to risk another call, as the slightest failure in its tone would be fatal. Finally, in desperation, we uttered one more call, and so perfect was it that the bull at once started forward. We could hear the rattling of his antlers against the trees, and the welcome bark given with each step. Nearer and nearer came the sounds, till at last they ceased, and a bellowing challenge followed so close to us that it made the few hairs on my head fairly stand on end. Rising, I beheld a sight which few city men have seen. Within ten yards, his magnificent antlers towering over his massive head, his eyes red and savage, and his mane erect and bristling, stood the 'king of the Maine woods.'

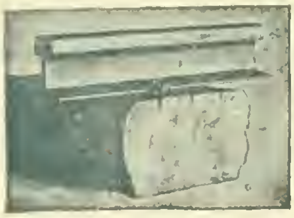
"A rash movement, a tremor of the arm, might have spoilt it all, and the probability that a wound would send him charging down upon us did not tend to steady me.

"Aiming until I could see the very curl in the center of his forehead, I pulled the trigger. Though blinded for a moment by the smoke, I knew from the thrashing the game was mine."

This experience is by no means an occasional but frequent occurrence, as many a hunter can attest.

The train leaving via the Eastern Division of the Boston & Maine Railroad each day at 7 P. M. will land you at Greenville (from which point 185 deer were shipped during October of this year before noon of the following day, and the country all about there for miles and miles abounds in the richest of game trophies, and a week spent gunning in Maine forests will be one of the happiest of your life.

Standard on most of our Railroad Systems



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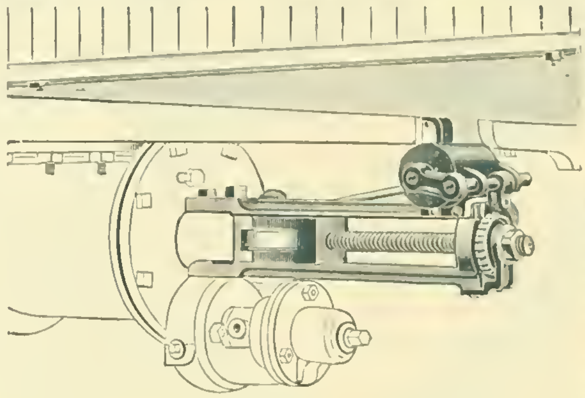

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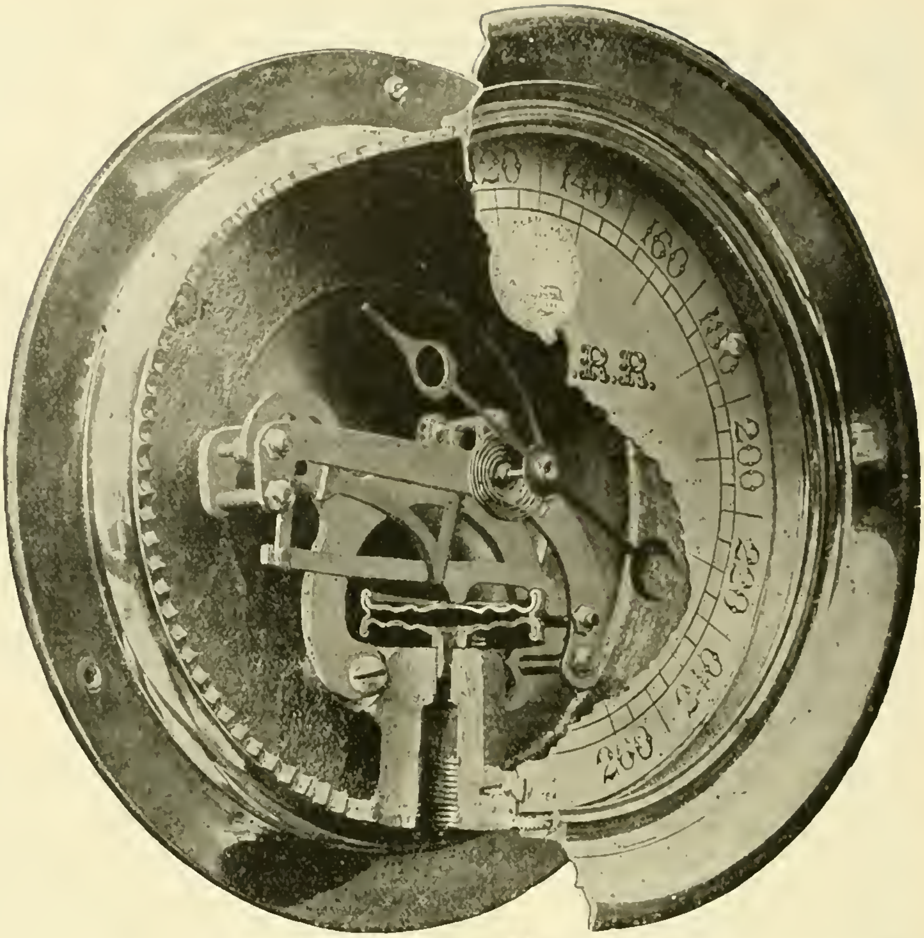
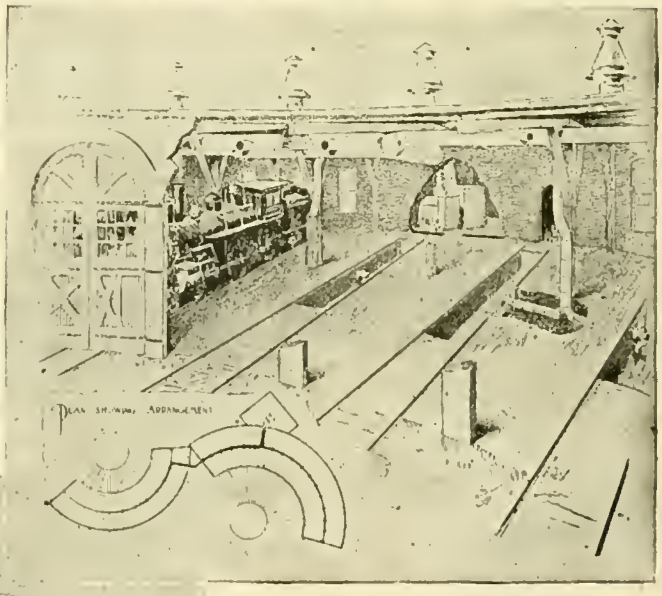





Locomotive Engineering N.Y.

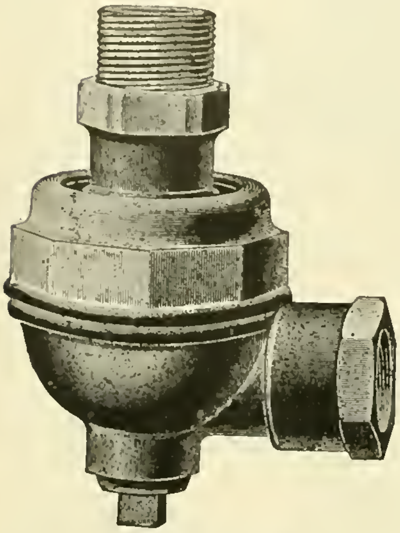
ADVANTAGES OF THE MORAN FLEXIBLE JOINT.

ALL METAL CONNECTION
ABSOLUTELY FLEXIBLE.

POSITIVELY STEAM TIGHT
UNDER ANY PRESSURE.

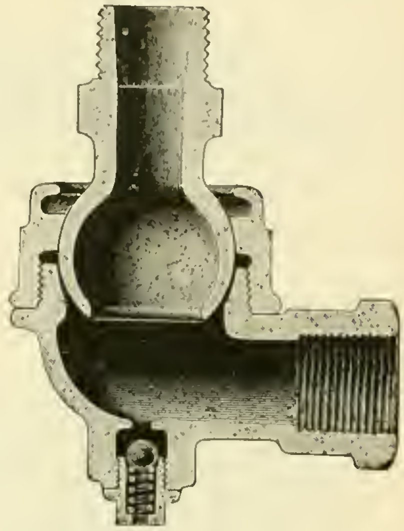
INDESTRUCTIBLE,
SHORT OF WRECK.

NO DELAYS, NO REPAIRS,
FIRST COST IS THE ONLY COST.



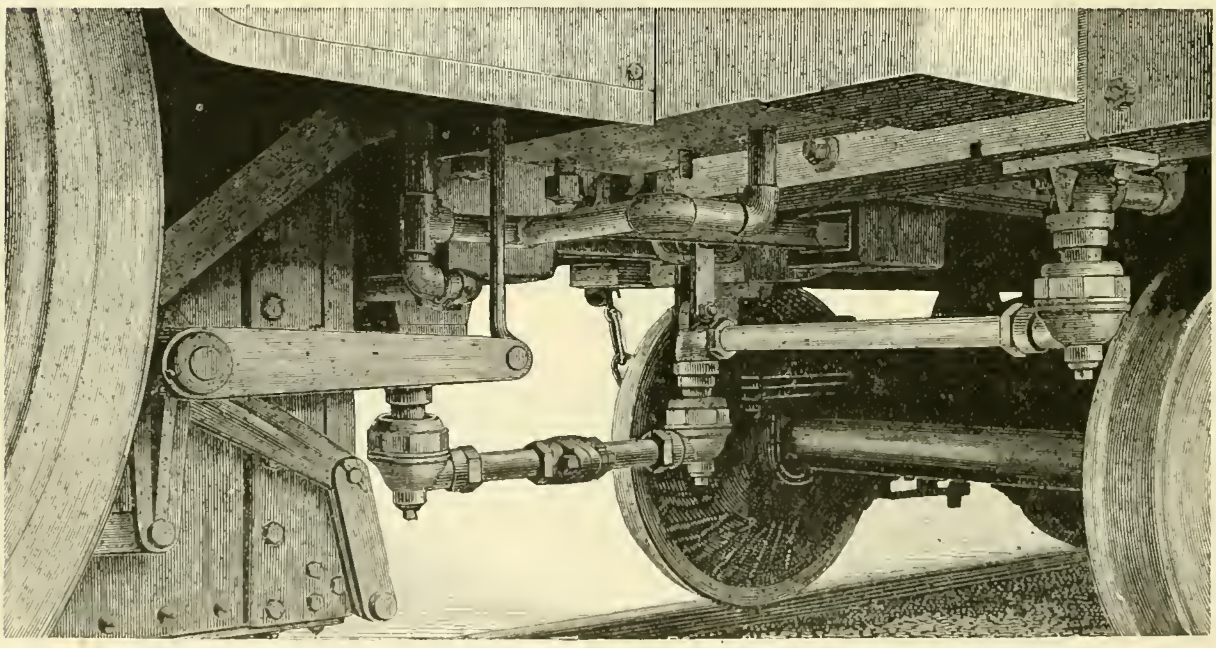
Steam, Oil, Hot Ashes or Dirt

Does Not Affect Its Life.



SPECIAL JOINT FOR STEAM HEATING CONNECTION BETWEEN ENGINE AND TENDER.

Sectional View Shows Automatic Relief Trap.



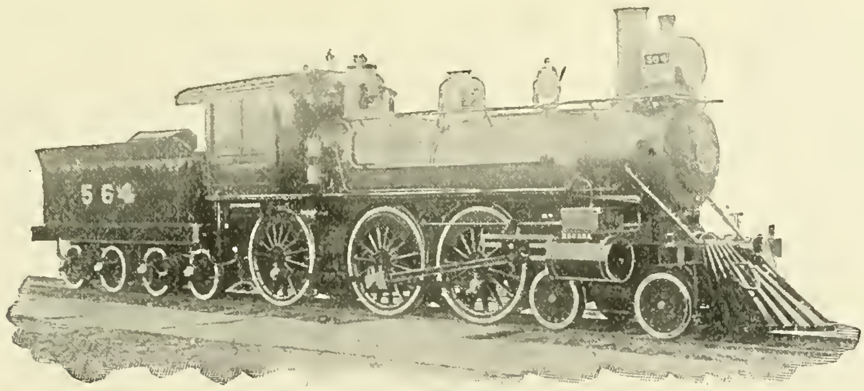
SHOWING APPLICATION OF THE ABOVE BETWEEN ENGINE AND TENDER.

PARTICULARS ON APPLICATION.

MORAN FLEXIBLE STEAM JOINT CO. (Inc'd),

(HENRY U. FRANKEL, President).

149 THIRD STREET, LOUISVILLE, KY.



RECORD BREAKER.
L. S. & M. S. R.R., OCT. 24, 1895.
72.91 MILES PER HOUR, DISTANCE 86 MILES.
MAXIMUM, 92.3 MILES PER HOUR.

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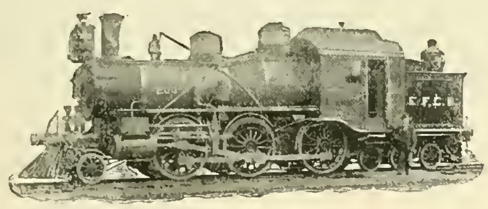

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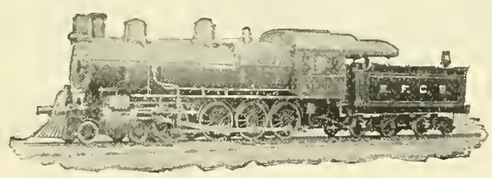

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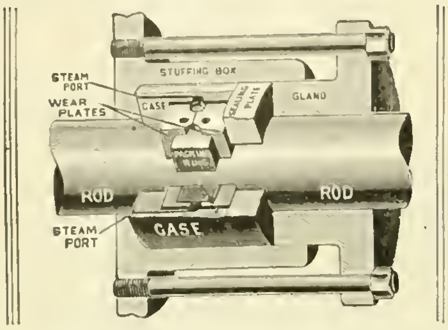

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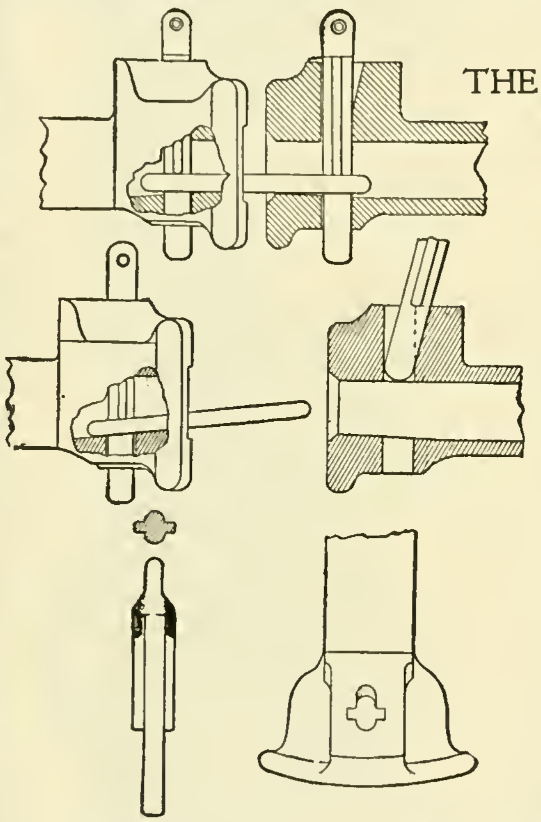

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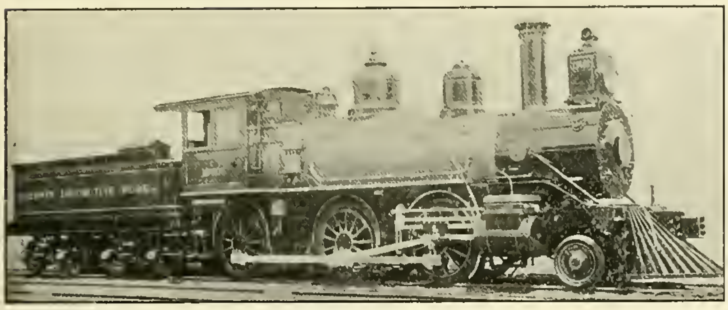

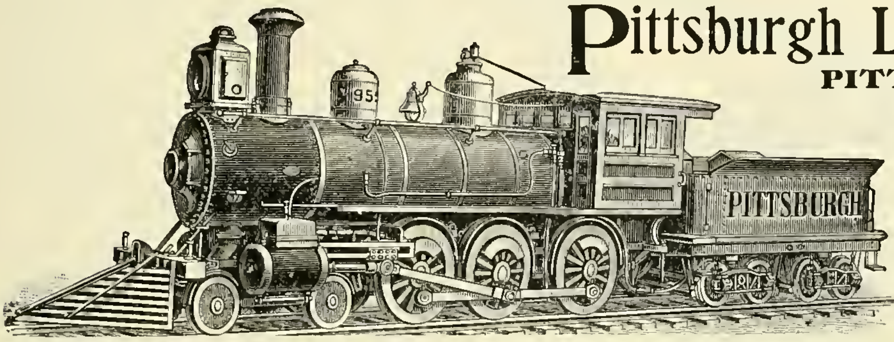
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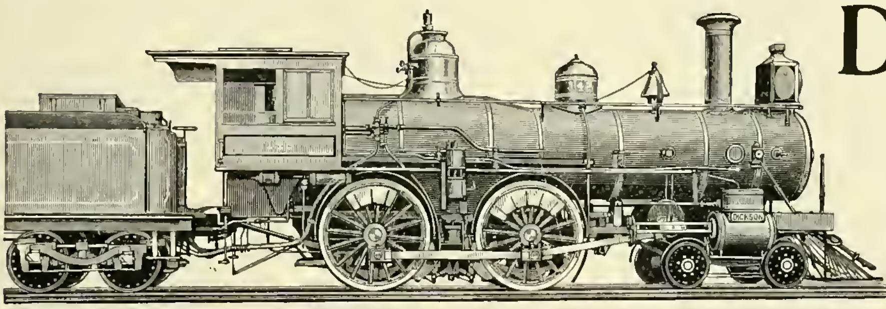

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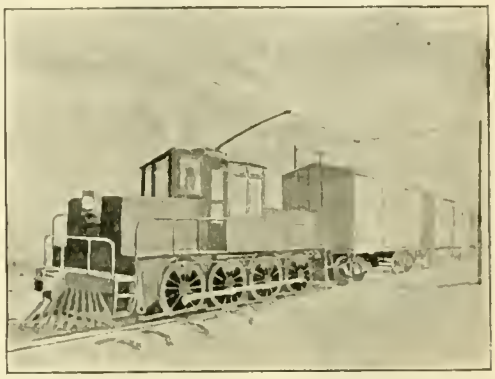

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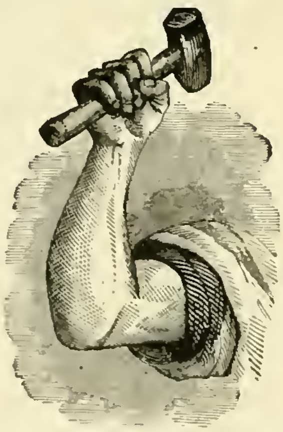

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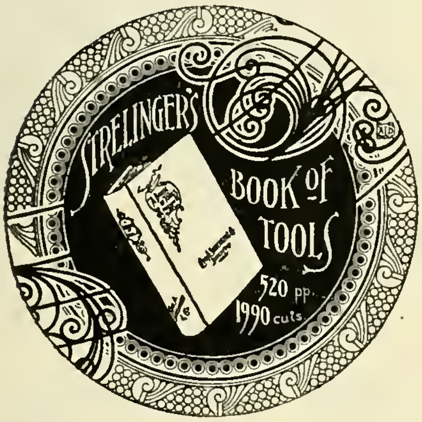

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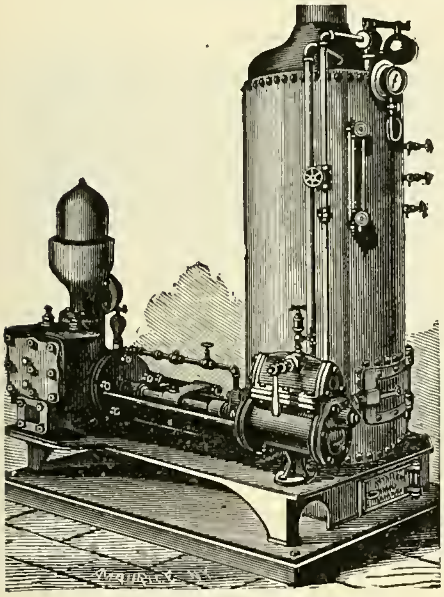

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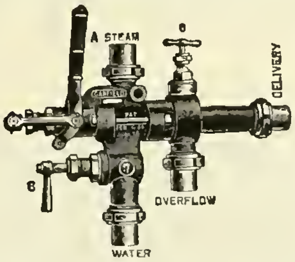

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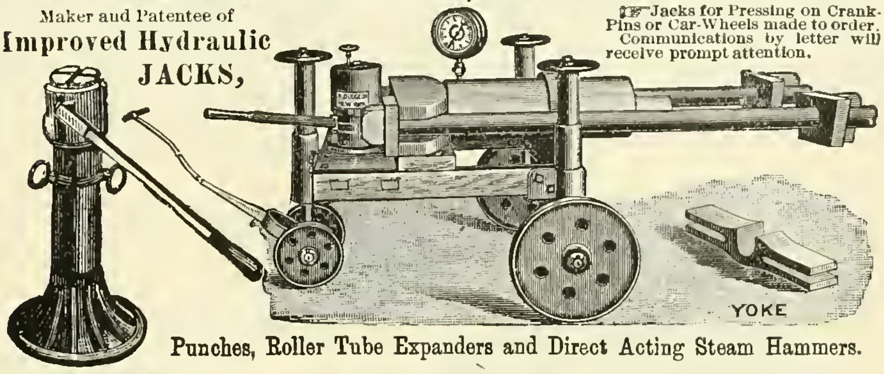

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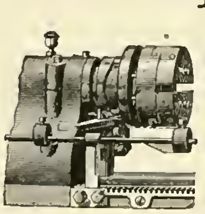

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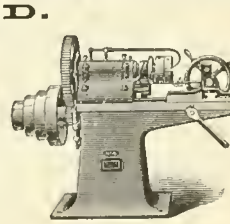

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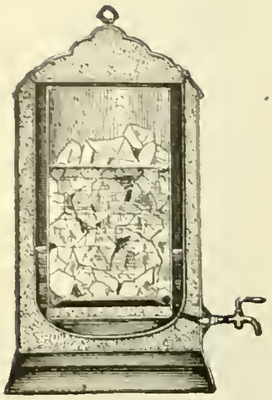

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one that filters the water and doesn't simply catch the large particle of dirt and let the small ones pass through.

This filter is brand new — simple, easy to use and practical. It consists of enameled iron cylinders, at the bottom of which is a section of the famous Gate City Stone Filter. They are also made of galvanized iron. The Filter is put into a water-cooler (it comes in different sizes, so as to fit any kind of cooler), ice is put in it and the water poured in. The water flows down through the filter and up again around the sides, where it is kept cool by flowing all around the steel filter.

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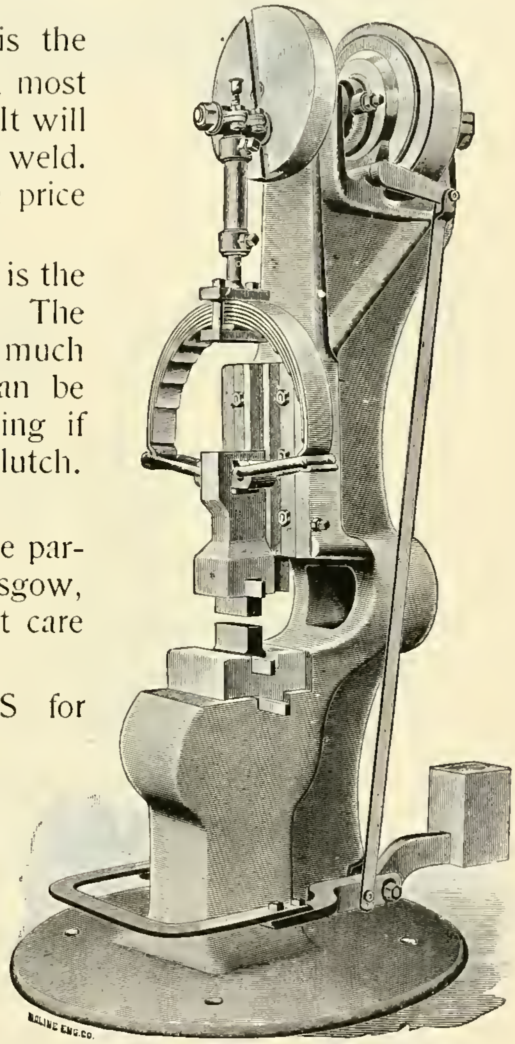
Please examine our TAPER ROLLING MACHINES for tapering brake-beam standards, etc.



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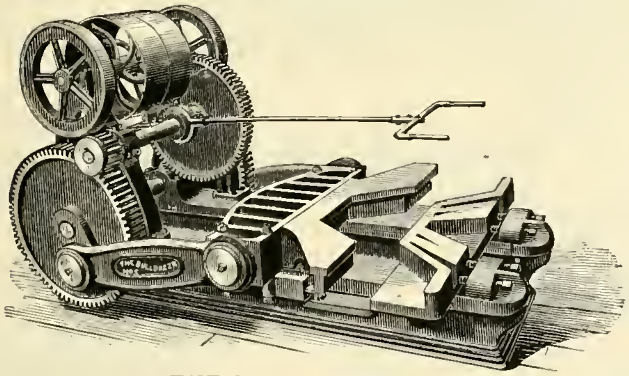

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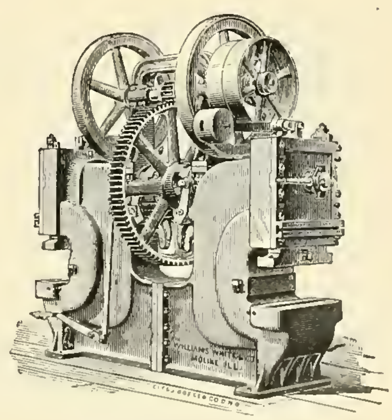

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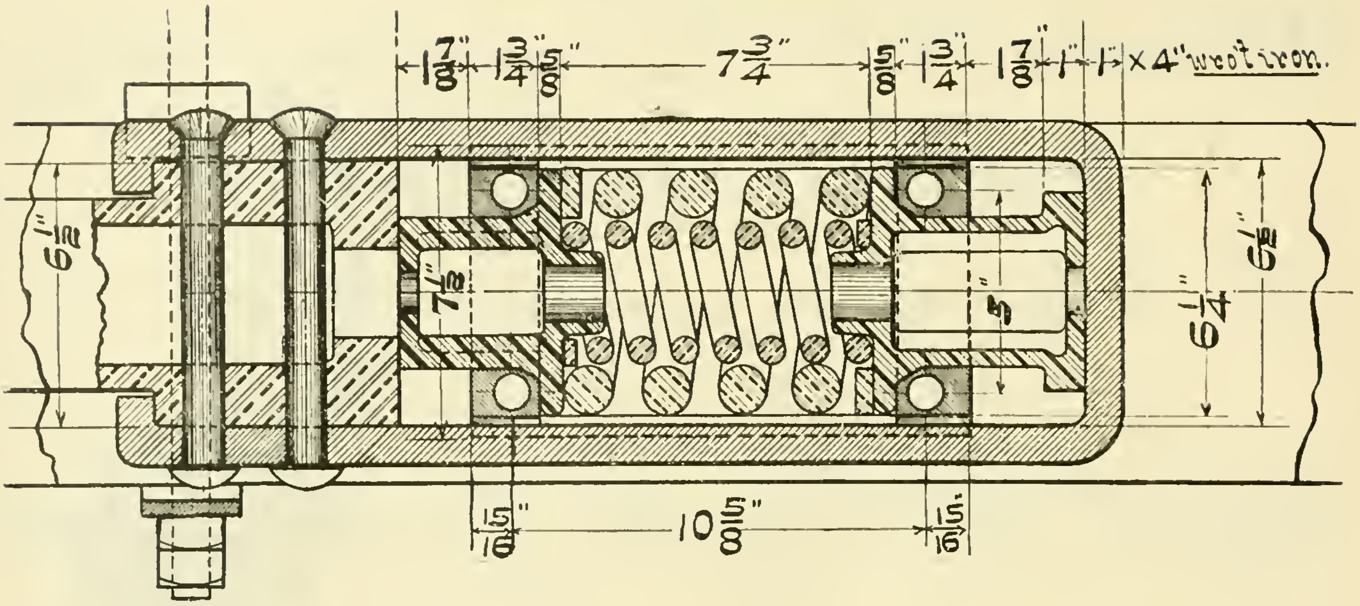

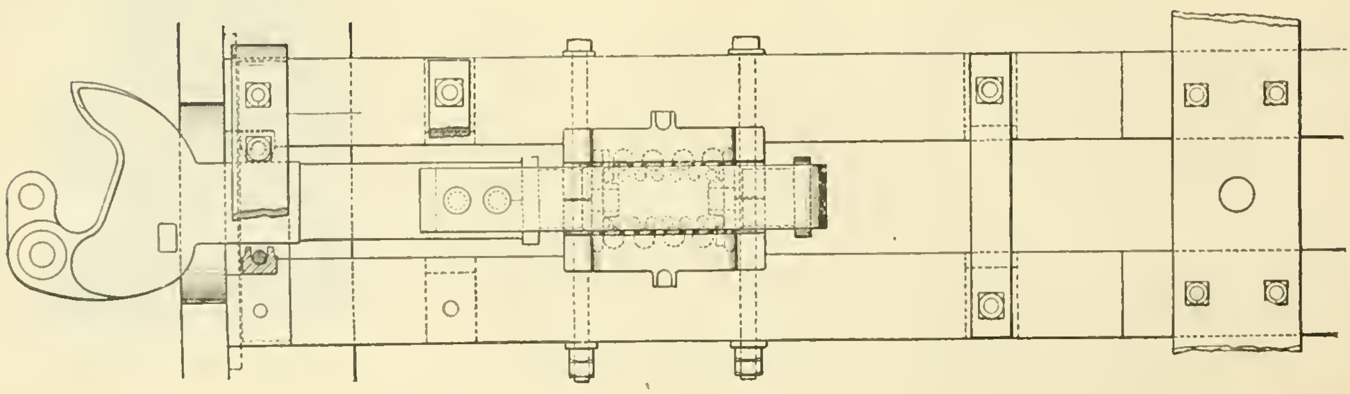

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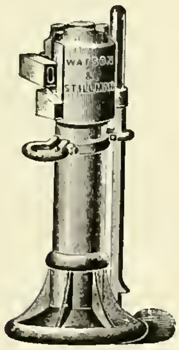
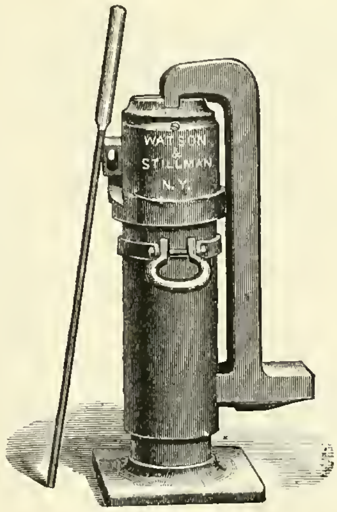


BASE JACK.



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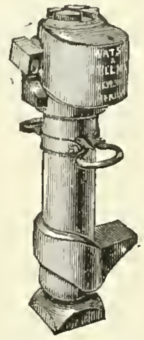

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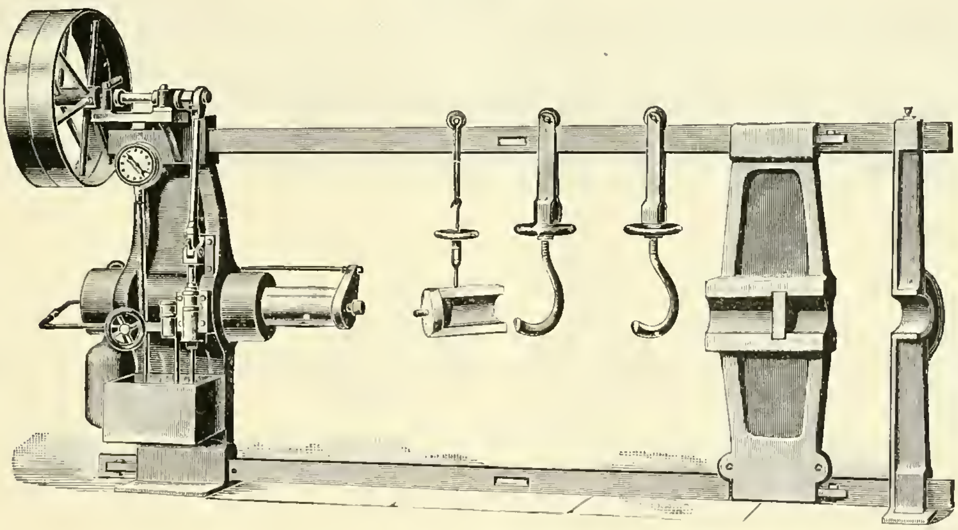

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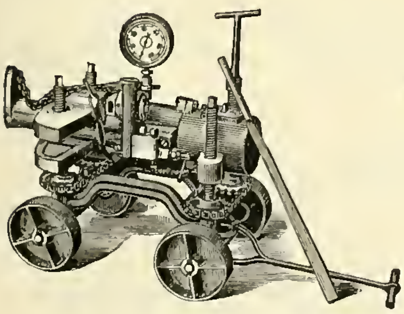
Car Wheel Presses. Crank Pin Presses.



ADJUSTABLE CRANK PIN PRESS.

Rail Benders,
Rail Web Punches,
etc., etc.

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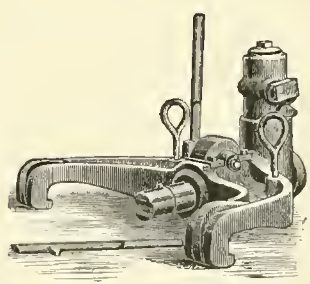

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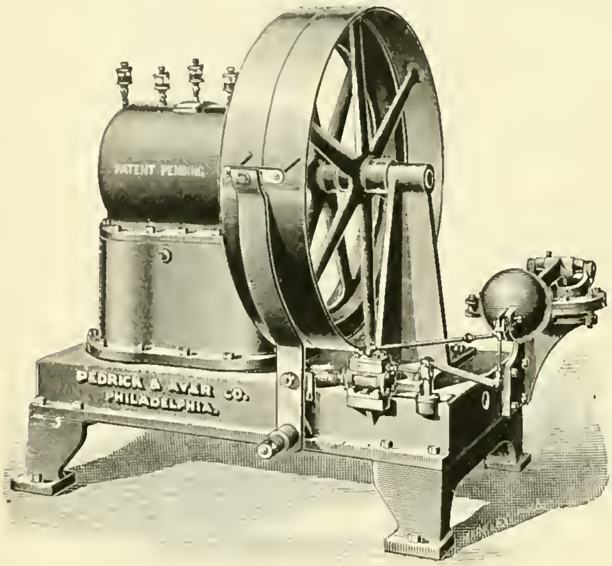
Automatic Compound Belt Air Compressors.

Patented August 13, 1895.



Built in two sizes. Nos. 1 and 2.

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It occupies very little space and can be located under a line shaft or where belt power can be applied.

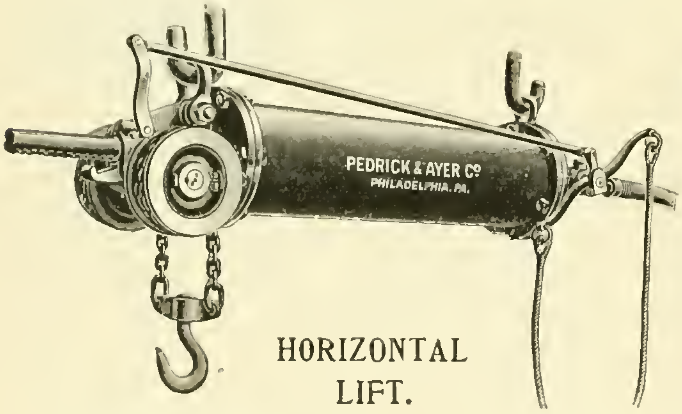
It is entirely automatic in action in maintaining air pressure and oiling. When the desired air pressure in the receiver is obtained, the machine stops *running*; commencing again when the pressure in the receiver falls from 3 to 5 pounds, and continues to run until the supply is more than the demand. Saving power, wear, etc.

The large cylinders gather in the air and makes one compression. As the air passes to the small cylinders it is cooled before entering it, where it is compressed again and enters the receiver.

These cylinders have trunk pistons and are packed with an improved metallic packing that causes very little friction, and are perfectly tight. The cranks driving them are set over them and opposite one another, balancing the work, and making a very steady running machine. All the oil from the bearings runs down, lubricating the piston and lower bearings. The valves are all made of drop forged steel and work vertically, requiring no springs, sitting squarely on their seats without friction.

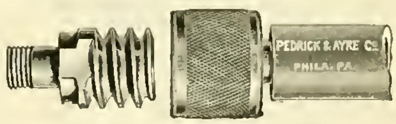
The automatic device is positive and can be set for any pressure desired by shifting the weight on the lever as shown in the cut.

No.	Size of Cylinders in inches.	Revolutions per Minute.	Cubic Feet of Free Air	Horse Power Required	Size of Pulleys in inches	Shipping Weight of Compressor.	Floor Space in inches.	Telegraphic Symbol
1	11 x 6 6 x 6	100–160	32– 50	2–3½	40 x 4½	2875 lbs.	60 x 40	Parian
2	15 x 10 8 x 10	90–120	90–120	5–7	60 x 6	5370 lbs.	76 x 60	Parish



HORIZONTAL LIFT.

Used where ceilings are low. Locks and holds load anywhere.



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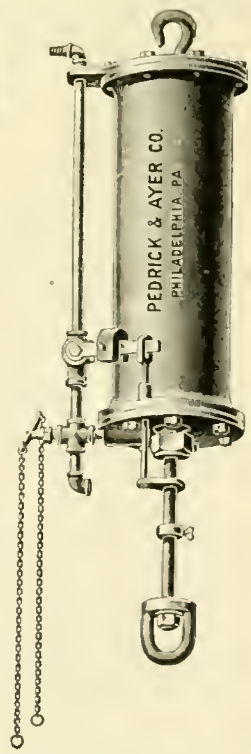
Made to suit ½ in., ¾ in. and 1 in. hose.

OUR "STRAIGHT LIFT" HOIST.

Has retaining and releasing valve that will hold the load, by air, at any given point. The ideal for foundry work.



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A full line of Special Tools for Ry. Repair Shops.

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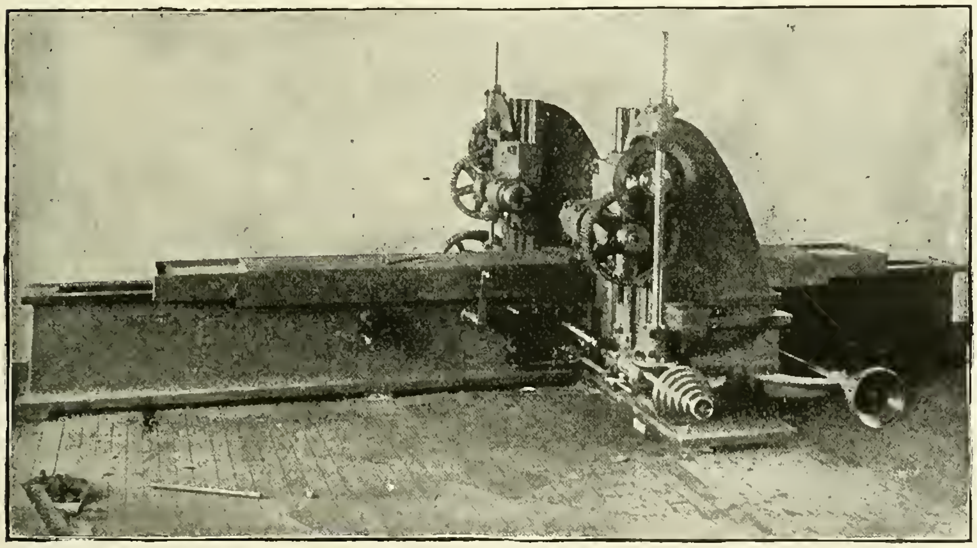
For General and Railway Machine Shop Service.

Modern Machine Tools for Manufacturing, on the Interchangeable System, Locomotive Work, Electrical Apparatus, Bicycles, Typewriting Machines, Guns and Sewing Machines.

Specially Designed Machinery for Manufacture of Brass Goods, Agricultural Implements, etc., and for every purpose where accurate, rapid and economical production is essential.



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Specially Designed for Milling Locomotive Connecting and Side Rods and other parts. Entire depth of channel cut from solid forging at the rate of 2 inches per minute.

Single and Double Head Milling Machines used as Substitutes for Planers for Heavy and Rapid Cutting in Cast and Wrought Iron and Steel.

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Metal Band Sawing Machines for Cutting Sprues from Brass Castings.

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Holders, with Inserted Cutters for Turning, Shaping and Threading Metals.

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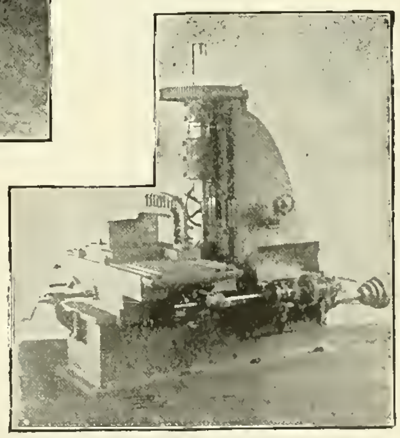

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For Manufacture of Frogs and Switches by Milling instead of planing joints.

U. S. Standard Thread Gauges, M. C. B. Standard Automatic Coupler Gauges.

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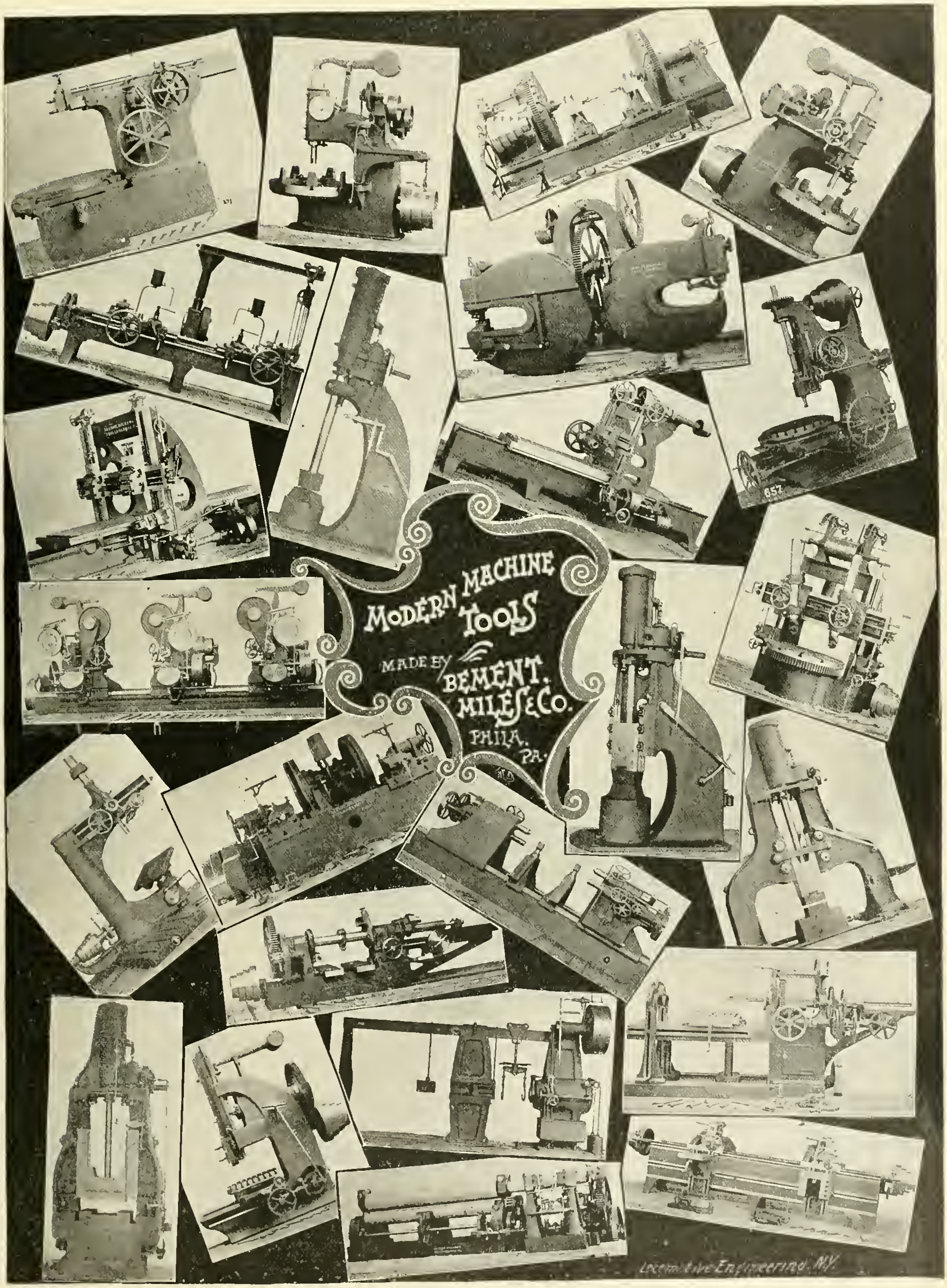
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IN USE ON MORE THAN FIFTY LEADING RAILROADS.

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"Excellence of design and workmanship of Pneumatic Crossing Gates, accomplishing their operation without mechanical connections underground."

Several crossings operated by one watchman. Trolley wires are no obstruction.

PNEUMATIC DEVICES FOR OPERATING DERAILS ON STREET CAR LINES,
WATER TIGHT AND PERFECTLY LOCKING; CAN BE CONNECTED OR INTERLOCKED WITH THE GATES WHEN DESIRABLE.

PNEUMATIC SEMAPHORES that can be interlocked with either of the foregoing devices, with draw bridges, or with each other.

All machinery simple, durable and free from obstruction by frost at any location or season.

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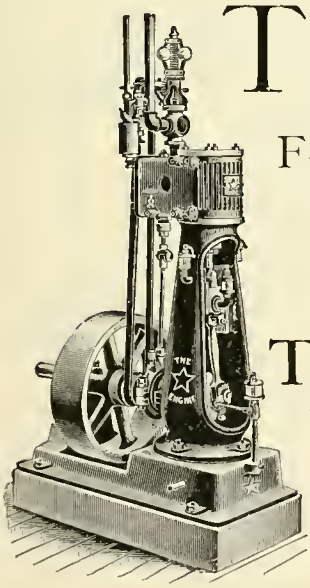

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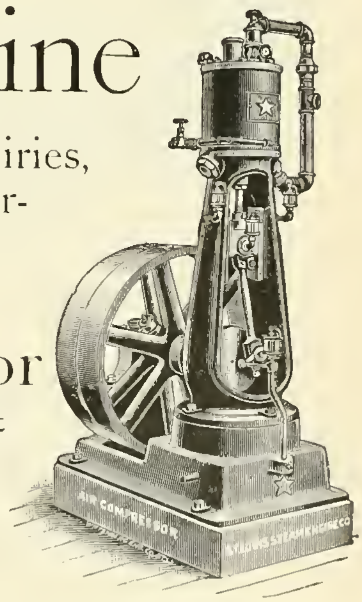
Both Belted and Direct-Connected, are the Latest and Best Design for Pneumatic Tools, Oil Burners, Air Hoists, Pumping Water and all other purposes where Compressed Air is used.



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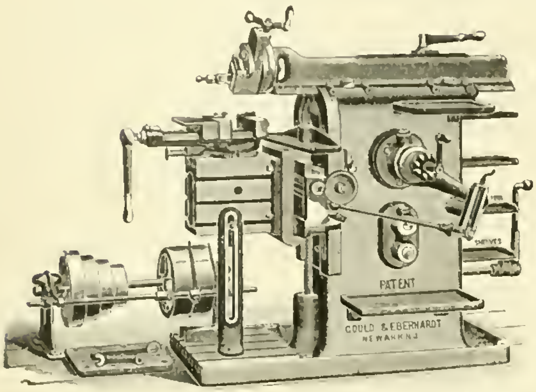
Give double the number of strokes per minute (on short work), OVER ANY OTHER MAKE IN THE WORLD.



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Used by all the Large Railroads, Government Arsenals, and Leading Firms.

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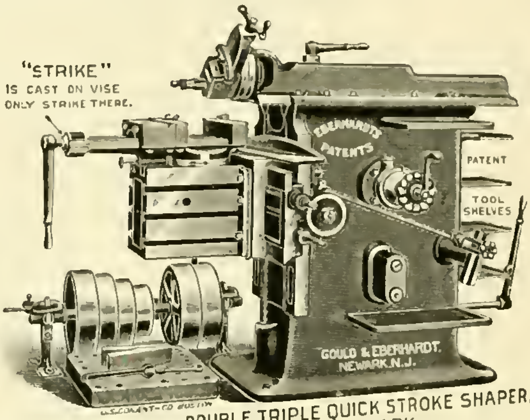

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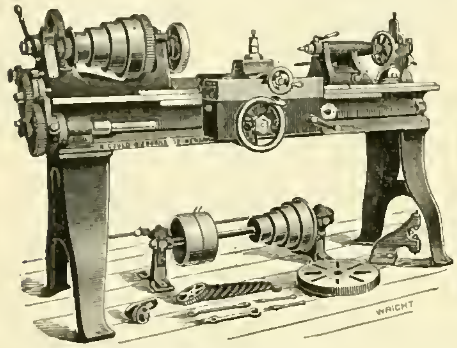
12, 14, 16, 18, 20, 24, 28 and 32 inches.



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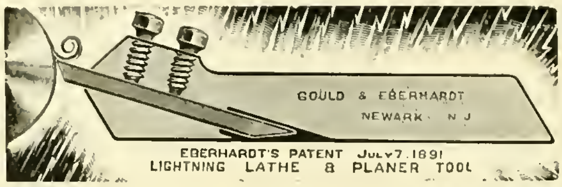

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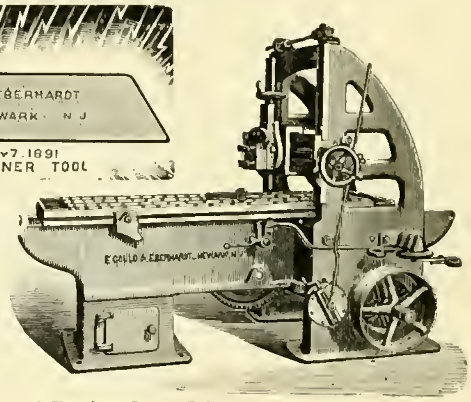

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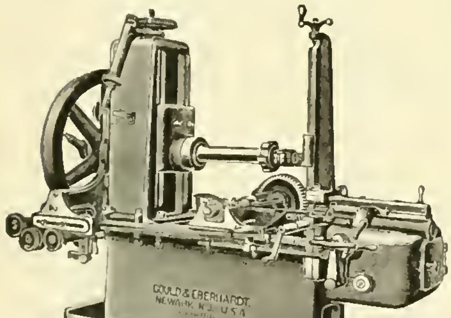

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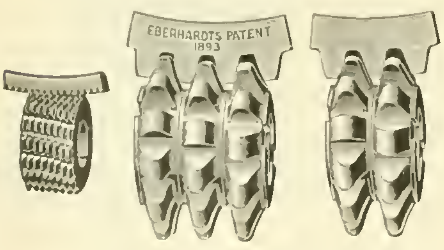
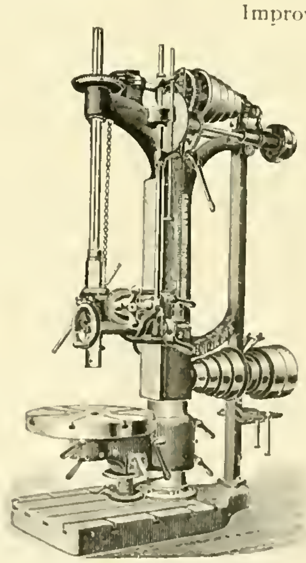
ACCOMPLISHES WONDERFUL RESULTS BY THE AID OF

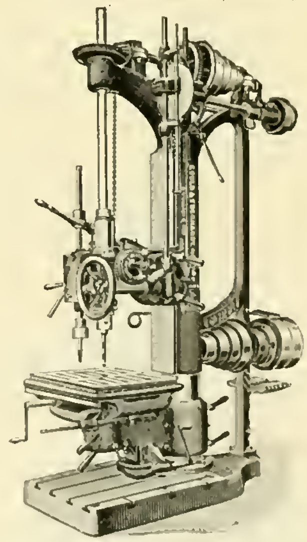


No 1 No 2 TRADE MARK No 3

EBERHARDT'S PATENT "RADIAL-DUPLEX" CUTTERS, (Trade-Mark.)



Eberhardt's Patent Standard **Drill Press,** 25, 32, 37, 43, 48 and 52 inches.



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WE BUILD MACHINES TO CUT

SPUR, BEVEL, WORM, FACE **GEARS and RACKS.**

What are your wants?

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Lathes for turning printing-press cylinders.
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Planing Machines for frogs and split-switches.
Planing Machines for connecting rods.
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Boring and Turning Mills for steel tires.
Boring and Turning Mills with extensible housings.
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Retaining-ring Bending Rolls.
Car-wheel Plate Lathes, etc., etc., etc., etc.

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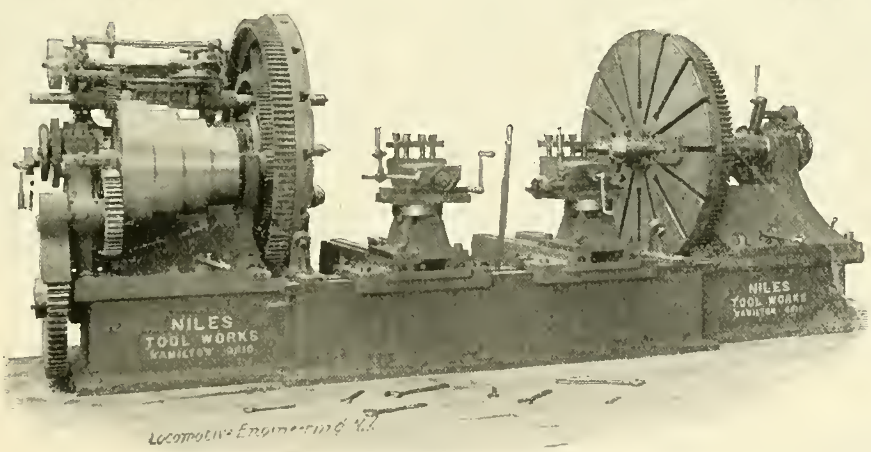

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WORKS:

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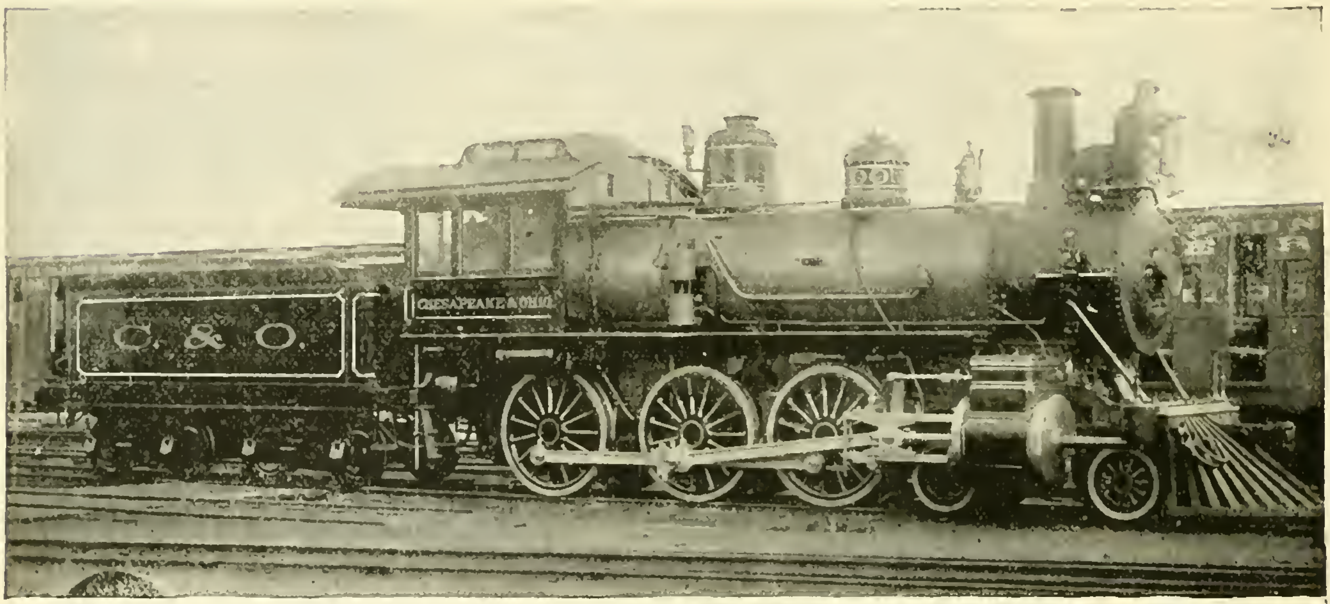
Builders of

Locomotives

Both <u>Simple</u> and <u>Compound</u>, for every service.



With a large and modernly equipped plant, to which extensive additions have recently been made, we invite an opportunity to bid upon locomotives to specifications or to our own designs for the service required.

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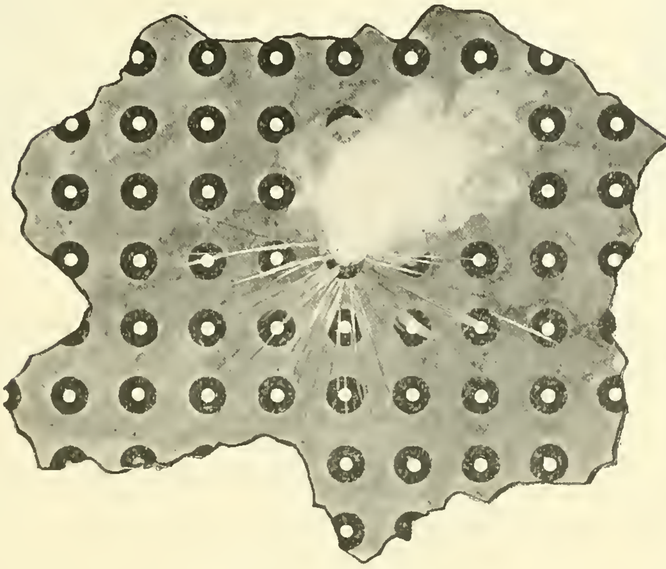
You can't Neglect the Warning Given by a Broken Stay-Bolt—if it's a "Falls Hollow." It won't be Happy 'till You fix it.



Absolutely Safe.

No waiting till there are many broken and then —trouble.

Every Stay-Bolt is a Detective.

Ask for Circular.

Falls Hollow Stay-Bolt Co.
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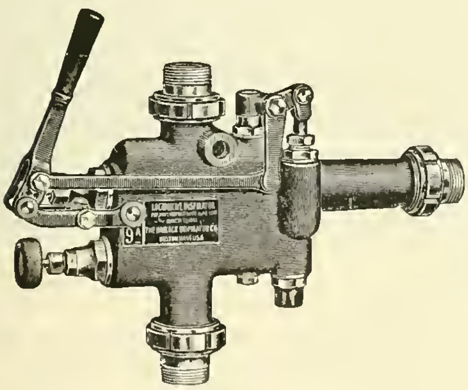
That Tells.

THE HANCOCK LOCOMOTIVE INSPIRATOR,

TYPES A, B, C and D,

Adapted to the several differing styles of Standard Fittings.
Combines all the latest and best ideas in

BOILER FEEDERS.



Constructed with the special purpose of filling fully the most exacting demands of modern railroad requirements. It is simple in construction, and the inside parts of all types are interchangeable. It is reliable under all conditions, and of great range. It can be easily taken apart and repaired at small expense. **It will lift water when Inspirator and Suction Pipe are hot, or when water is at a temperature of 120° Fah., and deliver to Boiler at steam pressures of 35 to 200 lbs. without adjustment.** It has a minimum capacity of less than 50 per cent. of its maximum, and its **capacity increases with increase of Steam** pressure up to 200 lbs.

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The Largest and Most Completely Equipped Electrical Manufacturing Establishment in the World.

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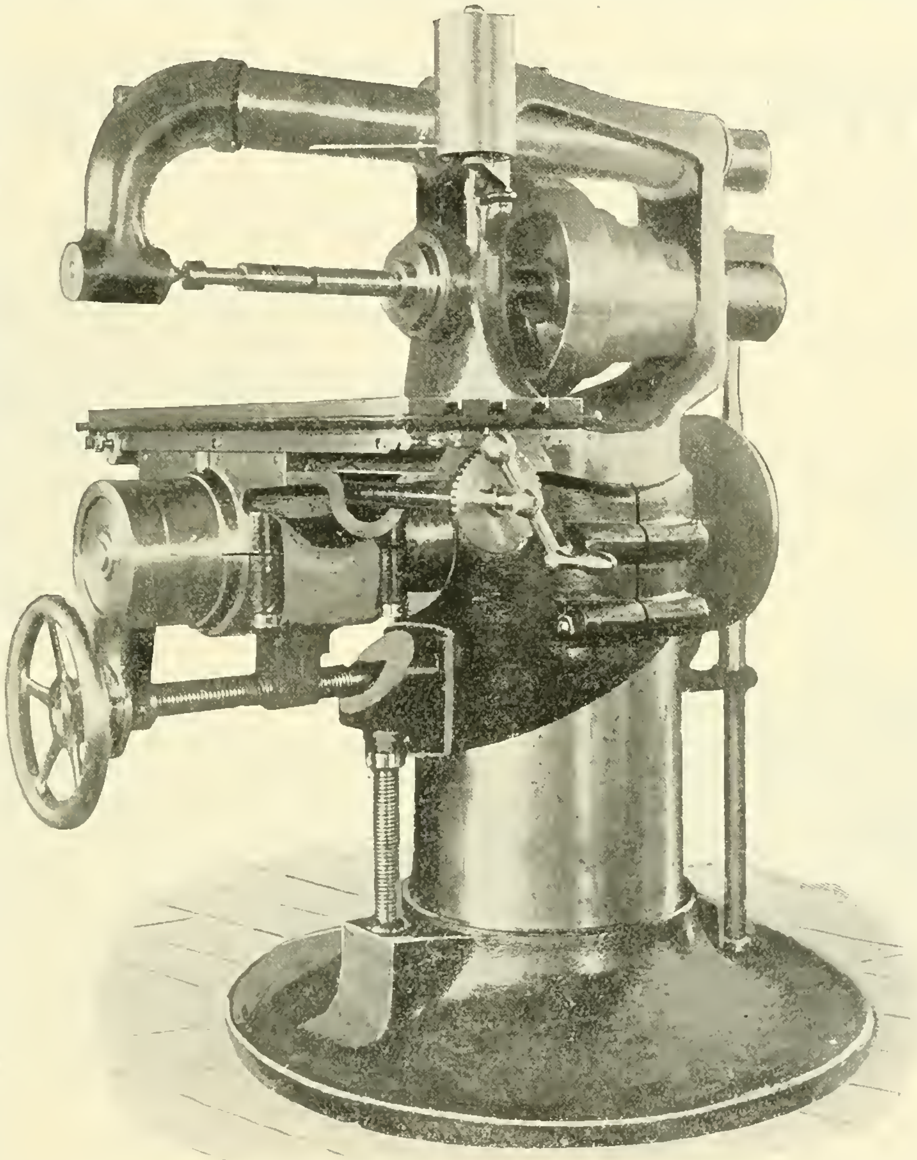


I ORIGINATE, OTHERS IMITATE.

IN ORDERING

Hydraulic Jacks, Punches, Roller Tube Expanders, Wheel Presses, or Direct Acting Steam Hammers,

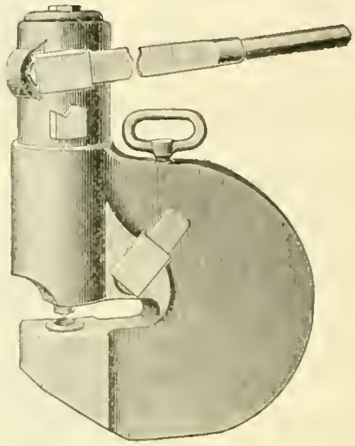
SPECIFY

DUDGEON'S LATEST IMPROVED

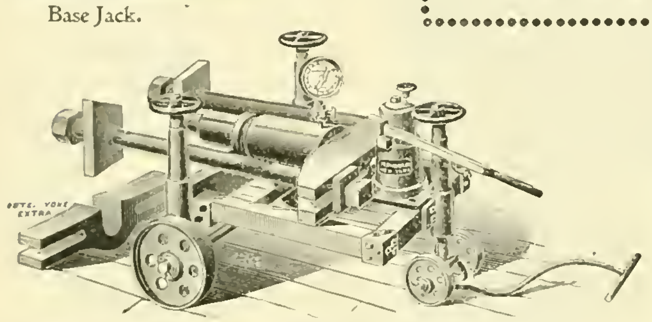
And take no other, if you would procure the best value for your money.

Base Jack.

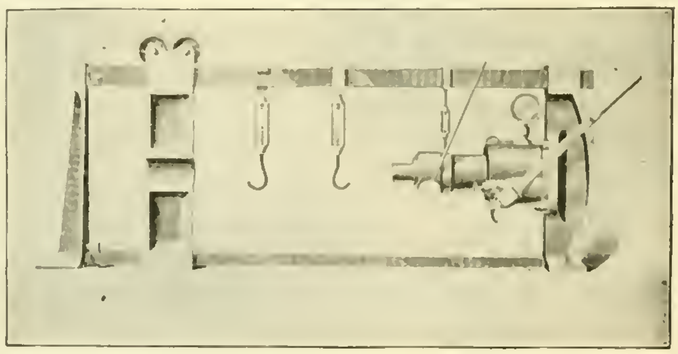
USED BY LEADING RAILROADS THE WORLD OVER.



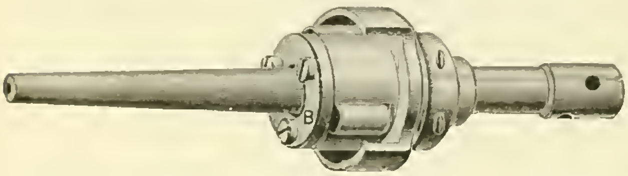
Hydraulic Head Punch.



Elevating Hydraulic Crank Pin and Small Wheel Press.
From One Hundred Tons up.



Small Wheel Press.
Sixty Tons up.



Improved Tube Expander.
This tool will expand two sizes up to 2 in., and three sizes above.

Correspondence will receive prompt attention.

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Original Inventor, Patentee and Manufacturer of the Hydraulic Jack,

AND CONTROLLER OF PATENTS FOR THE SAME, AS FOLLOWS:

July 8, 1851.	Apl. 15, 1873.	Jan. 23, 1883.	Nov. 17, 1885.	Jan. 12, 1886.	Sept. 13, 1887.
Aug. 1, 1865.	Feby. 2, 1882.	May 6, 1884.	Nov. 17, 1885.	Sept. 13, 1887.	July 5, 1892.

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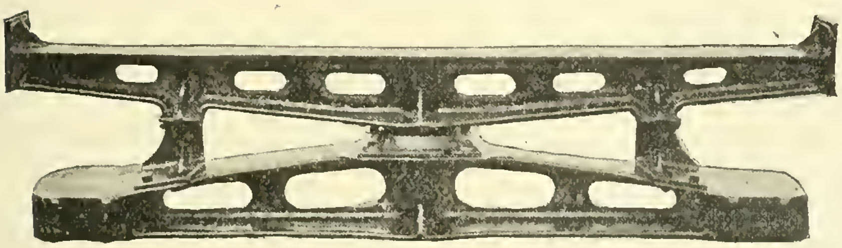
Founders of Open Hearth Steel Castings.

Railway Supplies Our Specialty.



Pat. July 4. 1893; Feb. 13, 1894.

The **S. H. & H.** Cast Steel Body and Truck Bolsters.

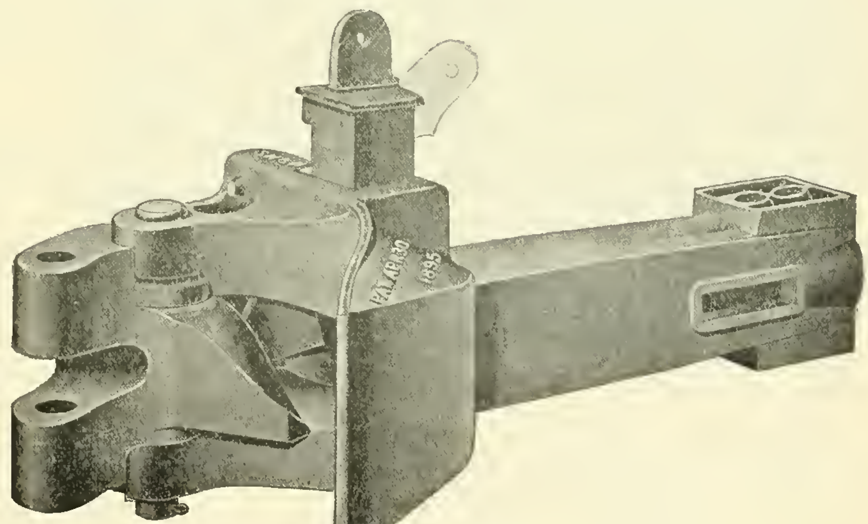
Will wear without repair the natural life of car.

NOTE.—Spring Seats recessed to conform to any height of truck. Center Plate and Side Bearings made to match any design.

The **S. H. & H.** COUPLER.

Made of Open Hearth Steel throughout.

Completely automatic and also provided with Special Device for Releasing in case of emergency.



Pat. Jan. 16, 1894; April 30, 1895 (3 Pats.).

Driving Wheel Centers, Driving Boxes, Cross Heads, Rocker Arms.

Knuckles for M. C. B. Couplers. General Machinery Castings.

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Locomotive Engineering
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Vol. IX. 256 BROADWAY, NEW YORK. No. 2.

Cercovado Railway, Brazil.

BY LEWIS GLEASON.

On entering the beautiful bay of Rio de Janeiro, the most imposing sight that attracts the traveler's attention are the numerous peaks rising from the chain of mountains which serve as a picturesque background for the city, over which they seem to stand like grim sentinels. Old sailors will point out many fantastical shapes which the peaks and depressions of this mountain range assume, such as the Sleeping Giant, the Church Organ, the Ship under Sail, the Two Brothers, and the Padre's Hat. Each peak has its own distinctive name—the Sugar Loaf, Cercovado, Tijuca, etc.

Cercovado (humpbacked) is the most imposing peak of the group, as well as the most interesting, from the fact that up its rugged side's runs a rack railroad, "Riggenback" system, a counterpart, as near as possible, of the pioneer road of that description, which runs up the Righi mountain, in Switzerland.

Years before the introduction of rack railroads, the summit of Cercovado was reached by a graded road—easy, but circuitous—winding to the mountain top. Close to this roadway runs one of the aqueducts which supplies the city with pure mountain water. It is an antique but solid-looking piece of masonry, built one hundred and fifty years ago, when Brazil was a colony of Portugal. It has stood the test of time, and evidently is good for centuries to come.

To reach the station of this mountain-climbing railroad, a tramcar can be taken from the Lergo do Carioca, in the center of the city; and after a pleasant ride through some of the principal residence streets, the modest little station at Larangieras (Street of the Orange Trees) is reached. Here, for the sum of two milreis (about fifty cents), a ticket can be bought, which entitles the holder to take a ride to the top of the mountain and return.

The train consists of engine and one car, of the usual type employed on roads of this class, and of Swiss manufacture. The engines are built so that the boiler stands comparatively level on the average grade; cars are constructed in like manner, thus bringing the floor of car level when placed on inclined track. Engines are equipped with three separate cog-wheels, operating from a drum placed nearly central under boiler. The cogs of these wheels fit into the teeth of the rack rail, which is placed centrally between the ordinary rails. By this arrangement the

RIO DE JANEIRO, FROM SUMMIT OF CERCOVADO.

engine can climb up the steep grade, and descend same with safety.

Ample braking power is provided on both engine and car. Accidents on account of brake failures hardly ever occur. The car will seat forty passengers. The grade varies from 16 to 25 per cent., the latter being the percentage at, the Point Sylvester, where the road is carried over a chasm on a very neat iron trestle (shown in one of the illustrations accompanying this article).

POINT SYLVESTER, ON ROAD TO CERCOVADO.

The little engine has to work to her full capacity to push the one car up the heavy grade. At a point called "Painheres" is located a large hotel much frequented by the citizens of Rio during the summer months. It is 2,000 feet above the city. The pure mountain air is a safeguard against the yellow fever. The nights are delightfully cool and the scenery magnificent. At this point, the tourist bound for the top has to change cars; a heavier engine is necessary, on account of the sharper curves, and a little heavier grade. Finally we come to the end of the line, on account of want of space for the roadbed, the mountain top coming to a sharp point. A journey of about one hundred yards up a series of steps cut into the solid rock, brings us to the top. So small is the natural space at the summit, a wall had to be built around it to accommodate the small building or observatory which crowns the peak.

From this observatory, 3,000 feet above the sea level, the visitor has one of the grandest of panoramas to look upon. To the East and South are seen the restless waters of the South Atlantic; to the North, the magnificent bay of Rio de Janeiro, dotted with three hundred islands; to the West, the Organ mountains, looking bare and gloomy. Three thousand feet below is the fair city of Rio, its yellow-painted and red-tile-roofed houses relieved by the bright green color of the trees and plants in its public squares and parks. The ships riding at anchor in the bay look like specks upon its bosom. Looking over the east side of the mountain, is seen a perpendicular wall of rock; 1,500 feet downward, under its shadow, is the beautiful botanical garden, the pride of Rio de Janeiro, whose lofty palms and tropical plants look dwarfed from this dizzy hight.

The tourist, after feasting the eye again and again on the beauties and grandeur of Nature, and the handiwork of man, so lavishly spread on every hand, reluctantly leaves the scene with an inward feeling of thankfulness for the pleasure afforded by a view from the summit of Cercovado.

The descent is made at about the same rate of speed as the ascent—forty minutes after leaving the summit, the train has arrived at the end of its five-mile journey,

The Cercovado Railroad is operated by a private company, and fairly well patronized. While it has long since ceased to be a novelty to the citizens of Rio de Janeiro, however, it can be safely assumed that every man, woman and child of the 600,000 inhabitants of the city and vicinity has at least made one trip to the summit of Cercovado; and no stranger would be justified in leaving the city without taking a trip on the rack road, and from this mountain peak, look upon one of the finest views in the world.

BOTANICAL GARDEN, RIO DE JANEIRO, CERCOVADO IN THE DISTANCE.

There is another rack road in Brazil,

on the line of railway known as "Estrada do Ferro, Principe do Grao Para," which runs from Rio de Janeiro to the fashionable summer resort of Petecoplis. The rack roads of Brazil have the advantage over like roads in other parts of the world, such as Righi, Mount Washington and Pike's Peak. On account of the snow, these roads are open only a few months during the summer season; the Brazilian roads do business all the year round.

Distortion of Flue Sheet.

Some time ago, officials of the Pennsylvania Railroad shops at Juniata made very exhaustive experiments, to find out how much movement there was in a locomotive boiler when heat was applied. The main purpose of the experiments was to ascertain how much the back flue sheet pushed upward when the fire was first started. This upward movement is believed to be the cause of much damage to the flue sheet, and leads to leakage of the front top seams of the firebox, particularly with Belpaire boilers. Very sensitive apparatus was applied, which multiplied the movement about five times. The moment the fire was lighted the levers began fluctuating rapidly, and they settled down when the heat had time to extend to the different sheets. The greatest movement was found about twelve inches in the middle of the flue sheet, which went up about 1-16 inch. The greatest movement took place immediately after the fire was lighted. It gradually decreased to nothing at the sides of flue sheet. If all locomotive boilers act in this way, the movement of the back flue sheet could be compensated for by putting a few flexible stays in the middle front of the crown sheet.

Incidentally, they found out that a locomotive boiler is wonderfully susceptible to changes of temperature. When the boiler was full of cold water and no fire on the grates, they applied a blower in the smokestack, and the rush of air at ordinary temperature made changes which drew down the front of the roof sheet of the firebox about 1-100 inch. This was tried repeatedly and the same effect followed. The cause was reasoned out thus: The air, being considerably warmer than the water inside the boiler, expanded the flues, pushing the back flue sheet outward. That, in its turn, pulled down the crown sheet, which drew the roof sheet with it. When these changes follow such small changes of temperature, we can readily understand the distortion caused by a fire-door being thrown wide open as a locomotive reaches the top of a grade, where the fire has been forced to the very utmost.

When the fire was started, no uneven movement of parts was found, except that of the back flue sheet. The back sheet of the inside of the firebox did not move any.

Jim Skeevers' Object Lessons.

Train Delays—Sullivan's Lesson—How to Cure the Trouble on Freight and Passenger Trains—The Grief Committee.

BY JOHN ALEXANDER.

Sullivan, the general superintendent, always delighted in rawhiding Massey, and he commenced on Skeevers before that worthy had gotten his seat warm.

The Air Line has been notorious for train delays—freight and varnished cars alike—and Sullivan seemed to take a savage delight in writing and telegraphing the mechanical department, asking what was the matter with this engine and that, and carrying his complaint to the old man.

Skeevers made up his mind to give Sullivan an object lesson.

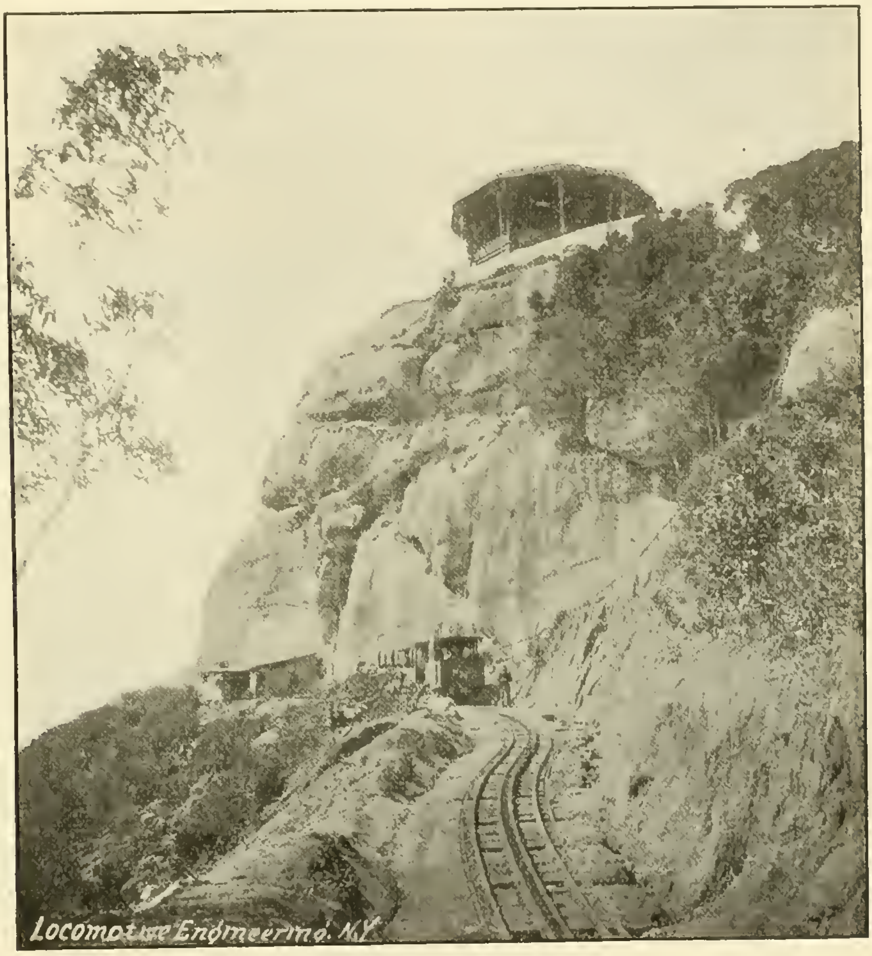
Sullivan told the general manager that he (Sullivan) would spring an object lesson on Skeevers at the first "council of war."

This "council of war," as he was pleased to call it, was a new idea of the general manager's. He had noticed the custom of having all the master mechanics meet, that Skeevers introduced, and proposed that all the heads of departments should meet monthly in his office. The first meeting was set for a certain Saturday three weeks away.

Now, the old time-keeper in Skeevers' office owned a pretty daughter, and a clerk in Sullivan's office was young.

He also knew the girl.

Visiting with his prospective "poppa" one evening, he remarked that "His Highness" was working up some new scheme, and proceeded to explain that Sullivan was having a tabulated report gotten up of the passenger-train delays for six months and the cause. As the cause was taken only from the conductors' reports, there was a woeful lot of "low steam," "hot box on engine," "lost time, act. wind," and "bad coal." Both men wondered what he was going to do with it.



SUMMIT OF CERCOVADO.

The elder man told Skeevers in the morning—and Skeevers knew.

The general manager's car was in for repairs, and Skeevers took the Boyer speed recorder off it and had it put on Dick Murray's engine, boxed over, and put the key in his pocket. Murray was sent for and told to keep still and saw wood. He was not supposed to know what was in the box; if asked, to say that Mr. Skeevers told him that he was getting ready to indicate the engine—which was true.

Dick Murray's engine is double-crewed, on a local passenger train, over two divisions.

Then Skeevers had some slips printed.

with a list of the stations on the road, with room enough between the names to write a line, and sent for every passenger engineer on the division. He also sent a supply of the slips to each division master mechanic, with instructions.

The result was that the evening before the date of the "council of war," Skeevers had a complete record of every delay to a passenger train on the whole road. He knew between what stations time was lost, at what station, and just how many minutes and seconds could be properly charged up. This information was in the shape of many thumb marked slips; but Skeevers got his best clerk up to the house that evening, and they tabulated the whole thing, and he had it in his breast pocket when he shook hands all around in the old man's office.

"Gentlemen," said the old man, opening a box of domestic cigars and placing them on the table, "this is an informal meeting. I desire that each and all of you will talk freely here on everything that has any bearing on the operating of the road. Suggestions are in order. Complaints can be made and remedies will be discussed. If there is any friction between department heads, here is the place to apply the grease. I shall refrain from saying much—suppose I act as judge? If there is any man present who thinks he has a plan for saving a dollar, or improving the service, we will discuss it. Sullivan, here, always has a suggestion; Doris is a kicker; O'Hara's pet grievance is over-worn tires on frogs, and Skeevers' hobby is object lessons. Gentlemen, I'm listening to you."

For about two minutes after the old man sat down there was a very embarrassing silence, and then General Superintendent Sullivan arose and pulled out a formidable-looking table, full of figures, red and blue lines, and an array of totals.

"Your Honor, and Gentlemen of the Jury," began Sullivan, who is a taking kind of fellow: "I hardly expected to assume the role of attorney for the prosecution, but it seems as though that honor should be mine.

"Gentlemen, I ask you if there is any one bad thing our road is noted for above another, and we were asked to name it, if there is one of you who would venture to dispute me if I declared it was delays to passenger trains? We seem to be more unfortunate in this matter than neighboring roads; the newspapers are pounding us, the general manager making personal inquiries, and delays are getting no better.

"Going into details proves something, and I propose putting before you a mass of statistics, compiled from the official reports in my office, that shows the number, extent and cause of all delays to passenger trains for every day of the past year.

"Before going into details I will simply quote you the totals, to show to what extent the delayed-train business has reached and the percentage of each known cause of delay.

"I find that of 9,388 passenger-train trips made during the year, 4,931 trains arrived at destination or connecting train points late. If an outsider should declare to any of us that more than half our trains were late, we should resent it, but it's a fact, nevertheless.

"Investigating further, I find that there are five legitimate causes of delay, namely:

"Defects of equipment;

"Motive-power failures;

"Hot boxes on trains;

"Operating faults;

"The elements.

"The total delays for the first only amount to the small sum of .3 per cent., which, I think, you will all agree with me in saying, reflects great credit on our general manager"—and the taffyer bowed low to the judge.

"Operating failures—delays in dispatching, etc.—5 per cent. The elements, wind, snows, wash-outs, etc., 9 per cent. Hot boxes on trains, 14 per cent. Motive-power failures, 69 per cent.

"Gentlemen of the Jury: I leave the case in your hands; each of you can now see the amount of total delay and what part of it comes under your jurisdiction. I think, if it were not for stealing the thunder of my friend Skeevers, I should be strongly tempted to call this an object lesson." And with a smile of triumph, "Himself" sat down, while the trainmaster and the purchasing agent clapped their hands.

Slowly the old man rose to his "pins," looked around the circle, took his cigar out of his mouth, and said:

"Gentlemen, this is the one sore place in my life, and Sullivan has tore the scab off. I think he has done a good thing in compiling this information. It's a basis to work on. In other days I should have abused Massey and threatened to discharge him; but now we have a new head to the offending department, and I shall certainly expect a reform in it—in fact, I believe I shall demand it. But—well, there is one thing more to be done before I get too angry, and that is to hear from Mr. Skeevers. Maybe he's got an object lesson bigger than this one up his sleeve—but, of course, a man who comes prepared for battle is twice armed. Mr. Skeevers, it looks as if the burden of proof lays with the attorney for the defence, and you seem to be that attorney."

Skeevers stepped over to his overcoat, fished up his package of slips and his balance sheet, and laid them on the table.

"If It Please the Court," he began, gravely: "It seems a good business policy when you bring in your bank book from balancing it, to produce the vouchers.

"I take exception, your Honor, to your allowing the attorney for the prosecution to bring charges against an officer for the shortcomings of his predecessor in office.

"These statistics extend back a year. I claim an alibi for my client, the superintendent of motive power, and stand ready for trial on any charges that may be made against him during his term of office."

"Quite correct," said the judge, with a merry look in his eye, for he knew that Skeevers was loaded.

"Statements based on last year are too far away to be a good basis for instituting reforms, but last month would be of use. The learned counsel for the transportation department states that he has a detailed record there of every day."

"I have," broke in Sullivan.

"Very well," said Skeevers. "Let me ask from what source this information was obtained?"

"From the conductors' reports made at the time."

"If the learned counsel for the other side had lived and worked with conductors as long as I have, he would not so freely take their simple word on so important a matter. Men whose excuse for a delay can be shifted from their own shoulders to some inanimate thing, like a hot box, or a bad coal pile, can hardly be expected to protect the coal or the hot box.

"But, generalities prove nothing specific. You can't charge a man with being a thief and send him up without proving a specific case. You have got to point out at least one actual theft. Now, with the permission of the Court, I will state that I have some evidence to offer, irrefutable evidence.

"For nearly a month past, I have had a Boyer recorder on '7' and '8,' from this end of the road to the other; the sheets are here, and have no interest on earth but to tell the cold, naked truth. Further, I had printed and put into the hands of every passenger engineer on this road a slip like this"—holding one up—"with a list of the stations. These slips are dated, and state number of train and engine, and give the names of crew; and each engineer has marked down at the time and place—not the end of the run—just what time was lost between stations, and at stations, with the cause.

"With this data, your Honor, I hope to at least explain some of these delays; and, now, going into details, I should like to cross-examine a little, and would ask the last witness and lawyer combined to please state to the Court, how much late No. 8 arrived, say, last Saturday?"

Sullivan ran his finger along a line on his chart, and then followed down a red line. Skeevers stretched a long recorder sheet across the table, and sorted out a slip.

"Twenty-one minutes," said Sullivan.

"What caused this delay, according to your information?"

Again Sullivan consulted his chart, and looked up a bundle of reports in a file.

"Lost seven minutes at Holdin, cleaning fire and taking water; twelve minutes at Carey's, hot box on train; eight minutes at Midland crossing, brakes stuck—twenty-seven in all; made up six."

"If It Please the Court," said Skeevers, "I should like to call attention to the fact that seven minutes' delay at Holdin is a remarkable record for celerity. No through train—no matter how light or fast—ever stopped at Holdin and got away in less than six minutes, and ten is a fair average. The cause of this is threefold, and I will leave it to you whether or or no any of them should be charged to the motive-power department. In the first place, no train can pass there without water; the tank is located in the yard, making it necessary to make a special stop for it. This takes three to five minutes. This delay to every train should be charged to bad equipment; water plugs should be placed at the station, so that trains in either direction could take water at the station stop. In the second place, it is register station. In the third place, it is a big town and there is lots of baggage and express to unload. In the fourth place, there is no cinder pit going West, making fire-cleaning hard. In the fifth place, the head of our operating department seems to understand nothing of the cause and necessity for all this time at Holdin, and makes out his time-card with leaving time only. Between Taylor's and Meadows, a suburb of Holdin, going West, a distance of 10 and 3-10 miles, the time of express trains is a little over 28 miles per hour; it's down hill on straight track—have to kill time daily—there is no dead time at Holdin, and the time from there to Parkland, West, on a grade of 64 feet per mile, is 30½ miles per hour. This delay to every train is directly chargeable to bad equipment at station and want of judgment in making time card. Good judgment in the latter could be made to remedy the fault of the other, in a large measure.

"Now, then, to proceed. The other side report a delay of 12 minutes at Cary's—a little town of fifty inhabitants—cause, hot box on train. Gentlemen, the speed recorder says that this train stood at Cary's 16 minutes, and the engineer's slip says: 'Sixteen minutes at Cary's; conductor went over to store and bought two sacks of potatoes and a tub of butter, had them carried over to the baggage car, and asked me to make up the time, as they were for Mr. Sullivan.' Evidently, the report of 'hot box' is a plain lie. This can be charged in the liar column, or against the operating department, or the culinary department, or any place it may please the Court—except against the fellow who made up some of the time."

The old man looked so hard at Sullivan that his cigar went out.

"'Eight minutes at Midland crossing, brakes stuck.' Your Honor, the honest recorder says that the stop at Midland crossing occupied only a fraction of a minute, just a full stop and no more. I would ask the Court who lies—the Boyer or the conductor?"

"The conductor!" said the old man.

"Yet," continued Skeevers, "here is a nine-minute stop half-a-mile west of the crossing. Let us see what the engineer says"—and he picked up one of the thumb-marked slips:

"'Conductor pulled on brake to put off tramp; didn't know enough to close closet valve (kind without spring); had to bleed off brakes.'

"This should be charged to faults of operating. Probably it would be a good thing to send for the Westinghouse instruction car, or the fool-killer.

"Now," continued Skeevers, calmly, "take our Atlantic express—makes the fastest time, the most connections, and loses the most time. Will the judge please mention any date, and we will compare data?"

"Try the 13th."

"That's unlucky," said Sullivan. "But let's see; 13th—Arrived six minutes late; engine not steaming.'"

Skeevers hunted up his slip.

"'Lost six minutes on running time. Cause—picked up officers' car 101 at Holdin, making eleven, six sleepers; left Holdin three minutes late, lost three on hill.'

"Here is another case of operating," said Skeevers. "The general superintendent stops our most important train, already too heavy, to put on his private car, to come 47 miles on the heaviest grade we have; when, by waiting sixteen minutes, he could have come in on the Granger local, a three-car train, arriving home only thirty minutes behind the express. Will you charge that to engine failures?"

The judge bit the end off his cigar, made a memorandum in his note-book, but didn't say anything.

"What about No. 3, yesterday?" asked Sullivan.

"What does your conductor say?"

"'Eighteen minutes; engine not steaming.'"

Again Skeevers hunted up a slip and read: "'Arrived eighteen minutes late; lost four minutes on Hardscrabble Hill on account of leaky flues and bad coal;

A SUGAR JUICE TRAIN OF TANK CARS IN QUEENSLAND, AUSTRALIA.

fifteen minutes at Coolredge, waiting for two freights to saw by—two 50-car trains east ordered to meet double-header west; siding wouldn't hold, down trains couldn't back up.' I dislike very much to say anything to show that the coal-dust and snow now furnished, and called "fuel," is not bad—for it is—but here is a case of fool-dispatching. Coolredge holds 21 cars; a 28-car double-header is ordered there, against two 50-car sections on down-grade, for a meeting and passing-point for No. 3. Time could have been saved by letting No. 3 meet the up freight at Downs and passing both sections there, or of holding the two extras at the junction for the up freight—they were ore or company coal loads. Will you charge this all to failures of motive power?"

The old man made another note.

"What about No. 9's engine, last Monday?" asked Mr. Sullivan.

"That was a failure of the motive power, a main crank-pin broke. Some of Mr. Shaver's special brand of steel—cost the company a cent and an eighth less than the steel I ordered; but this one accident cost more than all the new crank pins put in in ten years—and, beside, we haven't settled with Robert's widow yet."

The judge made another note.

"Your Honor," said Skeevers, bowing, "I leave this specific case in the hands of the Court and jury. I confess that I find in these slips, made out by my orders, many delays for causes directly chargeable to the motive-power department. I should like to call your attention to one important point Mr. Sullivan has entirely overlooked, and that is the fact we have not had a hot box on a passenger-engine truck, tank or on any coaches in the past three weeks. I have put good lead-lined brasses under them all; when I get the mail and express cars fixed, we will be pretty free from that, if decent oil is furnished. Mr. Shaver's patent cheap brasses may do for freight cars that are too old for service, but we don't want 'em to run. I am after our men about hot boxes.

"There is a world of trouble ahead of us on account of bad material put into boilers, but we will have to shoulder that.

"Delays to passenger trains on this road is a scandal, and the whole truth is not told even in papers that are agin' us; and I, for one, shall labor to reduce them—not to see how much I can make someone else reduce them. I am going after every cause of delay in my department and hunt it down, and I hope all the others will do the same. I shall suggest that the simple word of men at the end of trips shall not be asked about delays; conductors will lie, and I have known engineers to handle the truth carelessly. Why not provide our engines with recorders? The record sheet tells the truth, the whole truth and nothing but the truth, and will compel others interested to tell the truth with it; and what we want is truth.

"Mr. Sullivan is right in taking the matter up; his evidence is hearsay evidence, but it's the kind he has been used to. If we start to stop these delays on his information table, we start wrong. We want to give the medicine only to the sick men.

"With recorders on the engines, we can find the truth; then we can treat every missed connection and late train as an accident, and call for a report as such, and find the real cause of delay; then we can put the plaster on the sore place. I venture to say the motive power will have to bear its share, but it won't be lonesome.

"If every one of us tries, he can do something to make it easier to get the trains through on time—let's break up this Air Line habit of being everlastingly late. Suppose there is no precedent for coming in on time, day in and day out—let's make a precedent."

Skeevers sat down and the old man got up, amid a profound silence.

"Gentlemen," said the general manager, "I second Mr. Skeevers' motion. Let's every one of us tackle his part of this problem and show some results at our next meeting. Mr. Shaver, order enough recorders for all our engines—no, let's see, as many as Skeevers wants. If at any time within a year it's proven in one of these experience meetings that all our passenger trains have been on time for a month, I'll buy every mother's son of ye a suit of clothes; and if it ever gets so near the millenium that all trains are on time for a month, I'll make it a house and lot, and drop dead into the bargain, and leave the job to Sullivan or Skeevers—say! by George! how would it do to offer a prize to the engineer that brings his train in on time for thirty consecutive days?"

"Suppose you make it—unless delayed by causes beyond his control," said Skeevers.

"Oh, that would be too expensive."

"Well, outside of the motive-power department?"

"I'm afraid if you was the lawyer, Skeevers, that they'd rob the treasury and I'd have to fire Sullivan. You'd prove that the shadow of his car made the track greasy and that——"

His office boy brought the old man a message.

"What's this, what's this"—putting on his "specs," he read aloud:

"'Engineers' Grievance Committee of the System respectfully ask that you name a day next week, preferably Tuesday or Wednesday, when they can meet you to talk over a matter of mutual interest.'

"'Grievance Committee.' Holy Moses! and me having to go East to-nght. Say, this beats the devil. Say, Sullivan—no; you better tend to the conductors. Skeevers, what do these men want? I don't care what they want, they can't have it. 'Grievance Committee.' Say, Skeevers, you see these men and settle with them. I can't bear to rawhide with 'em; they get me crazy. What do you suppose they want, anyway."

"Same old thing—overtime, hostlers at terminals, and so-forth."

"Well, Skeevers, you see 'em; but be firm with 'em, Skeevers. Say I was called East, see; say the finances of the road won't——"

"But, Mr. Wider, why not go to the root of the matter and settle it? They have seen you three times in a year, and you have been 'called' East twice; why not settle it?"

"That's the talk, Skeevers; 'settle it;' give 'em to understand that we can't afford to pay overtime—why, Sullivan figured it up and it's a fortune, Skeevers, a fortune—and they are so demmed unreasonable. But you can do it, Skeevers; give 'em one of your object lessons and show 'em—but how can you satisfy 'em, that's the point?"

"If you leave it to me I'll satisfy them, and save the company paying overtime to amount to one per cent. of the engineers' pay-roll."

"Say, Skeevers, do you want my job? No? Well, whisper; how will you do it?"

"Give 'em the overtime they ask!"

"The dev——! Say, but you said no."

"Then I'd stop the cause of overtime, and—presto, change!—there you are."

"Well, explain; I suppose it's another object lesson."

"Mr. Wider, there is not an engineer or fireman on this road that wants to earn a cent laying on sidings; but they do want pay when they are obliged to lay there. Pay them; then get after the causes of delays, stop this 'kid' train-dispatching, and get some railroad men there. Stop this mahogany-desk train rating, and make your trainmasters use a little sense and consult the weather a little in rating train-loads. Kill off some of these yard-masters who block yards so that trains can't get in. Lay off a few roadmasters who allow sectionmen to take up rails on the time of regular trains. Stop this ever-lasting flagging of work trains against regulars. Hunt the heads of departments and bear down on those who produce no results, and in a few months you will have the trains coming in before the first hour of delay, which belongs to the company, is up. The men need rest, we want them to get over the road; nothing on a railroad earns a cent except the car-wheels—and then only when in motion. Move 'em!"

"Skeevers, I'll stay and see the boys myself—but you be there. You don't happen to have a twin brother just like yourself? No? I thought not; cusses like you come only one in a box—and there ain't but one box."

The assembled men felt rather out of the conversation, and commenced to look at their watches and coats. The old man noticed this and dismissed them.

"Gentlemen of the Jury," said he: "You

couldn't have found any other verdict. You are all guilty! Go home and think, think hard, and don't dare to think what anyone else might or ought to do. Just think what you can do to relieve the situation, and one month from to-day meet me here and let me know just what you have done—not what you are going to do, but *net!* Good-night!"

As the old man and the vice-president went down the stairs, the general manager asked: "What do you think of my man, Skeevers?"

"Appears to know what he's talking about; wouldn't be surprised if he was a rough diamond."

"'Rough diamond!' Why, sir, he's a regular diadem; yes, sir, a diadem, with Koorinoors and crown jewels and pearls and cut-glass and cats-eyes and whiskers on it. Why, sir, if I had a Skeevers at the head of every department of this road, I'd lay down four tracks of eighty-pound silver on rosewood ties inside of ten year! Yes, sir; and I'd equip it with nickel-plated '999's.' and I'd—well, say, I'd eat all the freight the Midland got to carry!"

A correspondent, writing, in another part of the paper, on the cutting of wheel flanges, gives some explanations of this trouble, which are very well worthy of attention. There are very few disorders about railway machinery which cause more annoyance than the cutting of wheel flanges, and it is very often difficult to identify the real cause. All sorts of far-drawn theories are given to account for cutting of flanges, when the cause is not apparent. This correspondent, evidently a very close observer, found that tapered journals and the coning of wheel tread not being uniform, had more to do with the cutting of flanges than any other cause. This seems to be a very rational cause for making wheels run to one side, and it is strange how little attention has hitherto been given to it.

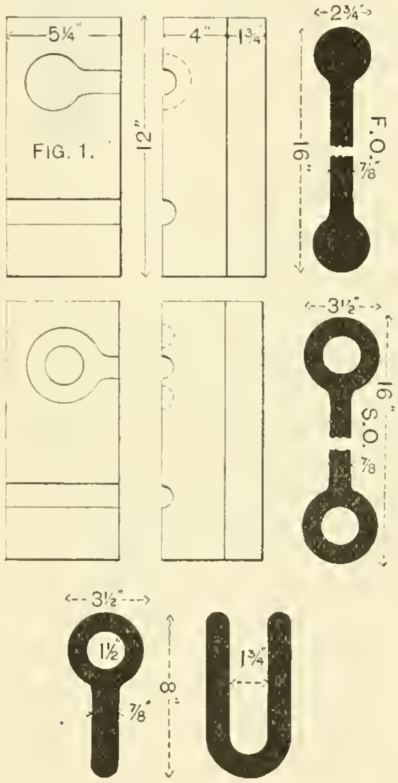
Mr. McKelvey, roundhouse foreman of the Pennsylvania Railroad shops at Altoona, sent out 5,423 engines from one roundhouse in the month of November last. He had taken all those engines into the house, and put them in order to take out their trains. If any roundhouse foreman in the country can show a record equal to this, we should like to hear the particulars. Mr. McKelvey is noted for making certain that all the work reported to be done on locomotives is faithfully executed before the engines go out.

An unusual sight that recently could be seen in the Seaboard Air Line shops at Portsmouth, Va., was workmen converting two officers' private cars into baggage cars. A new policy has been adopted by the company, which means more business and less pleasure.

The Helve Hammer in a Railroad Shop.

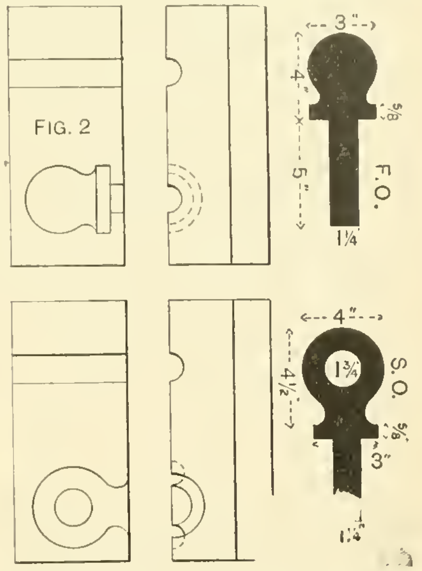
There are few shops without a certain representation of the numerous types of steam hammers, drop hammers and helve hammers, and it is the latter that we desire to touch up on this occasion, for the reason that it don't receive the attention it properly deserves.

In most railroad shops the helve hammer is located in such a position as to be inaccessible to all—generally near the spring-maker's fire—but, whatever the causes for its non-use, it is notorious that the steam hammers are always in demand. The helve hammer stands in a good many shops at the present time, with only a few calls in the course of a day on its splendid capacity for fast work, and positively none whatever for the rapid duplication of parts by means of dies.

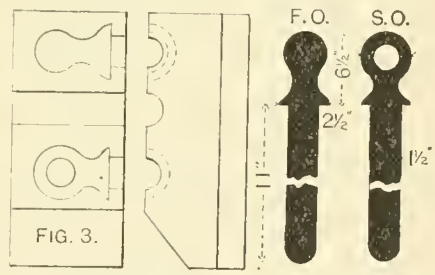


Among those who seem to have an exact appreciation of the full value of this tool, is the management of the Chicago, Rock Island & Pacific Shops, at Chicago, and the amount of work that can be turned out by a helve hammer is not an unknown quantity there. These hammers are never idle, for the reason that there are dies fitted to them to cover so many jobs that it is but the work of a moment to have the hammer in readiness for any order, from one to a thousand pieces, and to show what is being done at the shops named, we illustrate some of the dies in use, together with their products and the output of same per day. The several stages in making the finished part will be referred to by letters—F. O. indicating first operation, and S. O. the second. The completed article is shown in solid black. For brevity, only the lower die is shown, as the upper one is similar in all respects.

Fig. 1, a clevis for truck safety chains, is made of a bar of $1\frac{1}{8}$-inch iron, having an enlargement welded to each end; and

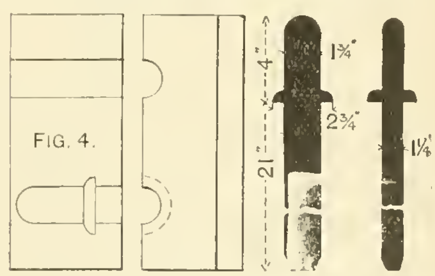


the first operation in the dies is to round these ends into a ball. After this is done to the lot of several hundred, the dies are changed for the second operation, and the ball ends are flattened to 4 inches diameter, and the $1\frac{3}{4}$-inch holes are punched by the same dies, forming the eyes. This finishes the clevis as far as



the dies are concerned; it is then bent to the U form, as shown, by hand. Seventy-five per day is said to be an easy day's work.

Fig. 2 represents an eye-bolt for truck safety chains. The first operation is to draw from the blank, a piece having a body, collar and ball, and when the num-



ber comprising the order have been turned out, the dies are changed for the second operation, which consists of flattening the ball and punching the eye; these bolts are made at the rate of 150 per day.

Coupling pins, as shown in Fig. 3, are made of $1\frac{1}{2}$-inch bar iron, in dies similar to those already shown, and by the same cycle of movements; these are completed at the rate of 200 per day.

Fig. 4 shows dies for coupling pins also, but of a heavier type, as used on tenders. These pins are rectangular in section, $1\frac{1}{4}$x$1\frac{3}{4}$ inches, and, having flat

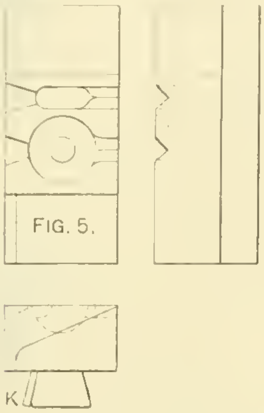


FIG. 5.

heads with a collar, the work is simply a drawing-out process from the round bar. The output for these pins is 200 per day.

The shanks and eye-ends of train hooks are formed in dies shown in Fig. 5. These

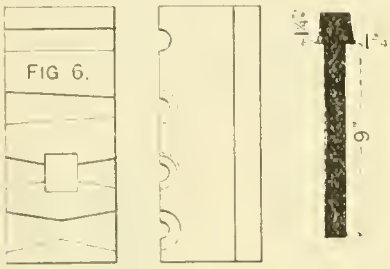


FIG 6.

hooks are made of $1\frac{3}{8}$-inch square iron, one end of the bar being drawn to a point, and the opposite end having the eye is formed in the dies, which are made exactly similar to those for the clevises and eye-bolts. This completes the hammer work on the hooks, and they are then bent to shape in the bulldozer.

Wedge bolts are drawn and headed in

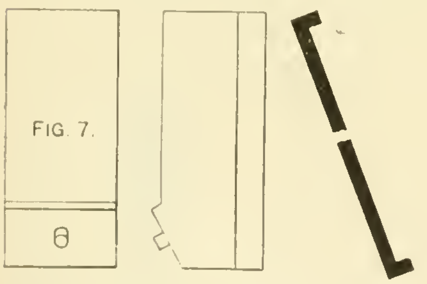


FIG. 7.

die Fig. 6, at the rate of 500 per day, and are left in the most desirable size to avoid removal of stock by machining.

Fig. 7 shows the die for forming the lip on drawbar yokes of the old style, many of which are still in service, and must be renewed. Three hundred of these are turned out per day.

The fulcrums for hangers used on the vacuum brake are made in dies shown in Fig. 8. These dies are also made so as to leave as little stock as possible to remove in the lathe. One hundred is a day's work for these.

Christie brake keys are hammered to size and the head formed, in die Fig. 9 — 1 a minute, or 600 per day.

Fig. 10 shows the die forming the grip-end of switch handles, which are made of $1\frac{1}{4}$-inch square bar. Eight hundred per day is the output for these.

Track chisels, which have always been an expensive tool to make and dress, when done by hand, are, by means of the dies Fig. 11, shaped so rapidly and well that 200 per day is well within the limit.

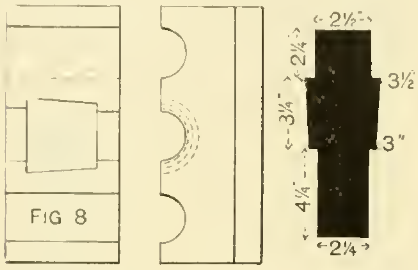


FIG 8

These chisels were formerly made in dies under the steam hammer, at the rate of only 30 per day.

Spike mauls were another job in which a decided saving was made by the abandonment of the old process of sledge and anvil, where ten was a good day's work. The helve hammer and dies quickened the pace to 30 per day, and made a job equally as good in one-third of the time. Fig. 12 explains itself.

Rod oil cups of wrought iron are stand-

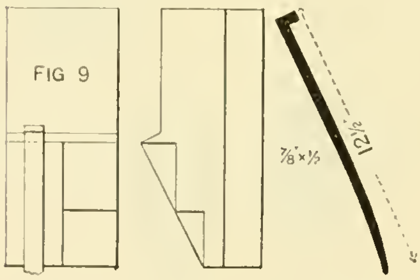


FIG 9

ard on this road; and the dies for making 500 blanks per day are shown in Fig. 13.

A die similar in all respects to the above, except in dimensions, is shown in Fig. 14, and is used to make the bosses which are riveted to face of followers for the purpose of holding the draft springs in a central position. One thousand per day is capacity of hammer on this work.

Fig. 15 is a die for sling stay connections, and these are made at the rate of 600 per day.

Ladder irons and handholds presented themselves as a very live issue in this shop, as in all others, within the past few months, and the issue was met with the hammer in a way that divested it of all difficulties, and enabled the management to be in the front rank in filling the requirements of the Interstate Commerce Commission in respect of handholds. The rods of $\frac{5}{8}$-inch round iron were first headed on both ends, in the bolt-header, and left as shown in Fig. 16; after which they were taken to the hammer and formed in the dies Fig. 17, where the heads were flattened down to form the bolt-end, and the body bent to shape without a marred feature of any kind, at the rate of 800 per day.

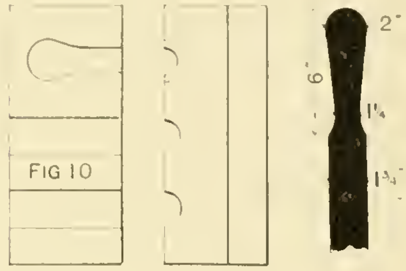


FIG 10

Recognition of the value of the helve hammer is not confined to the smaller types, but extends through the whole range of hammer work, where forming by dies is involved.

There is one large tool of this kind at work here on the heavy forgings, that is a mastodon of its kind, and is operated by steam. The helve is 16x22 inches square, and 22 feet long over all, with 12 feet from

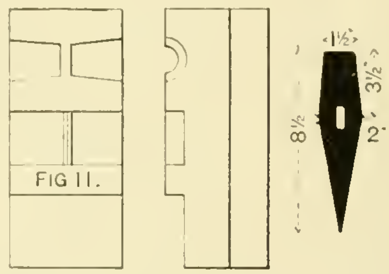


FIG 11.

center of trunnions to center of hammer-head.

This hammer is used in preference to the steam hammers, for the reason that much wider dies can be used, and the opening of 24 inches between dies makes it available for all heavy work.

It can wade through a heap of scrap in a day, and, standing close to the scrap furnaces, with the helve lifted, the thing looks like a voracious monster with its

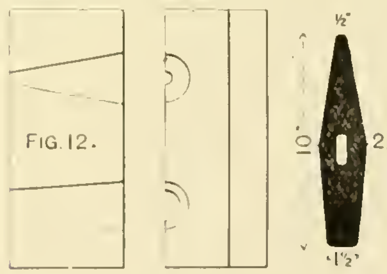


FIG. 12.

jaws open, impatient to chew the white, hot pile.

It was crank pin day when we where there, and the hammer was working up iron into bars 6 inches diameter and 10 feet long, which left stock enough to nicely true up with a rough and finish cut —no weary waits at the lathe on account of removing useless material. The dies used were such as to form the wheel fit, and the portion of pin outside of the wheel, over the largest bearing, thus making but two sizes to swage—the lathe doing the rest.

Each bar has material in it sufficient for six pins, as shown in Fig. 18; and, when leaving the hammer, it is taken to a special cutting-off machine (located near the hammer), where, resting in two gear-driven heads, it is faced-off at the ends, and cut up into suitable lengths by template. This squaring-up and cutting to length saves some considerable time and expense at the lathe, and is a good thing, as every lathe man knows who has wreck-

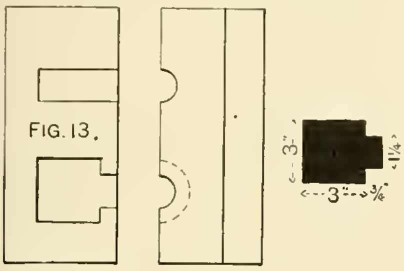


FIG. 13.

ed a few tools in bucking-off ragged stock on the end of a piece of iron as large as these.

Driving axles, frame sections, and, in fact, all heavy forgings, are pounded out on this hammer. This is not all of the work done here on helve hammers, by any means. It would require more space than we can spare to mention in the briefest manner all the dies in use. As our purpose has been to show up methods of rapid work on many jobs that are yet regularly turned out by the old hand process in a great many railroad shops, we believe that there is some light thrown on the possibilities of the helve hammer, when transformed from a dust-covered

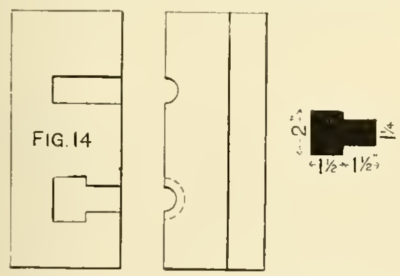


FIG. 14

and beltless piece of inert matter, into a useful adjunct in the working out of economies that are yet undreamed of in most shops. O. H. R.

The Pratt & Whitney Co. have completed special machinery for making the decimal gages for measuring sheet-metal tubes and wire adopted by the Railway Master Mechanics' Association, and are prepared to fill orders for the gages. About 500 gages have been ordered, several of the leading railroads having made the gage standard. There is every reason for believing that within two or three years no other gage will be employed by the railroad companies of America.

Increase the Earning Power of Locomotives.

One of the most seasonable papers ever presented to a railroad association was one by Mr. J. H. McConnell, of the Union Pacific, read before the Western Railroad Club. The paper was called "Locomotive Service," but its text was embraced

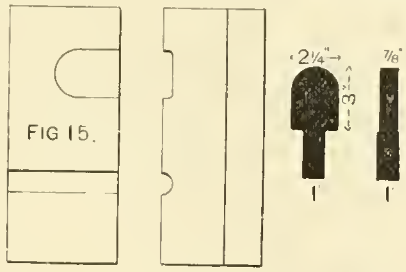


FIG. 15.

in the last sentence, which reads: "The problem of to-day is, how much does it cost to haul a ton of freight one mile, not what does it cost per mile to run your locomotives."

After reviewing at some length the increase in the capacity of freight cars and the power of locomotives during the last twenty-five years, he referred to the constant pressure put upon railroad companies to move freight at lower rates. Reduction of expense of moving freight

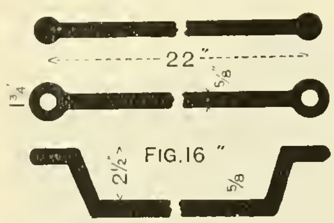


FIG. 16

could be accomplished only by making the locomotive earn more for the company. To accomplish this, the idea must be given up that an engine should run from 75,000 to 100,000 miles before it is taken into the shop. When freight engines are kept in service until they have made that mileage, the company is not getting the revenue the engines could earn. An engine in freight service should haul every ton of freight it is capable of doing, regardless of cost for repairs and fuel. When the performance is considered on a mileage basis, or with reference to how cheap it can be run and how many miles it will make between general repairs, there will be frequent complaints made by the mechanical department of overloading, and an effort will be made to have the train reduced, in order to favor the engine, so there can be a better average made on repairs and coal. After four years' experience with tonnage, rating on grades ranging from 40 to 96 feet to the mile, it has resulted in a general increase in average number of cars per train. Where 22 loads was a train over some of the heavy grades, by the tonnage system frequently 26 cars are hauled with the same engine that hauled 22 cars for a full train. In another case, where 28 cars was a full train, a tonnage rating has increased the train to 35 loads with the same engine. It was supposed that 28 loads was a full train, and trainmen were of the opinion that the engine could not pull 35 loads; but after several tests it was demonstrated that the engine was capable of doing this, and no further trouble was experienced in hauling a train of 1,100 tons.

When the mechanical departments of our railroads give the same attention to

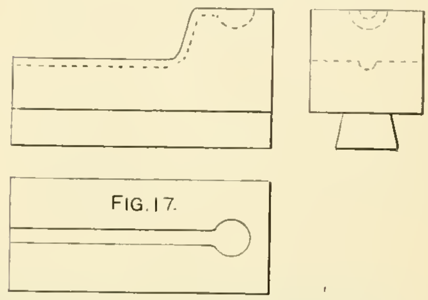


FIG. 17.

increasing the train haul that they do to make a showing of how cheap they can run the locomotives per mile, they will find they have obtained increased service from the locomotive, decreased the cost of hauling a ton of freight, and increased the revenue of the company.

Mr. George Westinghouse is very enthusiastic in advocating the use of electricity for the operating of railroad trains. Speaking to one of the officers of the Pennsylvania Railroad, he said: "You burn altogether about 5,000,000 tons of coal every year on the Pennsylvania Railway east of Pittsburgh. If you used electric motors fed by the current produced by gas engines, it would only require one-eighth of the quantity of coal now consumed to prepare the gas. That would save you about $5,000,000 a year, which would justify the large expenditure needed to change the motive power from steam to electricity."

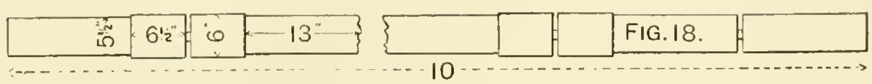


FIG. 18.

A member of the Railroad Master Blacksmiths' Association says that breakage of steel is often caused by the blacksmiths working the material too cold. One-half the blacksmiths like to make a fine polish and beautify the job, by hammering it nearly cold. This frequently starts minute cracks, that afterwards cause fracture.

New York, Ontario & Western Passenger Locomotive.

Our illustration shows a 17x24 engine designed by Mr. Geo. W. West, superintendent of motive power of the New York, Ontario & Western R'y, and built by the Cooke Locomotive & Machine Co., Paterson, N. J.

This engine embodies some practical ideas in locomotive design that are likely to attract no little attention in railway circles, for it is built not only for speed, but to accomplish some other results quite as valuable in railway operation, among which may be mentioned economy in fuel consumption; and the performance thus far more than justifies the belief that it is built wisely.

A glance at the picture will not be convincing as to new points in detail, but they are there, the proportion of parts telling the story of modern practice in every line.

The 17-inch cylinder in connection with the Wooten firebox and 68-inch wheels, and 76,000 pounds holding all to the rail, is a combination not commonly met in these days, when the tendency is to get big cylinders on anything that can give the faintest assurance of supplying them with steam.

There are no conveniences omitted that can bring comfort to the engineer and fireman in the performance of their duties, and this may have some bearing on her exceptional record.

This engine with 175 pounds boiler pressure will have a mean effective pressure of about 90 per cent., or 157 pounds, and neglecting internal friction will exert a pull on the drawbar equal to 16,000 pounds.

With the 76,000 pounds on drivers, the ratio of adhesive weight to tractive power is 4.75, a proportion that gives a coefficient of adhesion of 0.21, and one that will not make mauling the sand pipe any part of the fireman's duty—under average conditions of the rail.

The diameter of the boiler, it will be noted, is one usually given to an 18-inch cylinder, with this difference in favor of the boiler, that it is not choked with tubes; the heating surface of firebox being relied on, as it should be, to furnish the heat for the liberal water storage.

There are two advantages in the 17-inch cylinders over larger sizes—first, they give less weight on the truck; and second, they present less surface for refrigerating effects of the atmosphere, and also less internal surface for condensation; and these are said to be vital factors in the economy of a locomotive, by some people who have given the subject a little attention.

Decreasing the diameter of cylinder, increasing the boiler pressure, and at the same time the diameter of the wheel, together with the best-known practice in construction, has produced a machine that fills all the conditions that were responsible for its existence.

Gage, 4 ft. 8½ in.

Height top of stack from rail, 14 ft. 11 in.

Height center of boiler from rail, 8 ft. 6½ in.

Weight of engine in working order, 110,000 lbs,

Weight on drivers in working order, 76,000 lbs.

Weight on truck in working order, 34,000 lbs.

Total wheel base of engine, 23 ft. 1 in.

Rigid wheel base of engine, 8 ft. 6 in.

Total wheel base of engine and tender, 47 ft. 2 in.

Cylinders, 17 x 24 in.

Length of ports, 15½ in.

Width of steam port, 1½ in.

Width of exhaust port, 3 in.

Piston, with follower.

Piston packing, Stevens.

Piston rod, of hammered iron, 3¼ in. diam.

Piston rod packing, metallic, N. Y., O. & W. standard.

Slide valve, Richardson balanced.

Slide valve lap, ⅛ in. outside.

Slide valve, full travel, 5¾ in.

Driving wheels, four.

Driving wheels, diam. outside tires, 68 in.

Driving wheels, diam. of center, 62 in.

Driving wheels, tires material, Latrobe steel.

Driving wheel tires, size, 3 x 5¾ in.

Driving axles, steel.

Driving axles, diam., 8 in.

Driving axles, length of journal, 11¼ in.

Engine truck, center bearing.

Engine truck, wheels, 33 in.

Engine truck, axles of, hammered iron.

Engine truck axles, diam., 5 in.

Engine truck axles, length of journal, 9 in.

Crank pins of, steel.

Crank pins, main journal, 5¼ x 4½ in.

Crank Pins, side rod journals, 4 x 3½ in.

Boiler, straight top with wide firebox.

Fuel, fine anthracite coal.

Working pressure, 175 lbs.

Shell material, carbon steel.

Firebox material. Shoenberger steel.

Thickness, shell plates, ½ in.

Thickness, sides firebox, 5/16 in.

Thickness, front of firebox, 7/16 in.

Thickness, crown of firebox, ⅜ in.

Thickness, flue sheets, ½ in.

Diameter first course, outside, 56 in.

Firebox, length, 9 ft.

Firebox, width, 7 ft.

Firebox, depth of front, 44½ in.

Firebox, depth of back, 39½ in.

Tubes, material, charcoal iron.

Tubes, number, 197.

Tubes, diam., length and thickness, 2 in. diam., 11 ft. 1 in., No. 11.

Crown stays, radial stays.

Grate, combined rocking bars and water tube.

Ashpan, cast iron with plate iron top section.

Smoke stack, 16 in. diam., straight.

Exhaust pipe, Smith triple.

Injectors, two No. 8 monitors.

Brake, Westinghouse-American, outside equalized.

Lubricators, Nathan triple sight feed.

Car heater, consolidated.

Frame, white oak.

Trucks, combination.

Truck wheels, 33 in. chilled.

Truck axles, hammered iron.

Truck axle journals, 4¼ x 8.

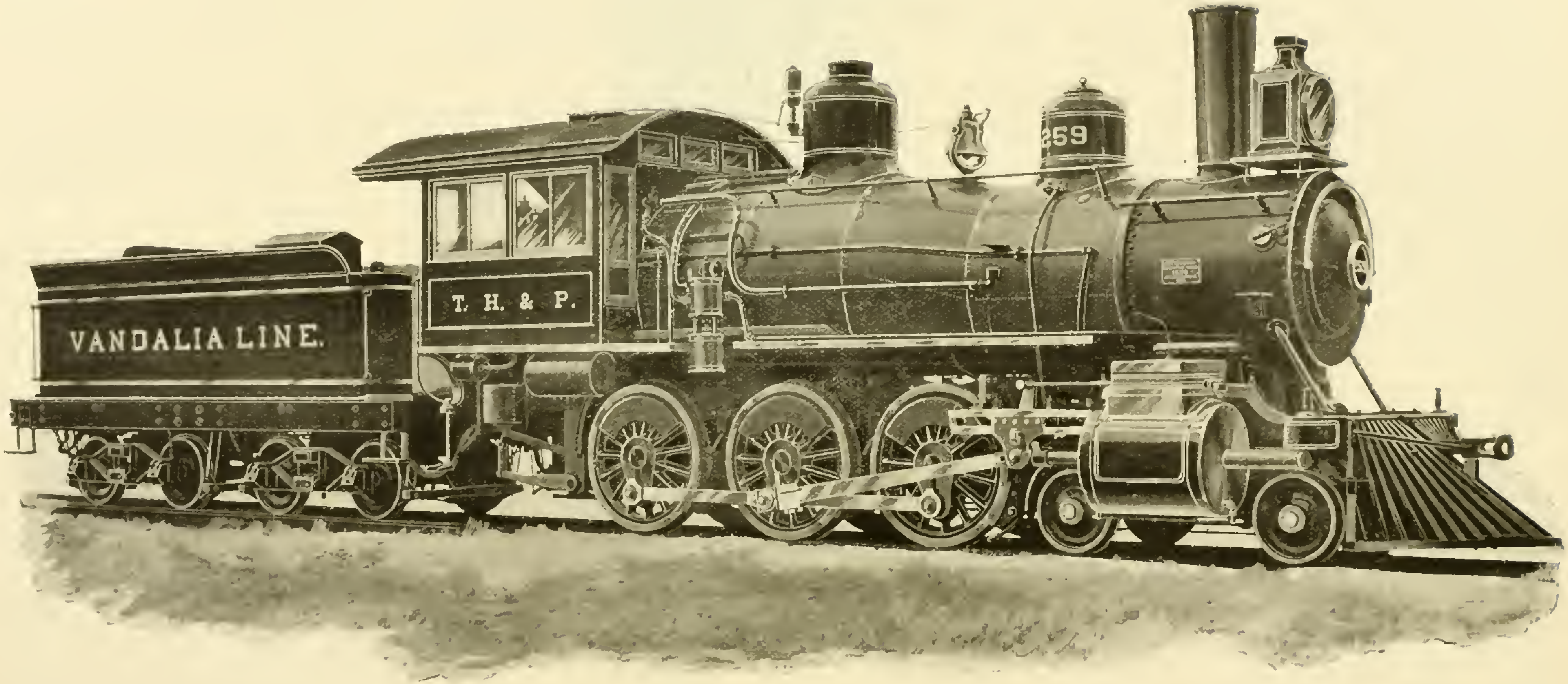
Tank, capacity for water, 3,750 gallons.

Tank, capacity for coal, six tons.

Tank, weight loaded, 78,000 lbs.

We have it from a reliable source, that the new Erie organization is likely to come into possession of the engine "E. B. Thomas," designed by the Erie engineers, and built for them by the Cooke Locomotive & Machine Co. This engine, embodying the ideas of men who handle the machine, and are better fitted to pass on many points of construction than any other authority, was exhibited at the World's Fair, and fully described in this paper for May, 1893. This arrangement is the result of a conference of President Thomas with a committee of Erie engineers, and is a deserving recognition of the work of progressive men, notwithstanding it comes at a late day.

On last Labor Day there was a bad accident on the New York & Sea Beach R. R., which brought upon the company damage suits, aggregating $1,000,000.



PITTSBURGH COMPOUND TEN-WHEELER, FOR VANDALIA LINE.

Ten-Wheel Pittsburgh Compound for the Vandalia.

The handsome full-page illustration shown herewith represents the latest development of the compound locomotive, as built by the Pittsburgh Locomotive Works.

This form of locomotive can fairly be stated as representative of the best American practice for two-cylinder compounds.

The extended wagon-top, radial-stayed boiler is here to stay. If it has drawbacks—and no doubt it has—it has many advantages over any other form, notably in the facilities for washing out and keeping it clean.

Hollow staybolts are an improvement in American practice that is gaining headway very fast. Very little, if any, dependence is placed on the hammer test on many roads. Certainly the staybolt with the hole entirely through it will tell at once when a breakage occurs.

The Vandalia management have been for some time experimenting with compounds, and this seems to be the result of their investigations. The weights and dimensions are as follows:

Fuel, bituminous coal.

Gage of track, 4 ft. 9 in.

Total weight of engine if working order, 127,000 lbs.

Total weight on driving wheels, 101,000 lbs.

Driving wheel base of engine, 11 ft.

Total wheel base of engine, 21 ft. 8 in.

Total wheel base of engine and tender, 49 ft. 9½ in.

Height from rail to top of stack, 14 ft. 7½ in.

Cylinders, high pressure, diameter and stroke, 19x26.

Cylinders, low pressure, diameter and stroke, 29x26.

Slide valves, balanced.

Piston rods, steel, 3½ in. diam.

Type of boiler, extended wagon top.

Diameter of boiler at smallest ring, 60 inches.

Diameter of boiler at back head, 69 in.

Crown sheet supported by radial stays.

Staybolts, 1 in. hollow staybolts, spaced 4 in. from center to center.

Number of tubes, 256.

Diameter of tubes, 2 inches.

Length of tubes over tube sheet, 12 ft. 5 in.

Length of firebox, inside, 108 in.

Width of firebox inside, 32⅜ in.

Working pressure, 180 pounds.

Kind of grates, cast iron, rocking.

Grate surface, 24.0 sq. ft.

Heating surface in tubes, 1653.0 sq. ft.

Heating surface in firebox, 152.0 sq. ft.

Total heating surface, 1805.0 sq. ft.

Diameter of driving wheels outside of tire, 56 in.

Diameter and length of journals, 8x9 in.

Diameter of truck wheels, 28 in.

Diameter and length of journals, 5x10 in.

Diameter of tender wheels, 33 in.

Type of tank, level top.

Water capacity, 4,000 U. S. gals.

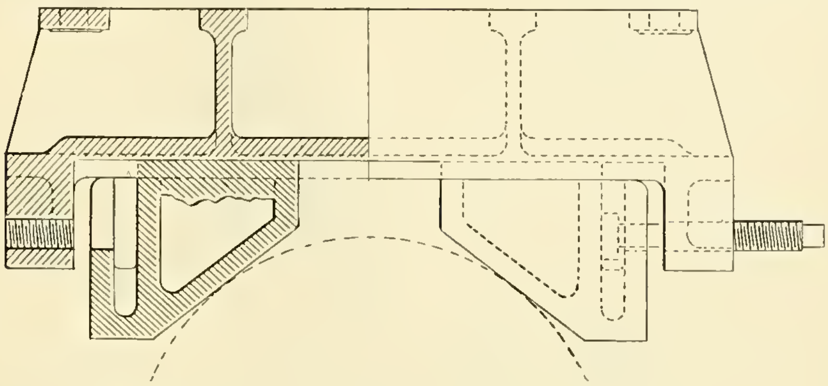
Fuel capacity, 300 cu. ft.

Weight of tender with fuel and water, 78,700 lbs.

Type of brakes, Westinghouse American automatic.

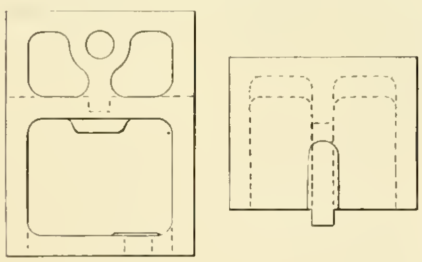
Adjusting Blocks for Boring Cylinders.

Mr. Jas. Cullen, superintendent of motive power of the Nashville, Chattanooga & St. Louis Ry., has in operation in his shops a device for leveling and adjusting cylinders for boring, and one that ought



to be a valuable aid in setting a cylinder in line with the boring bar, whether the job is bored in a lathe, where a large percentage of this work is done, or in a regular cylinder-boring machine.

A pair of cast iron frames or bases of a suitable height are bolted to the bed of the machine—one at the inside of each flange on the end of cylinder; on these frames



are fitted a pair of cast-iron wedge blocks, having a tongue which fits into grooves on the frames and serve as guides to the wedges.

These frames are tapped for two screws which actuate the wedges, and raise or lower the cylinder as desired, to bring it central. The illustration shows that this device is a great improvement over the old-time blocking and shims.

When a locomotive begins to give trouble from leaky steam-pipe joints in the smokebox, the condition of the cylinder fastenings ought to be examined. Loose cylinders nearly always cause leaky steam-pipe joints.

Learn to Write English.

In an article contributed by Henry Floy to the "Engineering Magazine," we find that the author investigated very fully the question, "Are we educating too many electricians?" His decision was in the affirmative, and he gives what seem to be reliable statistics to prove the position taken. In the article occurs the following sentence: "The letters written by the graduates of one college were particularly noticeable as indicating their authors' lack of training in the use of good English!"

We believe that there is a tendency among a great many of our colleges, especially those devoted to technical education, to neglect instructing students how to write good English. This is a great mistake, for it often proves a great disadvantage to their advancement in after life.

There is such a large proportion of technically-educated men who drift into mercantile and other pursuits, that it is highly important they should understand how to write their native language. It would be a great advantage to most of them if they received less drilling in mathematics and in science, and a little more in how to express themselves intelligently. The same criticism can be truthfully advanced concerning the instruction given in nearly all colleges. The students will be burdened with studies that are supposed to supply knowledge of a high order, and instruction in the principles of English composition is not considered worthy of attention. We have known college graduates who wrote Greek compositions that were considered good, while their method of expressing themselves in English was of the Sam Weller order.

The New York Central has ordered a Tabor molding machine, to be used in molding brake shoes and journal bearings. The expense of casting is so materially reduced by the use of this machine, that no foundry having much uniform work to do can afford to be without it.

More Kinks from the Rock Island Shops.

The papers on special methods of handling work in a smith shop, which have appeared in these columns, have adhered rigidly to the text, which was specially on the forming of shapes by pressure and impact. Some good forging by dies is done, however, under the

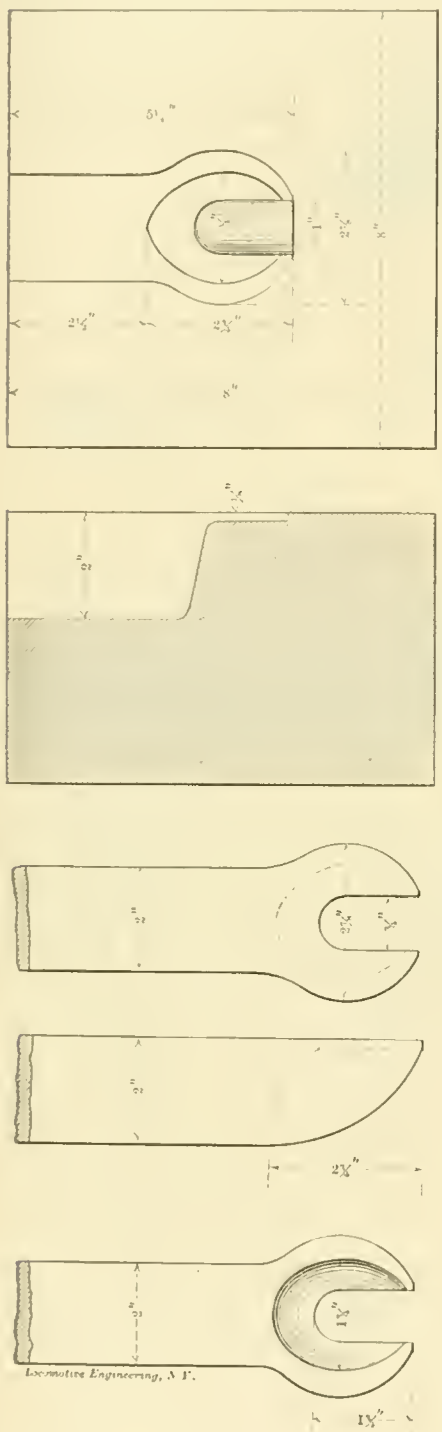


Fig. 1.

steam hammer, and is entitled at least to "honorable mention."

Claw bars are made by steel dies, under the steam hammer, that are certainly as creditable samples of die-forging as can be done anywhere. The forming die is shown in Fig. 1, together with claw-end of bar. By the old anvil process, twelve of these bars were a big day's work; at the hammer, they are made at the rate of thirty per day.

Patch bolts for boilermakers' use are also made by dies, the lower of which is a cast-iron base, keyed to the anvil block of the steam hammer. The top of this block is bored 1¾ inches deep and 3½ inches in diameter, to receive the upper die; and in the bottom of this bored recess is still another counterbore 1⅛ inches deep, into which is pressed a steel bush having a hole ¾ inch in diameter, and whose top is chamfered into the hole, so as to give the bolt the countersink fit

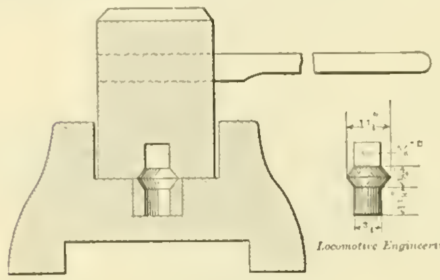


Fig. 2.

when in the patch. This bush forms the body of the bolt.

The upper die is made of steel 5 inches long, and turned to fit lower die; on its lower face it is also countersunk for the top part of the conical head of the bolt, and recessed into a ⅝-inch square to form the bolt head. Fig. 2 shows this die and its work.

The blanks for these bolts are cut the correct length; one end is then squared at the helve hammer roughly, so as insure entry in the upper die; a white heat, and the steam hammer does the rest, turning out 600 per day, at a cost of less than one cent each

This work is exceptionally smooth and true, as it must be, since they cut the threads in dies, and use the bolt direct from the hammer. No machine work whatever is done on them, except to cut the thread—the chuck for threading, holding the bolt true axially, so that the conical fit on the bolt is true with the threaded portion. This practice of not turning the bolt, will be noted as a wide divergence from old standards. It is said that the abandonment of machine work on these bolts, together with the hustle on the hammer, have brought the cost away below the manufacturer's price and its inevitable appendage of several discounts.

The large combined punch and shear is harnessed to do its share of cheapening the cost of work, and at the same time elevating the quality of it. All cotter holes and the smaller keyways are punched cold on this machine; the punches are kept in a locker, and have more the appearance of tools of precision for a machine shop of the first order, rather than for use in a smith shop—and the diminished expense account says it pays.

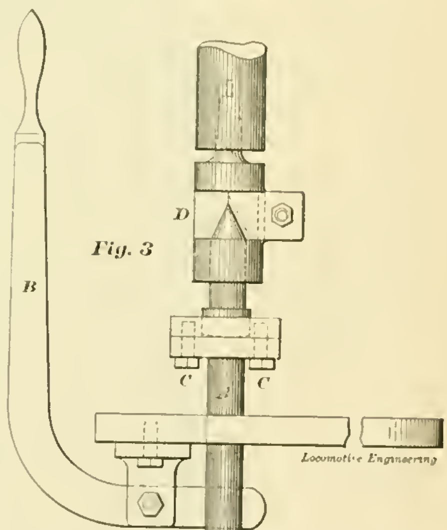
Handholds and ladder-irons are also punched in this machine. One thousand holes per day was lower than the average when the recent rush was on for handholds.

A drill in the average blacksmith shop is generally distinguished by an air of loneliness and crude petroleum; but in this shop it was made to help out in a novel way, by having a rig applied by which lag-screws, joint-bolts and all other rough bolts requiring smooth ends were quickly chamfered, even to a point if necessary.

Fig. 3 shows this device in position on the table of the 30-inch drill, where it was in operation. A shank *A*, having a socket to receive the bolt head, passes through a hole in the table, and receives its motion to raise and lower the bolt to and from the revolving cutter by means of the lever *B*, which is fulcrumed to the underside of the table. The sockets for different-sized bolt-heads are all made to fit the one shank, and are secured to same by the bolts shown at *C*.

The cutter for this device is carried in a head *D*, which is fitted to the socket on the drill spindle; it is made of ⅜x1¾-inch steel, and secured to a lug on the head by one bolt.

As will be seen in the sketch, all move-



ments of the bolt are positive, with no chance for it to avoid the cutter, which, by the way, is always run dry—no lubricant used whatever. The cutters are kept in quantities, so that a sharp one can be at once substituted for one dulled by the dry ordeal; this policy keeps the tool moving, without any stops for grinding, until the job is completed, when the cutters are all put in shape again.

The high speed at which the machine is run, and also the cutting being done dry, are both at variance with what a machinist would call "rational practice;" but there are lots of our old theories going to pieces when tackled by the record-makers. O. H. R.

The Deceptive Performance Sheet.

Every railroad man who has paid attention to methods of making up mileage sheets, knows that the comparison of the statements made by different roads is deceptive. The Master Mechanics' Association have striven at different times to bring about uniformity, but without success. The existing condition of these statements is commented on by Mr. J. H. McConnell thusly:

The monthly statements of locomotive performances sent out by railroads, when compared, show a wide difference in cost, and unless the conditions of making them up are known the comparisons are unsatisfactory. Some roads allow engines only actual mileage between terminals, regardless of length of time making the trip. Should the train be delayed several hours by switching or meeting trains, no mileage is allowed. If held at terminal waiting trains, no mileage is allowed. In helping service, the engine is only credited with actual mileage. While the crew will receive a day's pay, the engine may make but 30 miles in 12 hours.

It is the practice of a number of roads to allow constructive mileage to all engines in passenger and freight service. Some roads add 10 per cent. to the mileage, as it is claimed to make up for the coal and oil in taking the engines from the roundhouse to the train, and in leaving the train and being put in the roundhouse. In addition to this, they are allowed 10 miles per hour for switching or lay-outs on the road. Where overtime is paid the engineer, the engine is given mileage to make up for it. By this system of watering mileage, a locomotive report is made to show a good average on coal and oil, and low cost for repairs, and a large individual engine mileage, when the actual cost is 10 to 15 per cent. greater than that shown by the report.

Taking the annual reports of some Western roads, considering the freight engine mileage, with freight car mileage, they show the following percentages of freight engine mileage to freight car mileage: 4.06 per cent., 4.76 per cent., 4.37 per cent., 4.24 per cent., 5.35 per cent., 5.32 per cent.

The combined mileage of passenger and freight trains, compared with the engine mileage in same service, shows following percentages of engine to car mileage: 8.78 per cent., 7.57 per cent., 7.44 per cent., 7.76 per cent., 11.29 per cent., 6.48 per cent.

The following gives number of cars per train when figured on same basis for all the roads: 18.80, 18.66, 23.60, 22.86, 20.99, 17.73, 24.66.

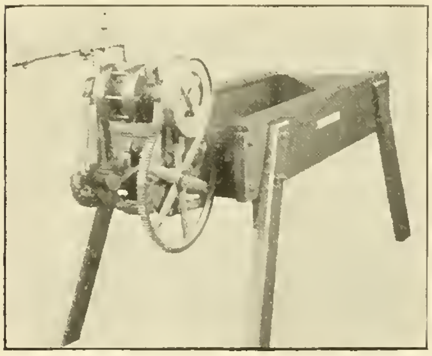
There is no uniformity in rating trains. One road rates 2 empties as 1 load, others 3 empties 2 loads, and others 5 empties 3 loads. A train of 10 loads and 20 empties, under these systems, would be called, respectively, 20 loads, 22 loads and 24 loads. But the showing on paper would convey the impression that one road was hauling a greater number of cars per train than another, when there is a probability that the road showing the smaller train haul was moving the same tonnage.

Following this matter still further, the average tonnage for a loaded car for the year on five roads shows: 12.87 tons, 9.09 tons, 9.87 tons, 11.40 tons, 12.26 tons.

With such a variation in the manner of allowing mileage and rating trains, no satisfactory comparison can be made; and until all roads show the cost of moving a loaded passenger and freight car one mile, locomotive performance sheets will be of little value for comparison.

Pneumatic Sand Sifter.

The meagre mechanism of the foundry has lately received the important addition of the machine illustrated in the annexed engraving. It is a sand-sifting machine, operated by compressed air. It consists of a heavy oak frame, containing a swinging riddle or sieve, that can be removed by simply lifting it out of the frame when necessary to use a sieve of different mesh. The motive power is a substantial bal-



anced rotary motor, which drives the gear connected to the three-pointed knocker attached to the sieve. Foundries which are using these machines state that they not only cover their cost in a short while by saving in labor, but that the tempering of the sand can be done much better than by hand. Those interested in such a machine are requested to correspond with C. H. Haeseler & Co., Philadelphia, Pa.

Operating Tools by Electricity.

We find that nearly all the men in charge of railroad shops are becoming alive to the advantage of employing electric motors for driving certain parts of their machinery. We have lately heard more than one shop manager say that if he had to equip a new shop he would put no line shafting in it. This indicates a highly progressive spirit; but the desire for doing away with line shafting may lead to expensive mistakes if it is not obeyed judiciously. Those looking towards the introduction of electric motors as means of transmitting power, should bear in mind that there are losses incident to the use of electric motors that may be as great as the loss by friction that results from the use of shafting. The electric motor can be used most economically for driving machines that are frequently used when other machines are idle, as, for instance, wheel lathes that are frequently employed after regular working hours. Machines placed in positions difficult to reach from a line shaft, and the machines in boiler and blacksmith shops, can also very often be operated to advantage by electric motors; and there may be gain in doing away with overhead shafting to make room for traveling cranes. Otherwise, line shafting is likely to be found as satisfactory as any means that can be employed for transmitting power.

Some remarks made in the "American Machinist," by an electrical expert, on the subject of transmitting power by electricity, are worthy of attention. He says:

"Too many electricians—electrical engineers and electrical editors alike—seem to proceed upon the idea that if electricity offers a means of doing a piece of work it therefore offers the best means.

"Our attention was recently called to a case of a factory proprietor in Connecticut who had applied an electric motor to a special case in his workshop with decided advantage—so much so that he at once conceived the idea of driving his entire plant with motors, and proceeded to take advice in the matter from those who should have been able to give it. With a single exception, his advisers assured him that the proposed application was a legitimate one, from which he would reap many advantages. The exception (who, to his still greater credit, was a manufacturer, and directly interested in making sales) was a gentleman whose mental vision had not been blinded by the brilliancy of electrical achievement. He saw, on investigation, that the conditions were such that the various machines were very compactly arranged, and the running of them was practically continuous. In other words, the amount of idle shafting and belting to be eliminated by electrical transmission was small, and as the actual power consumed by the machines could not be changed, electrical transmission could save nothing, and the proprietor was so advised."

When the average reporter, who collects facts of interest for press dispatches, writes anything about train accidents, such as collisions of passenger trains, he invariably tells that the engineer whistled for brakes and reversed his engine. Those who have got it through their skulls that air brakes are provided for stopping trains, sometimes say that the engineer grasped the air pump, but the favorite expression is that he whistled for brakes. That seems to convey the idea that he was making a noisy effort to stop.

Sketching.

In tracing the progress of any mechanical idea, we find it so closely interwoven with lines and figures in the mental sketch-book, that the effort to put it in tangible shape is sometimes too much for the author of the visions, because he cannot put his thoughts on paper and make a per-

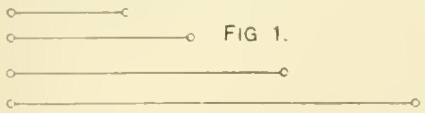


FIG 1.

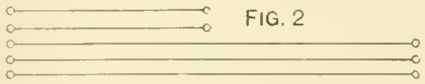


FIG. 2

manent record of the fact that wheels are more useful in a sketch than in the head. The man who is able to express himself graphically is always better equipped to handle the problems of life than the one who is unable to do so. No tiresome talks are necessary to prove this proposition.

The information acquired and imparted by this agency is one of the important factors in the broadening of the understanding, doing its work so quietly and effectively that, without special attention is directed to the fact, it seldom gets its full share of credit in the general round-up. By its help, one absorbs the intent of others at once, without useless waste of time and words; and this is of no small importance to the man who has little time, or a limited vocabulary, to draw on. But, however voluble the tongue, the sketch will always reach the goal first; and in the race for shekels, a tip on the winner is not a bad thing to have.

There is a well-defined feeling that to be able to make a sketch it is necessary to

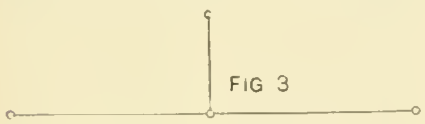


FIG 3

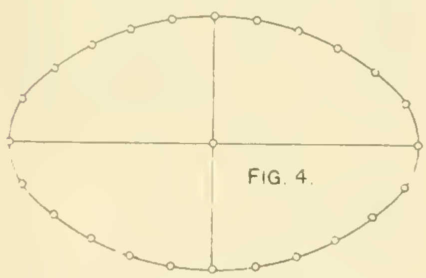


FIG. 4.

be well up in drawing—that is, to be posted in all the details of drawing-office practice. Nothing could be farther from the truth; for there are many good draftsmen who find it difficult to make a creditable sketch.

It is a fact that many are deterred from making a start by the fear of complexity, and that they would be unable to give the subject sufficient study. Yearning for a knowledge of the accomplishment, they never make the attempt to attain it. A proper understanding of a few easily-acquired principles is all that is necessary to make a correct beginning; practice will do the rest.

The pencil should be held firmly be-

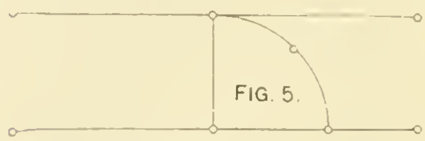


FIG. 5.

tween the thumb and two fingers; the index finger resting on top of the pencil, the second finger serving only as a guide and support. Since the whole system of geometry is based on straight lines and curves, the first trial of the student will be found when he encounters these apparently innocent things, and realizes how little control he has over the pencil. Lines, like most other things, have a beginning and ending. Where to have these limits is best decided by locating two dots or points any distance apart, like Fig. 1, and drawing the line between them with an easy but sure hold on the pencil; beginning with points, say, one inch apart, and

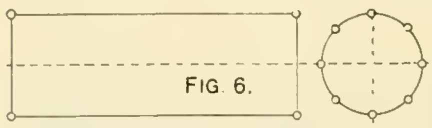


FIG. 6.

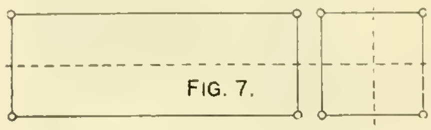


FIG. 7.

increasing the distance gradually, as improvement is noted. An attempt to make a straight line should be done without any halting by the wayside, or uncertain dabs at the paper. A continuous movement from the left to the right, and from the top downward, is the correct method.

Parallel lines like Fig. 2, and drawn from points as before, should be next drawn, varying the length of lines, and the distance between them, at pleasure.

Fig. 3 is a line perpendicular, or at right angles to another. The lower line is drawn precisely the same as those before, and the perpendicular erected on it at any place chosen, by first locating the position by means of dots as before, and drawing a line to connect them.

To draw the major and minor axes of an ellipse, we proceed as in Fig. 3, but must locate the point of intersection so as to be at the center of the longer or major axis. Drawing from one dot through this point, and producing the line to the second dot, we have the two axes of the ellipse, which only lacks the curve to complete the figure. The curve can be easily drawn in by placing dots equidistant from the longer axis, and afterwards connecting them.

A circle is drawn the same way, with the difference that the two axes are equal in length, the ends forming four points in the curve. It is plain that in both cases, if dots enough were made in locating points in the curve, the dots themselves would make a solid line; therefore, the fewer guiding points, the greater the skill shown in constructing the curve.

Two lines, when placed at right angles to each other, are the fundamental center lines on which to build a solid, they being a guide to the symmetry of the figure, which is laid off each side of them, just as the dots are a guide in the case of the curves.

Fig. 5 shows an arc, tangent to a straight line. This is a combination of Figs. 2 and 3, with two parallel lines, and line perpendicular to them. The curve is made tangent to the upper line by setting off a point (measured by the eye, of course) on the lower line, equal to the distance between the parallel lines; and this will represent the radius of the curve, whose center lies in the lower line. Making another dot at an angle of 45 degrees to this center, and at a distance from it equal to radius, or, in other words, bisecting the arc, we have three points through which to draw the curve, that shall be tangent to the upper line. Here, again, more dots would give more points in the curve, and make it easier to draw; but practice will make any dots whatever unnecessary. Any angle may be laid down with this figure as the base. It is seen that we have an angle of 90 degrees, subtended between the vertical and parallel lines; and this angle was bisected by the dot, making two angles of 45 degrees. This process

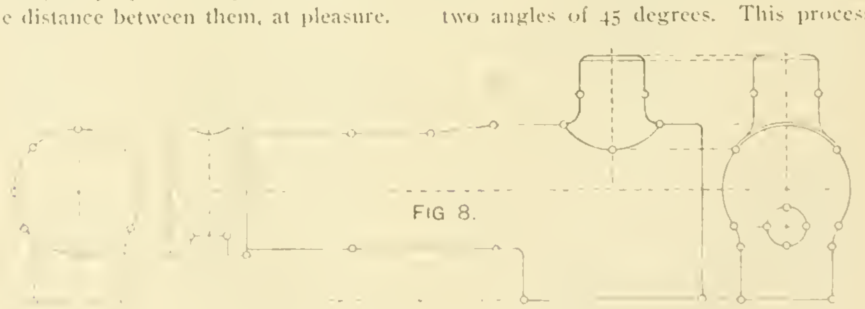


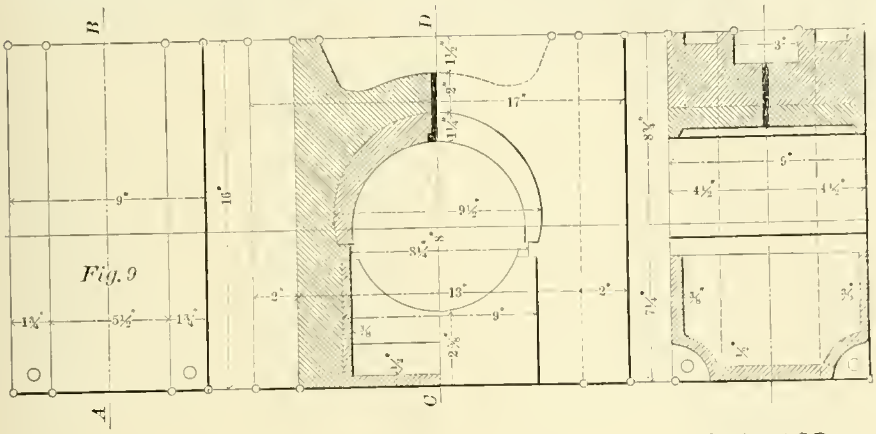
FIG 8.

LOCOMOTIVE ENGINEERING N. Y.

can, of course, be repeated indefinitely, with an approximation to accuracy depending on the care taken in laying off the points of division.

These primary exercises are the groundwork for freehand sketching of mechanical subjects; absolutely nothing being required except a knowledge of these lines and a lead pencil, to reproduce on paper anything from a line to the most complicated mechanism—when once their application is learned.

In order to use these hints, it is necessary to be entirely clear, mentally, on the point of what we desire to sketch, if it is a creation of the brain awaiting development. As many views should be made of the thing to be shown as would tell us all we require to know about it; the views taking rank in importance usually by the amount of detail in them. In general, the side view will be found to be the important one—as, for example, the side of a locomotive. This view is also known as "side elevation." Around this should be grouped the other views or elevations, in such a position as would indicate what they represent; this method brings the end view or elevation to a point nearest the end of the side elevation that it delineates, the top view or plan above the side view, and the bottom view or inverted plan below the latter.



Half Section at A B *Section at C D*

Locomotive Engineering

These views are known as "projections" in the drawing office, and are the same in the sketch, notwithstanding they are produced by means of the eye and a steady hand, instead of the T-square.

In arranging the views on the side of the elevation from which they are taken, it will be found to simplify the subject, and will also give the advocates of the different angles of projection an opportunity to continue the fight for their theories.

These points have reference to the outside of an object only, or the parts that are visible to the artist; but the interior or invisible portions are of equal importance and must also be represented. Such views are known as "sections." A section is named by the direction in which the body is supposed to be cut—as, when lengthwise, it is called a "longitudinal section;" or, if taken in a transverse direction of the figure, it is called a "cross-section." But, in intricate figures, it is necessary to state at what part the section is taken, no matter what the direction; and it then locates itself at once. A section can therefore occupy any position on the sketch, since reference to it is made by letters—as, section on line *A B* or *C D* etc.—leading at once to its identification.

One important point to be kept in mind when starting on a sketch is, that only one side can be drawn at a time, and that the best position from which to sketch any view of an object is immediately in front, looking squarely at it, and dropping out of sight all thoughts of perspective, leaving nothing in the mind's eye except the view to be drawn, as the mental picture is what must be reproduced.

A cylinder, Fig. 6, will require but two views to explain what it is. Following the instructions laid down, the center line should be drawn first, around which to construct the figure. Laying off points each side of this center line, and at equal distances from it, the diameter will be delineated when the points are connected by lines; perpendiculars now drawn to these lines, will then determine the length of cylinder. As the figure now stands, it is a rectangle having only length and breadth. It is apparent that a section or end view is necessary to give the remaining dimensions; and since the lines in the side view are parallel, it is evident that a section taken at any point would be similar to a section at any other place. We can, therefore, show the shape of the figure, which is a circle, by means of an end view, drawn through points as explained for Fig .5, the center of the circle being at the intersection of center lines.

A prism, Fig. 7, in side view is exactly similar to the preceding case, and is drawn on center lines as before. The end view, constructed on the center lines, is also necessary here, to make the figure complete; and so with all figures having more than two dimensions.

In the outline sketch of a boiler, Fig. 8, which is drawn from center lines, all three views are set off with one common center line as a base—as will be seen, it passes through the smokebox, the barrel of the boiler and the boiler head. These center lines on the sketch serve a double purpose: First—they make it possible to give a symmetry to the sketch, that would be wanting by any other freehand method; second—they are indispensable when putting in dimensions, for the reason that they are in the very places where figures are required.

Fig. 9 is a locomotive driving box, sketched in accordance with the center-line method, and the views arranged as suggested. The grouping and sections represent good practice for the subject. The side elevation is also a half section, which is a clear method of showing the outside and interior in the same view. The view marked "Section at *C D*" is a full section taken on line *CD*. This view could have been made a half section and half elevation, and shown the same as the side elevation, thus saving the labor on the left-hand view; but the three views were made to emphasize the possibilities of arrangement; for the section at *C D* would still answer all requirements if the full end view were omitted, by simply dotting the thickness of flanges in, as shown. It is seen that all particulars of this box can be given by means of two views only. The top and bottom views, not being necessary to a clear understanding of it, can be made or omitted at pleasure.

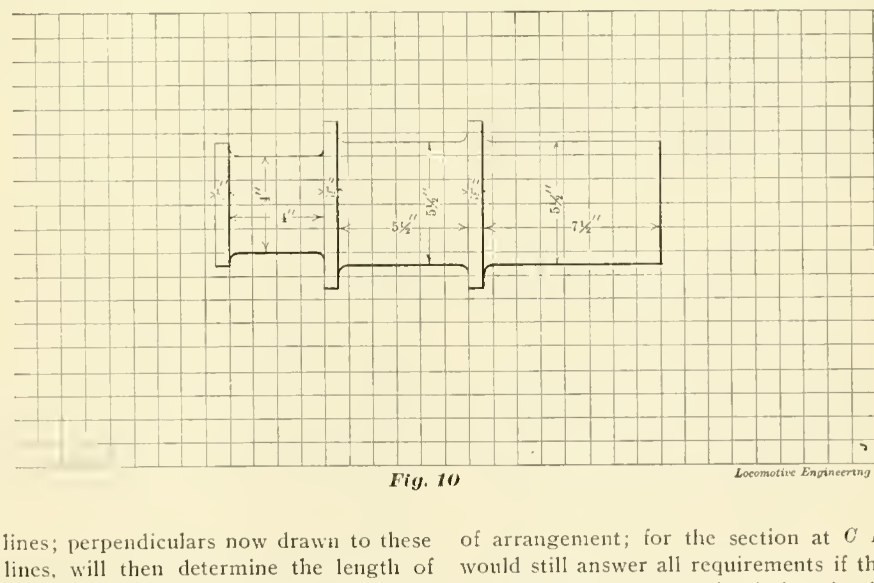


Fig. 10

Locomotive Engineering

Fig. 9 has the dimensions, to show how they would be generally applied in practice. The vital thing to keep in mind is, to have the figures so plain that there can be no question as to their value.

The examples before us refer to free-hand work exclusively, as we have seen, in which the matter of proportion depended entirely on the eye and hand. There is, however, what is called a "sketching pad," that is made expressly for draftsmen's use in rough sketching; this pad is 8x10 inches, and cross-sectioned into squares one-eighth of an inch wide, in blue lines on a smooth, firm white paper. This paper being ruled, it is not difficult to make a sketch that will approximate closely to the correct size. The best feature about it, perhaps, is the fact that the artist is relieved of most of his responsibility in getting the sketch to its proper proportions; as, from the ruling, the sketch can be drawn to any scale desired.

The crank pin in Fig. 10 is sketched on this paper, at a scale of 1½ inches to 1 foot, or one-eighth size, in which each square represents one inch. In the first process, the sketch had precedence, and the sizes were determined afterwards. In Fig. 10, the sizes must necessarily be found before the lines can be drawn, if the scale idea is followed out; and this tends to reduce the chances for error.

While a clean, mechanical-looking sketch excites pleasureable emotions in the observer, it is possible to conceal in those lines that we admire, some very expensive mistakes, when the figures are not correctly put on; and, as we have found in the heartless school of experience that there is no excuse discovered up to date for a "bull" thus made, we do not hesitate to recommend that accuracy should be the first and constant care, letting the artistic features come in for a close second. "It is better," as an old draftsman once told us in our callow days, "to be sure than sorry.

O. H. R.

Increase in Capacity of Cars and Locomotives.

"Twenty-five years ago," said Mr. J. H. McConnell, in a paper read before the Western Railroad Club, "a large portion of the freight and passenger traffic in the United States was handled with 16 x 24-inch cylinder engines. On a few roads with heavy grades 45-ton ten-wheel engines and 50-ton consolidation engines were used. The maximum load in a freight car was 20,000 pounds; and to prevent loading cars beyond that limit, a charge of double first class was added to the excess. With an increase in freight traffic came the 28,000-pound capacity car; this was very shortly followed by the 32,000-pound capacity car. As new equipment was needed, the 40,000-pound capacity car was introduced, which for a time was considered as having reached the limit for freight cars. The 50,000-pound capacity car followed, then the 60,000-pound capacity car, while to-day we see occasionally a car with a capacity of 80,000 pounds. The modern refrigerator car, with its load and ice weighs about 100,000 pounds.

"The 20,000-pound capacity car carried 300 bushels of grain; the modern box car carries 1,000 bushels of grain. Every part of the railway equipment, the track and bridges has been increased to keep up with the advance in the freight car. The same is true of the passenger equipment. With the 30,000-pound car we had the sleeping car weighing 60,000 pounds, and considered by many people entirely too heavy for the track. It is quite common now to see coaches weighing 80,000 pounds, and sleepers weighing 100,000 pounds. The 56-pound rail was followed by the 60, 67, 70, 75, 80, 90-pound rail, and 100-pound rail is being laid on some of the Eastern roads. The locomotive, to meet the increased service, has grown from a 30-ton eight-wheel engine to a 60-ton eight-wheel engine; the ten-wheel engine from 45 tons to 70 tons, and the consolidation engines from 50 tons to 80 tons.

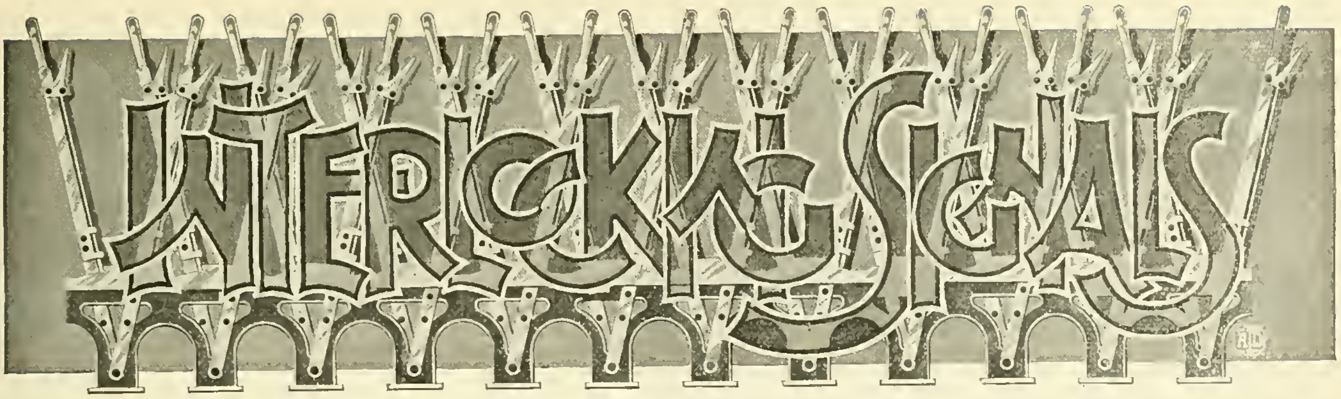
"The question is often asked if the modern locomotive moves as much tonnage in proportion as the smaller engine did twenty-five years ago. Old engineers frequently remark that the engines of to-day do not do the work in proportion to their size that the smaller ones did twenty-five years ago. Facts show that we are getting better work with the modern engine. Every condition is more favorable to the modern engine; we have greater weight on driving wheels, larger heating surface and increased steam pressure. Some records show a consolidation engine built in 1870 to have had 20 x 24-inch cylinders, a total weight of engine of 100,000 pounds, with 85,000 pounds on driving wheels, 1,500 feet heating surface in the boiler, and 140 pounds steam. A consolidation engine built in 1895 shows a great difference in everything except the cylinders, which are the same. The total weight of engine now is 150,000 pounds; weight on drivers, 137,000 pounds; heating surface in boiler, 2,200 feet; steam pressure, 180 pounds. The engine of 1870 hauled 24 loads weighing 528 tons, while the 1895 engine hauled a train of 35 loads weighing 1,120 tons over the same division. The increase in passenger service is almost as marked. Twenty-five years ago, with a time schedule of 22 miles an hour, it would have been considered an impossibility to make an engine haul 10 cars on a schedule of 40 miles an hour; yet it is now done every day, and these engines maintain a speed of 55 miles per hour between stations, with 10 cars. Have we reached the limit with the modern engine, and have we determined how much a locomotive can be made to earn for the company?"

Favors Springs Made by Specialists.

In the Master Blacksmiths' Convention, Mr. R. A. Mould, of the Erie, said: "From my own practical experience and knowledge, from my observation in repair shops and railroad shops, and what I have seen of manufacturing springs, I conscientiously say that I do not believe a spring can be made in the ordinary repair shop to compete with those of the specialist in spring-making. On our road, at least at the point where I am, we repair no spring only in a case of emergency, and then we go through the usual form, as is done by all mechanics. We use fish oil in tempering, and apparently our spring comes out all right, and possibly does as good service as though from the manufactory. But that is only one spring, while the manufacturers represent in all, tonnage from the lowest to the highest rate. We do not know the tonnage that is placed upon the different springs where they are applied. We are furnished with blueprints of a certain number of leaves. We build them accordingly, and they take the place to which they are to be applied. We do not know the strain those springs must endure to do their work properly; and I, for one, believe it is useless in the ordinary repair shop to undertake to compete with the general spring makers of this country, because I believe that in the long run we are getting a better spring, with better service and with less expense to our companies that employ us."

Other speakers expressed great admiration for the methods followed by the A. French Spring Works, in the manufacture of springs and for the material used.

In setting the flues of locomotives, the most common plan is to put copper ferrules on the firebox end and the plain tube on the smokebox end. The copper ferrule is put on the firebox end as a means of helping to prevent leakage, and it is very useful for that ; but it would pay railroad companies to put ferrules on the other end, also, if it were only for the saving of time effected in removing flues. When the flues get covered with scale, and a few lower rows have to be removed, it is a most difficult job drawing them out through the small holes made to snugly fit the size. The twisting and hammering necessary to get the flues out often results in distorting the hole, and even in cracking the flue sheet. The companies that use ferrules in front have no trouble in getting the tubes out. Ferrules cost little, and their use is a convenience worthy of general adoption.



By W. H. ELLIOTT, Signal Engineer, C., M. & St. P. R.R.

Agreements, Contracts, Specifications, Installation and Repairs.

In the early days of railroading, before many roads were built and while the rights of each were in process of development, it appeared a just and reasonable thing for one road to grant any other road the privilege of crossing its tracks whenever such a thing was desired—it being understood that the road making the crossing would be responsible for the maintenance of the same. As business increased and the demand for other tracks arose, the question immediately presented itself as to who should pay for the additional crossings made necessary thereby, each road very generously desiring to make the other road stand the entire cost.

This led to the roads interested drawing up an agreement, in which it was clearly stated who should maintain the crossing and what proportion of the cost each road should bear when any new work was to be put in.

The expediency of so doing having been established, any road desiring to cross the tracks of another was forced to sign an agreement whereby they were to put in and forever maintain the crossing at their own expense, and, furthermore, would put in and maintain any crossings made necessary by the laying of new tracks by the road first built.

The protection afforded at a crossing by the use of an interlocking plant having, in comparatively late years only, attracted the attention of railroad officers, no mention was made in the earlier crossing agreements of any appliances to make the use of the crossing safe, a flagman to signal trains being all that was thought necessary at even the busiest crossings. In these cases, when it was desired to install an interlocking plant, a new agreement had to be drawn up, covering the proportion of the original cost which each road should bear, and what proportion each should pay of the cost of operation and maintenance, one road or the other taking charge of the installation, operation and maintenance and billing against the other for their proportion of the cost.

At the present day, when one road desires to cross the tracks of another, the requirement is generally made that an interlocking plant shall be put in and maintained by the road wishing the crossing, as well as putting in and keeping up the crossing frogs, ties, etc., whether or not the business over either of the tracks will be such as to warrant the additional expense. But as laws have been passed in several of the States requiring all new crossings to be protected, and as it is in most cases only a question of a few years before an interlocking would be needed, it is certainly good policy for any road in drawing up an agreement allowing another road to cross its tracks, to include an interlocking plant in its requirements, stating what form of apparatus will be required. Such an agreement should practically be an "iron clad" affair, covering every point, of which the following list comprised the main items called for in an agreement lately made and which are given here for the information of those who may not be familiar with what may be required.

First. That the party of the first part, or the road first built, shall have the use of the tracks now owned and operated by it without any material impairment of their usefulness or safety by the party of the second part, or the road desiring to put in the crossing.

Second. That all crossings which it is the desire of the first party to construct, maintain and operate over the tracks of the second party shall be furnished and properly put in by the party of the second part.

Third. That the second party will furnish all the materials for and construct and put in all crossing frogs, crossing signals, gates, targets and other fixtures, according to plans and specifications furnished by the first party. All parts to be forever maintained and kept in good repair at the sole cost of the second party. And in case of failure to promptly furnish and put in or keep in repair any of these parts, the party of the first part may do the work and bill against the party of the second part for the full amount so expended. Any damages resulting from defective condition of said parts being paid for by the party of the second part, saving the party of the first part harmless therefrom.

Fourth. In the passage of the respective trains of the parties interested over the crossing, the passenger trains of the party of the first part shall have preference over the passenger trains of the party of the second part, and in like manner the freight trains of the party of the first part shall have preference; but in all cases passenger trains shall have preference over freight trains of either road.

Fifth. If at any time a difference of opinion between said parties shall arise, the question in dispute shall be referred to a board of arbitration consisting of three competent disinterested parties, one to be chosen by each of the parties to the agreement, and the two so chosen to choose a third. That written notice shall be given of the time and place of meeting, and that at the time and place appointed they shall proceed summarily to hear and dispose of the matter in dispute, the determination of such board of arbitration being absolutely final and conclusive upon the parties interested.

Sixth. That within ninety days from the date of these presents the party of the second part will provide said crossing with an interlocking plant, with pipe home signal connections, electric locking, and annunciators, and if at any time a device satisfactory to the chief engineer of the party of the first part be manufactured for the purpose of giving a continuous rail over the crossing on the line having the right of way over the same, it shall be put in and connected with the interlocking plant. The specification, locking, dogsheet and general plan of the interlocking shall be submitted to and approved by the party of the first part before the contract shall be executed. That the party of the second part shall bear the entire cost of such interlocking plant, operating and maintaining it at their own expense. That any additional tracks laid by either party are to be connected to the interlocking and maintained at the sole cost of the party of the second part, and that the party of the first part may take charge of and maintain and operate the plant, if the operation and maintenance by the party of the second part be not satisfactory to the party of the first part, the party of the second part paying all bills upon presentation for the amount expended in maintaining and operating said interlocking plant.

While the above conditions comprise the most important points generally considered in an agreement between two steam roads, there are several other points which have to be included when the agreement is entered into by parties controling a steam railroad with those controling a line operated by electricity. Briefly, these are, that all overhead wires shall be maintained at a height of twenty-three feet above the tracks of the steam road, conductors to be arranged for the return electric current, so as to prevent, as far as possible, leakage from its tracks, that will affect the operation of electrically controled railway signals, telegraph or telephone wires. That the overhead electric wires shall be so arranged as not to interfere in any way with the operation of the street gates, which the steam road is compelle l by city ordinance to maintain at such points of crossing.

The agreement having been signed by the parties interested, the next step is to prepare the plans and specifications for the interlocking and submit them to the signal companies for their bids. The plans submitted by the railroad company, when drawn up by the signal engineer, usually consist of a plan of the tracks with all the derails, switches and signals required, properly shown and numbered, the location of each and the distance from the crossing being clearly stated. Lines representing the connections to the switches and signals are also drawn, as well as lines to show where any heavy boxing is to be put in and which it is desired to have the signal company include in their bid. Where no signal experts are employed by the railroad company, a plan of the tracks is usually submitted to the signal companies with a request that they draw up a plan showing the proper signals to be used and how the several connections should be run, their bid being made upon the plan so drawn up.

Their bids are usually made upon specifications gotten up by them for the kind of apparatus which they manufacture, it being understood that the work is to be put in to the satisfaction of the railroad company contracting for the same. These specifications usually state the kind of machine, the number of levers and the number of switches and signals to be operated. They also give the size of the tower and of what the signal connections shall be made, practice in this regard being different on the different roads. The switch connections are given in detail, the size of pipe, method of fastening and means of compensation being also given. The distances apart that the pipe carriers and wire pulleys are to be spaced is stated, as well as the sizes of the different foundations and the thickness of lumber to be used in the boxing.

The part of the work that the railroad company is expected to do is plainly stated, comprising, for the most part, the track work in preparing the switches, derails and movable frogs ready to be connected. All preliminary grading necessary to be done and proper drainage wherever required. To furnish broken stone, sand and cement for concreting the heavier foundations, and to provide permits for building the towers and for digging across streets when necessary in cities. Railroad companies having a signal department usually submit with the plans to the signal company for their bid, any specifications in regard to details that they may wish to have followed when the work is put in. These generally relate to standards of the railroad not called for by the specifications of the signal company, or where some apparatus is to be used of a different design from that manufactured and furnished by the company bidding on the work.

The bids having been submitted and a selection made, the contracts are signed and the work commenced by the signal company, the rajlroad furnishing the material and doing the work that it was agreed in the contract they should do. The signal expert appointed by the railroad to inspect the work goes over the ground with the signal company's foreman and gives the exact location of the tower, the derails, signals and where the pipe lines shall pass under the tracks. The different ways of doing work are discussed and an understanding arrived at as to what will be considered good work and what the railroad will require, it being specified in the contract that the work shall be done to the satisfaction of the railroad company.

As the work proceeds, points in regard to construction will, from time to time, come up which the signal inspector will be expected to settle, to prevent a possible rejection on his part when the plant has been completed. Inspections will have to be made quite frequently to see that the work is being properly done and that the standards of the railroad are being followed.

When railroads have a regularly organized signal department, they often install a plant with their own men, buying the material from one of the signal companies, as their experience has been that the work will, at least, be better done, even if it should cost no less.

After the plant has been completed and before it is put in service, each lever should be connected to the switch or signal it is to throw, and a trial made to see that every part works properly. To do this without interrupting traffic only one switch, or the switches to be worked by one lever, should be connected at the same time, the connections to the arm plate casting of the signal being left connected, as, until the blade is bolted up no indication is made.

Should the work prove satisfactory, a day is appointed on which the plant will be put in service, this being a day or so before the signal company will have finished the boxing, painting and other work that can be completed after the plant is ready to be connected up and put in service.

Notice of the fact is given to all the railroad companies interested, so that proper bulletins can be issued notifying trainmen that the interlocking will be put in service at such a time and that they must be careful to obey the signals in running over the crossing. In connecting up the plant the signal blades should first be bolted on, this being done so that all the blades will be put up at the time appointed for the plant to go into service. After the time has passed, but not before, the derails may be connected up, the trainmen then being responsible for the consequences should they allow their train to run past a signal when at danger.

With States that require an inspection to be made by the railroad commissioners, or some one appointed by them, before a permit will be granted allowing trains to proceed over a crossing without stopping, an appointment with the Commission must be made, when they will inspect the plant, blue prints of the general plan, locking and dog sheets being sent in for examination and approval before the inspection is made. Should the work have been done as they think it ought to be to make the operation of the plant safe, a day is usually named in which the plant may be put in service, the permit when received reading as having been issued on that day.

Should the locking of the levers not meet their approval, or some part be left undone, in their judgment essential to the safe operation of the plant, a permit is refused and, when the changes or additions desired have been completed, another inspection has to be made. For this reason, when the Railroad Commission has to approve the plans and inspect the interlocking, it is a very good scheme to submit the plans to them before the work is proceeded with, so that no delay will be caused by any objection on their part.

If some other interlocking plant is already in service on that division, a bulletin notice is all that need be issued to trainmen, informing them that the interlocking will be put in service. But if it is the first plant to be installed, a set of rules should be issued to the men and an examination made to see that they know how to read the signals and understand what the consequences will be if they disregard them. These rules should describe a signal and explain what the different indications mean ; they should make it clear as to which signal will be used to govern a given track, and what will be the several duties of the trainmen when using the tracks protected by the interlocking.

After a plant has been accepted by the railroad and put in operation, they are then responsible for its condition and will have to see that it is kept in good working order, repairmen and inspectors being kept for this purpose. The organization of the force differs on almost every road, each one believing that theirs is the best and that the others are either not keeping up the plants as they should be, or else are doing it at a very much greater cost.

Several roads employ men as inspectors, who are responsible for the proper condition of the plants within a certain district, other men being employed to do the work and report to them. Each repairman is given so many plants to take care of, he being expected to go and look them over as often as possible, making any adjustments or slight repairs that may be needed. Should there be no repairs to make, he is to put in his time cleaning up the plant, or, at any rate, looking for work.

This way of doing things is, in the long run, a somewhat expensive one, as in most instances there is no work for the repairman to do, or rather, none but what in the majority of cases the signalman can look after. The man's time has to be charged to repairs, whether there is any work to be done or not. In case of any large amount of repairs being needed, additional help has to be employed, as one man is not able to do very much by himself, and while the claim may be made that by keeping a man on the ground almost all the time the plant will not be run down sufficiently to need any very general repairs, experience and reason will, I think, prove that this is not so, and that no matter how well this man may attend to his duties, it is not practicable for him to keep the plant in first-class condition, or, in other words, from wearing out.

Another plan is to divide the road into districts, making each one so large that the repairman is able to get around only occasionally, making inspections and light repairs only and having help furnished him when any large amount of work is to be done. At some central point an additional force is employed, which is used in putting in any new work, making general repairs, or any repairs needed in case of accident. These men should all be experienced workmen, one or two of them being capable of taking charge of or putting their hands to any work that may turn up. They should be able to do a good job in pipe fitting, machine work, blacksmithing, carpentry, cleaning batteries and adjusting relays, and while such men are not to be found every day, if the signal engineer will see to it that only good men are employed and that they are given a chance to learn, they will become very efficient and be able to do good work in any of the lines enumerated. Of course, at very large plants, one, or perhaps two repairmen will be needed at all times, their presence being made necessary more as a protection in case of accident, to keep the road from being blocked, than because of the amount of work there is to do.

Another plan, again, is to have practically no regular repair force, but only such men as are needed for new work and general repairs. On the road following this plan, the signal engineer has the hiring of one of the operators, who will be responsible for the maintenance of the plant and must make all necessary repairs and adjustments while attending to his other duties. This man must have had sufficient experience, before being appointed to a position, to enable him to make any ordinary repairs, and being in a position to reap the benefits from keeping the plant in good condition, is very apt to do so, provided he can find the time. And right here is where the greatest objection to the plan can be made, for, if the road at that point is a very busy one, then the man will certainly not be able to leave the tower long enough to do anything more than to change the adjustment of the connections, or to clean and oil the different parts when necessary.

Of the three ways spoken of, the last is much the cheapest, but if the chances of accident and possible delay to trains where this plan is followed be taken into consideration, the conclusion must be arrived at that it is economizing in the matter of labor at the expense of safety. Where a road has in service a number of block signals, interlocking plants and switch signals, sufficient to keep a regular repair force employed, such as is outlined in the second plan, it will be found by far the best and easiest method of having any new work done or repairs quickly made. The cost will be but little, if any, more than with the last plan outlined above, and the equipment will be kept in better condition.

In regard to the railroad employing their own men and putting in their own work, I think that, as a rule, this is not a good plan, for unless the railroad has as good foremen as the signal companies employ, and they seldom have, the work will be more cheaply done by the signal company. The claim that the work will be much better done when put in by the railroad will not count for much, if a competent inspector is appointed to supervise the installation, as the signal companies are certainly willing and try to put in the work to the entire satisfaction of the parties having the work done. Their reputation is at stake, and while they may not do as good work when no one is sent to supervise the installation, they can hardly be blamed for this, as they have not to take care of a plant after it is finished, and by doing new work only, do not find out the weak points in their work.

Unless a railroad will employ the services of a good foreman, it will, I venture to say, cost them more in putting in an interlocking plant than if the work was done by one of the signal companies. The chances of a man's doing the work wrong and having to go over it a second time are so great, and the work is so often done in the country, where the men have of necessity to be left very much to themselves, that unless the man in charge not only knows how to do the work, but is capable of properly handling men, the work will cost very much more than was expected.

As a matter of protection, in case of accident or breakage of the apparatus, every signalman should be taught how to disconnect and spike a derail or switch, to make adjustments, or any repairs that may be needed to make it safe for trains to pass through the interlocking. A catalogue of the apparatus manufactured by the signal company installing the plant will be found an excellent book to put in each tower, as the signalmen will then be able to make themselves familiar with the correct name of each part, and, in case of accident, to give page and order number of any new pieces that may be wanted, in this way insuring that the right parts will be sent him.

To enable the signalman to make temporary repairs, he must be provided with a set of tools, of which the following is a list of those commonly furnished, the articles needed in furnishing a tower when first put in service being also given: One machinist's hammer, one spike maul, one hand axe, one hand saw, one claw-bar, one 12-inch combination monkey wrench (Fig. 1), one socket wrench for ¾-inch bolts, one pair 10-inch Button's pliers, two cold chisels, one fine file, six sheets emery cloth, one long-neck oil can, one short-neck oil can, one squirt can, one white hand lantern, one red hand lantern, two red flags, one telegraph table with drawer, one office chair and cushion, one bracket lamp, one corrugated rubber mat the length of the machine, one Seth Thomas eight-day clock, six fire buckets, six hand grenades, one water bucket, one tin drinking cup, one broom, one mop, one coal hod, shovel and poker.

The number of fire buckets and hand grenades in this list may be surprising, as one would hardly think there would be much danger of a tower catching fire when as isolated as they usually are. But the fact is they catch fire very easily, from matches carelessly thrown away, from blazing grass and from many other causes, and, from the fact of their being isolated, generally burn down entirely after once catching fire, the interlocking machine being destroyed, causing delay and great inconvenience in the handling of trains. To reduce the chance of a fire no lamps should be allowed in the tower, nor should any greasy waste be allowed to lie around or accumulate. The lamps should be cleaned in the day time, in a house provided for the purpose—the design shown in Fig. 2 being that of the coal and oil house supplied to all of the interlocking plants of the Chicago, Milwaukee & St. Paul railway—the house being placed not less than one hundred feet from the tower.

For the guidance of the signalman, the following set of rules, signed by the general superintendents of the roads interested, is framed and put in all the towers of the St. Paul Company, the man in charge being held strictly accountable for the proper observance of every one of them:

1. Trainmen are instructed to obey the

directions and signals of the signalman; you will, therefore, see that trains are passed without delay or stoppage when it is known to be safe to do so.

2. Precedence on conflicting routes will be determined by time cards. A delayed train must not be given the line when running on the time of an opposing regular train.

3. The normal position of signals is at *danger;* of derailing switches, open; of levers, thrown *ahead*, where they must always remain when no train movements are being made. Each signal in succession *must be* thrown to its normal position as soon as rear of train has passed it.

4. When train gives notice of its approach, set switches and signals for the desired route; but be sure that no obstacles exist on route before setting signal for it.

5. When a signal has once been given for any train, should it be necessary to change the position of signals or switches, the signal may be changed to *danger*, but the switches must not be changed nor the signal given to another train on an opposing route until the train which first had the signals has come to a full stop.

6. No switching which requires blocking the main track must be allowed within five minutes of the time of any regular train.

7. Levers used in switching must be returned to their normal position as soon as switching is completed.

8. In case of derailment at switch, disconnect switch and take detector bar off by removing clips from rail. Take great care to protect interlocking from unnecessary damage while replacing cars or locomotives. Report all cases of failure of trainmen or others to observe proper precautions to prevent unnecessary damage, as you will be held accountable for the same. Pass no trains after derailment until all parts liable to damage have been examined and steps taken to protect trains. Be sure that track is safe before allowing trains to pass over.

9. In case of accident, notify division superintendent and mechanical engineer at once by telegraph and call section foreman.

10. In case of accident to switch, disconnect it, set it for the main line and spike it. Use a flagman to protect all disconnected switches.

11. Should it be impossible from derangement to throw signals when switches are closed train must come to full stop; signalman may then flag it past *home* signal after protecting all conflicting routes by placing their signals at *danger*.

12. Never move a switch lever when a train covers the switch or detector bar.

13. During freezing weather move all levers frequently and keep apparatus free from snow or ice.

14. *You* are not allowed to and must see that *no one* but an authorized workman makes any change in the apparatus or locking, except under written order from the division superintendent or mechanical engineer.

15. Do not handle the apparatus roughly; pull the levers with a steady movement, being especially careful to move the signals without injurious jerk.

16. Keep all switches, locks and detector bars clear of cinders, ballast, sand, etc., and keep apparatus oiled.

17. Report at once any disregard of rule forbidding use of sand by engines, with number of engine, train, etc.

18. Inspect all switches, signals and

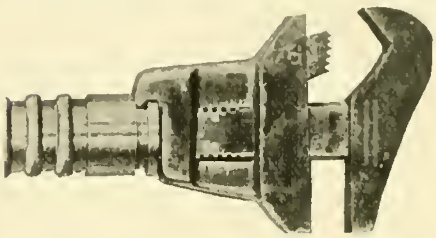


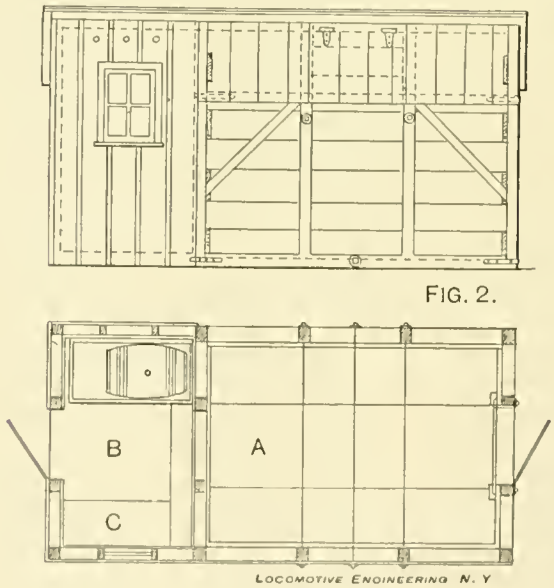
Fig. 1.

lighted lamps carefully as often as the weather or other conditions may require, reporting every case of trouble.

19. Lamps must be handled carefully; keep them clean and in order, as per special circular of instructions; light and place them in position at the proper time.

20. Daily reports must be filled out according to instructions and sent regularly to division superintendent and mechanical engineer. These reports must be full and intelligible, giving exact character and location of trouble or defects in plant and pattern number or correct name of broken part.

21. Allow no one to enter tower whose



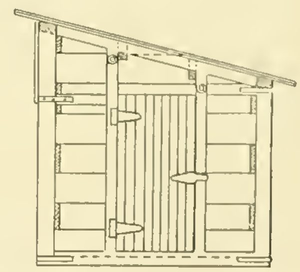


FIG. 2.

COAL AND OIL HOUSE, C., M. & ST. P. RY.

A, Coal room, floor plank laid on cinders.
B, Oil room, earth floor.
C, Zinc-lined shelf.

duties do not require him there, without a written permit from the division superintendent or mechanical engineer.

The daily reports alluded to are made on manifold paper of the form as given herewith, a copy being made out each day by each of the signalmen and sent to the proper officers.

Form S–1.

CHICAGO, MILWAUKEE & ST. PAUL RAILWAY CO.

DAILY SIGNAL REPORT.

....Tower.

Time...........M............ .....189..

To.... ....

Is apparatus in good working order?...
What trains have been delayed?.... ....
....

Note carefully any defects, looseness or breakage of apparatus or trouble with lamps, and state what steps you have taken to repair. Give train and engine numbers in cases of disobedience of signal rules.

Remarks:........... ....

....

(Thirteen blank lines.)

....*Signalman.*

These reports are of great assistance in keeping track of the workings of the different plants and of any accidents or delays which may have happened. It also permits of a record being kept of almost everything that takes place at each of the towers, and by summarizing them comparisons can be made of the performance of each.

The following list is a somewhat condensed summary of these reports for forty-one interlocking plants for the month of July, 1895, from which some idea can be formed of what has occurred during the month, and has been mentioned in the reports:

Damage by accident, 2.
Failure through neglect of operator, 5.
Train off track at derail, 1.
Ran through open derail, trailing point, 1.
Defects of apparatus; lack of adjustment, 6.
Other defects, 2.
Track relays out of adjustment, 1.
Failures of circuits from other causes, 2.
Large repairs completed, 8.
Number of times at work making repairs, 88.
Inspections made by repairmen, 147.

Trains delayed; defects of apparatus, 1.
Trains delayed by other trains, 32.

EAST BOTTOMS INTERLOCKING.

C., M. & St. P. Ry., and C. & A. Ry.

crossing

Mo. P. Ry. and K. C., O. & S. Ry.

Machine.	*Agreement of Expenses.* Date of, 5–28–92. Construction and Maintenance.	*Agreement of Expenses.* Operation.	*Contract.*
Saxby & Farmer. 8 Signal Levers. 9 Switch Levers. 1 F. P. L. 2 Spare. 20 Lever Frame.	C. & A. Ry., 25 per cent. Mo. P. Ry., 25 " K. C., O. & S. Ry., 25 per cent. C., M. & St. P. Ry., 25 "	K. C., O. & S. Ry., 50 per cent. C., M. & St. P. Ry., 50 "	Date of, 1–26–94. Cost of, $4,791. Tower, 800. Built by U. S. & S. Co. Maintained by C. M. & St. P. Ry.

A general plan of each interlocking, with a sheet giving the agreement as to division of expenses and other information, as shown above, if made on a sheet 4x7½ inches in size and all fastened together, will be found a very convenient form in which to keep any information pertaining to interlockings, which has to be referred to so frequently by the superintendents, the auditor and the men in the signal department.

By making the originals on tracing cloth, copies can be cheaply and easily made and furnished to each officer desiring a set.

On the Seaboard Air Line.

The Seaboard Air Line is one of the most valuable railroad properties south of the Potomac, and has done most valuable service in developing the resources of the rich districts which it traverses. It is the transportation artery for Southern Virginia, Central North Carolina and South Carolina, with terminus in the center of Georgia, and with connections that lead directly to all the most important cities of the South. Until lately, the capabilities of this fine property have not been much developed; but the new management, of which Mr. E. St. John is the representative, is inspiring new life into all the departments, and is putting the system upon a basis which will not only perform better work for the interests depending upon good transportation facilities, but will give the stockholders satisfactory returns upon their investment. The change of policy has worked hardships to some individuals; but it was necessary for the good of the company, and had to come, sooner or later.

The men previously in charge were respectable railroad officers, but they were not inspired with progressive ideas. What had been good enough for their fathers was good enough for them. While competing lines were adopting the most approved modern methods, the old regime of the S. A. L. were contented to abide by the practice found satisfactory to a past generation. This was particularly apparent in the mechanical department. While the nominal heads were good men, they were so much dominated by general officers, who meddled with mechanical details which they did not understand, that the men in charge were discouraged from making any improvements. The new blood that came in with Mr. St. John are under no such restrictions, and they are laboring hard to put the department upon a modern basis. This has caused considerable heartburning among the interests stirred into unwonted activity. When the smoke of the conflict clears away, I feel certain that those who have made the strongest opposition to changes will acknowledge that the changes introduced were necessary and beneficial.

In the course of a Southern tour, I enjoyed the pleasure of visiting the repair shops of the company at Portsmouth, Va., and at Raleigh, N. C. Mr. W. T. Reed, superintendent of motive power, now makes his headquarters at Portsmouth, and he is laboring hard to put the shops on a basis for doing the work expeditiously and economically. In this he is heartily supported by his master mechanic, Mr. C. B. Royal, but they have by no means an easy task to perform. I have visited most of the railroad repair shops in this country and I have never seen an establishment so badly planned for the purpose intended as the Seaboard Air Line shops at Portsmouth. They are good, substantial brick buildings, arranged roughly in an equilateral triangle. If a man had deliberately sat down to plan buildings in a way to making the transfer of work from one shop to another as difficult as possible, he could not have devised a better plan than that put into brick and mortar at Portsmouth. The plans were drawn up by a general superintendent, and protests made by the master mechanic were overruled as unworthy of consideration. The company will pay, as long as these shops stand, for the luxury of permitting officials clothed with a little brief authority to supervise work they were ignorant of.

The men in charge are not attempting to make any revolution in the shops, but they have been cleaning up the scrap accumulations of many years, and are introducing labor-saving tools and improved methods of doing work. They have splendid locomotives and cars which are kept in excellent condition, and they have as fine a class of enginemen as I have ever met.

At Raleigh the shops are much better arranged than those at Portsmouth, but many of the tools are old, and Master Mechanic Maglenn has no easy task keeping up with the work. While visiting there, I was treated in a most hospitable fashion by various officials, and was introduced to the Governor by Labor Commissioner Lacy, who is one of the leading citizens of the place. It troubles me not to be able to praise everything I saw, but truth compels me to draw the line outside of the shops. The men were as fine fellows as I ever met. A. S.

Colombia seems to be rather a hard country for chief engineers of railroads to live in. In an article contributed to a late number of the "Engineering Magazine," mention is made about the chief engineer of the Bucaramanga Railway being bitten in the leg by a snake while fording a creek, which caused his death. The same year the chief engineer of the Cauca Railway was drowned in the Dagua River—that mountain torrent of whose navigation Humboldt wrote that "each canoeman was a god, and each push of his pole a miracle"—and the engineer of the Cucuta Railroad had the yellow fever twice, but survived it, much to the amazement of the citizens of the city, who seem to take a pride in the fact that chickens, hogs, cattle, and even mules, imported from the United States, die of yellow fever.

It is strange the changes that time makes among the best-regulated authorities. Steel for fireboxes of locomotives began to come into general favor about 1875. At least there was an inclination to believe that it was the best material for the purpose, and all the more progressive master mechanics were specifying it. In looking over a number of the "Railway Age" for 1880, we find the remarks: "Master mechanics seem to be reaching the conclusion that steel for fireboxes is a failure, and the substitution of copper is going on." That was a case where the substitute proved worse than the original.

Nashville, Chattanooga & St. Louis Shops.

[EDITORIAL CORRESPONDENCE.]

A traveler going from Chattanooga over the Nashville, Chattanooga & St. Louis Railway, sees close to the track near Nashville a village of red brick buildings, which a railroad man will readily identify as the locomotive and car repair shops of the railway he is riding on. A brief glance in passing impressed me with the belief that these were the finest shops south of the Ohio River; a day spent examining them convinced me that there are few such fine shops to be found on this continent.

The shops were built four or five years ago, on a triangular site about two miles from Nashville, the main line of the N., C. & St. L. bounding the ground on one side and the Charlotte pike on the other. The shops consist of eight or ten substantial buildings, very tastefully designed and rather ornate, with stone foundations.

A FINE ROUNDHOUSE.

Beginning at the apex of the ground, we examine the roundhouse, which is of brick, has 40 stalls, and is 75 feet between walls. The roof is a light steel truss, supported by pillars of double Z-bars. The doors open inward. The pits are arched to secure proper drainage, and special attention has been bestowed upon sewers to carry off water. In fact, a noticeable feature about the whole of the shops is the excellent system of drainage and water supply. There is a substantial floor of oak planks set on a concrete foundation. Movable smoke jacks are used, and for every two stalls there is a slatted ventilator on the roof. The appliances for washing out boilers are the most approved for doing the work with hot water.

There is a good equipment of brake-testing appliances in one part of the house, which is also used by Mr. Otto Best for the instruction of the trainmen. Otto is one of our most accomplished air-brake experts, and has a set of well-informed trainmen.

Near the entrance to the roundhouse are the clinker pit, coal chute, water tank, sand house and oil house. Engines have an outgoing track, separate from that used to enter. They are so arranged that an engine on the clinker pit, or at any of the other supply places mentioned, does not interfere with an outgoing engine.

After a very careful examination of this roundhouse as a building, of the methods for caring for the engines, and the conveniences for handling supplies, I came to the conclusion that it was the most comfortable and convenient engine house I had ever seen.

THE SHOPS AS A WHOLE.

Leaving the roundhouse by a side entrance which is used for moving engines to and from the machine shops, we encounter the power house, light house and smaller buildings. Entering the main building, we find a splendidly-lighted machine shop, and, annexed thereto, the erecting shop, 250 x 100 feet. Separated from this by a transfer table is a building 250 x 60 feet, where accommodation is provided for the boiler shop and tender repair shop. At right angles to this are the blacksmith shop, 200 x 70 feet, and foundry, 200 x 60 feet. Beyond these buildings are the sand house for foundry, pattern storage and store house. Alongside of the iron-working buildings are a large storage platform and a variety of service tracks; then beyond them are the wood-working shops. By this arrangement, car and locomotive shops, with their minor offices, are grouped into a ground plan that is almost square. The arrangement is very convenient, for no erecting or finishing building is far from the shop where its supplies originate. For instance, the foundry and blacksmith shop are situated so that their product can be sent to the locomotive shops or to the car shops with the least possible trackage. The planning of the whole establishment has been done with the view of making the handling of material between the various shops as convenient as possible.

The shops, as a whole, form a monument of the good sense of the management. President Thomas employed good engineers to plan and supervise the building of the shops; but all the arrangements of buildings and tools were put under the charge of Mr. James Cullen, superintendent of motive power. He was interested in having convenient shops, and knew what he wanted. The result is an establishment which will meet the wants of the system for many years.

THE MACHINE SHOP.

The machine shop has the tools grouped with the view of performing all operations, to an article, with the least possible handling. As we enter the shop, we find the first section devoted to wheel and axle work. Here are, in convenient proximity, wheel borers, wheel presses, axle lathes, and all tools needed for this species of work. Wheels are turned out from this point ready to go under locomotives and cars. From here they are run upon an adjoining track and distributed to the various shops. Carloads of them are brought here from the foundry, with very little handling. The principal labor in handling weight is done by two overhead traveling cranes—one of five tons' capacity, the other for lighter weights. The heavy tools are all placed so that the work can be conveniently handled by the traveling cranes. Some of the tools are served by differential pulley blocks, and the intention is to introduce air hoists. They are piping the shop to transmit the power necessary for operating a variety of pneumatic tools. All the tools necessary for finishing cylinders are grouped together, and the same plan is followed for frames and all the heavier parts of locomotives. The tools, as a rule, are first-class, but there are a few that might be retired to advantage. The light machine tools are placed near the windows, beside the vise benders.

They have a very well-arranged tool room, which contains a good collection of first-class small tools, gages and templates.

The tracks of the erecting shop are set at right angles to the machine shop, and work is handled by the overhead cranes.

The locomotives belonging to this railroad are required to do very heavy work, as there are numerous steep grades. On such roads there is generally much grief from broken piston rods. I was surprised to find that the N., C. & St. L. have very little annoyance from this source. They fit the rods very carefully, grinding them into crosshead and piston. They say that there used to be considerable trouble from broken piston rods when they used fibrous packing, but that the use of metallic gland packing and ground fits has almost ended that source of annoyance. They also say that when fibrous packing was used, bent piston rods were common, but that disorder is no longer known.

THE BLACKSMITH SHOP.

All the other shops are well provided with tools, and are well managed by good foremen. The blacksmith shop is noteworthy in this respect, having a fine collection of formers devised by Mr. Grant, the foreman, an old Scotchman, whose heart is very much in his work.

THE CAR SHOPS.

The car shops are arranged similar to the iron working shops, the passenger-car shop and paint shop—two fine buildings—being set parallel, with a transfer table between. The planing mill and freight-car repair shop are set parallel, and at right angles to the others. The car department is as well equipped for doing work economically as any shop to be found. There was nothing of special interest in these shops, the only notable thing being that great care is taken to do the work well. They are particularly careful about the selecting of wheels and the fitting of axles. All wheels are put in centers before being put under cars, and if they are found 1-16 inch out they are not put under passenger cars.

MAKING THE EMPLOYÉS COMFORTABLE.

Much attention is bestowed upon providing comforts for the workmen. All the shops are heated by the Sturtevant system, which in summer is used to cool the shops. Unusually good lavatories are provided, and the men have neat cupboards for holding their clothes. The management appear to take a personal interest in the welfare of the men, and their kindness is appreciated. There are more passes given to employés on this system than on any railroad of equal size in the country. Mr. Thomas, assistant general manager, not only gave passes to Atlanta for all who wished to attend the Exposition, but got sleeping-car passes for most of the women who made the journey.

A. S.

Great Inventions Originated in New Jersey.

We notice in an article published by "The Stevens Indicator" that Mr. J. Elfreth Watkins, curator of the technological collections in the National Museum at Washington, claims that New Jersey was the first to give the following inventions to the industrial world:

"The first steam engine on the Western Continent was erected at the Belleville Copper Mines, near Newark, in 1753, by Hornblower, sixteen years before Watt began his investigations.

"The first steamboats driven by a single and twin screw propellers were constructed by John Stevens, at Hoboken, in 1802 and 1804.

"The 'Phoenix,' the first steamboat to navigate the ocean, was designed, constructed and navigated by Jerseymen—John Stevens and his son, Robert L. Stevens, in 1807-1808.

"The first charter for a railroad in America was granted by the Legislature of New Jersey in 1814, for a railway from Trenton to New Brunswick, during the war of 1812.

"The machinery of the 'Savannah,' the first steamship to cross the Atlantic ocean, was constructed at the Vail Works, Speedwell, near Morristown, N. J., in 1818.

"The first steam locomotive in America to convey human beings on a railroad track was constructed at Hoboken in 1825.

"The first successful experiments with the electro-magnetic telegraph, based upon the discoveries of Professor Henry, of Princeton College, were made by Vail and Morse at Speedwell Works, near Morristown, in 1838."

Cleaning An Oil Cask.

BY SAM SHORT.

"I had a funny experience with my stationary engineer the other day," remarked the master mechanic from Maine.

"Fritz is a good man and attends to his duties in fine shape, but he is not burdened with an overplus of brains.

"He came to me and said: 'Mr. M., I haf some abbles dot I vill make de cider, an' I vud lige un oil gask for holt de cider. Vill you sell me de gask?'

" 'Put cider into an oil cask?' I said; 'why, you must be crazy. No one could drink cider that was flavored with kerosene oil.'

" 'But, Mr. M.,' said Fritz, 'I vash de gask mit shteam.'

" 'Well, you may take a cask,' I said.

"An hour or two after that conversation, I happened to be passing the engine house, and there was my brave Fritz preparing to 'vash his gask mit shteam.'

"There is a 1½-inch pipe leads from the boiler house through the wall, to the outside. It is used for blowing out the boiler. There is a cock outside for convenience of opening. The pipe is pretty close to the ground, but not so close that the bung of an oil barrel cannot be pushed on to it.

"When I got there, Fritz was working the end of the blow-off pipe into the bunghole of the barrel. It was a tight fit, but after considerable wrestling he got it in. Then he reached over for the blow-off cock and opened it gradually. As the pressure accumulated, the tendency was for the steam to force the cask off the pipe. Fritz resisted this, with all his weight lying upon the cask; and as he found that he could hold it in position, he reached over and opened the blow-off cock wider. Then there was a struggle between the forces of fat and muscle and the power of expanding steam. One end of the cask would jerk out; then, under the weight of Fritz, it would bound back, and the other end would plunge to escape from its moorings. There seemed to be nearly an equal combat between the contending forces, when, all at once, cask staves, hoops and Fritz went into the air in a promiscuous mass! They all came down together, after having gone up about twenty feet, and I ran up, expecting to find Fritz dead. He looked up, a little dazed; and, lifting a stave and looking at it, he remarked: 'By golly, I clean dat gask goot!' "

Position of Exhaust Nozzles.

It appears still to be an open question whether single or double nozzles are calculated to produce the best results with a locomotive. If there is carelessness in managing the locomotives, which permits nozzles to get badly coated with incrustation, double nozzles can be used with the least obstruction to the escape of steam. Where constant care is exercised to keep the tip clean, a single nozzle on a well-designed exhaust pipe will let the steam out with a minimum of back pressure. With a badly-designed exhaust pipe, a single nozzle will send so much steam into the exhaust passage of the adjoining cylinder, that a serious loss of power and waste of steam results. In fact, the steam from one cylinder shoots over into the other, putting obstructive pressure upon its piston.

Bad designs of exhaust pipes are not, however, confined to those intended for a single nozzle. Mr. Lape, superintendent of motive power of the Southern California, speaking on the subject of exhaust nozzles, said: "In some engines built not long ago we ordered double nozzles, and the builders put in nozzles 11½ inches across the front. We had a good deal of trouble with the engines not steaming, and we took those nozzles off and put on our own, which are only 9¾ inches across, and it made all the difference in the world. When double nozzles are too wide, the steam is not delivered central into the stack, and the draft-creating effect is impeded." This is a phase of the nozzle question which has received little attention. In fact, we do not remember having seen it mentioned before in any public utterance of railroad mechanical men; yet it may make all the difference between a good and bad-steaming engine. Many experimenters have labored to find the relative effects of high and low nozzles; but none of them seems to have paid any attention to the spread of the exhaust tips.

Doubling Train Speed.

Hiram S. Maxim, the famous inventor, has been writing to "Cassier's Magazine" about the possibilities of train speed, in which he predicts that our fastest speed of to-day will be the slow speed of the future, when electricity gets turning the wheels of surface railroad trains. He said he could see no reason why we might not expect to double the speed of steam-driven trains, by so constructing the trains that they could pass through the air without any great resistance. He says the trains should be pointed at both ends, and have the appearance of being in one piece—even the wheels and the axles should be boxed in. He had found in his experiments that atmospheric skin friction on a smooth surface is so very small that it need not be considered as a factor at all; that the power required to drive a rough or irregular body through the air is very great.

If Mr. Maxim is correct in what he says about the reduced resistance, particularly of smooth surfaces, we think it would pay some railroad company to make a practical test of the thing, even before they begin to abandon their steam locomotives.

Automatic signaling devices are not in favor among trainmen in Europe. They have been so long accustomed to depend on human intelligence for giving notice of danger, that they have no confidence in any other method. In the neighborhood of London, fogs are frequently so thick that extra signalmen have to be placed about one or two hundred yards apart. An automatic signaling arrangement would be perfectly suitable under such circumstances, and could be made more reliable than flagmen, but the engineers object to anything of the kind, and the officials back them. The enginemen say that they have "no use for anything that can't swear at a 'chap' when he don't pull up at the time he ought."

Who First Contracted the Base of Stack?

Editors:

I learn from page 57 of the January number of "Locomotive Engineering," that the question "is settled, for good and for all, who it was that first contracted the base of the stack to increase the pull on the fire." It might, perhaps, be considered presumptuous for me to question the correctness of the above statement; but I think I will provoke no just cause for censure if I describe a device in use by me in 1843 or '44, in a locomotive called the "Franklin." I put a horizontal partition in the smokebox, above the tubes, and made the inside pipe of the smokestack (all stacks in those times had an inside pipe) much smaller at the bottom than at the top, and put it down through the top of the smokebox and connected it with the partition. By this arrangement, the smokebox, for all practical purposes, was made smaller, the inside chimney longer; and being smaller at the bottom than at the top, all tended to and did "increase the pull on the fire."

Springfield, Mass. WILSON EDDY.

[It appears to us that Mr. Eddy has shown beyond dispute that he was the first to contract the base of the stack for the purpose of increasing the draft. In his long career as master mechanic of the Boston & Albany Railroad, Mr. Eddy originated a great many improvements which have found a permanent place on the locomotive. But he made so little noise about what he had done, that others have repeatedly received the credit—Eds.]

Governors for Water Pumps.

Editors:

I notice in the January issue of "Locomotive Engineering" where Mr. Hitchcock mentions and describes an attachment for water pumps. We are using a No. 6 Knowles pump for boiler-washing, and for some time we experienced considerable trouble and delay in getting pump started and stopped. Several months ago we attached a Westinghouse governor to the pump, thus obviating all previous difficulties and maintaining an even pressure at all times, and not requiring any attention other than to fill the lubricator.

T. L. STEVENS.

Temple Station, Tex.

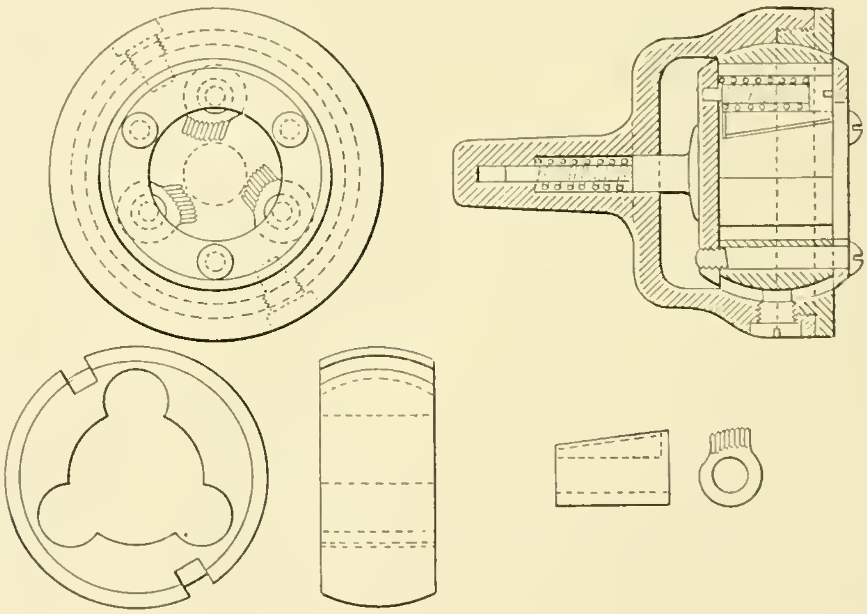
A Chuck for Screwing Stay-Bolts.

Editors:

I send you a drawing of a chuck for screwing in stay bolts which I find far superior to any I have ever seen, and which is being successfully used in the Mo. Pac. Ry. shops at St. Louis.

B, the jaws, are eccentric like, and of such shape they will satisfactorily grip from ⅞ to 1 3-16 staybolts. When jaws are placed in ball A, a spring is placed on the inside of each jaw, and will thereby be held open for the purpose of relieving itself quickly. A plate on the inside and one on the outside hold jaws in place.

The object in making a ball is, it can be



held at any angle. This chuck will be easily understood from the drawing.

F. W. ROEBBEL,
Tool-maker, Mo. Pac. Ry.

St. Louis, Mo.

Too Much Cylinder.

Editors:

It is not so very many years ago that the practice became quite common to employ locomotive cylinders entirely too large for the capacity of the boiler, and cases were not rare when the inevitable was to occasionally stop between stations, cut loose, pump up, raise steam and go ahead.

Gus. L. was an unfortunate individual who, some twenty years ago, was running a "Dutch wagon," as the Schenectady engines were then generally known. This engine had, when Gus. "took" her, as he expressed it, a 14-inch boiler and 16-inch cylinder, but he managed to get along fairly well, being a first-class engineer and ambitious to make a record.

In time, the old "8," like all engines, went into the back shop, and the master mechanic concluded to give her 17-inch cylinders. Eventually she came out, thoroughly overhauled, with lots of polished brass and variegated striping, and Gus., with many misgivings, resumed his place in the cab. Everything came his way excepting steam, and his grief and trips were inseparable.

He generally stopped about three times to get her hot while covering the division of 70 miles, but never a word of complaint.

One day the writer was standing in the roundhouse, conversing with the M. M., when Gus. happened along. The "old man" called Gus. to him and said: "Gus., what is the matter with you?"

"Nothin'."

"I think there is."

"Maybe," said Gus., "but I didn't know it."

"Gus., here you have been running a new engine with 17-inch cylinders, while Bob Lawton has a little Detroit with 14½-inch cylinders. You start out of B——, right behind him, with the same number of cars, and he gets home and has a pretty fair night's sleep before you show up. Now, what's the matter with you?"

Gus. straightened up, looked the M. M. squarely in the face and replied: "Well, Mr. G., what in h—— does the size of the cylinders amount to if you ain't got nothin to put in them?"

Chicago, Ill. S. J. KIDDER.

Cutting of Wheel Flanges.

Editors:

We have been troubled greatly on our mountain road with cut driving-wheel flanges. We have tried water, throwing the wheels, moving and redistributing the weight, but all to no purpose. The flanges generally cut more on the left side; but, of course, that is easily accounted for, as the pull over the division is heavier one way than the other, and one way they run over a great part of the division shut off.

But this is not always the case; for in some instances they cut the reverse. In these cases, no doubt, one wheel is a little larger than the other, which I have proved in a few instances; in others, the journals have not been trued up when in shop. The journals are taper; and if one journal is the least larger than the other, even if both journals are worn out of parallel the same, the wheel will habitually crowd the rail next the large part of the large journal, whether on the off or near rail. I have also noticed that the least difference in the coning will cause drivers to crowd—and a great deal less than people generally think.

I remember on one occasion a wheel having two badly worn flats, which was put down to two things—one person put it down to soft spots in the wheel; and a second, who knew, put it down to steam distribution, and, of course, looking very wise and scientific while explaining. But I sawed wood and would not allow my little soul to soar to such altitudes. I had tried the journals—they were oval, and the flats on the wheels were causd by the same. The wheels were turned up twice with the oval journals never touched. The wheels had the same flats again; but the third time the journals were trued up—no more flat spots, but a wheel that did good service for every 1-32 worn from her tire. This engine was always called a "Sheol" of an engine to keep together; but after this she got a good name, and the wiseacres who tried to soar forgot their arguments of "too much lead," "bad steam distribution," soft tires," "not properly balanced." But your humble servant "caught on"—it taught him a lesson not to be too scientific, not to be too theoretical, not to cram more than my little intellect could thoroughly digest, and then—and not till then—cry for more.

My pointer is this: We don't look at little or common practical things enough to account for some things that may happen; but are liable to be led far away from the reality by wishing to show how learned we are, by bringing forward some abstruse problem which we know and hope the other fellow does not.

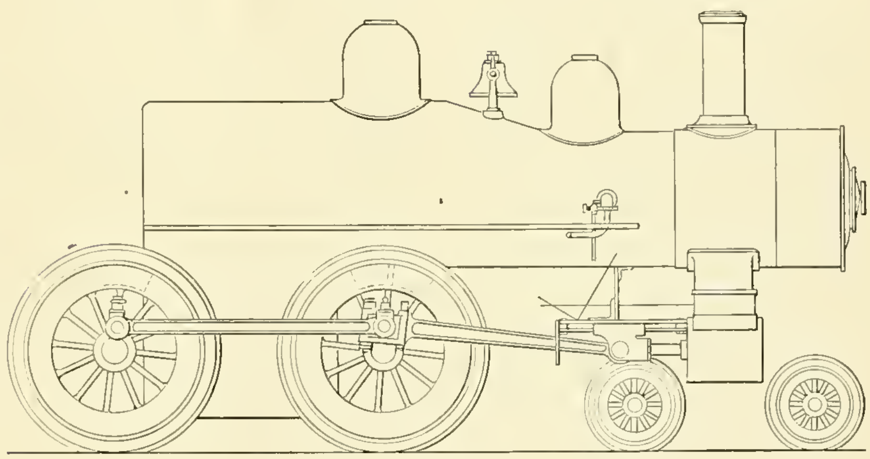
Edgemont, So. D. G. SMART.

A New Method for Counterbalancing a Locomotive, and Other Suggestions for Improvement.

Editors:

The inclosed sketch will convey my ideas of a steady-running high-speed locomotive. You will notice I have taken a radical departure from present practice in designing driving wheel centers. To show that I do not believe in light wheel centers, the wheels under the "Eli" are unusually heavy, and in making them so, I am following a natural law—in fact, two of them—momentum and inertia. Do I hear some one say: "That man is a lunatic. Those heavy wheels will pound the track to pieces." My good brother, don't get excited; those wheels are all right. And now comes the hammer-blow man—well in the main he is about right. What is it produces this so-called "hammer-blow?" Simply by bunching the counter-balance in the rim of the wheel and outside the path of the crank. You will notice in these heavy wheels the counter-balance is outside the path of the crank; but it is carried around the wheel to a point nearly in line with the crank, at which point the rim is chambered to meet the weight of the crank and reciprocating parts.

I claim that the heavy wheels are easier on the track than light ones, for the reason that the stiff springs required will overcome the inertia of the light wheels, and force them into low joints. Heavy wheels absorb all shocks without transmitting them to the upper works. Heavy wheels overcome the inertia of the reciprocating parts, while these parts overcome the inertia of the light wheels; hence, an unsteady-running engine. What we are after is a running balance; and, to get it as near as possible, there must be a harmony of the moving parts, and between the moving parts and upper works. The heavy wheels also overcome the inertia of the unbalanced factors of the reciprocating parts. These unbalanced factors are "the unknown quantity," due to a variation in speed and point of cut-off. In my road experience, I had occasion to handle two engines of the same size, but of different build, except that one had unusually heavy wheels, while the other one had unusually light ones. Now, I have often leaned out of the cab window and watched this little "Cooke" spin along as steady as a clock, without a shock or jar. This experience convinced me that heavy driving wheels with their stored energy, are the secret of a steady-running engine.* Our modern large boiler, high-saddle engines, with light-running gears, may look very nice, but they are hardly the correct thing. Too much top hamper; better carry a little ballast. A clipper cannot carry royals on an empty bottom.



DE SANNO'S "ELI."

You will also notice the 19x22 cylinders. This short stroke is another illustration of my road service; having had as good satisfaction with 16x22 cylinders as 16x24, both doing the same work. It is very good practice to reduce the stroke and increase the diameter in high piston speed. A long, quick stroke is not a natural movement in both piston and valve travel. Long cylinders on locomotives are back numbers. I propose to run with the links up out of the dirt, as it is just as easy to have them in that position; but it calls for a change in the location of the reversing shaft; which also calls for a change in the guide yoke, as shown in sketch.

The "Eli" is not drawn to a scale, the proportions being guess-work. The type of boiler is not arbitrary. Sketch represents a 68-inch wheel.

No; I am not trying to see how differ-

* Now, let me be understood. These wheels are quoted as heavy. The heavy feature is the rim; while, by making the centers of steel, I aim to have hub, crank and spokes as light as possible, consistent with strength.

ent I can make an engine; rather, to get out of some old ruts.

The "Eli" has no wedges. The shoes are cast iron with chilled faces and flanges. The shoes are cast heavy enough to prevent chilling so deep as to prevent planing the jaw fit. The chilled surface to be ground on an emery grinding machine. Shoes and driving boxes to be fitted up by machinists, not helpers. Main frames and jaws, steel castings. Forward section of frame, best hammered iron. Smith triple-expansion exhaust. All bearings, crosshead gibs, rod brasses and bushings to be Ajax Metal Co.'s specialties. Steam and air gages, Utica Steam Gage Co.'s specialties. P. R. R. chime whistle. Rue's "Little Giant" injectors. Leach sanders. Detroit lubricators. Electric headlight. American driver brake. Valves, balanced. One inch outside lap, line and line inside. One thirty-second lead, full gear forward. Blind, full gear back. Steam ports, 17½x1¼; exhaust, 18x2½; travel of valve, 4½ inches. Rocker—lower arm, 8½ inches; top arm, 10½ inches long. This variation is to get a quick motion to valve. Driving-axle journals, 8½x11; piston rods, 3¼ steel, secured in crosshead by split nut. Metallic packing for piston and valve rods. Valve rods, 1⅞. Rocker, steel casting, 5 inch diameter, cored out. Eccentric rods, Schenectady T-ends; on eccentric straps, connection.

Now, boys, if you want a regular wind-splitter, all wool and a yard wide, pin your faith to the "Eli," and get there every time. Criticise her all you please; but be sure you are right and I am wrong.

W. DE SANNO.

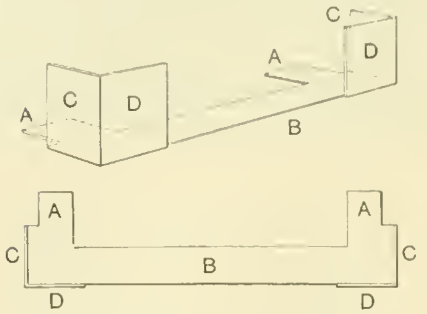
Pan Handle Shop, Indianapolis, Ind.

Safety Case for Broken Balance Valve Springs.

Editors:

I forward you rough sketch of a safety case for holding broken springs under strips of balance valves.

On the Black Hills Division of the Burlington and Missouri River, we have had considerable trouble, valves being broken by broken springs getting out from under valve strips. We tried dowels and small lugs under strips; also bands around valves. These were more or less valuable; but now and then we would have a broken valve from this cause. Now we use the case as shown, which is fitted at each end of valve made of 1-16 sheet iron, the corners welded. *B* lies flat in groove at end of valve, with spring resting on it, and strip moves vertically on top of spring, inclosed at corners by walls *D* and *C*. *A* protrudes into the long groove extending from one end of valve to the other. The end *A* is bent down and filed to razor edge, so that edge always bears tight on bottom of groove. This is perfect, as we have not lost a single piece of broken spring, nor had a chipped valve since June 1st, making a considerable saving in valves and expense putting them in. The cases cost 15 cents apiece, fitted and in place, when



you make a dozen; and about 25 cents, making single pairs.

I may state, referring to the sketch, *B* is bent slightly, so that ends are always down solid.

Edgemont, So. D. G. SMART.

When Full Throttle Wastes Steam.

Editors:

Some months ago I read an article in "Locomotive Engineering," concerning short cut-off. The writer stated that, while riding on an engine, he noticed the engineer worked his engine one notch further down than usual, over a particular part of the road. When asked the reason, the engineer said that he had a long run to make for water, and by working his engine at a longer point of cut-off, and less throttle, he could make the run with ease, while otherwise he could not. The man writing did not give any theory for this. Perhaps he agreed with most of our theoretical enginemen, that the shortest point of cut-off, with wide-open throttle, is the most economical way that an engine can be worked. Nearly all of our best master mechanics concur with this idea. When a fireman is called for examination for promotion, the question is asked, How would you work your engine? He invariably answers, At the very shortest points of cut-off, with wide-open throttle. He does not make this statement because he thinks it the most practical or economical way; but he makes it because he knows that that theory is advanced by most all theoretical enginemen, though he knows by experience that it is not always the most economical way in which an engine should be worked; yet he does not wish to disagree with the man conducting the examination, because he can only explain the practical side of his idea, and cannot give the theoretical reasons why it is not always practical or economical to follow out this theory. He knows, however, by experience that too much of any good thing is not always best, and expansion is no exception. The old man that he fired for did not always run with throttle wide open, and he knows the old man was the best runner on the road. He cannot give the reason why the old man did not always work his engine at shortest possible cut-off. Possibly the old man himself could not know; yet they both knew, by practical skill attained by long experience, that there is only one point, considering conditions, at which an engine can be worked that she may perform her duty with economy and dispatch, and that point is not found by going to either extreme on the quadrant.

Mr. J. A. Ewing, Professor of Engineering, says: "There is only one way that steam can be worked expansively with success, and that is by experiment; consequently, when an engineer starts out with a train, there can be no fixed rule whereby he may be governed in regard to handling his engine, but, considering size of train, grade and speed, it must be left to the skill and intelligence of the engineman." Nearly all theorists claim that the most economical way an engine can be worked is at the very shortest points of cut-off. Their theory is, that by throttling at boiler the steam becomes wire-drawn, thereby losing a part of its expansive force.

This is true; but there is another factor that must be considered—That is, the loss of heat and power, produced by condensation and re-evaporation on the walls of cylinder and piston, which is sure to occur when working steam too expansively. Cylinder condensation is increased when the ratio of expansion is increased, because the metal is then brought into more prolongéd contact with low-temperature steam.

When steam is admitted into the cylinder, it strikes the walls and piston, leaving a film of water thereon after the point of cut-off has been reached and expansion commenced, and piston nears end of stroke, the steam then being reduced to a lower temparature. The water on cylinder walls is re-evaporated from heat of cylinder, thus taking heat from cylinder, and also augmenting the volume of steam to be exhausted, causing back pressure; and all heat taken from cylinder to re-evaporate the water is lost, because the walls must again be heated on return stroke. Consequently, an increase of expansion beyond a certain limit does not increase the efficiency of an engine. When the limit is passed, the loss of heat from condensation overbalances the economy from expansion.

W. E. WIDGEON.

Logansport, Ind.

Proper and Sufficient Cylinder Lubrication.

Editors:

It is now thought by nearly all concerned, that the best way to lubricate valves and pistons of steam engines is by the continuous feed, through a sight-feed lubricator. But the question of how many drops per minute should each valve and piston get, in order to sufficiently lubricate them, is a question I have often been asked by the enginemen, foremen and heads of machinery departments. This question, however, cannot be answered without many considerations of conditions and surroundings. When first two-pint lubricators were placed on locomotive engines, it was considered far too small an amount to run one hundred miles, or over a division. Drops were fed almost to a running stream, and then often the auxiliary cups were used in addition. But the time has arrived when men have accomplished hundreds of miles with such a reduction in the consumption of oil that a few years ago would have been considered impracticable. But though strange it may seem, yet it is correct, that one may use less oil on one engine than he could possibly get along with on another engine of the same class, size and build.

Many reasons could be given for this. I have seen engines that called for 11 and 12 drops per minute, when others would do well with 6 or 7. But much depends on the engineman, how he carries his water in boiler, whether he runs with dry or wet steam; also the size of drops, which may be small or large, caused by the point of feed and oil passages being clogged or not, or the different temperatures of the oils used, or the class of oil used. All these conditions are to be considered.

I know of four tests having been made to ascertain the amount or number of drops there are in a pint of oil, as fed from a Nathan lubricator. These tests were made in the East, West, North and South; neither of them knowing, at the time, of the others making a test, or the number of drops which the others obtained; and while each of them were careful, and took much care to be accurate, yet they differed much in the results of their tests; still each used the Nathan lubricator and the Galena oil. I think that some of the above-stated conditions were the cause of the difference in the number of drops obtained in these four tests.

By putting the numbers of each test together, and then taking the average, we can get very near to the correct number of drops in a pint of oil (Galena) fed from a Nathan lubricator, which is 13,200. Now, I will not undertake to say how many drops per minute each engineer shall use, but will say that it is very surprising how little oil will serve all purposes or requirements of the majority of locomotive engines, and some enginemen accomplish more than is thought possible, keeping valves and pistons in good condition. Some engines will do well with 3 and 4 drops per minute, while others seem to want 6 or 7; but I will name 5 drops a minute for each side of locomotive. A large number of engines will run well on 5 drops per minute. So at this rate of feed, we give you the number of hours it will take to feed out a Nathan double or triple feed lubricator, and the miles run in freight and passenger service, making it so plain to enginemen that they can tell to a few minutes or miles when it will stop feeding, by spending a little time considering the following table:

Size of Nathan Lubricators.	Total Number of Drops Contained in Lubricator	Number of Drops for Each Cylinder per Minute.	Length of Time in Hours Consumed in Feeding Out a Lubricator.	Total Miles Run on a Basis of: Passenger, 30 Miles per Hour.	Total Miles Run on a Basis of: Freight, 18 Miles per Hour.	Number of Miles Run to One Pint of Oil on a Basis of: Passenger, 30 Miles per Hour.	Number of Miles Run to One Pint of Oil on a Basis of: Freight, 18 Miles per Hour.
No. 8	13,200	5 Drops.	22 Hours.	660	396	330	198
No. 9	19,800	5 Drops.	33 Hours.	990	595	330	198
Triple-feed No. 9	19,800	5 Drops and 1 Drop for Air Pump.	30 Hours.	900	540	300	180

Chicago, Ill. GEORGE ROYAL.

The Railroad Blacksmiths' Convention.

One of the most interesting technical reports which has ever come to this office, is the "Proceedings of the Third Annual Convention of the National Railroad Blacksmiths' Association." The report is got out in the standard form, 6x9 inches, and covers 104 pages that are full of practical information of a character never before made public. The smith has been a mighty man in the world's history, and has been the foundation artizan of nearly all industries; but his worth and importance have not been fully appreciated, because he was a man of deeds that were covered by golden silence. We rejoice to see that, under the auspices of the association whose convention is made public in this report, the railroad blacksmiths of this continent have found voice to make their art known and to impart secrets of their skill to others.

When a man, informed on mechanical work, meets a foreman blacksmith in his own shop, and is desirous of obtaining information concerning blacksmithing operations, he is likely to receive interesting and valuable facts. If he possesses the art of bringing out the knowledge possessed by the foreman blacksmith, he is likely to come away with a notebook full of items well worthy of publication. The report of the Blacksmiths' Convention reads to us like a report of twenty interviews with the leading railroad blacksmiths of the country. It contains reports on hydraulic forging; bulldozer forging; bending and cutting machines; hammer dies, etc.; electric welding processes; furnaces and best designs for economy of fuel; proper material for and best methods to make side rods; crank pins and motion work in general; springs; three papers on the utilization of scrap iron; tool steel; tests of twisted iron; and qualities of iron and steel.

Following the reading of each report were discussions in which the leading members took an active part, and talked freely of their experience of the subjects under discussion. We regret being unable to give more particulars concerning this interesting report, but we should very strongly advise all the railroad master mechanics in the country to secure copies and give them to their foreman blacksmiths. We consider it would be one of the best investments they could possibly make. In passing, we would also advise each individual in any way interested in blacksmith work, to read the report carefully. It can be obtained from the secretary of the association, Mr. George F. Hinkens, St. Paul & Duluth R.R., Gladstone, Minn., who deserves much credit for the style in which the report is got up.

A Massachusetts Congressman who was on board the train which was wrecked at Hyde Park, Mass., last fall, says that when the shock came, one of the passengers was pitched over several seats just in time to receive the contents of the water cooler, which tipped over and soaked his clothing with ice water. A highly-excited passenger rushed up to him and told him to keep cool. "Go away," said the wet man; "I am the coolest man in the car. I have just had two buckets of ice water emptied down my back."

"There are plenty of individuals," says Josh Billings, "who can't make a boy's windmill that will grind, to save their lives, who wouldn't hesitate a minute to tell you how to improve a steam engine."

Gain or Loss from Use of Electric Motors?

The successful operating of the better classes of street railroads by electricity, made it manifest that that form of transmitting power could be applied, without any difficulty, to elevated railroads and suburban railroads now operated by steam. The Metropolitan Elevated Railroad of Chicago presents the first object lesson on a large scale of what can be done in operating trains by electricity. The trains are operated as smoothly and as quickly by electric motors as other elevated railroads are by steam locomotives, and passengers not informed about railroad power would not appreciate any difference in the trains handled by the two forms of motors. When the cost of operating by steam locomotives and by electric motors is compared, there is found to be very little difference between the two. Electric motors which can be run to advantage with a single-car or two-car train, effect some saving at times when traffic is light, and provide the means of giving frequent service at small expense. As the trains are operated on the Metropolitan Elevated of Chicago, an important item of saving is in the wages of trainmen. There is only one motorman employed, as against an engineer and fireman on a steam locomotive, and the wages of the motorman is low. This will be leveled up after a time. The wages of motormen is low, because the companies employing such men act upon the assumption that little skill is required to handle an electric motor. The men employed are probably dear at the price paid for their services; but it is only a matter of time when the managers of electric railroads, stimulated by public sentiment, will learn that cheap motormen are dear at any price, and that it will be a good investment to pay men for being skillful in their business. Having one man in charge of an electric motor will not long be tolerated by the traveling public and by those responsible for protection of human life. The law requires that there shall be two men in the pilot house of all ferry boats, whereever traffic is heavy. The sudden sickness of a single man involves risks too appalling. The same precautions are necessary in the case of elevated railroad trains. One of the electric elevated motors in Chicago has already fallen into the street, and there is good reason for believing that such accidents will be common unless first-class help is employed and two men kept on the motors.

When changes on these lines are taken into consideration, it will be found that the cost of operating by electricity will be about as great as that resulting from the use of locomotives. On the Metropolitan Elevated, the cost per car-mile is said to be about 3 cents less than that of operating trains on the Manhattan Elevated. All the machinery on the former line is almost new, and structure and permanent works require no repairs. When motors require to be rebuilt, when rails and ties must be renewed, when the structure begins to need repairs and painting must be done to buildings and all exposed parts of structure and buildings, the time for a fair comparison will have arrived. Meanwhile, the managers of roads having steam locomotives that are doing work satisfactorily, had better figure very closely what the eventual cost will be, before they venture to try electric motors as substitutes for their steam locomotives.

Current reports say that the directors of the Manhattan Elevated Railroad are seriously contemplating changing from steam locomotives to electricity. Should this change be made, they will find it to be exceedingly difficult to save anything on wages by making such a change. The people of New York would not tolerate one man in the cab of a motor handling elevated trains, and the nature of the structure and service would require the employing of men who are familiar with the track and with the handling of trains on lines difficult to operate safely. The men possessing these qualifications could not be hired cheaper than the men now handling the locomotives. The wisest course would be to train the men they have to the use of electric motors. These men are skillful in the handling of trains, and their presence in the motor cab would be a guarantee of safety. Their responsibilities would not be reduced, and therefore it would be unreasonable to expect that they would work for less pay.

Gas Engines and the Making of Cheap Gas.

Gas engines are making rapid progress as motive power for driving machinery, and there are indications that they will soon come largely into service for driving electric machinery. As a gas engine will give one horse-power from an equivalent of ¾ pound of coal, as against from 2 to 5 pounds for good steam engines, the saving effected is very material. What has kept the gas engine from coming more rapidly into use has been that it was very liable to get out of order, and it was not easily regulated to run evenly. It is said that these shortcomings have been entirely overcome by recent improvements.

Recent improvements in making cheap gas also help the cause of the gas engine. In gas, as it used to be made, there was almost as much waste of heat as in the making of steam now. Soft coal was put in an iron retort and coke placed in a furnace under it to drive off the gas. When the gas was all driven into gas holders, the coal from which it was made was drawn out and quenched with water, becoming coke by this process, with enough heating power to supply the furnace for the next retort full of soft coal.

Nowadays gas is chiefly made from water, with some mineral oil mixed with it to give it greater illuminating power. When this gas is roughly made it is called producer gas; when it is scrubbed and cleansed from its impurities it is called water gas.

Water, as every professor of chemistry tells his classes, is composed of two gases—oxygen and hydrogen. Oxygen exists in the air diluted with four times its bulk of nitrogen; it is non-inflammable, but necessary to support combustion, which it does by uniting with the burning material to form oxides. Hydrogen, on the contrary, is very inflammable, and, if lit, will burn with the oxygen of the air to form the oxide of hydrogen, which we call water.

For a long time after it was known that water was composed of two gases, chemists tried in vain to find some simple method of splitting it up. For a whole generation the only two ways they knew of doing this was either to pass an electric current through it or to pass a stream of steam over red-hot iron filings.

This was a slow process and was not adapted for making gas for commercial purposes. But it struck some genius that red-hot coal might be used to absorb the oxygen, instead of iron filings. The method of making water gas was thus devised.

To make water gas, a charge of coal is put into a closed furnace. As soon as the mass of coal is red hot, the admission of air is cut off and jets of steam blown into the burning fuel. The intense heat splits the steam into its constituent elements, and part of the oxygen released combines with the fuel, leaving a mixture of carbonic oxide, which is inflammable, and hydrogen. When the burning coal shows signs of being extinguished, the gases formed are drawn off, the dampers are opened, and the process is repeated. The product of this operation is known as producer gas, which is well adapted for use in gas engines. To make the gas suitable for illuminating purposes, it goes through a refining process.

Westinghouse Air Brake Co. have issued a circular of general information, giving a great deal of useful facts about the equipment of cars and locomotives with air brakes. There has been too much of a tendency to put on all cars the brakes suitable for the lightest equipment, the consequence being that many trains are inefficiently braked. This circular indicates the character of the brakes which should be used on different weights of cars. It ought to be a handy reference for every official, responsible for the equipment of cars and locomotives with air brakes. We recommend everyone interested to apply for the circular.

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The Father of the American Locomotive.

Many people, who ought to be better informed, believe that the steam engines that operate our factories, propel our steamboats and pull our railroad trains, are merely imitations of machines originally imported from Europe, and that all our pioneer mechanics did was to adapt the engines to American purposes. The facts are very different.

If James Watt, the inventor of the condensing engine, and the crowd of Europeans reputed to be the inventors of the locomotive, had never been born and their work had remained undone, it is doubtful if the mechanical progress of America would have materially suffered.

When Watt, in Scotland, was struggling to obtain assistance in his work of developing the low-pressure condensing engine, Oliver Evans, a native of Delaware, was working out his invention of the high-pressure engine, where power was obtained direct from the expansive force of steam. Both inventors started from the same point, which was the atmospheric engine of Newcomen. Watt aimed at using steam very little above the pressure of the atmosphere, the vacuum formed in his condenser being the principal source of power. His engine was necessarily a ponderous, slow-moving machine, a very heavy cylinder being necessary for the development of moderate power. Evans, on the other hand, made high-pressure steam the potent principle in his engine. By the employment of high-pressure steam with high piston speed, he aimed at obtaining moderate power with very light machinery. Mechanically, Evans was as successful as Watt, and his engine was much better adapted to the needs of a new country. The trouble with Evans was, that he was a quarter of a century ahead of his time, for America had not begun to feel its need of a steam engine, the mechanical industries in the country being few and the water power unparalled. This is really the explanation of the nation's indifference towards Evans' great invention.

Under very great discouragement, Evans perfected his engine and established its utility. He was brought up to the trade of a millwright, and the skill which he acquired in his business gave him great advantages in working out the details of the steam engine. The backward condition of the people's knowledge in regard to mechanical matters, towards the end of the last century, may be inferred from the fact, that when Evans applied to the Legislature of Pennsylvania for a patent on the steam engine, it was promptly refused, and several of the leading scientific men of Philadelphia denounced it as a useless invention. Yet some of the men who were most active in their opposition lived to see that same engine driving machinery all about the city.

Although his work has never received proper recognition from the mechanical world, Evans' engine is the prototype of the high-pressure, high-speed engine that became our national standard, and of which the locomotive is the most successful representative. Readers who receive their knowledge about inventors from such sources as the romances of Smiles, called "Lives of the Engineers," believe that Richard Trevithick invented the high-pressure engine; while the facts are, that Evans applied for a patent on the high-pressure steam engine fifteen years before Trevithick began experimenting in that line. One cause of the popular mistake is, that many English industrial writers, while thinking it necessary that they should be thoroughly versed regarding the scientific experiments carried on in Egypt and Greece thousands of years ago, have been perfectly content to remain ignorant of what is going on in America in their own time.

About the time Evans made his first engine, the subject of improving the means of inland transportation was exciting a great deal of attention in the various States, and Evans believed that he could successfully apply his engine to the running of carriages on common roads. He worked for several years on that problem, but finally abandoned road traction on account of the inferior condition of the existing highways. That he could make his engine run a carriage under favorable conditions he proved, by making the engine of a steam scow he built for Philadelphia propel the craft, which was mounted on wheels, through the streets of the city. This was in 1804, and was the first case of a vehicle being moved by steam on the American continent.

Oliver Evans was a prolific inventor, an accomplished mechanic and a far-seeing man. In any other country he would have been regarded as a hero who achieved a great victory in the walk of industrial progress; but we are so independent and prone to hold one man as good as another, that we habitually refuse to give even empty honor to whom high gratitude is due. The life and labors of Oliver Evans ought especially to be familiar to our mechanics, for his successes under the most depressing conditions teach lessons that all of us ought to learn. His steam engine made but little progress into favor during the life of its inventor, but he had perfect faith in its great future. He predicted that his high-pressure engine would yet be the means of accelerating travel, so that people would leave Washington in the morning, dine in Philadelphia, and sup in New York. Oliver Evans has the right to be regarded as the father of the American locomotive; for, although he never built a locomotive of the railroad type, he designed the essential parts of the engine and pointed out the line of its proper development.

The Practice of Throttling Steam.

A correspondent, who is a road foreman of engines, takes up, in another page, the question of throttling locomotives. It appears to be a practice, when examining firemen for promotion, to ask: "How would you work your engine?" and the answer expected is: "At the shortest possible point of cut-off." We believe the better answer would be: "At the point of cut-off found to be most economical." It is many years since Clark, the famous engineer, gave to engineering literature the expression, "Expansive working is expensive working;" but his views were long ignored. There is no doubt that the hard-and-fast order to work all locomotives at the shortest possible point of cut-off has been responsible for much waste of steam.

At the last convention of the Traveling Engineers' Association, there was a curious discussion raised by Mr. George H. Brown, master mechanic of the Chicago, Milwaukee & St. Paul, who said: "I will state in connection with this, that, on the road on which I am employed, we had an engine in passenger service, and while in charge of a certain engineer the coal performance was carefully watched. This man was as fine a runner as could be found anywhere, took the very best of care of the engine in every respect, and a good man for making time. The valve motion of his engine was particularly adapted to working steam on a very short cut-off; the boiler carrying 180 pounds of steam. The results of the engine were always inferior to those of four others of the same class and in the same service, in fuel performance. About one year ago that engineer left the road to take a better situation elsewhere, and the engine was put in charge of another man, equally as good, and since that time the performance of the engine has been watched very closely. The first man worked full throttle on all occasions where speed would admit it. The other man was not so particular about it. He was apt to lift the reverse lever back to the shortest possible cut-off, and the throttle less than wide open. The engine shows an average of about two miles to the ton better performance with coal with the last-named man than it did with the first. I am not prepared to say that it is altogether due to the man, or the engine, although the last-named man, ordinarily, should have had the poorest showing, because the engine had been longer in service. You can draw whatever moral you please from it, but the results were not radical enough to say that either man was right or wrong.

"With such trains as they haul on ordinary roads, the engine would perform excellently with 4⅓-inch cut-off. The next notch forward of the first was an intermediate notch. The cut-off was 6½ inches. This is where the second man has been doing most of his work."

Several of the members attempted to show that the engines worked with the longer cut-off must necessarily be more wasteful of steam than that worked at 4⅓ inches. They insisted that with the lower pressure of steam caused by throttling, the steam must have been wetter than that of the higher pressure used with a full open throttle. That is just where they were wrong. The throttled steam would be slightly superheated. The man who worked his engine cutting off at 6½ inches, happened to strike about the shortest cut-off that a locomotive can be operated on to advantage. Those who were most in favor of short cut-offs have rarely advocated anything short of quarter stroke. A shorter cut-off than that is certain to produce loss from cylinder condensation.

After all, there is good reason for believing that the army of locomotive engineers know enough about their business to work their engines in the way that would do the work with the least possible expenditure of steam. They are a highly intelligent class, and naturally know more about how to work a locomotive than scientists who have never spent a day in a locomotive cab. All concerned may therefore feel confident that when an engineer is running with the steam partly throttled, he has good reasons for so doing. Don't make a hard-and-fast rule of how the engine should be worked, for firemen under examination for promotion.

Does It Pay to Build Belpaire Boilers?

Since we published the engravings and description of the new type of express locomotive for the Chicago, Burlington & Quincy, in our December issue, we have heard a great deal of talk about the engine, particularly about the boiler, which is much admired. The question has frequently been asked, Why have the "Q" people abandoned the Belpaire boiler? That question we cannot answer; but we think that several railroads which cling to the Belpaire would save money by changing to some other type. In the first place, it is a very expensive boiler to build, and in service it is less satisfactory than other forms that cost less.

There may be railroads using Belpaire boilers that find them as cheap to maintain as those having radial-stays or crown bars; but we have failed to find out where they are. The Belpaire boiler is reputed to be the strongest form in use; but we do not find that it is more exempt from accidents than well-designed wagon-top or straight boilers, and it certainly is more troublesome to keep tight. From some cause, not clearly determined, the front corners are much given to leaking. All sorts of strengthening and stiffening devices have been tried to remedy this source of annoyance, but with very little success.

Considering the trouble experienced with the Belpaire boiler, it is strange that it has not been abandoned for the good, reliable wagon-top boiler, which gives plenty of steam room, carries water better than any other boiler ever tried, gives excellent distribution of weight on the wheels, and exhibits no weak spot to keep boiler makers busy. This attribute of carrying water well means something that ought to receive serious attention from the designers of boilers. Boilers that do not carry water well, and are given to priming as soon as there is five or six inches of water above the crown sheet, are wasteful of steam. When the steam room is contracted, water is constantly passing into the dry pipe along with the steam, and all the heat that has been put into that water is worse than wasted. The moisture passing into the cylinders with the steam acts as a condenser to take the energy out of more steam as it reaches the cylinders. There is good reason for believing that the enormous amount of loss from cylinder condensation in some locomotives is due, in a great measure, to the initial condensing action of moisture carried out of the boiler.

Mr. W. F. Dixon, who was chief draftsman of the Rogers Locomotive Works, a good authority on locomotive construction, writing on this subject, said:

"There is one objection to the Belpaire boiler—and, indeed, to any straight boiler, apart from any question of boiler-making, to be found more especially in the case of eight and ten-wheel engines—and that is, the unduly large percentage of the total weight of the whole machine which is thrown on the leading truck.

"With the ordinary wagon-top, crown-bar or radial-stay boiler, with the firebox down between the main and back axles, the drivers of an eight-wheeler get, on an average, about 64 per cent., and a ten-wheeler about 74 per cent., of the total weight; but if the Belpaire boiler is used, this percentage in the case of the eight-wheeler sinks to about 61 per cent., and of the ten-wheeler about 68 per cent. The reason of this is, that with the wagon-top boiler a sufficiently large space can be obtained for steam room over the crown sheet, while keeping the waist of boiler tolerably small in diameter; but the Belpaire being straight on top in the great majority of cases, the waist must be increased at least four inches in diameter in order to obtain the necessary steam room. The larger the waist, the larger the smokebox and front end must be; the branch and exhaust pipes must be longer and heavier; and, altogether, the weight of the front part of the boiler, which comes directly on the truck, is materially increased. Whether the Belpaire boiler presents advantages to offset this disadvantage is a moot question."

Against all these drawbacks, the only explanation offered for preferring the Belpaire boiler is, that it is a particularly strong form. There seems to be little weight to this argument, when other boilers have been found just as safe, while costing less for construction and maintenance. We think it would be edifying to compare the cost for repairs of the old Class P locomotives of the Pennsylvania Railroad, with their wagon-top boilers, and that of the newer engines, which have Belpaire boilers.

The technical schools and industrial educational establishments, that are increasing so rapidly all over this continent, are doing much to impart information concerning mechanical matters to the mass of the people. This will have a very wholesome effect in preventing the people from being decoyed into taking financial interest in schemes that are impracticable and based on claims of action contrary to the principles of nature. What has been badly needed among the rising generation of the past, was accurate knowledge respecting nature's laws. The common schools have too often taught smatterings of various "isms" which the pupils would never find useful in their daily lives. Time devoted to vagaries of study would have been well spent on natural philosophy. In this respect, technical schools are doing the elementary work which ought to be carried out in the day-schools.

A Turn of Fortune's Wheel.

About the time the January number of "Locomotive Engineering" went to press the proprietors secured a controlling interest in the capital stock of the American Machinist Publishing Co.; and at the annual meeting of the company, Angus Sinclair was elected president, and John A. Hill managing director. "Locomotive Engineering" and the "American Machinist" are now under the same management, and the offices of the latter paper have been moved to the fifteenth floor of the Home Life Insurance Building, 256 Broadway, adjoining the offices of "Locomotive Engineering." The intention is to keep the papers entirely separate, and to make vigorous efforts to improve the reading pages of both papers. The "American Machinist" has been changed to the same size of page as "Locomotive Engineering," and a cover put on.

There is a little sentiment connected with Sinclair and Hill securing control of the "American Machinist." Both of them left railroad life to work for the American Machinist Publishing Co. In 1883, Angus Sinclair left the Burlington, Cedar Rapids & Northern to become associate editor of the "American Machinist," and about the same time John A. Hill, then on the Denver & Rio Grande, began to figure as a contributor to the paper. In 1888 the American Machinist Publishing Co. commenced publishing the "Locomotive Engineer," and Mr. Hill was appointed editor. At that time the present proprietors of "Locomotive Engineering" had as much expectation of controlling the movements of the moon as they had of controlling either of these papers; but it came round that in 1891 they raised the wherewithal to purchase the "Locomotive Engineer." The enlarging of the scope and size of the paper, the changing the name, and the earnest endeavors exerted to make it the best and most interesting paper published, are known to our readers. Our ambition now is to make the "American Machinist" as good and successful in its field as "Locomotive Engineering" has been with railroad men.

The new officials will not do any editorial work on the "American Machinist," a highly efficient staff of editors being engaged on that department, all of them being well known mechanical engineers.

Water-tube boilers are making rapid headway in Great Britain, for use in places where a maximum steam-making power is required in a minimum of room. It is only a short time since this type of boiler was first tried in torpedo boats; but it has now been applied to five or six boats, and is reported to be giving much greater satisfaction than the ordinary tubular boiler.

PERSONAL.

Mr. J. J. Dewey has been appointed foreman at the Erie shops at Hornellsville, N. Y.

Mr. C. W. Risley has been appointed superintendent of the Lima Northern, with headquarters at Lima, Ohio.

Mr. R. H. Brown has been appointed chief engineer of the Delaware & Hudson, with headquarters at Albany, N. Y.

Mr. W. Atwood has been appointed assistant train master of the Lehigh Valley Railroad, with headquarters at Sayre, Pa.

Mr. E. F. Adams has been appointed foreman of locomotive repairs of the Southern Railway shops at Birmingham, Ala.

Mr. L. B. Houck has been appointed superintendent of the St. Louis, Kennett & Southern, with headquarters at Caruthersville, Mo.

Mr. W. J. McLean has been appointed master mechanic of the Third Division of the Plant System, with headquarters at Montgomery, Ala.

Mr. W. H. Young has been appointed master mechanic of the Charlotte Harbor division of the Southern, with headquarters at Sanford, Fla.

Mr. F. E. Falk has been appointed general store-keeper of the Cleveland, Akron & Columbus Railroad, with headquarters at Mt. Vernon, Ohio.

Mr. E. Svindell, of Chicago, has been appointed R. H. foreman at San Bernardino, Cal., in place of Mr. Geo. Langton, transferred to Los Angeles.

Mr. W. D. Trump has been appointed assistant to the general manager of the Flint & Pere Marquette Railroad, with headquarters at Saginaw, Mich.

Mr. Robt. T. Pace has been appointed purchasing agent of the Atlanta & West Point Railroad and Western Railway of Alabama, with headquarters at Atlanta, Ga.

Mr. C. B. Hart has been appointed traffic manager of the Hutchinson & Southern, with headquarters at Hutchinson, Kan. He was formerly with the Rock Island.

Mr. J. B. Musgrove has been appointed superintendent of motive power of the Panama Railroad. He was formerly on the Chattanooga & Lookout Mountain Railway.

The friends of Mr. N. J. Paradise, master mechanic of the Hannibal & St. Joseph, will be sorry to hear that he was recently stricken with paralysis while traveling.

Mr. G. W. Barns, for some time chief clerk to Supt. Egan, of the Great Western Railway, has been appointed superintendent of the Vincent Stock Yards at Des Moines, Ia.

Mr. W. A. Garrett has been appointed superintendent of the Western division of the Wabash Railroad, with office at Moberly, Mo., in place of F. H. McGuigan, resigned.

Mr. Geo. C. Jones has been appointed division superintendent of the Grand Trunk, with headquarters at Montreal, Can. He was formerly chief train despatcher of the Wabash.

Mr. C. F. Parker has been appointed general manager of the St. Louis, Alton & Terre Haute. He was formerly assistant general manager, and is a son of the president of the road.

Mr. J. W. Lutterell, master mechanic of the Illinois Central shops at Burnside, Ill., has had his jurisdiction extended to the car department, and performs the duty formerly done by Mr. Wm. Apps.

Mr. W. E. Hodges has been appointed assistant to President Ripley, of the Atchison, Topeka & Santa Fé Railroad. Mr. Hodges has been for some time traffic manager for Frazer & Chalmers.

Mr. C. A. Wickersham has been appointed superintendent of the Alabama Great Southern, with headquarters at Birmingham, Ala. He was formerly train master on a division of the Southern.

Mr. H. S. Cable has been elected vice-president of the Rock Island & Peoria Railroad. He is manager of the Manitou & Pike's Peak Railroad, and is the son of President Cable of the Rock Island.

Mr. Seely Dunn has been appointed superintendent of the Owensboro & Nashville division of the Louisville & Nashville Railroad. He was formerly train master on another division of the road.

Mr. Geo. Donahue, master mechanic of the Erie shops at Cleveland, Ohio, has been transferred to Meadville, Pa., to succeed Mr. F. B. Smith, who left to go to the New York, New Haven & Hartford.

Mr. T. C. Sherwood has been appointed general manager of the Kansas City, Pittsburgh & Gulf, with headquarters at Kansas City, Mo. He was formerly with the Des Moines & Kansas City.

Mr. Daniel Breck has been appointed assistant to President Smith of the Louisville & Nashville, with headquarters at Louisville, Ky. Mr. Beck has been for several years superintendent of the same road.

Mr. A. J. Frazer has been appointed superintendent of the sixth division of the Southern Railway, with headquarters at Birmingham, Ala. He was formerly superintendent of the Alabama Great Southern.

Mr. John C. Doyle has been appointed general master car builder of the Missouri, Kansas & Texas, with headquarters at Sedalia, Mo. He was formerly master car builder of the Texas lines of the same company.

Mr. T. E. Brooks has been appointed train master of a division of the Louisville & Nashville, with headquarters at Clarkesville, Tenn. He was formerly chief clerk to the superintendent of transportation of the road.

Mr. J. C. Gregory has been appointed superintendent of the Galveston, Houston & Henderson Railroad, in addition to being superintendent of the International & Great Northern. His headquarters are at Palestine, Texas.

Mr. Wm. A. Garrett has been appointed superintendent of the Western Division of the Wabash, with headquarters at Moberly, Mo. He has been for some time terminal superintendent at St. Louis for the same railroad company.

Mr. Frank E. Charles is foreman of the East St. Louis Connecting Railway shops at East St. Louis. He is a graduate of the Burlington, Ceder Rapids and Northern shops at Cedar Rapids, and is a particularly well educated mechanic.

The numerous friends of General John B Gray, so long associated with the American Brake Co., will be sorry to learn that he is in very delicate health. He has gone South in the hopes that the change of air will help him.

Mr. A. M. Tucker has been made agent for the Western Lines of the Erie, with headquarters at Cleveland, Ohio. He was for many years general manager of the New York, Pennsylvania & Ohio, and his duties will not be much changed.

Mr. A. W. Greenwood has been appointed superintendent and master mechanic of the East Broad Top Railroad, with headquarters at Rockhill Furnace, Pa. He has been for some time acting superintendent and master mechanic.

Mr. Willard Kells has been appointed master mechanic of the shops at Cleveland, Ohio. He was formerly general foreman of the shops at Meadville, Pa. He is a son of the late Ross Kells, superintendent of motive power of the Erie.

Mr. John Muir has been appointed traffic manager of the Panama Railroad, with headquarters at Colon, Colombia. Mr. Muir has been for several years Eastern traffic agent of the Pacific Mail Steamship Co., with headquarters in New York.

Before Mr. Chas. M. Hays, late general manager of the Wabash Railroad, left St. Louis to go to Canada to begin his duties as general manager of the Grand Trunk, he was given a farewell reception at St. Louis by a great many of the old employés of the road.

Mr. H. Delany has been appointed master mechanic of the Philadelphia & Reading at Philadelphia, with office at Berks street. Mr. Delany was for several years superintendent of motive power of the Louisville, New Albany & Chicago Railroad.

The machine and car shops of the Atlantic & Danville Railway Company have been removed from Portsmouth, Va., to Lawrenceville, Va., 96 miles from the former place. The office of Master Mechanic Reid has been transferred from Portsmouth to Lawrenceville.

Mr. J. E. Gimperlin, formerly general superintendent of the Cincinnati, Dayton & Ironton Railroad, has accepted the position of general agent for the Boyer jacks. He will devote himself especially to the railroad business. The headquarters of the Boyer Jack Co. are in Dayton, O.

Mr. Oscar G. Murray, second vice-president of the Cleveland, Cincinnati, Chicago & St. Louis, has been elected third vice-president of the Chesapeake & Ohio. This was done for the purpose of having Mr. Murray represent two roads on the Board of Managers of the Joint Traffic Association.

Mr. Thomas Williams, general foreman of the erecting shops of the Baldwin Locomotive Works, and William McCarroll, traveling engineer for the same concern, have gone to Russia to set up and put into service the large order of compound locomotives recently turned out for the Russian government.

We learn that Mr. H. B. La Rue, the well known railroad supply man, has been engaged by Merchant & Co., of Philadelphia, as a traveling salesman. Mr. La Rue is one of the best known and oldest salesmen in the railroad supply business, and there are few men who have so many warm friends among railroad officers.

Mr. A. W. Worley, who has been in the store department of the Great Western Railway at Des Moines, Ia., has been promoted to be chief clerk to Supt. Egan, in place of G. W. Barns, resigned. Mr. Worley has been one of the best friends of "Locomotive Engineering" in the West. His headquarters are at Des Moines, Ia.

Mr. G. A. Akerlind has been appointed chief draftsman of the mechanical department of the Chicago, Rock Island & Pacific, at Chicago. He has been for years in the drawing office of the Brooks Locomotive Works. He was winner of one of the prizes given by "Locomotive Engineering" two years ago for the best design of locomotive.

Mr. Geo. B. Reeve has been appointed general traffic manager of the Grand Trunk Railway, with headquarters at Montreal, Can. He has been in a similar position on the Chicago & Grand Trunk for the past fifteen years. This is the beginning of the changes likely to be made by General Manager Hays in reorganizing the personnel of the Grand Trunk Railway.

We are pleased to learn from a circular issued by Burnham, Williams & Co., of the Baldwin Locomotive Works, that Messrs. Samuel M. Vauclain, Alba B. Johnson and George Burnham, Jr., have been admitted to partnership. That is a cheerful New Year's day announcement, and is a pleasant acknowledgment of men whose services have been very valuable to the firm.

Mr. John D. Campbell has resigned the position of master mechanic of the Buffalo & Susquehanna, to take effect when his successor is appointed. Mr. Campbell has been in bad health since he went to Galeton, and is unable to hold the position on account of the place, which is quite malarial. The management of the road are looking for a man to fill the position, and have several names under consideration.

Mr. J. J. Casey has resigned his position as assistant superintendent of machinery of the Illinois Central, to accept the position of superintendent of Haskel & Barker Car Co., of Michigan City, Ind. He was formerly superintendent of motive power of the Yazoo & Mississippi Valley, and for some time superintendent of Missouri Car & Foundry Co. He was in charge of the car department of the Illinois Central.

Mr. George Thompson has been appointed master mechanic of the Beach Creek Railroad in place of Mr. La Mott Ames, resigned. Mr. Thompson has been for several years general foreman of the shops at Jersey Shore and has been in the habit of taking charge in Mr. Ames' absence. A correspondent in Jersey Shore, writing about this appointment, says: "It is highly satisfactory all round, especially to the men, and that Mr. Thompson deserves any good thing that we can say about him, being a first class shop manager and a good executive officer."

About the time we went to press last month, Thos. A. Lawes, mechanical engineer of the Cleveland, Cincinnati, Chicago & St. Louis at Indianapolis, was appointed superintendent of machinery of the Chicago & Eastern Illinois, to take the place of Mr. Allen Cooke, resigned. Mr. Lawes is a very able mechanical engineer, and has had considerable experience as a master mechanic, so his new position will have no novelty for him. He is one of the most industrious workers on the committees of the Master Mechanics' Association, and his report last year on boiler tubes excited a great deal of attention.

Mr. Wm. C. Arp has been appointed superintendent of motive power of the Vandalia Lines, with headquarters at Terre Haute, Ind., to succeed Mr. G. H. Prescott, resigned. Mr. Arp has been on the Pennsylvania Railroad all his working life, having served his apprenticeship on the Northern Central, at Williamsport, Pa. He rose through the usual course of foreman and to master mechanic, the position which he held at Dennison, O., for several years. This appointment results from the Pennsylvania Railroad Company having taken possession of the Vandalia Lines.

On the occasion of his leaving the Chicago & East Illinois, Mr. Allen Cooke and his wife were surprised by a deputation of the officials of the road and presented with some very valuable presents. Mr. Cooke has left railroad life for good, and intends to devote his time to looking after his own property. Mr. Cooke has been a long time with the Chicago & East Illinois, and was considered one of the ablest master mechanics of his generation. He has at different times been offered good positions elsewhere, but he preferred to remain with the Chicago & East Illinois. General regret is expressed at his quitting the position he has honorably held so long.

Mr. R. B. Reading, who has been for several years general foreman of the Elevated Railroad shops in New York, has received indefinite leave of absence, having been appointed by Prest. Gould to superintend some of his private industries. The appointment is very creditable to Mr. Reading and puts him in a good position for advancement, but he dislikes the idea of leaving railroad life, and hopes to be able to return to it after he gets the factories running smoothly which are now under his charge. Mr. Reading is a graduate of the Erie mechanical department, and was for some time with the Pullman Car Co. before going to the Elevated. He is very popular with the men on the Elevated, and general regret is expressed on account of his leaving the shops.

Many master car builders and master mechanics will be interested in learning that Mr. Joseph Wood, for some time general manager of the Pennsylvania lines west of Pittsburgh, has been elected fourth vice-president of the company. It is only a few years ago since Mr. Wood attended the Master Car Builders Conventions and took an active part in pushing through the adoption of the M. C. B. coupler and other standards. He was then superintendent of motive power at Columbus. He rose to that position through the engineering department, and was a decided success. As an operating officer he lost none of his prestige gained in the engineering and mechanical departments, and his elevation testifies that the directors of the company appreciate his ability.

Mr. William Thornburgh, general superintendent of the Columbus, Sandusky & Hocking Railway, has adopted the system of "Discipline without Suspension," which he has taken from that practiced by Mr. George R. Brown, general superintendent of the Fall Brook Railway. He has issued a circular, describing the system, with some modifications suitable for the road where he is in charge. He calls for the coöperation of the heads of the departments to make the new system a success, and we have no doubt but what he will greatly improve the service of the road by the action he has taken. While a strict disciplinarian, Mr. Thornburgh has very warm sympathies for mistakes made unthinkingly, and we have no doubt whatever but his popularity will be increased by the action he has taken in this matter.

The "Railway World" is publishing a very interesting series of articles, giving "Reminiscences of a Railroad Engineer," by W. Hasall Wilson, president of the Belvidere, Delaware & Philadelphia Railway. Mr. Wilson is said to be the oldest railroad president in the United States, and he has had a most varied railroad experience, which makes his reminiscences of very great value. He rose through the engineering department of the Pennsylvania Railroad, having worked as a roadman on the South Carolina Railroad. He was assistant engineer on the construction of the first part of what is now the Pennsylvania Railroad, and he has been with the company ever since, rising by degrees until he became president of one of the proprietory roads. We understand that his reminiscences are going to be published in book form. It will be one of the most valuable contributions ever given to railroad history.

In the death of Thomas Prosser, Sr., the railroad supply business loses one of the older representatives, who was exceedingly well and favorably known to railroad men. He died at Brooklyn last month, in the sixty-seventh year of his age. He was head of the steel firm of Prosser & Sons, who are the American representatives of the Krupp Manufacturing Co., of Germany. He was born in Worcester, England, but came to this country with his parents when he was a young lad. Forty-five years ago he established himself in the steel business in Paterson, N. J., and opened a store in New York City. A year afterwards he became the representative of the Krupp Co., and to his energy and good management is due much of the popularity which the Krupp steel has enjoyed among the railroads of this country. The business will be carried on by his sons, who are almost as favorably known among railroad men as their father.

The Standing Committee of the Supply Men's Association have sent out a circular, intimating that it is their wish that a very complete exhibition should be made at the next convention at Saratoga. Those who wish to show articles that are of interest to railroad men should apply at once to Mr. W. C. Ford, Secretary of the Standing Committee, 29 Broadway, New York.

EQUIPMENT NOTES.

The Mexican Central have ordered 550 freight cars with the St. Charles Car Co.

The Quebec Central are reported to have ordered some 50,000-pound box cars.

The Bay Terminal of Toledo, Ohio, is reported to be about to order some cars and locomotives.

The Chicago & Grand Trunk are having four passenger cars built by the Barnes & Smith Co.

Schenectady has received an order for 10 six-wheel connected engines from the Chicago & Northwestern.

Brooks have received orders for 5 engines for the Ilinois Central and 5 for the Chicago & Northwestern.

The Chicago & Northwestern have placed an order with the Peninsular Works for 550 feight cars.

The Cincinnati, Jackson & Macinaw are reported to be in the market for a number of freight locomotives.

The Madison Car Co. have received an order from the Overland Fruit Dispatch Co. for 100 refrigerator cars.

Brooks have received an order from the Buffalo Creek road for three heavy, six-wheel, switching engines.

The Duluth, South Shore & Atlantic have ordered 500 gondola cars from the Michigan Peninsular Car Co.

The Pittsburgh Locomotive Works have received an order from the Arkansas & Choctaw for some mogul locomotives.

The Illinois Central have ordered 200 freight cars from the Mt. Vernon Car Works. They will all have Westinghouse air brakes.

The Duluth, South Shore & Atlantic have placed an order with the Peninsular works for 600 freight cars. They will all be equipped with the Westinghouse air brake.

The Fitchburg have ordered five mogul locomotives from Schenectady of the type illustrated in "Locomotive Engineering" last June. A report that they are compounds is not correct.

The Maryland Steel Co. have, in their shops at Sparrows Point, Md., the famous Strong locomotive, "Darwin," converting her into a four-cylinder compound, after designs by Mr. Strong.

The presidents of the anthracite coal roads met in New York, about the end of last month, and tried to form an agreement which would stop the demoralization of rates, which has prevailed for the last two years.

What is probably the largest locomotive form of boiler ever built, was recently designed by Mr. F. W. Dean, mechanical engineer, of Boston. The boiler is 10 feet in diameter, has two corrugated furnaces, and has 5,300 square feet of heating surface.

Baldwin's people have recently received orders as follows: 2 engines for the New York, Philadelphia & New York; 6 consolidations for the Duluth & Iron Range; 1 ten-wheeler for the United Verde & Pacific; 6 consolidations for the Central Railway of Brazil; 6 eight-wheelers for the Lima & Northern; 1 special engine for the Philadelphia & Reading; and 32 engines for the Eastern Railway of Russia. The later have Westinghouse air brakes and the American brake on drivers.

The boiler of a passenger engine, belonging to the Delaware, Lackawanna & Western, exploded while the engine was in the roundhouse, one day last month. Fracture took place on the course nearest to the smoke box. It is very difficult finding out what was the cause of the explosion, as the sheets seem to be in good order, and no signs of corrosion were found. Fortunately no one was killed by the explosion, although the fireman was rather severely injured.

While a passenger train of the West Shore Railroad was approaching a deep cut, near New York, George Cole, the engineer, saw a big negro roll a large rock down upon the track. Cole applied the brakes promptly, and stopped the train before striking the obstruction, then he and his fireman chased the would-be train-wrecker and caught him. The negro was armed with a razor, and slashed the men rather badly before he was overcome, but they took him along, and landed him in the hands of a sheriff.

Mr. C. F. Quincy has been receiver of the Q. & C. Co. for several years, and he has been discharged by the courts within the month, his vigorous and successful management having brought back prosperity to the company. The past receiver is now treasurer and general manager.

BOOK REVIEWS.

"Machine-Shop Arithmetic." By Fred H. Colvin and Walter Lee Cheny, Editors of "Machinery." The Practical Publishing Co., East Orange, N. J. Price 50 cents.

To a mechanic wishing to learn the problems of everyday shop experience, this little book will be the best pocket companion we have ever examined. It has been prepared by two mechanics, who make no pretensions to a range of mathematics soaring above the heads of plain lathe or bench hands. There is nothing in the book that a man who has learned arithmetic will have difficulty in understanding, and every problem and rule in it ought to be understood by every mechanic with ambition to become anything higher than a common workman. The first subjects taken up are decimals, square root, cube root and mensuration. The rules of these divisions of arithmetic are plainly stated, and examples given of their application to shop practice. The formulas employed to indicate methods of calculation are very simply explained. If mechanics would study this department a little, they would not be so readily scared by an article that contains a few formulas to indicate abbreviated calculations. We regret not having the space to give a more detailed review of the book. Among the principal chapters are: Rules for Screw-Cutting; Drilling for Taps; Depth of Thread; Bolts and Nuts; Speed of Pulleys and Gears; Speed of Milling Cutters; Speed of Drills and Taps; Speed of Grindstones and Emery Wheels; Principles of Screw-Cutting.

Mr. G. R. Henderson, mechanical engineer of the Norfolk & Western, is an ideal chairman of a committee of investigation. In connection with a committee of the Master Mechanics' Association, appointed to investigate the subject of slide valves, he is issuing monthly bulletins to the rest of his committee, reporting progress and stimulating interest in the work. This is a plan well worthy of imitation. From the latest bulletin, we learn that Mr. Philip Wallis, of the Lehigh Valley, is making a dynamometer, to be used in tests; that Mr. Hammett, of Troy, N. Y., has promised to donate a new Richardson balanced and an Allen balanced valve; that the committee have determined to make tests at Purdue University with the C., B. & Q. locomotive; that the Norfolk & Western Co. have agreed to make the necessary valve yokes and valve rods to conduct the experiments; and that the Schenectady Locomotive Works have been asked to donate a steam chest, with fittings for testing the special Allen valve.

The Burlington, Cedar Rapids & Northern Railway people are using Keasbey & Mattison's magnesia sectional lagging for all their locomotives, and they are satisfied that it is the cheapest material they have ever used. They order a carload at a time, have the sections made to fit the boilers, apply the material with care and skill—with the result that the lagging needs no attention till it has to be removed, that the boiler may be examined. Then it is put back, and found as good as when applied.

The hollow staybolts, referred to in the article on the Union Pacific shops at Omaha, on page 8 of January number, were made by the Falls Hollow Staybolt Co. We are informed by this company that several of the large railroad systems have adopted the hollow staybolt exclusively in the construction of their fireboxes. This staybolt is made of the best quality of charcoal iron, and every staybolt is guaranteed to give satisfaction.

The Fitchburg Railroad people have adopted the Union Switch & Signal system of controlled-manual signals in the Hoosic tunnel. The trainmen are reported to feel thorough confidence in the system, which makes collisions almost impossible.

The Compania Mexicana de Ferrocarriles Industriales has received a concession from the Mexican Government to construct and operate several railroads, and the necessary telegraph and telephone lines, in the Federal District and the States of Mexico, Hidalgo, Puebla, Morelos and Michoacan, to connect the various lignite or coal mines with factories, mining establishments or towns. The railroads are for the transportation of freight. The road will be constructed and operated entirely by American capitalists.

Fire destroyed the office of the Whiting Foundry Equipment Co.'s works at Harvey (near Chicago), on the evening of January 6th. The drawings and records were saved, and new office quarters convenient to the works were at once engaged. The fire communicated to the erecting shop, damaging a portion of roof; but the machine, cupola, blacksmith shops, foundry building and power house were not harmed. Work will continue as usual. The space formerly occupied as an office will be added to the machine and erecting shops, to increase the capacity of these already crowded departments, and a new and separate office building will be erected at once. The company announce that they will be able to handle all business as usual, without delay or interruption.

Samuel Hall's Son, 229 West Tenth street, New York City, manufacturer of Hall's improved pipe wrench, which has gained such a widespread popularity during the past year, states that any part of this wrench broken with fair usage will be replaced without charge; also, that Messrs. Dunham, Carrigan & Hayden Co., of San Francisco., Cal., have been appointed distributing agents for the Pacific Coast.

A correspondent in Chicago writes us, saying that the fireman who was on the engine when the famous fast run was made on the Lake Shore & Michigan Southern Railway, ought to have as much credit as the engineer. This writer is disappointed because he does not know even the name of the fireman. We are in the same position, although we have tried to obtain the name. We are afraid that this hero, like many others, will pass through the world with his famous achievement associated with no name.

We learn from the officers of the Fitchburg Railroad that they are having very satisfactory results from a system of electric lighting which is in use on some of their suburban trains. It combines primary and storage batteries, and after charging will keep the lights going for forty hours.

AIR BRAKE DEPARTMENT

Conducted by F. M. NELLIS.

Danny Dugan's Air-Brake School.

" 'Lo dere! Wot t'ell? Say, isn't yuse dat air brake felly wot uster come chasin' yerself t' chin de ol' man w'en I was 'is offus kid? I t'ought so. Deys a natchel look on yer mug.

"Say, yuse is queered t' see me here in dese togs? I t'ought so. Say, dis chob's chust me size. Dat offus chob fitted me like a pair o' Jew pants. Dat's straight. Chasin' errands ain't in it wid a chob firin'. See? Say, I've been stuffin' rocks into a hog now fur nearly t'ree munts, and I'm stuck on me chob. I'm feelin' like a t'ree-time winner, an' am 'ere t' stay wid bote feet. See?

"Wot's dat? Keep 'er hot? Wot t'ell! Say, de devil o' Tyrone ain't in it wid me, an' dat goes. Say, some o' dem big mugs wot t'ink deys firemen—I kin give dem weight and lose 'em in a walk, an' dat goes. See?

"Say, on de level, me injineer is a dead hard stiff t' fire fur. W'en 'e ain't draggin' de links on de ties 'e's opening' de injectur wider. Dere's no low tide wid August. It's all de time high tide wid 'im.

"An' dis ol' injin' '84,' is a bloomin' refrigerator, an' dat's right. She'd make more boodle hired out to an ice cream joint 'an she does haulin' cars. Say, all de boys lays down wid de '84' on de hills and gives her time t' boil 'er water. See?

"Say, August is wot dey calls a long-stroke man. I doesn't know wot dat means, but I tumbled long ago dat it is somet'ink wot makes a felly's back hurt.

"One day I says t' August, says I: 'August wot t'ell's dat long stroke?'

" 'Dat means she cuts 'er fire better,' says August. 'Dat's wot it means, Danny.'

"I t'ink dat August is dead onto de game, 'cos w'en August points 'is finger at de coal pile, den at de fire door an' makes dem dinkey pantomine motions wid 'is 'and, it queers me t' t'row de rocks into 'er fast enough. She cuts de fire all to pieces. If it wuzzent fur de grates I t'ink dat de ash-pan would be cut out too. Dat's right. I'm givin' it to yuse on de level. See?

"Wot's dat? Does I know anyt'ink about dem air brakes? Sure! Say, dat's me long suit. Mebbe I'm shy on trumps, but I'm gettin' a lead-pipe cinch on de air-brake biz. Say, some of de fellys t'ink dat de air-brake school's a fake, and dey's dead sore on it, but let me tell yuse dat I gives it de hug. I pushes it along. See?

"Wot's dat? How did I get interested in air brakes? Dead easy! Say, dis is de way dat it was, see? Las' T'anksgivin' ev'nin', w'en I chases myself up to see Sadie; yuse know dat Sadie's me steady. Wot't dat? Yuse ain't on? Say, yuse is a farmer, sure. Sadie's me reg'lar comp'ny. She's me best goyle. See? Wot t'ell?

"Sadie, she says t' me, says she: 'Danny, wot t'ell does yuse know about dem air brakes?' Dem's not ezactly her words, but dey means de same t'ing.

" 'Not'ing,' says I. 'I ain't played a chip on de game.'

" 'Den yuse 'ad better play de new air-brake school fur a winner, an' put every plunk yuse got in yer bloomers on it,' says she. See?

" 'W'y,' says I.

" 'Because,' says she, 'I heerd Mr. Simmons say dat every mug uv an injuneer and fireman had t' swally dere dose at de new air-brake school wo's just been finished.' Mr. Simmons is de master mechanic an' is de man wot Sadie woickes fur. 'I heerd 'im tell Mr. W'ite, wot's 'is foreman, dem very words. 'E said dat de time was now almost here dat all de fellys 'ud have to know de air brake to hold 'is chob.' See?

"Den Sadie says t' me, says she: 'Dannie, dat means dat yuse has t' get into de push. I wants yuse t' get a hump on yerself an' learn all about dem air brakes, or I'll break yer face.' Dem want de same words she said, but dey means de same ting. Sadie talks more highfallutin' langwidge. See?

"Den me an' Sadie chewed de rag for a while. She said de new air joint was to be give to some mug wot understood de whole t'ing from start to finish,an' dat I mus' stan' in wid 'im somehow, an' get de inside track of de odder fellys. No more firemen would be set up wot couldn't pass a way up air-brake examination. Hully Gee! Say, de t'rottle fever's got a dead strong grip on me, and I liked to hear dat, I don't t'ink.

"I t'ought I saw my openin' to score a point, so I makes a right-hand lead fur Sadie's left ribs and I lands like dis. 'If I tackles de air-brake bizness, Sadie,' says I. 'and puts it t' sleep, will dat make me solider wid yuse?'

" 'Sure!' says she. Say, Sadie's the stuff, all right, an' wot she said makes me feel like a t'ree-time winner. Dat's on de level. See?

"Say, de nex' day I chases meself down to de air joint. Dere was four million fellys dere. Wot? Four million? Well, at first I tought dere was, but I guess dere wuzzent quite dat many. Dere was a young felly dere talkin' de dinkiest langwidge yuse ever heard, an' he wore a go-ahead and back-up cap and blonde shoes. Wot? Tourist cap and tan shoes? Yes, I guess dat's right, but de rig would queer an older man, sure.

"Say, dere was more rag chewin' dan I ever heerd before. Dey all wanted t' talk, and dey all kicked t' see w'ich would teach de instructor, as dey call de bloke wid de swell clothes. But de young felly was cool and perlite like, an' one after de odder was brought down t' 'is milk. At first de t'ing was a reg'lar wranglin' bee.

"Say, I wasn't in it a little bit for a minute wid dem big tall fellys, and I coudn't see not'ing. Jus' den some mug pulled me coat sleeve, an' w'en I turns around, I sees dat it was Fiddle Face Farley, wot married Sadie's sister, an' 'e keeps de dirtiest engine an' is de laziest fireman on de road. But fur purs'nal reasons I wants to stand in wid 'im, aldough he is lazy.

" ' 'Lo, Danny,' says 'e.

" ' 'Lo,' says I. 'Are yuse onto de game?' says I.

" 'Sure,' says 'e. 'I knows more about de game in a minute dan dat felly knows in a munt.'

" 'Put me on,' says I. 'I'm a dead green farmer on dis lay.'

"Say, de way Fiddle Face looked at me den made me dead sore in a minute. Dat look said plainer dan words: 'Danny, yuse ain't in it wid me for a minute. Yuse has no business on the 'eart. Get off!' But Fiddle Face 'as been firin' more dan t'ree years. So I took it. See?

"I wos just about t' tell 'im t' button up some of dat pity or dere'd be a scrap, w'en 'e says, says 'e: 'Listen close, Danny, 'cos I t'ink dis is too deep fur yuse to understan'. Does yuse see dat curly spring?' says 'e.

" 'Sure,' says I.

" 'Well, dat's wot sets de brake.' says 'e. 'Den de murgency pressure works de exaggarated falve, and de brake lets off t'rough de excess port until de pump recharges de cylinder again.' Say, I've found out since dat dat was de rankest stringin' I ever got. I t'ought dat Fiddle Face was a corker den, an' wished dat I was onto de game half as much as he was. I t'ought dat he orter have a chob wid de Westin'ouse; but I 'as learned more, an' know dat he's only a big game of wind, an' was a-stringin' uv me. T'ell wid a fool, even dough he's only a day old!

"Say, w'en de odder mugs all left, I chases up to de young felly, an' says I to him, says I: 'Say, can a felly like me wot's a farmer at dis bizness learn de tricks of de dinky falves wots ev'rywhere here?'

"'Cert,' says he, 'De ting's dead easy.'

"'Say, yuse is a peach,' says I. 'All dem fellers was tryin' ter string yuse, but yuse was cool and perlite like, and stood dem all off. Every man of them was put on Queer street before you trun 'em down.'

"'Dere all right,' says 'e. 'We'll get along better next time.'

"'Say!' says I. 'I wants t' get de bulge on dese tricks bad, an' will do anyt'ing if yuse will chust put me on. See?'

"Den he looked up and smiled, and we shook hands. He axed me my name, an' said he was glad t' see one man at least dat didn't know it all. Den he takes me fur more dan an hour, jus' de same as dough I was some swell chap, an' he told me all about de dinky falves an' dere tricks, an' he filled me nut wid wheels. But I remembered a whole lot of it..

"I t'ought I never'd get onto dem falves, but de young felly dropped dat high-falutin' langwidge, an' 'e made de t'ing s' dead easy dat I couldn't 'elp see it.

"'Danny', says 'e, 'does yuse know any t'ing about dem air brakes?'

"'Nary a t'ing,' says I.

"'I'm glad o' dat,' says 'e. 'Youse 'as no wrong ideas to undo,' says 'e. Den 'e says, says 'e: 'Danny, de first kind of an air brake wuz wot dey calls a straight air brake. De very first t'ing wot wuz done wuz fur de pump t' squeeze de air into de main drum on de injun, an' den we wuz ready to set de brake. Before de brake wuz set, de only place dat air wuz, wuz in de main drum on de injun. Dere wuz none on de cars. Dere wuz a pipe from de main drum to de t'ree way cock. De main train pipe begin at de t'ree-way cock, and run de whole lengt' o' de train. Each and effery car 'ad wot wuz called a brake cylinder, wot wuz connected to de main train pipe by a dinky pipe. We'n de injineer wanted t' set de brake—an' 'e wuz de only mug wot could set it—'e trund de t'ree-way cock han'le a bit, an' de squeezed air in de main drum went t'rough de t'ree-way cock into de main train pipe, t'rough de dinky pipe t' de cylinder. Dis 'ud push de piston out and pull de lefers around an' dey 'ud pull de brake shoes up onto de wheels, and rub hard. Dis 'ud stop de train. W'en de injineer wanted t' t'row de brakes off, he'd trun de han'le a' de t'ree-way cock de odder way a bit, w'ich 'ud shut off de squeezed air comin' from de drum, an' de air wot pushed de piston out o' de cylinder 'ud come back t'rough de dinky pipe and main train pipe to de injun again, as far as de t'ree-way cock, an' den 'ud pass out t'rough a hole in de cock to de open air.'

"Say, dat wuz good English langwidge, wot I understands. Dere wuz not'ing highfalutin' 'bout dat. I gets onto dat straight wid bot' feet, and dead easy, too.

"Say, dat young felly's a peach. Yuse kin bank all yer plunks dat he savvies his drill on the air brake. Not only dat, 'es dead onto how t' chin about dem brakes to a felly like me, wot's a farmer at de biz.

"Den he says, says 'e: 'Danny, now de automatic brake is chust opposite to de straight air. De pressure fer de cylinder is a zallary razzerboy under de car, but I'll tell yuse more about dat nex' time.' He tol' me dat I had better chase meself home now, as I had all my nut would hold widout bustin', and I t'ought so too.

"Say, dat felly's a peach, an' dat's dead straight. But, Hully Gee! but dat air brake is a bute. Dat graduating valve and zallary razzerboy is out o' ——. Wot t'ell? Wot? T'ree-t'irty? Say, it's after t'ree o'clock now. Say, Slobby, did yuse call August? All right! Go chase yerself, y'ugly man's boy! I ain't got time t' jolly wid yuse now. Well, s' long till I sees you again. I'll put dis brake valve togedder again before Long Stroke sees it, fer he'd be sure t'ask, w'ere t'ell all dem dinky pieces came from. Yes! All right! Sure! Dat's wot I'll do. Wot t'ell? Dat's straight! I'll chase meself dere every time I'm in. Yes, I'll tell yuse more about how I gets along de nex' time. S'long!"

A Brake That "Wears Out Brake Shoes."

As proof to illustrate the increased efficiency of an improved tender foundation brake gear over an old discarded style, a correspondent states that more brake shoes are worn out with the new rigging than with the old. By some few officials, upon whom false economies have a death grip, the change which calls forth this extraordinary remark would be received with alarm and disapproval, and might possibly bring disaster upon the head of the intrepid individual who made it; but the officials of the nature above referred to do not have their abiding places on the Nashville, Chattanooga & St. Louis Railway. The officials of this line know the value of the change and appreciate the value of the man who made both it and the fitting remark.

It is quite safe to assume that a brake which does not wear out shoes in a reasonable time is doing but little work. It is not asserted that the prime consideration in a brake rigging is that it shall wear out brake shoes as fast as possible. On the other hand, it is denied that brake shoes shall last for years. Foremost of all considerations, the brake should have a proper holding power, and "you can't get something for nothing."

In making a brake shoe, the most important consideration should be the selection of a metal which will offer good frictional qualities; and after this should follow anything which increases the longevity of the shoe. Unfortunately for the good of the brake, the order of these considerations is often reversed. The experiments of the M. C. B. Association have brought out a great deal of information regarding brake-shoe metals, and their further experiments will bring out more. So far, soft cast-iron heads the list.

Insufficient pressure at the brake shoes, due to too low proportion of leverage, hard metal in the shoes and faulty design of brake gear, are condemning irregularities which permit undue longevity of brake shoes, and flourish to a greater degree on tenders than on any other vehicle in the train. The energies of the air-brake man cannot be better directed than to procure a first-class tender brake—one that will "wear out brake shoes."

The New "High-Speed" Brake.

An excellent paper, entitled "Air-Brake Equipment, and Its Application to Rolling Stock," was read by Mr. R. A. Parke, of New York, at the November meeting of the New England Railroad Club. Space will not permit of our reproducing it in its entirety, as we would like to do, and, in consequence, an extract of that portion which describes the Westinghouse "high-speed" brake is made, which is as follows:

"The remarkably fast time which has become an established element in practical passenger service within the past three of four years, however, has developed a demand for even a better stopping efficiency than that assured by the ordinary quick-action brake, and this requirement has instigated a modification of the quick-action brake apparatus which decreases the length of stops from high speeds about twenty-five per cent. As no description of this modification has been published, and as its importance to the safety of fast trains is becoming liberally recognized, a brief sketch of the features peculiar to the apparatus will be given, before a general review of present air-brake practice is undertaken.

"It has long been known that, while practically the same frictional resistance to the rotation of the wheels is required at all speeds to induce them to slide upon a dry rail, the same brake-shoe pressure produces much more friction at low speeds than at high speeds. It has therefore been customary to so limit the maximum brake-shoe pressure that the friction developed at low speed shall not be sufficient to cause injurious wheel-sliding. The total friction at any instant is the direct measure of the resistance which is then retarding the motion of the train, and a uniform brake-shoe pressure therefore offers much less resistance to the motion of the train at the high speed in the beginning of a stop than at the low speed toward the end. It is evident that a much greater brake-shoe pressure could be employed at high speed than at low speed without sliding the wheels, and this is the purpose of the modification of the quick-action brake which is now known as the 'high-speed' brake.

"The high-speed brake is, essentially, a quick-action air brake operating under a high air pressure. In emergency applications, it creates at first a high brake-cylinder pressure which is gradually and automatically reduced to sixty pounds while the speed is being reduced, and in service applications it limits the cylinder pressure to sixty pounds. These results are effected by the use of an automatic relief valve which is attached to each brake cylinder, and consists of a piston, a slide valve and an adjustable spring. The spring is so adjusted that the valve is inoperative when the air pressure in the brake cylinder is sixty pounds or less. If, after the cylinder pressure has reached sixty pounds, the supply of air to the cylinder continues, but with no greater rapidity than occurs in any service application of the brakes, a large port in the relief valve is opened and permits the excess supply of air to freely discharge from the brake cylinder to the atmosphere, so that no increased cylinder pressure occurs. In an emergency application of the brakes, however, the air is supplied to the brake cylinder so rapidly and in so much greater volume that the pressure rapidly rises above sixty pounds and causes a longer travel of the relief valve piston, whereby the large port of the relief valve merely opens and instantly closes again, and the air is caused to escape from the cylinder to the atmosphere through a more restricted port, until the the pressure has been thus reduced nearly to sixty pounds. When the pressure becomes reduced to sixty pounds, the further escape of air is cut off and that pressure is retained in the brake cylinder until the brakes are released from the locomotive.

"As locomotives which haul high-speed trains are generally also used in other kinds of service, it may be frequently necessary to change from standard train-pipe pressure of seventy pounds to high pressure and vice versa. In order that this change may be quickly effected, the feed-valve attachment of the engineer's brake valve is removed and replaced by a flanged fitting, from which two small pipes lead to a bracket under the running board. This bracket supports two feed valves, the one set at seventy pounds pressure and another set for the higher pressure, and contains a three-way cock by which either feed valve may be used as required. The pump governor is also supplied with a siamese and two diaphragms, one set at ninety and the other at one hundred and twenty pounds. The small air pipe leading from the main reservoir to the ninety-pound diaphragm of the pump governor is supplied with a cock which is open when a main reservoir pressure of ninety pounds is used, and closed when the higher pressure is required. Of course, if the locomotive is used exclusively to haul trains equipped with the high-pressure relief valves, the ordinary arrangement of engineer's brake valve and pump governor fulfils the requirements by merely adjusting them for the higher pressures. The train-pipe pressure used with the high-speed brake is from one hundred to one hundred and ten pounds.

"Experimental tests of the high-speed brake have demonstrated the importance of the use of sand on the rails in all emergency stops. Not only is a better stop made, but in case of a bad rail the use of sand is practically a necessity to prevent the wheels from sliding with the high cylinder presure employed. It is highly desirable that the application of sand should be automatic, so that the movement of the handle of the engineer's brake valve is all that will be required of the engineer in emergencies. The reasons for this are the same ones that condemned the use of a separate operative valve for the driver brake, when it was formerly employed as an emergency appliance. It is therefore urgently recommended that, in all cases where the high-speed brake apparatus is applied, a track-sanding apparatus shall be used which will operate automatically in every emergency application of the brakes.

"Besides shortening emergency stops about twenty-five per cent., another important advantage in the use of the high-speed brake is the ability to make more than one effective application of the brakes without recharging. The importance of this feature in fast train service was well illustrated by an incident which occurred some months ago. A train equipped with the ordinary quick-action brake was running at the rate of about sixty-five miles per hour when the engineer observed a block signal set against him. He had hardly obtained a full service application of the brake before the signal cleared and he released them. The speed had not been perceptibly reduced, but the air pressure in the auxiliary reservoirs had been reduced to fifty pounds, and, before it could be restored, the train rounded a curve just beyond the block signal tower, and the engineer encountered a drawbridge signal at danger. An emergency application of the brakes was promptly effected; but, when the train stopped, the locomotive was within ten feet of the open draw. That train is now equipped with the high-speed brake, and it is found that, immediately after a full service application and release, there is still sufficient air pressure to make a considerable better emergency stop than could at any time be made with the ordinary quick-action brake.

"Still another advantage of the high-speed brake is the positive limitation of the brake-cylinder pressure to sixty pounds in all service applications, regardless of the train-pipe pressure used. Although the brake leverage is such that a cylinder pressure of sixty pounds produces 90 per cent. braking power, and this braking power is available in full service applications, not a single pair of wheels is reported to have been removed from the Empire State Express trains on account of flat spots, during the two years that those trains have been equipped with the high-speed brake apparatus."

Quick-action triple valves on locomotives and tenders, even though containing very heavy graduating springs, would be of value in assisting quick action through engines and tenders having very crooked piping, and would also place a check on careless hostlers who make numerous unnecessary emergency applications in moving engines about coal and ash tracks, and over the turn-table; for, with a continuance of their present careless practice, they would soon be called to account for damaged brake rigging. Making this change, however, would be catering to unworthy practices.

An excellent article on tender brakes by C. B. Conger, which appears elsewhere in this department, is instructive and shows that the author is well posted on the subject. The foundation gear which he shows in an accompanying sketch is all that he claims for it. It is simple and effective. The only objection to it is that the multiplication of power necessary to brake at a standard percentage must be made in the brake-beam levers; but, doubtless, his tenders are all nearly of a uniform weight, and his plan is therefore good and justifiable.

If your driver and tender brakes do not "wear out brake shoes" they are not holding as they should. Examine them and ascertain the cause. A pressure gage connected into the cylinder may furnish some startling and valuable information.

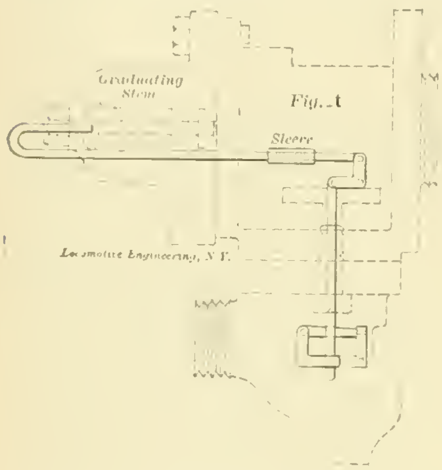
One of the inconsistencies incident to an alleged air-brake failure, or to an accident in which suspicion is directed to the air brake, is the minuteness with which every possible detail is observed, and the wonderful exhibition of memory by the parties involved.

CORRESPONDENCE.

A Valuable Illustrating Device for Air-Brake Instructors.

Editors:

Inclosed herewith I forward to you a sketch of an interesting and useful device which has been designed by Mr. P. P. Haller, air-brake inspector of the C. & O. R.R., for use in instructing men in the operation of the quick-action triple valve. Fig. A represents the back view of a sectional triple, showing the relative location of the mechanism which Mr. Haller has added, for the purpose of causing the main piston to move the emergency and check valves when it (the main piston) is moved to emergency position. All of the



readers of "Locomotive Engineering" are, doubtless, familiar with what is known as a "sectional triple valve," such as nearly all of the instructors use in illustrating lessons on the brake. It will be readily understood, therefore, what is the object of this arrangement. All the levers and rods being placed behind the valve, prevents confusion arising in the mind of the learner, on account of their presence.

In Fig. B is shown a perspective view of the operative parts, removed from the triple valve. From this it can be easily seen how a downward movement of the lever 3, which rests on the top of the emergency piston inside of the triple casing, will at the same time produce an upward movement of the lever 8, which bears against the under side of the check valve. Thus, when the graduating stem is moved by the main piston striking it, on an emergency application of the brakes, the rod marked No. 1 travels to the left, moving lever No. 2 so as to push down on rod 4; and this, in turn, pushing 5 and 7 to the right and moving 8 upward, raises the check valve, which is just below the emergency valve, but not shown in the drawing, just at the time that the lever No. 3 pushes the emergency valve and its piston downward. In the device used by Mr. Haller, the lever arms are so proportioned that the emergency devices will begin to move just as the emergency port under the slide valve is uncovered; and when the main piston is clear back, the emergency valve will stand open about one-quarter of an inch. The sleeve on the rod No. 1 makes it easy to adjust the parts so that this proper proportionate opening will take place just at the right time.

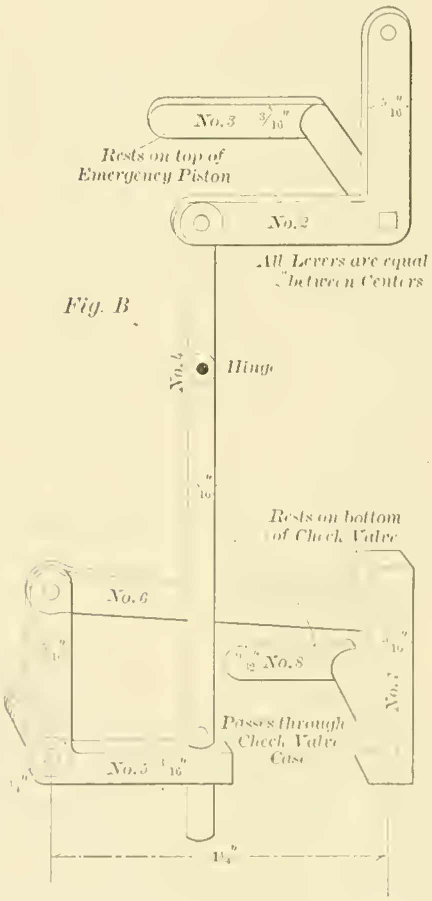
The levers are all made of steel so they will not yield, and the joints fitted with as little lost motion as possible.

Chicago, Ill. PAUL SYNNESTVEDT.

Quick-Action Triple Valves for Engines and Tenders.

Editors:

In my solution of Mr. Conger's problem, published in your January number, I notice an error which I desire to correct



before some considerate reader does it for me. Where it is stated that in release the engineer's valve handle was "put around to only service position," it should, of course, have read "running position" instead.

This problem of Mr. Conger's brings to my mind a question which has often arisen before—*i. e.*, Why would it not be good policy to use a quick-action triple valve on the engine and tender as well as on the cars? Are the railroads not committing a serious blunder in following the usual custom? I am not, of course, unmindful of the fact that there are some arguments which might be urged against departing from this established practice, but it seems to me that the points in favor of the use of quick-action apparatus on both engine and tender are very material.

In cases of emergency action, the strain thrown upon the drawbars during the moment when the car brakes are set, and the engine brakes only setting, must be enormous. Is it not very probable that a large number of the break-in-twos which occur at various times might be traced directly to the lack of a quick-action brake on the engine? It is a matter of record that in a large number of the experimental tests of the quick-action brake on fifty cars, made at different times, the train has pulled apart, generally near the front end.

PAUL SYNNESTVEDT.

Chicago, Ill.

[The preliminary exhaust port in the brake valve being restricted to a size which shall permit of a sufficiently rapid reduction being made in the train-pipe pressure, to cause the pistons to pass the leakage grooves in the brake cylinders of a long train, and not cause an emergency application on a one-car train, would prohibit the use of the quick-action triple valves on locomotives and tenders, unless some special provision, such as heavier graduating springs, were made. And if such springs were given sufficient stiffness to withstand the effects of a heavy continued service reduction, the additional cylinder pressure gained by a quick-action application would be very small.

That the plain triple valves on the locomotive and tender are not the cause of the train breaking in two in fifty-car train emergency tests, is proven by the fact that the breakage does not take place at the time of application, when the slower-acting triples of the engine and tender would throw the greatest strain on the couplings by a lunge forward; but, instead, the breakage invariably happens shortly before the train comes to a standstill, and a considerable length of time after all brakes have applied and are fully equalized. The parting, however, can be more properly traced to the difference in the frictional qualities of the brake shoes throughout the train, as they may not have the same effective bearing on the wheels, or they may be made of slightly different grades of metal.

When quick-action application has been made on a fifty-car train, and after the pressures have equalized in the brake cylinders, the different holding power of the many brake shoes creates a series of internal disturbances throughout the train, during which one part of the train may have the drawheads extended, while a few cars further forward they may be found compressed. This compression and tension is confined to no particular place in the train and may be found duplicated in several places, according to the holding power of the brake shoes. As the shoes become heated and their holding power increased, the strain on the couplers becomes so great that a breakage often occurs at a weak point. Sometimes more than one breakage occurs.

The breakage cannot be arbitrarily blamed to the opposing forces of the forward and rear ends of the train, but it is the result of numerous small factions, so to speak, which are formed and reformed, according to the varying friction of the shoes in different parts of the train, until the factions combine into two great opposing forces, which pull the train apart at a weak point. This may, in turn, cause another reforming of forces, which may cause a second, and even a third break before the train is brought to a standstill. With the elimination of the unfavorable conditions which prevent a uniform holding power of the brake shoes, this trouble will be very greatly reduced.—Ed.]

The Nashville, Chattanooga & St. Louis Railroad Standard Tender-Brake Gear.

Editors:

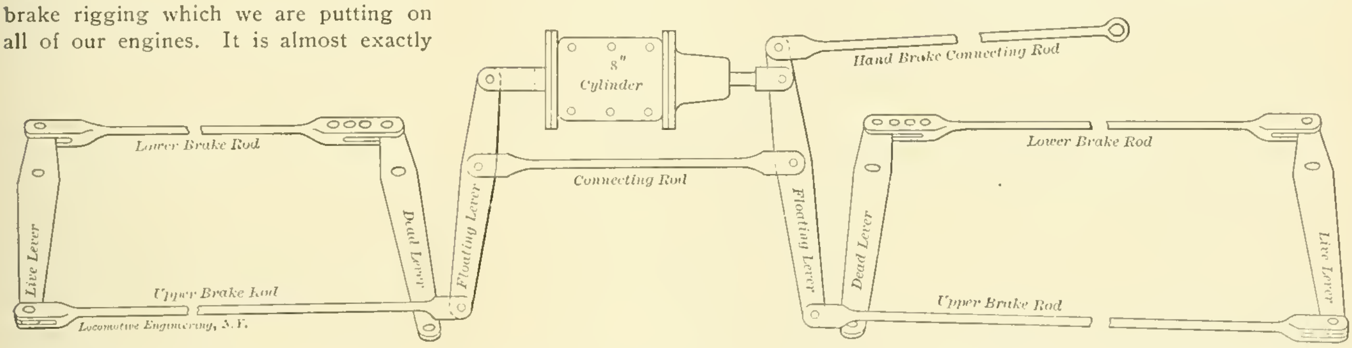
I am sending "Locomotive Engineering" a blueprint of our standard tender-brake rigging which we are putting on all of our engines. It is almost exactly like the kind recommended in the December number by Mr. S. J. Kidder.

In order that we may fasten the cylinder like it is done on a passenger car, I have a cast-iron foot made and fasten it to the cylinder head with studs and nuts. It is very easy and economical to do this. Care must be taken that the studs are tight. As there is a push on this foot instead of a pull, there is no danger of tearing it off. The brake-beam levers are all standard, four and a half to one, and are interchangeable on light and heavy-weight tenders. All tenders are braked at 100 per cent.

The cylinder levers are all the same length over all, but the middle hole for the connecting rod is drilled so that the braking power will be 100 per cent. This plan gives us a standard proportion of brake-beam levers for our tenders, and the difference required to suit the brake power to the tender is made in the cylinder levers. This gives us different-proportioned cylinder levers for the various weights of tenders; but cylinder levers seldom if ever break. I have not had to replace a broken one yet. We have the satisfaction of knowing that every tender is holding its own share, and that we have four of the levers out of the six that can be interchanged on all our tenders, and also on our passenger cars, as they also have four and a half to one brake-beam levers. The only non-standard proportion which we have is the cylinder levers, but they are the same length over all. I am waiting to find a broken cylinder lever; and until I have one, I will believe we have got the best tender brake possible to get.

About three years ago we commenced to change our tender brakes to the present kind, and there are but two or three engines which haven't got the improved gear; but they will get it when they come in the shop for repairs. I feel that we have given this brake gear a good hard trial, and that I can recommend it to any road that wants a first-class tank brake. One strong proof that this brake gear is better than our old one is that it wears out more brake shoes. But if you want good service you must pay for it. You can't get something for nothing.

OTTO BEST,
A. B. Inspr. N., C. & St. L. R. R.
Nashville, Tenn.



Train-Pipe Angle Cocks Working Shut.

Editors:

Reading the case of train-pipe angle cock closing from being struck by a loose deadwood, as described in the December issue of "Locomotive Engineering," calls to my mind the experimenting that Mr. Holmes did in that line, as described in "Locomotive Engineering," in 1893. He found that by striking sharp blows with a hammer on top of handle, every angle cock could be closed; also found every one that closed had spring No. 4 wound right-handed the same as a screw. In one old cock he found a left-hand spring, which was put in a cock in back of a tender; and opening the cock partly by hand, and then striking it on top of handle, it gradually worked open. Then took out left-hand spring and put in a right-hand one, repeated the hammering, and the cock closed again. From the above facts, as pointed out to us by Mr. Holmes, we are of the opinion that angle cocks with the spring No. 4 wound right-handed, are just as dangerous as a car running over the road with a loose deadwood.

WALTER C. GARAGHTY.
Baltimore, Md.

[Our correspondent's fears are entirely without foundation; for it matters not whether the spring under the key of the angle cock be right or left-hand wound, as experiment will prove. Mr. Holmes did make some experiments in this line some time ago, and the results obtained seemed to indicate that the right-hand wound spring was at fault. Subsequent experiments, however, proved that the true cause of the cock closing was due to the manner in which the man handling the hammer delivered the blow. Instead of striking squarely on top of the key, the obstructions required him to strike a slightly glancing blow. By selecting the proper side, it was found that he could close or open the cock at will. The same principle is used every day in shop work, where a square or hexagon nut may be either tightened or loosened by striking a little nearer one corner than the other, on the same face of the nut. Mr. Holmes' first article caused considerable alarm amongst railroad people at the discovery of this supposed fault; but their fears were dispelled by experiments made by themselves, and further experiments made by Mr. Holmes, the results of which were printed on page 172, May number, 1894. —Eds.]

Chicago & West Michigan Tender Brake.

Editors:

Mr. Kidder illustrates a very good design for a tender brake in the December number, which is likely calculated for new work, as it shows the passenger style of cylinder head, which is not ordinarily used on tenders.

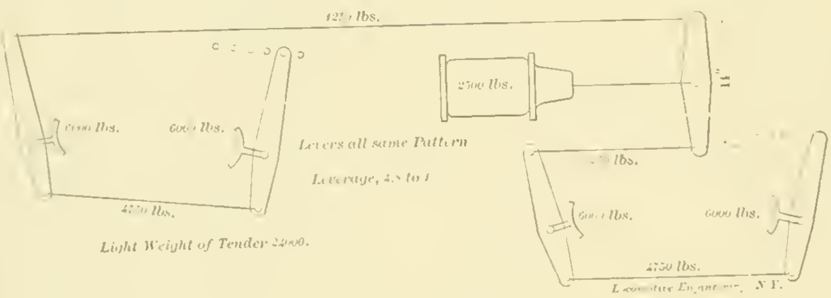
When it is necessary to put a double-connected brake on an old tender (a single truck brake on tender is not safe) and use the old material, it is quite a puzzle sometimes to get the brake cylinder set so it will not interfere with the various pipes for steam heat, air brake, air signal, and at the same time have it come where you can hitch on to the brake levers where they will move freely.

We use a plan, here illustrated, which has some advantages. In the first place, it is perfectly equalized on all beams, and the levers are all just alike, as to size, length and proportion; they cannot be put in wrong and spoil the action of the brake.

The brake cylinder sets near one side of the tender frame, between the trucks, where it is accessible to clean or repair. It should be just far enough in so the equalizer lever on end of push rod from piston will clear the inside of No. 2 pair of wheels nicely; this equalizing lever is about 14 inches long. This will let the brake levers set at such an angle that their bottom ends will be up high enough to clear crossings, etc., so they will run no risk of being torn off. Then the brake levers will be low enough at top ends to clear everything on tender framing, and the brake rods run the same way truss rods and pipes do, so they are not as likely to catch on them.

Both bottom and top rods, as well as levers, should be a standard length for same type of tender frame and truck arrangement, so only one set need be carried in stock, and careless repairers cannot spoil the brake by putting on wrong style of rods.

The dead-lever guide or stop should be set so lever will be connected to outside hole with new shoes, and have holes



enough to take up the slack till shoes are worn thin enough to change.

If chilled wheels are used, the bottom rods will need one hole for connecting pin at one end and two at the other. With steel-tired wheels, however, bottom rods need extra holes at each end to allow for tire being turned, thus decreasing size of wheel more than one hole can take up. Chilled wheels do not decrease in diameter very much before they are changed and a new pair of standard size put in.

If you use an old 12 x 33 auxiliary reservoir, such as we find on a great many old tenders, remember that an 8-inch cylinder with 8-inch piston travel will equalize at 7 or 8 pounds higher than with a 10 x 24 auxiliary, so you must figure on a strain on the push rod from piston as 2,850 pounds, instead 2,500. This higher piston pressure gives 1,425 pounds to top end of each live lever.

The auxiliary reservoir can be set most any place under the tender where it is convenient to get at triple and piping; but it pays to put it near the other side of tender frame, opposite the cylinder, where tender wheels or axles won't strike it, and where it can be got at easily when necessary.

It helps the work of the brake—if hand brake is not used—if the push rod is fastened to piston sleeve so piston release spring will pull rods back also, and clear shoes from wheels. A piece of thick rubber hose slipped over push rod, and thick enough so it will stick fast on outside of push rod and inside of sleeve, does this act nicely. Have a quarter-inch hole drilled in this sleeve, close to the end, to put a pin in. When you take down the cylinder head, to clean or repair the leather packing, this pin will keep the piston from coming out and chasing the repair man out of the pit.

A tender can be braked for 100 per cent. of its light weight, as the tools, and what water and coal are on a tender, even at the end of a run, will give the necessary margin to keep the wheels from skidding.

The absence of dead levers takes away the braking power from the brake beam that has no lever, to the exact amount of the strain on top end of live lever.

There is so small a percentage of the total weight taken care of, when braked on one truck only that it does not help much. A good tender brake, so arranged that it is easily adjusted and taken care of, will save you many a close call when running lght, or passing through crowded yards to and from the roundhouse. Air brakes are put on to stop with; but if they are not in the best possible shape, you can't stop in a hurry when you need to.

C. B. Conger.

Grand Rapids, Mich.

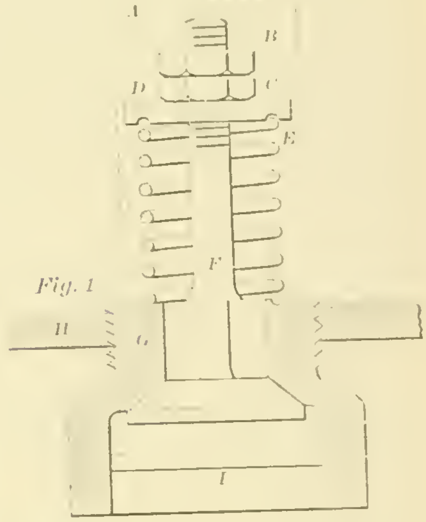
An Automatic Drain and Relief Valve for Main Reservoirs.

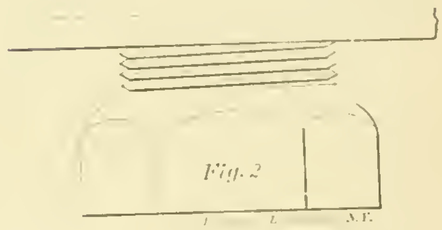
Editors:

I am sending for illustration in "Locomotive Engineering," a sketch of a useful device for draining the main reservoir. The operation is as follows:

Fig. 1 shows a sectional view of the device. The valve seat *g* is screwed into the bottom of the main reservoir *h*; the valve *f* opens downward; the grooved plate *d* rests on spring *E*; *b* and *c* are nuts on end of valve stem; *i* is a pin through opening under valve, to prevent it from falling out in case stem *f* breaks. The spring *E* is of a tension slightly in excess of the pressure allowed by the governor; *b* and *c* are adjusting nuts to give desired tension to the spring. Dotted line is a perforated cover over spring and valve, to prevent foreign substance from getting on the valve seat.

To operate the valve, arrange to cut out the governor and create an excessive pressure in the main drum, which will force the valve downward from its seat





and blow the water out of the drum. The discharge is straight down, to prevent the water from spraying.

Fig. 2 shows the device in place in the drum.

W. de Sanno,
Pan Handle Shops.

Indianapolis, Ind.

Designers and Inventors Please Notice.

Editors:

I would like to ask the readers of "Locomotive Engineering" if any of them have invented or designed any special device for easy handling of the 9½-inch pump. The 8-inch pump was easily handled by numerous schemes, but for the 9½ there seems to be a scarcity of such special tools. What is wanted is something by which the pump can be lifted easily by hand or a rope.

J. B. Downing.

Arkansas City, Kan.

That slack adjusters are not mere vanities will be proven to any one caring to make an investigation of their merits. Considerable information may be expected from the Air-Brake Association's committee report on slack adjusters, at their coming convention in Boston next April.

QUESTIONS AND ANSWERS

On Air-Brake Subjects.

(5) F. S., Mobile, Ala., asks:

What is the main object of putting the plug in the bottom head of the air cylinder of the 9½-inch pump? A.—That the piston may be moved to the upward limit to facilitate removing and putting on the upper steam cylinder head.

(6) H. G. A., Somerville, N. J., asks:

1. Was my solution of Conger's problem correct? 2. In the last, or emergency application, on account of the driver brake having such short piston travel, was not the driver brake auxiliary reservoir proportionately smaller than the auxiliaries for the other brakes? If not, it would not release sooner than the coach brake. A.—1. With the exception of the reference in question No. 2, your solution was correct. A.—2. The three inch piston travel on the two driver brake pistons, and the extra amount of pipeing between the triple valve and the cylinders would cause the auxiliary pressure to equalize at about the same pressure as that of the tender brake at seven inches.

(7) F. P. A., Newbern, N. C., writes:

Will you please give us information in regard to train signal blowing when brakes are released, and when the cord has not been used. We have searched for leaks on the engine, tender and cars, but have not found any. A.—The supply valve of the pressure reducing valve is held from its seat by some foreign substance, allowing main reservoir pressure in the signal line. When brakes are released, the main reservoir pressure is reduced below that in the signal line, and the latter pressure returns to the main reservoir, making the reduction which causes the signal whistle to sound. Clean and examine the reduction valve, and the trouble referred to will disappear. For further information on signal valve kinks, see page 704 of November issue. The roundhouse repairman should provide himself with a testing device. This will show up your trouble, and any other which the signal will take on.

(8) J. R. N., Buffalo, N. Y., asks:

Is an auxiliary reservoir which measures 12 x 33 inches the right size for 8-inch brake cylinders? I notice that some engines are so equipped, and that the same size is used on larger brake cylinders. Would you please say which is right and which is not? A.—Eight-inch cylinders should have 10 x 24-inch auxiliary reservoirs, and 10-inch cylinders should have 12 x 33 inch. When driver brakes were first introduced, it was the practice to supply the two driver brake cylinders and the tender cylinder from a 12 x 33 auxiliary reservoir under the tender. The one reservoir supplying three brake cylinders proved a failure, and a separate reservoir for the driver brake was furnished. This change rendered the 12 x 33 auxiliary too large for the 8-inch tender brake cylinder, and the brake manufacturers arranged to exchange a 10 x 24-inch reservoir for the old 12 x 33. A number of roads took advantage of this exchange, but others have not. This explains the presence of the 12 x 33 reservoir on the 8-inch cylinders you mention.

(9) J. B. D., Arkansas City, Kan., writes:

A 9½-inch Westinghouse air pump broke out a piece of the small reversing piston (No. 79 in Plate E5) and part of the packing ring. A new piston (77 and 79) was put in, but pump would not work; nor would it work with any other piston until a hole was drilled in the cylinder head (No. 84) and a small bolt put in for a stop. Until then the piston would travel so far that it would cover up port *g*, and allow no steam to enter to reverse the piston. What was the trouble? A.—The manufacturers have discovered that too little clearance has been allowed between piston head 77 and cylinder head 84, and that, after a season's wear, it is possible for the piston 77 to travel so far as to block port *g*, as you mention, and will permit no steam to enter through to reverse the main valve piston. All 9½-inch pumps now being made have the port *g* so arranged that no amount of wear can allow the piston 77 to cover port *g* and block the steam from entering. We would advise you to remove the bolt mentioned, which answers the purpose of a stop pin, and to slightly elongate the port *g* in the direction of the cylinder head 84. This elongation should be made with care.

(10) E. R., Wilkesbarre, Pa., writes:

In Conger's problem in December number of "Locomotive Engineering," I would say that in applying the brake in full service, the driver brake would equalize at a higher pressure than tender and coach; also tender had a higher pressure after equalizing than coach on account of it having shorter piston travel than the coach. The coach having the longest piston travel of all would release first when main drum pressure was fed slowly into the train pipe. In applying brakes in emergency, the quick action would operate on the coach, and would cause it to equalize at a higher pressure than either the tender or driver brake, and a slow increase of train pipe pressure would cause it to release last. The driver brake triple being nearest the engineer's valve would release almost as quick as the tender brake, although it equalized at a higher pressure. Would not the frictional resistance in train pipe cause the driver triple to let go ahead of the tender triple in this case? A.—Although your answer to Conger's problem arrived too late for printing in January number, we have decided to publish it in this number. Frictional resistance in the train pipe would be inconsiderable in this case, inasmuch that the train pipe is very short and the pressure being fed into it slowly finds space to occupy without traveling any great distance, and at a very slow rate of speed. Frictional resistance is a very considerable factor in long pipes where air pressure travels swiftly through them, but in the case cited it has very little, if any, effect.

(11) J. W. H., Wilkesbarre, Pa., writes:

After coupling on to an eight car passenger train the other day, the inspectors called for a test of the air brakes. I made a reduction, and all brakes applied, with the exception of the fifth car. The inspector looked around it, and tapped the triple valve with his hammer, but the brake would not set; he said he thought it was gummed up, so he cut it out. What was the matter with it? A.—Tapping a triple valve with a hammer is proof positive that the man does not know what the trouble is, but hopes that tapping will cure it. There are cases where tapping, in connection with other treatment, will bring a contrary triple valve to its senses; but tapping is not a cure-all for every ailment. The first thing to be done is to try the bleeder cock, and see if there is pressure in the auxiliary reservoir; possibly the strainer or the feed groove is clogged with dirt, and either prevents or partially restricts the passage of air from the train pipe to the auxiliary. Quite likely the latter condition existed, and the reduction made was too light to influence the triple. Possibly the brake did set partially and leaked off either through the leakage groove or defective leather packing. Possibly the hand brake was set, and caused the piston to stop on the leakage groove. Water may have accumulated in the triple and frozen. Never cut a brake out because it does not set. It can give you no trouble, and in the cases cited, it may go to work of its own accord after the cause has been voluntarily or naturally removed. "Gummed up" is the stock excuse of the hammer tapper and others of the same grade.

(12) F. P. M., Port Morris, N. J., writes:

On page 12, lesson 1, of his "Pocket Primer of Air Brake Instruction," Mr. Rogers says, "Coupling engine on to a charged train, and opening the angle cock on the train first in place of the engine, is a reckless waste. If there are thirty cars in the train, 12,000 cubic inches of air is wasted through the brake cylinders." While I see that if the cock on engine is opened first, the hose is charged from the main reservoir; but the hose only holds about thirty or forty cubic inches, and the train pipe of a thirty-car train could easily afford to contribute that amount without scarcely moving the triples, let alone using such a quantity of pressure as 12,000 cubic inches. Please explain. A.—It is not a question alone of filling the empty hose. It is possible for the cock to be opened sufficiently slow to fill the hose without applying the quick action; then the waste would be as you figure. But Mr. Rogers rightly assumes that the thirty cars are fitted with the standard quick-action triples now generally used, and if the train angle cock is opened first as quickly as train men usually do, the rush of pressure from the first car into the empty hose will cause quick action on that car. Once the first triple opens up its quick-action ports, it not only increases its brake cylinder pressure by what comes from the train pipe, but the reduction made sets the second brake, the second sets the third, and so on throughout the train. Quick action is like igniting a train of powder; once started, it will help itself along. Opening the car angle cock gives the start in this instance.

Mr. Otto Best handles the truth recklessly, but not pervertedly, when he states in his communication in this department that "one strong proof that this brake gear is better than our old one is that it wears out more brake shoes." At first this statement may seem absurd and derogatory, but a moment's reflection will convince one of the volume of truth and propriety which it contains, and that no stronger evidence could be advanced in support of the efficiency of the new gear.

There is no better way of keeping men bright on the air brake after they have been instructed and passed examination than to require all air-braked cars to be switched ahead, coupled up and used. Practice will keep men bright, besides teaching them more. Not only are the men benefited by this plan, but constant use will keep the brakes in better condition.

CAR DEPARTMENT.

Conducted by Orville H. Reynolds, M. E.

N. Y. C. & H. R. R. 60,000-Pound Box Car.

By the courtesy of Mr. Wm. Buchanan, superintendent of motive power and rolling stock of the New York Central, we illustrate their 60,000-pound box car, which has some points of excellence not found in all cars of its class.

Standing out prominently, is the strong construction with a downward tendency in dead weight, that shows plainly the designers are not seekers after effects through the channels of uselessly large equipment; there is no straining in the direction of the front row for heavy cars; no effort whatever has been made to be in line with the craze for a car that would eclipse anything of its kind—for dead weight.

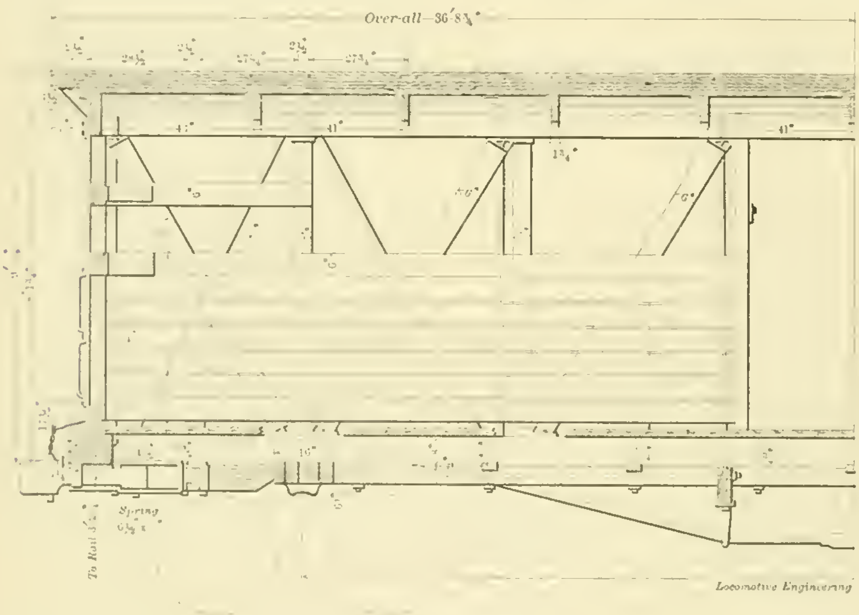
The whole trend of improvement has been in the strengthening of the present type of car, which has been found to fill all requirements for average loads; and in making a stronger car, they have also made a lighter one, by giving attention to any weak points developed, and by a judicious choice of material. The wisdom of this course is apparent when it is seen that an adherence to the dimensions of a car found best for their traffic will preserve the standards for all parts entering in its construction, and the word "template" will then retain its significance. These are items of no small moment, when hundreds of dollars worth of special appliances to expedite and cheapen car construction are ruthlessly consigned to the scrap pile, simply because the fiat has gone forth to build a "standard" car of dimensions varying so widely from the old type that the former useful adjuncts are no longer of any value. What has been said of templates applies with equal force to the drawings, bills of material and estimates of cost—all of the greatest importance in a railroad car shop, and too expensive to cast aside at the whim of an official having the authority to ride roughshod over the superior judgment of those who are alive to the minutest details of their business.

That the car under consideration is not the outgrowth of conditions inimical to the best practice, is evident at once. In general dimensions are: Length over end sills, 35 feet; width over side sills, 8 feet 10 inches; length inside, 34 feet 4 inches; width inside, 8 feet 3 inches; height from sill to plate, 6 feet 11 inches; width of door openings, 5 feet.

Fig. 1 shows a half-sectional side elevation of the framing, in which is seen the two end girths, 4 x 6 inches, a combination that makes a strong end; it would have to be a pretty bad blow to shift a load enough to punch that end out—or even start it. This is one of the weak points that has been made safe, by the additional girth and corner bands inside and out, 4 x 18 inches. The lower girth has the same corner bands; but they are 6 x 18 inches, all 3-16 inch thick.

Sills and plates also have the usual corner bands, those at plates being under the fascia; the plates at the sills are pressed steel.

The post and brace pockets are gray iron of the lightest pattern possible; in fact, as light as many roads use in the malleable article. The four corner posts, 5¼x5½, are lipped on sills and plate; the lower lip being at an angle (and the end



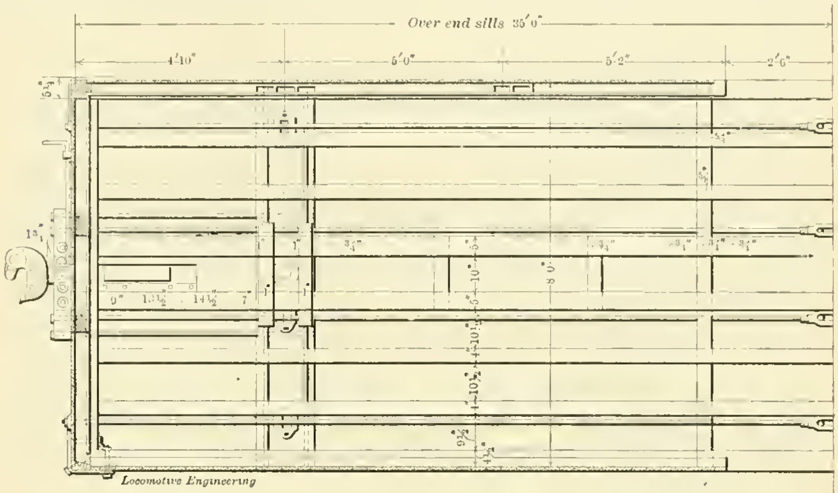
Half Plan through Center

Fig. 1

sill being cut to receive it), stands away from end sill the thickness of the outside sheathing; a bolt passing diagonally through post and sill makes the whole secure and, with the rounded corner on post, the finish is pleasing in effect. This construction will be noted as not of the ordinary kind for freight cars, partaking of passenger-car practice.

The door posts, 4¼x4½, are lipped and tenoned at both top and bottom, and rabbeted for sheathing and lining; and the remarkable thing about these posts is, that they are not cut to pieces for framing rods block that is seen, as a rule. A surface like that will stand up under the severest usage; it is a notable improvement over common practice.

This car has the wooden body bolster, 6⅛x16 inches, with two ½x6-inch steel plates between the three sections; and, besides this, there are two 1⅛-inch truss rods with 1¼-inch ends, to get in their work at critical periods. We have it from the proper authority that these bolsters never go down, and that they are always free at the side bearings, under the worst conditions of loading; this record ought



Half Plan Floor Removed

Fig. 2

and girths. The side posts, 5x2½ inches, seat in coat pockets at top and bottom; while the end posts, 5x3 inches, are tenoned at both ends.

All braces are 2½x6 inches; the nine carlines are 1¾x3x9 inches; the end plates are 3x6x13 inches. There are ¾-inch framing rods at side door-posts, intermediate posts, corner posts and end posts; no rods at the bolster posts, except the ¾-inch diagonals—another good thing, saving the plate from unnecessary carving.

Fig. 2 shows eight sills in this car; 5x8 inches at the center, 4½x8 inches at the outside and 4x8 inches intermediate. The end sills are 6x10¾ inches at center and 9¾ inches at ends, into which the long sills are double-tenoned. The cross-tie timbers are 4x11 inches and carry four saddles, 9½ inches deep, for the body truss rods which are 1⅜ inches diameter at the body and have 1¾-inch ends. The diameter of these rods and the depth of truss tell of an acquaintance with principles of trussing, that is sadly wanting in many cars.

The buffer blocks, 5x11½x35⅜ inches, are gained on the outer and under faces for an angle iron 3½x6 inches, extending the whole length of block, and well secured by two bolts in addition to the two central truss rods. This is one of the best forms of construction to receive the shocks of buffing that we have seen; there are absolutely no openings for distortion and the generally cussed appearance of the buffer

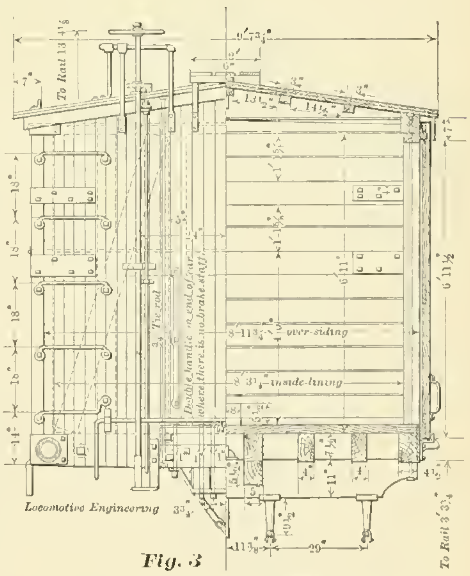


Fig. 3

Half section through Door

to be of some weight with any who have an itching to achieve distinction in bolster design, with a view to retiring the old standby.

A strong job is made of the underframing to resist shocks, by bolting to the under side of center sills a 5 x 5½-inch oak timber, continuous from body bolsters to needle beams, and also between the latter, making about as solid a construction against buffing as one would care to see. To distribute the draft-rig strains, a 1-inch tie rod having a flat, lugged end, which is secured to the outside face of draft timbers, extends on the line of draft, back to the inside face of needle beams, where provision is made for a nut adjustment. These are points in good construction not run up against every day.

Fig. 3 is a half end elevation and section that explain themselves.

Fig. 4 shows some strong points in draw-gear practice, that are worthy of imitation. There is a 7 x 17½-inch oak filler, abutting against the rear draft lugs and body bolsters, and securely bolted to the draft timbers, making an ideal job to resist end shocks and save the draft-rig extending, as it does, from drawbar to drawbar on the center line of strain. It effectually destroys the evil tendencies of the underhang of the drawbar, with its lever arm of 5½ inches below the sills.

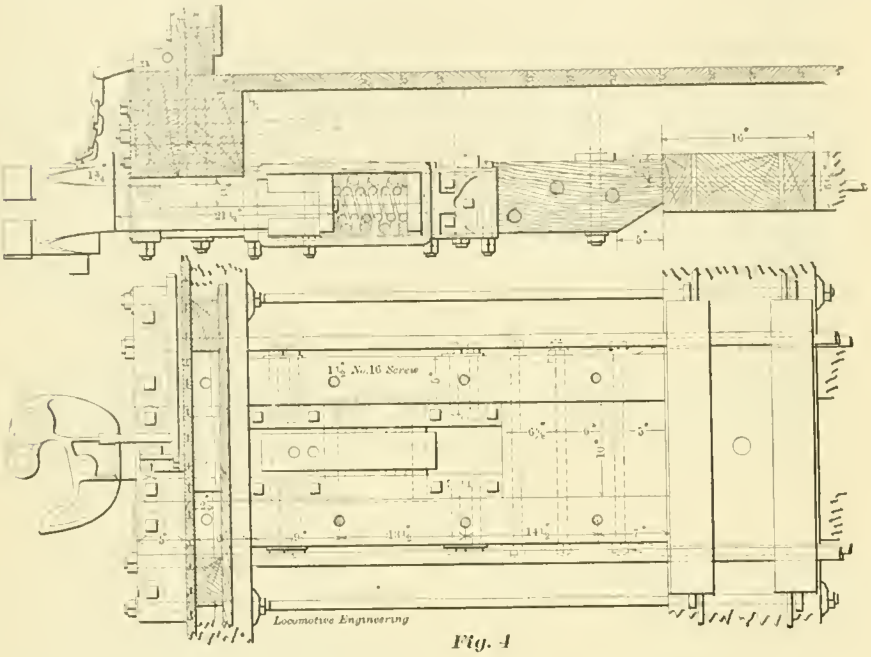


Fig. 4

Fig. 5 is given to show what is being done with the uncoupling levers. As shown, they are made to pass to opposite side of car, so as to be operative from either side. They are an improvement on the old style easy enough.

The Fox steel truck is under these cars, giving little trouble and always ready for business. Master Car Builder Crone has good reason to think this equipment right.

A box car of 60,000 pounds' capacity, as strong as this, and that tips the beam at 30,000 pounds, or less, *is* right.

Shocks in Freight Cars.

The effect of hard usage on a freight car hardly ever leaves its impression on the observer in a lasting way, until something fails that will necessitate more than a casual inspection. Then the full significance of the terrible blows that are absorbed by the members is apparent.

Shearing is the effect on the center pin when a center plate with ball faces is used; and center plates of that type are popular with many carmen, for the reason that the steel pins will come out of a "ruction" in better shape than will the cast-iron center plates, when the latter are made with shouldered bearing faces, and thus receive all the shock. This difficulty was supposedly met when the steel plates were introduced; such plates now stand up all right, but the shear on pins is not helped any by contact with the thin material of the plates, as made at present. There is no doubt that this trouble would be greatly relieved if both plates were flanged upward at the hole, and thus give a greater bearing surface for the pin. If this is done, the job will not be complete without flanging the bolt holes as well; otherwise they will take the shear, as they already do when the center pins are too small to fill the holes in the plates.

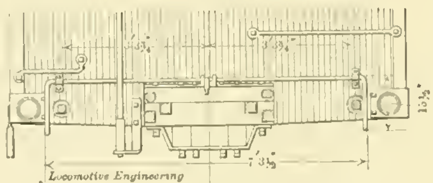


Fig. 5

That steel truck transoms are not exempt from these disturbances, is shown in the condition of trucks on many heavy cars. It is an ordinary occurrence to find a permanent set at the center, not less than ½ inch, the effect of the shock transmitted through the bolster; the ends of the transoms being held rigidly, the blow, of course, got in its work at the point of the least resistance, which was at the center, and the result could be nothing else than a distorted transom—all because the weak points above had been reinforced to resist the shocks of service, leaving them to be absorbed right where they left their footprints.

If we examine the influences at work to produce these results, we will find that the kinetic energy of a car at even slow speeds will be such as to rack the strongest construction when resisted in short spaces.

The amount of this energy in foot-pounds equals weight multiplied by velocity$^2 \div 2g$; and taking values as follows, we have 90,000 pounds for weight of car, 7.33 feet per second for a speed of five miles per hour, which is assumed to be about the size of the kick a car gets in ordinary switching service. Substituting, we have $90,000 \times 7.33^2 \div 64.4 = 75,088$ foot-pounds, which represents the amount of work the car will do in coming to rest. The distance moved through in coming to a stop is the next factor in measuring the resistance or shock, since to increase the one we must diminish the other; therefore, if the car is brought up standing in the distance of one foot, we will have a blow of $75,088 \div 1 = 75,088$ pounds to be absorbed by the car in coming to rest in a distance of one foot.

This work done is the kind of work that keeps rolling stock in the shop— not out of it—and the lesson in these figures is, that heavy buffer springs are needed on a freight car to ward off the brutal effects of these yard kicks, for it is notorious that draft springs are too weak to be of any assistance in relieving shocks to any helpful extent, as 20,000 pounds will put them together solid.

The trend of improvement in the draft rigging has been to reinforce the draft timbers, and thus have immunity from the effects cited; little attention being given it, except from the standpoint of rigidity. We can't help but think that this is the wrong point of attack from which to approach the problem of reducing the effects of shocks to freight cars.

Draft Springs.

Weak draft springs are receiving no little attention of late, with a view to increasing their stiffness under the increasing drawbar pulls of the heavier equipment, and the resulting creations are wonders of their kind. We have seen almost every sort of a makeshift to accomplish the end sought, except the one of increasing the diameter of bar and coil —the very thing that the wants of the situation would suggest— and the reason why it is not done is, because there is a standard distance over the shank of drawbar for the fit of spring yoke, and this dimension has determined the diameter of outer coils of the spring. The yoke being 6½ inches inside, it is deemed impracticable to make the spring more than 6¼ inches outside. Rather than change this standard to lines that would fill all requirements, almost every conceivable arrangement of springs has been tried, from placing two coils side by side and one above the other, to the tandem style. It is needless to remark that there are objections to all these methods of reaching sufficient stiffness, and still retain the proper amount of elasticity to reduce shocks to a minimum. As the thing looks to us, it were fully as well to tie to an increase of size (opening the yoke for the purpose), rather than to multiply the complications, as is now being done, without any material improvement in the situation—or, if any, at a cost that looks bad when weighed against that of the simpler construction.

Some Causes of a Hot Car Journal.

The method of polishing a car journal, as followed in many shops is barbaric to the last degree; and there can be but one effect when put in service—that is, to get hot. A journal to run cool, when not overloaded, should be turned as true as possible, and then polished without destroying the truth of it. It must be understood that it should be as smooth as it is possible for a tool to make it, before any effort is made at polishing. It is an ordinary occurrence to turn a journal and leave it rough, with the exception of putting the thing in shape with a file. This is the barbarous part of the operation. No journal ever ran cool on leaving the lathe with one of these buffalo finishes; because, in the first place, there is no man on earth who can file anything in a lathe and have the object filed preserve its truth—every push of the file will make a series of facets, and these little flat spots are what makes the journal out of round. And, besides this, there are scratches put in the surface that emery may gloss over, but cannot remove. These will hold the emery; and, between the abrasion and the flat spots, that journal is doomed at the start. It is better to close the surface by means of a steel roller, after the journal is trued, than to give it a dose of file and emery. When a journal is turned, it should be finished with as smooth a cut as possible, and with as little filing and emery as possible. Many a broken journal has had its genesis right there, in the incipient groove left by the file.

Ignorance About the Properties of Wood.

In the introduction of a report on "Timber," made to the United States Department of Agriculture by Filibert Roth, the author says:

"Although wood has been in use so long and so universally, there still exists a remarkable lack of knowledge regarding its nature in detail, not only among laymen, but among those who might be expected to know its properties. As a consequence, the practice is often faulty and wasteful in the manner of its use. Experience has been almost the only teacher, and notions—sometimes right, sometimes wrong—rather than well-substantiated facts, lead the wood consumer. Iron, steel and other metals are much better known in regard to their properties than wood. The reason for this imperfect knowledge lies in the fact that wood is not a homogeneous material, like the metals, but a complicated structure, and so variable that one stick will behave very differently from another stick, although cut from the same tree. Not only does the wood of one species differ from that of another, but the butt cut differs from the top log, the heartwood from the sapwood, the wood of the quickly-grown from the old monarch of the forest. Even the manner in which the tree was sawed, and the condition in which the wood was cut and kept, influence its behavior and quality. It is, therefore, extremely difficult to study the material for the purpose of establishing general laws, and it becomes necessary to make a specific inspection of the individual stick which is to be applied to a certain purpose. The selection, not only of the most suitable kinds, but of each stick for the purpose for which it is fit, will enter into that improved practice to which we may look both for greater economy and greater efficiency."

A large number of engineers in, and in the neighborhood of Chicago, have organized to form an Engineers' Social Club, similar to a very successful one which is located in New York. The committee of organization are anxious to receive as many engineers as possible for charter members. Chicago is a good point for establishing a club of this sort, and we have no doubt but that it can be made a thorough success. The proposal is, that the charter members pay $50—this amount to cover initiation and one year's dues—and that others joining the club be required to pay this amount for initiation only. It will be seen that there is a decided advantage in joining as charter members. Anyone wishing to obtain full particulars should apply to D. L. Barnes, Monadnock Block, Chicago, Ill.

The Southern Pacific Company deserve the credit of being the first railway company to make the decimal gage, adopted by the Railway Master Mechanics' Association at last convention, the standard of the road. A circular has been issued by Mr. H. J. Small, superintendent of motive power of the Pacific System, and J. J. Ryan, superintendent of motive power of the Atlantic System, intimating that these gages have been made standard, and will be furnished at all the shops at an early date. The circular says that after these gages have been received, master mechanics and foremen of car repairs will, in making requisitions for sheet metal, tubes, wire, etc., use the decimal gage for specifying thickness. This is a movement well worthy of imitation by other roads. Railroad companies exercised very great influence in making the standard screw threads a success by adopting them and holding to the sizes. If they will act in the same manner towards the decimal system of measurement, it will be only a few years when the present state of confusion in regard to such measurements will be at an end.

The Great Western Railway of England, which in early railway days was famous for its wide 7-foot gage and its fast locomotives, has not been noted for the last generation or two for fast trains; but the management have been wakening up lately. This line is the most direct route to the southwest of England, and the landing of the Hamburg-American Line steamers' passengers at Plymouth has induced the Great Western to convey the passengers to London in the shortest possible time. Special boat trains are now run, which make an average speed of about 55 miles an hour. It was expected that a rival line, the London & Southwestern, would start racing with the Great Western; but there are no indications that anything of the kind will be done.

Some mechanical fallacies are very hard to kill out. We supposed that the Swinerton polygonal wheel had lost its grip, but we find by a newspaper notice that the company which controls this peculiar invention are struggling to force it into use for street-car service. We understand that the Lobdell Wheel Co. are making cast-iron chilled wheels after the Swinerton design for street-car service. We hope they will be able to demonstrate more value for the thing than what surface railroads were able to do.

The claim is made that purchasers of steel for the making of springs in railroad shops are more responsible than the blacksmith for the failure of the springs. The steel is seldom uniform, material of the same reputed grade being often very different in quality. The difference is so great that the blacksmith has difficulty in giving some of it the proper temper.

People interested in boiler work ought to send to the Forbes Mfg. Co., Ithaca, N. Y., for their illustrated pamphlet describing the Forbes flue cutter. They will see something new in the line of flue cutters.

There were 364 failures of tires on British railways during nine months, ending with September last. Fifteen were engine tires, 6 were tender tires, 3 were coach tires, 13 were caboose tires, and 327 were wagon (freight car) tires. Of the wagon tires, 249 belonged to private owners.

Boston & Albany Driving Box.

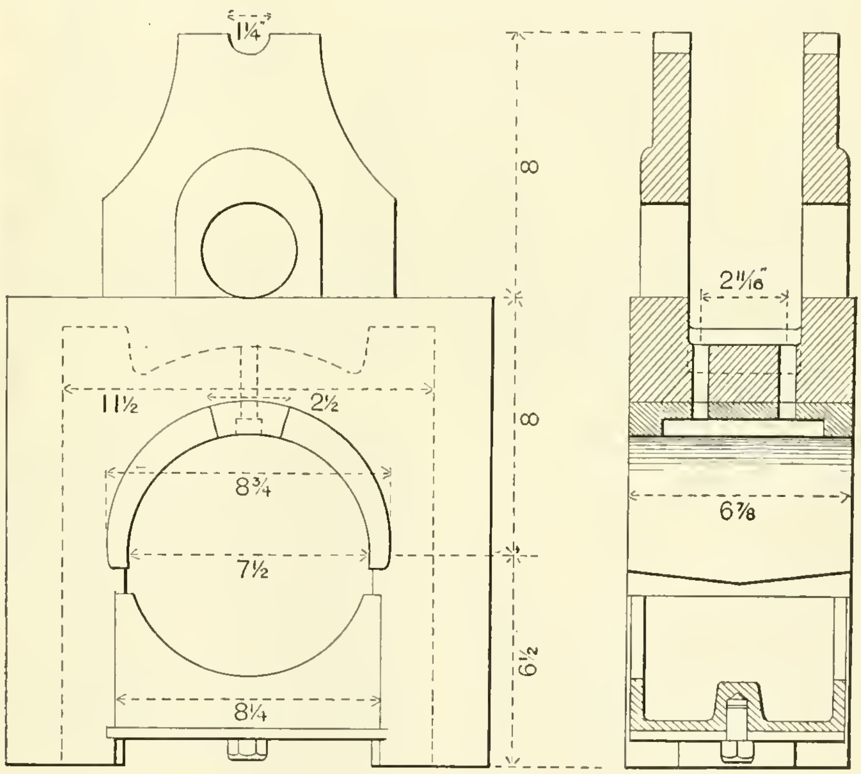
We illustrate herewith the standard driving box of the Boston & Albany road. Its unique feature consists in the form and manner of fastening in the brass of the box. This brass is in three pieces—two side pieces, alike, and a key piece.

No machine work is done on the brass, the lumps are filed off, the pieces put in place and the key-piece driven in, locking the whole together—the key having 1-16 of an inch taper.

As will be seen, the lower ends of the side pieces fit into V-shaped grooves in the box; this keeps the brass central and locks it in place.

The brass pieces are recessed for babbitt, the openings going clear through to the iron, and when poured the babbitt of itself locks the three parts of the bearing together.

This device has been in use a long time with good results. When a shell brass driving box can be made without machine work on the box or brass to fit them together, considerable saving of time and money is effected.



Rate of Pay on the Chicago Elevated.

A correspondent in Chicago writes: "I read a very nice editorial in 'Locomotive Engineering' about three years ago, extoling the management of the Alley Elevated road here on account of the high rate of pay they were so liberal in giving their trainmen. We had three years' personal contracts at that time, calling for an advance from $3.50 per day of eight hours to $4.25 at the beginning of the third year. Before the Fair closed, our first advance was due. We got it in the shape of an increase of hours from eight to ten hours, at $3.50 per day.

"These contracts were forced upon the men by the company, drawn by their legal advisers, made a matter of record to tie the men during the Fair. The receiver is now being sued to pay the balance due—about $1,100. I know you are publishing news of a mechanical nature only; but as your paper attracted many men here by taking notice of the high rate of pay offered, you might consistently take note of the present state of affairs, and tell your readers that those men never got the high rate offered, but they expect to get it through the courts."

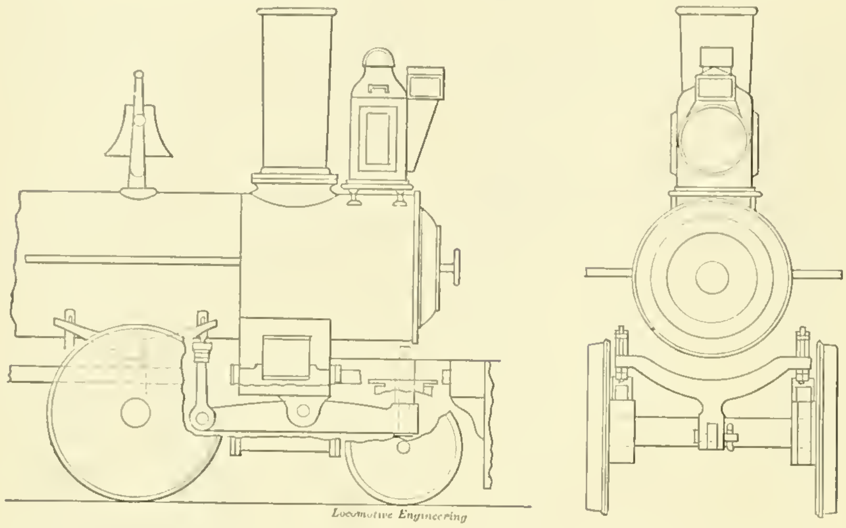
"Cross-Eyed" Headlights.

The Air Line "flyers" are provided with the double headlight devised by Col. N. H. Heft, of the electrical department of the Consolidated. Superintendent Ostrander explains the use of the two headlights, which, it appears, are set "cross-eyed," or precisely as the eyes are set in some cross-eyed persons. They are set thus so that each will throw a light across the other's rays. The light on the right-hand side is thrown over to the left, and that on the left over to the right. It has been found that this arrangement is of great advantage in throwing a light around a curve.

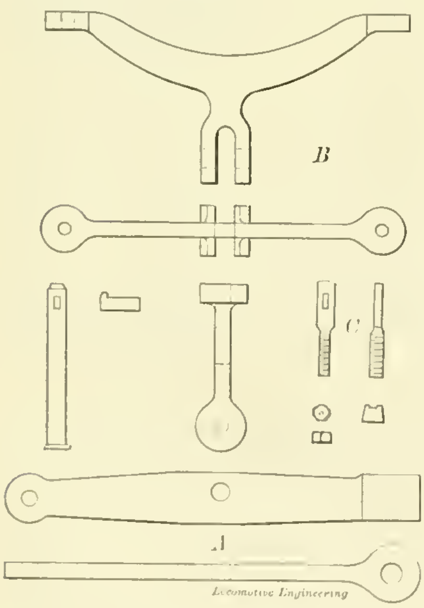
There was a terrible train accident on a railroad in South Africa, on December 30th last. One of the cars jumped the track on a curve. Thirty-seven persons were killed and fifty others severely injured.

The Hughes Equalizing Device.

The device herewith illustrated is patented by Mr. Thomas Hughes, an engineer on the St. Louis Southwestern Railroad (Cotton Belt Route), at Pine Bluff, Ark., and is intended to prevent the undue flange wear of the forward pair of driving wheels, so common on moguls and consolidated locomotives. The patented features are those whereby the pony



truck is guided from a center line behind, much in the same manner that a bicyclist guides his wheel when riding "hands off." The leaning of the engine toward the inside of the curve guides the pony truck, instead of the pony truck guiding the en-



gine. Ofttimes the tires of the leading pair of wheels on locomotives using a pony truck are turned off for flange wear long before the tread requires returning. This device claims to save this very considerable expense.

A number of mogul engines on the Cotton Belt Route have been equipped with this device for some time, and Superintendent of Motive Power Galbraith speaks very highly of its efficient service there. Sketches of the condition of forward and rear tires of engine No. 175 speak plainly for the goodness of Mr. Hughes' invention. This engine has made 67,984 miles in switching service at Bird's Point, where the track is very crooked and of a generally trying character. Mr. Hughes had been presented with a handsome check by the Cotton Belt line for the use of the device on some of their engines. A number of other roads in the Southwest have the device in service trials. Any further information may be had by applying to Mr. Hughes.

Pedrick & Ayer Co., of Philadelphia, Pa., are reported to be very busy with their various specialties for railroad shops. They are receiving numerous orders for their straight lift pneumatic hoists, which are reported to be very popular. They are built in three styles, to suit different kinds of work: No. 1 is for ordinary lifting of material to be handled quickly; No. 2 is adapted for exact lifting, such as putting work into lathes, etc.; and the third style is intended for foundries and similar work, where the load is varying.

The Foster Engineering Co., of Newark, N. J., has received an order for eleven of their new "Class W" steam-pressure regulators, ranging in size from 1¼ to 4 inches, for the United States cruiser "Newark," now at Montevideo. These valves are to take the place of their old styles, furnished the "Newark" when she first went into commission.

The Ashton Valve Co., Boston, are giving away a beautiful calendar. Those who like to have a pretty picture associated with the passing line of days and months, should send for this calendar without delay.

Mounting Blueprints.

They have at the Rock Island shops in Chicago, a method of mounting blueprints for use about the shops, that while not new in principle, is new in the extent to which it is carried out. The print is mounted on a piece of Russia iron of the proper size, coated with shellac, and filed on its edge in a cabinet made for the purpose; and one made with the object of filing will hold many prints in a small space.

Those mounted for use in the smith shop were on sheets of Russia iron 12½ x 14½ inches, and 12½ x 24½ inches, leaving a border of ¼ inch of iron all around the print. There are other sizes of mountings, but the above comprise the principal work in hand, and were most in use.

The sizes of prints for details for locomotive and car work were properly fixed for standards in the drawing office, as most suitable for the work, and they are adhered to in all cases.

When a print becomes obsolete through correction, or change of design in any particular, it is at once filed away and replaced by the new, furnishing a record of progress that is accessible at all times to the foreman, without a trip to the drawing office.

This system may be said to be the survival of the fittest, for almost everything in the way of preservation of the prints had been tried, only to be cast aside as falling short of the ideal—from the rolling-up process and mounting on wood or strawboard, to the present metallic backing that will stand the hard usage of service in the smith shop. Some of these prints were so bright and clean that it was not easy to believe that they had seen three or more years' constant use at the forge.

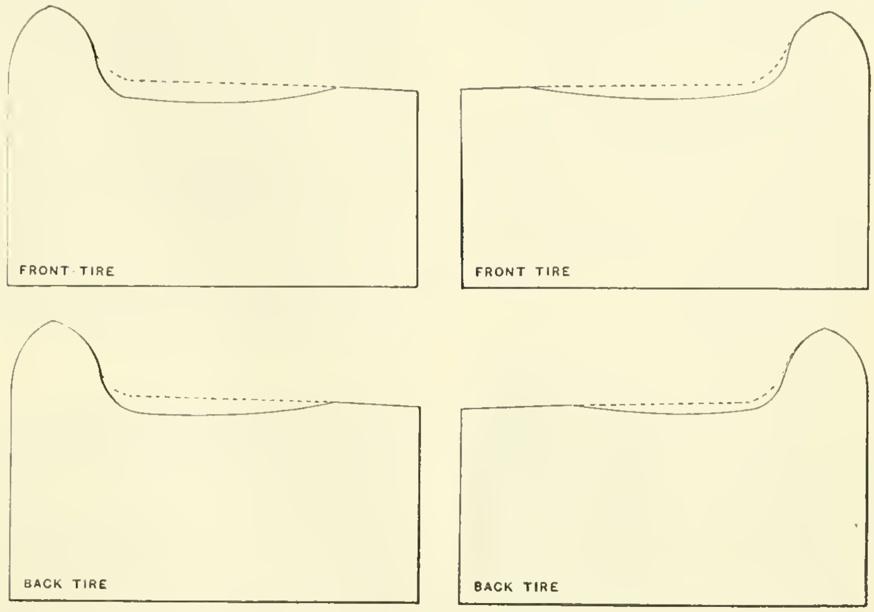
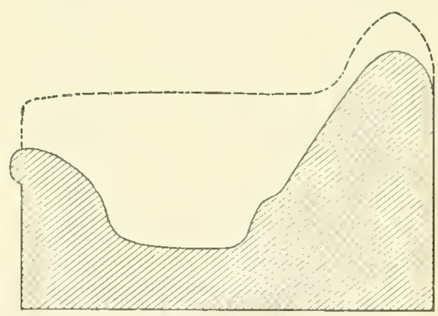


DIAGRAM SHOWING TIRE FLANGE WEAR OF ENGINE 175,
St. Louis Southwestern, equipped with Hughes Patent Spring Equalizing and Guiding Attachment; made 67,984 miles on incline service, with curve to left.

A Badly-Worn Tire.

Most of us have seen badly-worn tires on locomotives that are run as long as possible between the times of shopping; but the tire illustrated in the annexed engraving is the worst we have ever seen, and is probably as bad as any tire ever used. There is a section of it in this office, and it is regarded as a great curiosity by our railroad visitors. It was removed from a locomotive belonging to a



coal-mining company, which was sent to Altoona for repairs. The dotted line shows the original outline of the tire.

The West Shore Railroad management have issued an order that no cars of less than 30,000 pounds' capacity shall be received from interchanging roads. This rule has been made necessary through accidents caused by the small, weak cars breaking down in trains. Railroad companies that still have old cars of less than fifteen tons' capacity, ought to keep them on their own lines to be run in trains composed of light cars. The consolidation locomotive and the cars of thirty tons' capacity crush the old, weak cars like egg-shells.

WHAT YOU WANT TO KNOW.

Questions and Answers.

(8) W. H. M., Louisville, Ky., writes:

Does piston travel faster when passing over top quarter than bottom quarter, or does it gain in velocity after leaving top quarter? A.—There is no difference in the velocity of a piston at the instant of pin passing the quarters. The piston loses velocity in nearing the centers from either quarter, instead of gaining it.

(9) J. A. B., Grant, Pa., writes:

I would like to know why the steam from the cylinder cocks seems to have more force when the engine is cut back than when running in full stroke. A.—It is not plain why this should be so. On the contrary, the greatest force is present when running at maximum cut-off; for the reason that there is a greater volume of steam to escape from the cylinder cocks at the long point of cut than in the shorter points, assuming throttle opening to be the same in all cases.

(10) E. P. K., Toronto, Can., writes:

Is the piston rod of a locomotive on a line with the centers of the driving wheels, or is it a little higher? On our designs I think it is the latter case. Why is this? A.—The center line of pistons on a locomotive is usually higher than the center line of drivers, and this is made necessary to give more room for the cylinders, between the engine truck wheels. It is impossible to use a truck wheel larger than 26 inches diameter on many engines, because the cylinders and frames are not high enough to clear.

(11) J. S. Moncton, N. B., writes:

There is a small round hole through the center of our balanced valves into the exhaust cavity of the valve. What is that hole put there for? We had an argument on this, and I was asked to refer the question to you. A.—The function of the hole in the top of the valve is to carry any steam that may leak by the balance strips, out to the exhaust, and not allow it to remain on top of the valve to destroy the balance. If the balance strips leaked badly, and allowed steam to reach the top of the valve, it is plain that the latter would no longer be balanced, as far as relief from pressure on the top was concerned.

(12) E. S. D., Tacoma, Wash., writes:

Will you kindly inform me what is a good thing for front ends and steam pipes on locomotives? I have been trying to find something that will stand the heat and not burn, scale or wash off. I have used plumbago and enamel paint; but they do not stand. Can you also tell me what is good to clean brass work? A.—In our January issue we print a recipe for stack black, furnished by Mr. Ayers, that is said to be a good thing; and we should think it would also do a good job on the front end, and on steam pipes as well. The United States metal polish, sold everywhere, is a good thing for brass work, following it up with lampblack for the final shine.

(13) W. O., Richmond, Ind., writes:

I would like to know if a 60 horse-power boiler having 60 pounds of steam pressure per square inch, would have more pressure than a 10 horse-power boiler with 60 pounds of steam pressure per square inch. O says it would not; B says it would. A.—The larger boiler would have the greater total pressure, tending to rupture it; for the reason that it would have more area for the pressure per unit of area to act on. To find this bursting effort, multiply the diameter of the boiler in inches by its length in inches, and multiply this product by the steam pressure in pounds per square inch. It will then be seen that the size of the boiler is the governing factor in determining the total pressure, when gage pressures are equal.

(14) J. E. G., Brainerd, Minn., writes:

1. Which cylinder heads of a Rotary snow plow are termed front and back heads, respectively? As you are aware, the cylinders of a Rotary snow plow are reverse to locomotive practice. A.—The ends of the cylinders nearest the forward end of plow are at the front; therefore, what is called the back head on a locomotive is the front head on the plow. 2. If the piston rod passes through what is termed the back head (in locomotive practice) in Rotary, which engine is called the right-hand engine? A.—Taking, again, the front of the plow as a base of operations, the cylinders are properly located when viewed from the rear of the plow—that is, the right and left-hand cylinders will be found, respectively, in the positions named.

(15) Wm. P., Toronto, Ont., writes:

In answer to Question 157 of December issue, you give a rule to find the capacity of an engine; but I seem to think you have made an error, or else I do not understand your formula. As it is an important rule, I herewith submit to you the manner in which I have worked the question, and which shows a difference of 11 tons. Please state if my answer is correct. A.—Your answer is not correct, because your expression $17 \times 17 \times .7854 \times 126 \times 24 \div 64$ is wrong. The question is simply one of finding the horizontal effort at the rail, and the correct formula, $17 \times 17 \times .7854 \times 126 \times 24 \times 4 \div 3.1416 \times 64 = 13655$ pounds, is based on the principle of work, which in mechanics means the overcoming of a resistance through a space. There can, therefore, be no work without motion. Then, referring to the formula as stated above, the area of the piston ($17 \times 17 \times .7854$) multiplied by the mean effective pressure (126 pounds), gives the total pressure on the piston, which multiplied by the stroke (24 inches), gives the distance in inches moved through by the force; and the product is, therefore, inch-pounds of work done in one stroke of the piston. Multiplying this work done in one stroke by the number of strokes in one revolution (4), we have the total work done by both cylinders in one revolution of the wheels. Dividing this work in inch-pounds by the circumference of the driving wheel in inches, we have a quotient representing the force in pounds exerted between wheel and rail as the wheel revolves, provided the latter has weight enough to prevent slipping. This fundamental formula is used merely to make the subject clear; it is simplified for practical use by reduction in cancellation. It will be seen that .7854 ($\frac{1}{4}\pi$) will go in 3.1416 (π) four times, and these two factors are therefore eliminated; these are then two fours which cancel themselves, and the formula thus stands, $17 \times 17 \times 126 \times 24 \div 64$, as first stated. The same result would have been obtained on the foot-pound basis, as will be seen by solving the expression $(17 \times 17 \times .7854 \times 126) \times 8 \div 3.1416 \times 5.33$, in which the factors are pounds and feet. In order to handle any problem in which work is involved, it should be clearly understood that the product of the force and the distance through which it moves must be equal to the product of the resistance and distance through which it is overcome. In the last proposition, we find the work done on the pistons to be the force 28,509.5

pounds moved through a distance of 8 feet, and the product is therefore 228,796 foot-pounds. The resistance, 13,655 pounds, was found to be overcome through a distance of 16.75 feet (the circumference of the wheel); and this product is also equal to 228,796 foot-pounds, fulfilling the above conditions.

The National Malleable Castings Company, of Cleveland, Chicago, Indianapolis and Toledo, have sent out a finely illustrated catalogue, showing their various works and their various products. It is a well-bound book of the standard size (9 x 12), substantially bound, and the letter-press and engravings got out in the very best style of half-toned work. Very striking perspective views are given of their works at Cleveland, Chicago and Toledo, and the principal articles made in the various establishments are illustrated and described. The catalogue covers 113 pages, and the articles illustrated number up to about 20,000, although all these articles are not illustrated. Railroad men will, however, find nearly everything made of malleable iron for cars and locomotives shown in the book. It will constitute an excellent reference for articles of this kind, and deserves a prominent place in the files of every officer having anything to do with ordering railroad supplies.

We have received a report of the proceedings of the third annual meeting of the Traveling Engineers' Association. It is of standard size and contains 168 pages, which are full of matter that cannot fail to interest railroad men. The report reflects great credit upon the secretary, Mr. W. O. Thompson, of Elkhart, Ind. If one might make a suggestion for the next report, we should say that putting a good index to it would be a decided improvement. Reports were made on a variety of interesting subjects relating to the economical operation of locomotives, and good lively discussions followed the reading of the reports. Every engineer in the country interested in economical locomotive operation ought to read this report carefully. It can be obtained from the secretary, Mr. W. O. Thompson, Elkhart, Ind.; price 50 cents.

"Monobar" is the name of a pamphlet issued by the Link-Belt Engineering Co., of Philadelphia, Pa., which describes apparatus for elevating and conveying material. Master mechanics and others interested in the handling of coal, ore and such material will find this a very useful pamphlet to study over.

In our January issue the advertisement of the Railway Cycle Mfg. Co., of Hagerstown, Ind., appeared as Hagerstown, Md. We regret that this mistake was made. We understand that the company is doing a very good business. Anyone wishing to communicate with them will find them at the Indiana address.

We have received from Messrs. S. F. Paterson and A. S. Markley, a copy of the Proceedings of the Fifth Annual Convention of the Association of Railway Superintendents of Bridges and Buildings, held in New Orleans, La., October, 1895.

This report is replete with the results of tests of material entering in bridge and building construction, and is of the greatest value to the engineering fraternities, as emboding reliable information of interest to all engaged in the use of native woods.

It is particularly valuable to the car departments of railroads, in the tabulated statement of the strength in tension, transverse and compression, both with and across the grain, of timber used in car construction. It is a document full of meat, and should be in the hands of every car-department official in the land.

The first number of "Home Study," published in Scranton, Pa., has reached us. It is a monthly, devoted, as its title indicates, to advancing the studiously inclined by means of lessons in each issue, which are to be followed at home, much after the style of the "correspondence school." It covers a field embracing, according to the prospectus, all branches of engineering—mechanical, civil, steam, electrical, mining—and also popular science. It is published by the Colliery Engineer Co.

A remarkably well-designed crane for catching mail bags at stations when a train is passing, has been patented by Dr. A. P. Hauss, New Albany, Ind. A committee of post-office experts made a special visit to New Albany last month to test the crane. It worked so satisfactorily that there are good prospects of its being adopted by the Government.

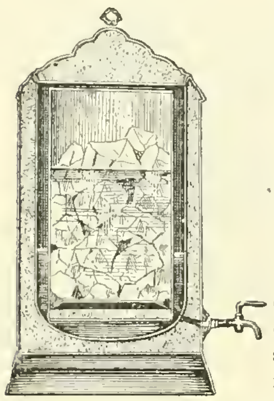
The Gold Car-Heating Co. shipped for Sheffield, England, on January 14th, material to equip 500 cars with their steam-heating system. The Great Northern, of England, has also recently adopted this system as standard for their line. They are shipping over 100 sets of their straight port couplings, per day, to satisfy the calls of the home trade, and are still behind on orders for same.

The "Digest of Physical Tests and Laboratory Practice" is the name of a quarterly publication commenced with January by Frederick A. Riehle, of Philadelphia, Pa., which contains a great deal of information concerning laboratory practice, and will be sent free to parties interested on application to the publishers.

A. Irving, 20 Magnolia avenue, Jersey City, N. J., will pay 50 cents for a traveling engineer's chart; write first.

PURE WATER ESSENTIAL TO HEALTH.

A FILTER that really filters has long been a thing impossible to get. A. Major, of 461 Pearl street, New York, has invented one that actually fills this "long-felt want." It filters the water instead of simply catching the larger particles of dirt and letting the smaller ones and noxious bacteria pass through. Major's filter can be placed in any water cooler, and can be cleaned out as easily as a saucepan. The filtering device consists of a piece of porous stone that extracts all the impurity from the water. The filter can be filled up with ice if desired, and the impurities that too often exist in the ice are also eliminated before the water reaches the faucet.



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34-in., 47-in. x 16 feet Pond Machine Tool Co. Lathe, C. Rest and P. C. Feed.
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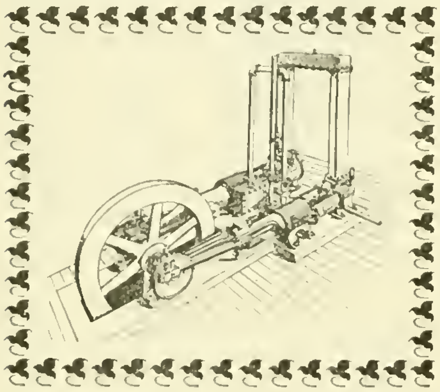

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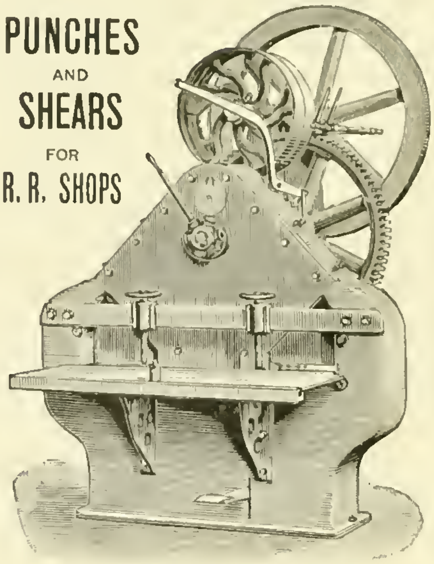

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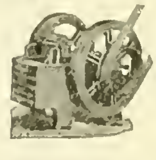

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It is drop-forged from tool steel.
It will grip galvanized as well as other pipe.
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It cannot lock or wedge on the pipe.
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As a Screw Wrench it has no equal.

Any part of this Wrench broken with fair usage will be replaced without charge.

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Car Lighting.
Safety Car Heating & Lighting Co., New York.
Car Paints.
Detroit White Lead Works, Detroit, Mich.

Continued on page 204.

BUYERS' FINDING LIST—*Continued.*

Car Roofing.
P. H. Murphy Mfg. Co., E. St. Louis, Ill.
Standard Paint Co., New York.
Warren Chemical & Mfg. Co., New York.
Car Seats.
Hale & Kilburn Mfg. Co., Philadelphia, Pa.
Car Ventilators.
M. C. Hammett, Troy, N. Y.
Car Wheels.
Boies Steel Wheel Co., Scranton, Pa.
Krupp (T. Prosser & Son, New York).
Lima Locomotive & Machine Co., Lima, O.
Ramapo Wheel & Foundry Co., Ramapo, N. Y.
Roberts, Throp & Co., Three Rivers, Mich.
Rood & Brown, Buffalo, N. Y.
Standard Steel Works, Philadelphia, Pa.
Washburn Car Wheel Co., Hartford, Conn.
Cattle Guards.
Q. & C. Co., Chicago, Ill.
Chain Pulley Blocks.
Moore Mfg. & Fdy. Co., Milwaukee, Wis.
Chime Whistles.
Crosby Steam Gage & Valve Co., Boston, Mass.
Clocks.
John J. McGrane, New York.
Coal Handling Machinery.
Link Belt Engineering Co., Philadelphia, Pa.
Coal Chutes.
Williams, White & Co., Moline, Ill.
Correspondence Schools.
Internat'l Corres. Schools Scranton, Pa.
The Scientific Machinist Co., Cleveland, O.
Corundum Wheels.
Sterling Emery Wheel Mfg. Co., Tiffin, O.
Cranes.
Manning, Maxwell & Moore, New York.
Maris Bros., Philadelphia, Pa.
William Sellers & Co., Philadelphia, Pa.
Whiting Foundry Equipment Co., Chicago, Ill.
Crank Pin Gages.
M. C. Hammett, Troy, N. Y.
Crank Pins.
Cambria Iron Co., Philadelphia, Pa.
B. M. Jones & Co., Boston, Mass.
Krupp (T. Prosser & Son, New York).
Crossings.
Ramapo Iron Works, Hillburn, N. Y.
Drills.
Cleveland Twist Drill Co., Cleveland, O.
Standard Tool Co., Cleveland, O.
Ejectors.
Rue Mfg. Co., Philadelphia, Pa.
Electric Lighting and Power Apparatus.
Westinghouse Elec. & Mfg. Co., Pittsburgh, Pa.
Emery Grinders.
Leland & Faulconer Mfg. Co., Detroit, Mich.
Emery Wheels.
Sterling Emery Wheel Mfg. Co., Tiffin, O.
The Tanite Co., Stroudsburg, Pa.
Enamel.
Detroit White Lead Works, Detroit, Mich.
Engines.
St. Louis Steam Engine Co., St. Louis, Mo.
Engravings.
Bradley & Poates, New York.
Standard Engraving Co., New York.
Exhaust Pipe.
The General Agency Co., New York.
Expanding Mandrel.
Geo. L. Weiss, Cleveland, O.
Files and Rasps.
Nicholson File Co., Providence, R. I.
Filters.
A. Major, New York.
Fire Kindlers.
J. S. Leslie, Paterson, N. J.
Flexible Shaft.
Chicago Flexible Shaft Co., Chicago, Ill.
Flexible Steam Joint.
Moran Flexible Steam Joint Co., Louisville, Ky.
Flues and Tubes.
Allison Mfg. Co., Philadelphia, Pa.
Tyler Tube & Pipe Co., Washington, Pa.
Forges.
Buffalo Forge Co., Buffalo, N. Y.
Forging Machinery.
Williams, White & Co., Moline, Ill.
Foundry Equipment.
Whiting Foundry Equipment Co., Chicago, Ill.
Frogs and Crossings.
Ramapo Iron Works, Hillburn, N. Y.
Gages.
Ashton Valve Co., Boston, Mass.
Crosby Steam Gage & Valve Co., Boston.
Graphite.
Jos. Dixon Crucible Co., Jersey City, N. J.
Hammers.
Williams, White & Co., Moline, Ill.
Hand Cars
Railway Cycle Mfg. Co., Hagerstown, Ind.
Roberts, Throp & Co., Three Rivers, Mich.
Heating System for Shops.
Buffalo Forge Co.
B. F. Sturtevant Co., Boston, Mass.
Hoisting Engines.
Earle C. Bacon, New York.
Hollow Stay-Bolt Iron
Falls Hol. Stay-Bolt Co., Cuyahoga Falls, O.
Hydraulic Tools.
Riehle Bros., T. M. Co., Philadelphia, Pa.
Watson & Stillman, New York.
R. D. Wood & Co., Philadelphia, Pa.
Indicators.
Ashcroft Mfg. Co., New York.
Crosby Steam Gage and Valve Co., Boston.
Injectors.
Automatic Injector Co., Cincinnati, O.
Hancock Inspirator Co., Boston, Mass.
Hayden & Derby Mfg. Co., New York.
Nathan Mfg. Co., New York.

Continued on page 205.

BUYERS' FINDING LIST—*Continued.*

Injectors—Continued.
Ohio Injector Co., Chicago, Ill.
Rue Mfg. Co., Philadelphia, Pa.
William Sellers & Co., Philadelphia, Pa.

Jacks.
E. C. Boyer, Dayton, O.
Richard Dudgeon, New York.
A. L. Henderer, Wilmington, Del.
A. O. Norton, Boston, Mass.
Watson & Stillman, New York.

Laggings for Locomotives.
Keasbey & Mattison Co., Ambler, Pa.

Locomotives.
Baldwin Locomotive Works, Philadelphia, Pa.
Brooks Locomotive Works, Dunkirk, N. Y.
Cooke Loco. & Machine Co., Paterson, N. J.
Dickson Mfg. Co., Scranton, Pa.
Lima Locomotive & Machine Co., Lima, O.
Pittsburg Locomotive Works, Pittsburg, Pa.
H. K. Porter & Co., Pittsburg, Pa.
R. I. Locomotive Works, Providence, R. I.
Richmond Loco. & Mch. Wks., Richmond, Va.
Rogers Locomotive Works, Paterson, N. J.
Schenectady Loco. Wks., Schenectady, N. Y.

Lubricators
Detroit Lubricator Co., Detroit, Mich.
M. C. Hammett, Troy, N. Y.
Nathan Mfg. Co., New York.

Lubricating Oils.
Galena Oil Works, Ltd., Franklin, Pa.
Leonard & Ellis, New York.
Signal Oil Works, Franklin, Pa.

Machine Tools.
Bement, Miles & Co., Philadelphia, Pa.
Bullard Machine Tool Co., Bridgeport, Conn.
W. D. Forbes & Co., Hoboken, N. J.
Gould & Eberhardt, Newark, N. J.
Hilles & Jones Co., Wilmington, Del.
Jones & Lamson Machine Co., Springfield, Vt.
Manning, Maxwell & Moore, New York.
National Machinery Co., Tiffin, O.
Newton Machine Tool Wks., Philadelphia, Pa.
Niles Tool Works Co., Hamilton, O.
Geo. Place, New York.
Pratt & Whitney Co., Hartford, Conn.
Prentiss Tool and Supply Co., New York.
William Sellers & Co., Inc., Philadelphia, Pa.

Malleable Iron.
C. E. Rood, Lancaster, N. Y.

Mechanics' Tools
Armstrong Bros. Tool Co., Chicago, Ill.
Keystone Mfg. Co., Buffalo, N. Y.
Chas. A. Strelinger & Co., Detroit, Mich.

Metal Polish.
G. W. Hoffman, Indianapolis, Ind.

Metal Sawing Machines.
Pratt & Whitney Co., Hartford, Conn.
Q. & C. Co., Chicago, Ill.

Milling Machines.
Cincinnati Milling Machine Co., Cincinnati, O.
Pratt & Whiting Co., Hartford, Conn.

Mining Machinery.
Earle C. Bacon, New York.
Gates Iron Works, Chicago, Ill.

Molding Machines.
Tabor Mfg. Co., New York City.

Oil Cups.
Nathan Mfg. Co., New York.
U. S. Metallic Pkg. Co., Philadelphia, Pa.

Over Clothes.
H. S. Peters, Dover, N. J.

Packing.
Boston Belting Co., Boston, Mass.
Columbian Metallic Rod-Packing Co., Phila.
Gould Packing Co., East Cambridge, Mass.
Jenkins Bros., New York.
H. W. Johns Mfg. Co., New York.
U. S. Metallic Packing Co., Philadelphia, Pa.

Packing Rings.
J. H. Dunbar, Youngstown, O.

Paints.
Standard Paint Co., New York.
Detroit White Lead Works, Detroit, Mich.

Patents.
George P. Whittlesey, Washington, D. C.

Perforated Metal.
Aitchison Perforated Metal Co., Chicago, Ill.
A. J. Beckley & Co., Meriden, Conn.
The Hendrick Mfg. Co., Ltd., Carbondale, Pa.

Photographs.
F. Moore, London, Eng.

Pipe Threading and Cutting Machinery.
Bignall & Keeler Mfg. Co., Edwardsville, Ill
Armstrong Mfg. Co., Bridgeport, Conn
D. Saunders' Sons, Yonkers, N. Y.

Pipe Wrench
Sam'l L. Hall's Son, New York.

Piston Rods.
Cambria Iron Co., Philadelphia, Pa.
B. M. Jones & Co., Boston, Mass.
Thomas Prosser & Son, New York.

Planers.
Detrick & Harvey Machine Co., Baltimore, Md.

Pneumatic Tools.
Chicago Pneumatic Tool Co., Chicago, Ill.
C. H. Haeseler & Co., Philadelphia, Pa.

Pressed Steel Materials.
Schoen Mfg. Co., Pittsburg, Pa.

Pressure Regulators.
Foster Engineering Co., Newark, N. J.
Newark Regulator Co., Newark, O.

Pump Valves
Boston Belting Co., Boston, Mass.

Punching and Shearing Machinery.
Hilles & Jones Co., Wilmington, Del.
Long & Allstatter Co., Hamilton, O.

Railroads.
C., H. & D. Ry., Cincinnati, O.
L. S. & M. S. Ry., Cleveland, O.

Continued on page 206.

BUYERS' FINDING LIST—*Continued.*

Railroads Continued.
B. & A. R. R., Boston, Mass.
I. C. R. R., Chicago, Ill.
Monon Route, Chicago, Ill.
Railway Fences.
Page Woven Wire Fence Co., Adrian, Mich.
Railway Gates.
Pneumatic Gate Co., Chicago, Ill.
Retaining Rings
Ramapo Wheel & Foundry Co., Ramapo, N.Y.
Rubber.
Boston Belting Co., Boston, Mass.
Rust Preventing Compound.
Otto Goetze, New York.
Safety Valves
Ashton Valve Co., Boston, Mass.
Crosby Steam Gage & Valve Co., Boston, Mass.
Sanding Apparatus
Henry L. Leach, North Cambridge, Mass.
Sherburne & Co., Boston, Mass.
Shafting
William Sellers & Co., Philadelphia, Pa.
Spark Arrester Plate.
A. J. Beckley & Co., Meriden, Conn.
Hendrick Mfg. Co., Carbondale, Pa.
Springs.
A. French Spring Co., Pittsburg, Pa.
Spring Steel
Thomas Prosser & Son, New York.
Stay-Bolts.
Ewald Iron Co., St. Louis, Mo.
Falls Hollow Stay-Bolt Co., Cuyahoga Falls, O
B. M. Jones & Co., Boston, Mass.
Steam Gages
Ashcroft Mfg. Co., New York.
Crosby Steam Gage & Valve Co., Boston.
Utica Steam Gage Co., Utica, N. Y.
Steam Hammers
Bement, Miles & Co., Philadelphia, Pa.
Steam Hose
Boston Belting Co., Boston, Mass.
Steam Pumps.
A. S. Cameron Steam Pump Works, New York
Steel.
Cambria Iron Co, Philadelphia, Pa.
Ewald Iron Co., St Louis, Mo.
B. M. Jones & Co., Boston, Mass.
Krupp (T. Prosser & Son, New York).
Latrobe Steel Co, Latrobe, Pa.
Schoen Mfg Co., Pittsburg, Pa.
Shoenberger Steel Co., Pittsburg, Pa.
Steel Tired Wheels.
Boies Steel Wheel Co., Scranton, Pa.
Krupp (T. Prosser & Son, New York).
Ramapo Wheel & Foundry Co., Ramapo, N.Y
Standard Steel Works, Philadelphia, Pa
Washburn Car Wheel Co., Hartford, Conn.
Steel Tires.
Latrobe Steel Works, Latrobe, Pa.
Krupp (T. Prosser & Son New York).
Standard Steel Works, Philadelphia, Pa
Steel Truck Frames.
Fox Solid Pressed Steel Co., Chicago, Ill.
Stocks and Dies.
Armstrong Mfg. Co., Bridgeport, Conn.
Stone Crushers
Gates Iron Works, Chicago, Ill.
Switches.
Ramapo Iron Works, Hillburn, N. Y.
Testing Machines.
Riehle Bros. Testing Machine Co., Phila.
Tie Plates.
Q. & C. Co., Chicago, Ill.
Tires.
Krupp (T. Prosser & Son, New York.)
Latrobe Steel Co., Philadelphia, Pa.
Tool Holders.
Armstrong Bros. Tool Co., Chicago, Ill.
Tool Steel.
B. M. Jones & Co., Boston, Mass.
Track Equipment
Ramapo Iron Works, Hillburn, N. Y.
Tube Expanders.
A. L. Henderer, Wilmington, Del.
Turnbuckles.
Cleveland City Forge & Iron Co., Cleveland, O
Merrill Bros., Brooklyn, N. Y.
Turret Machines.
Bullard Mch. Tool Co., Bridgeport, Conn.
Jones & Lamson, Springfield, Vt.
Twist Drills.
Cleveland Twist Drill Co., Cleveland, O.
Standard Tool Co., Cleveland, O.
Valves
Ashton Valve Co., Boston, Mass.
Jenkins Bros., New York.
Ross Valve Co., Troy, N. Y.
Valves, Reducing.
Foster Engineering Co., Newark, N. J.
Varnishes.
Detroit White Lead Works, Detroit, Mich.
F. C. Reynolds, New York.
Ventilating Fans.
Buffalo Forge Co.
Vestibules.
Gould Coupler Co., Buffalo, N. Y.
Vises.
Bignall & Keeler Mfg. Co., Edwardsville, Ill.
Merrill Bros., Brooklyn, N. Y.
Watches.
S. N. Clarkson & Co., Chicago, Ill.
John I McGrane New York
The Webb C. Ball Co., Cleveland, O.
Welding Compound.
E. G. Newhall & Co., Detroit, Mich.
Wire Fences.
Page Woven Wire Fence Co., Adrian, Mich.
Wood Working Machinery.
J. A. Fay & Co., Cincinnati, O.
Wrought Iron Pipe.
Allison Mfg Co, Philadelphia, Pa.

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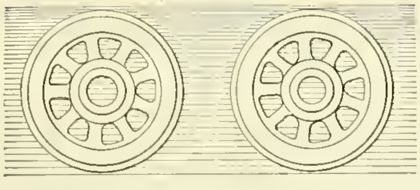
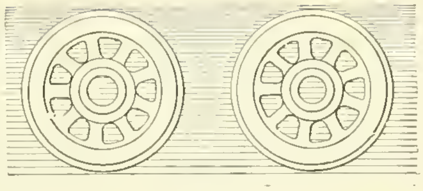
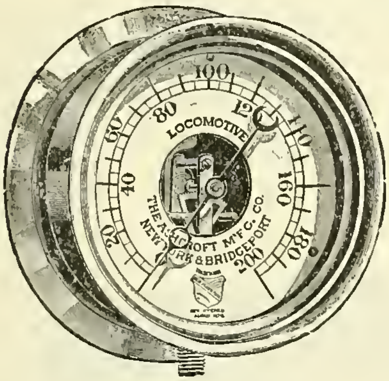
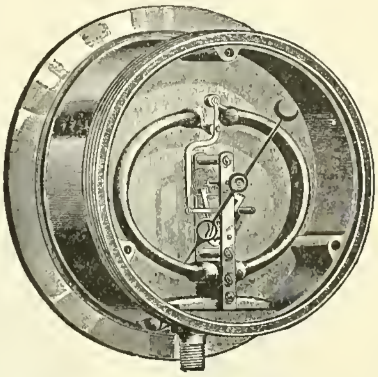


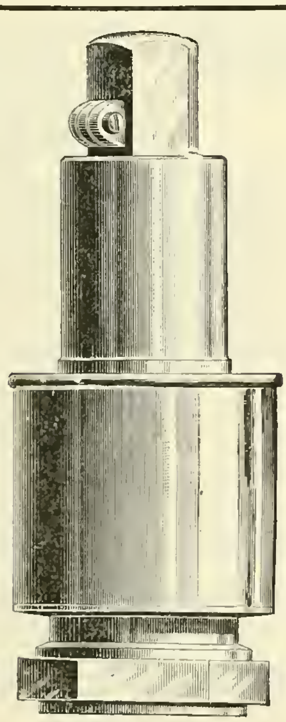


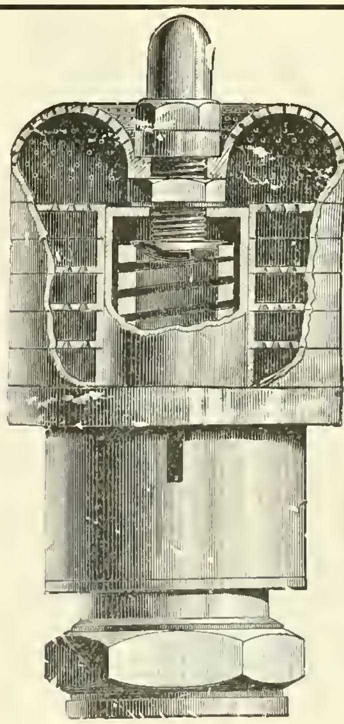


True to start with—and stays so.

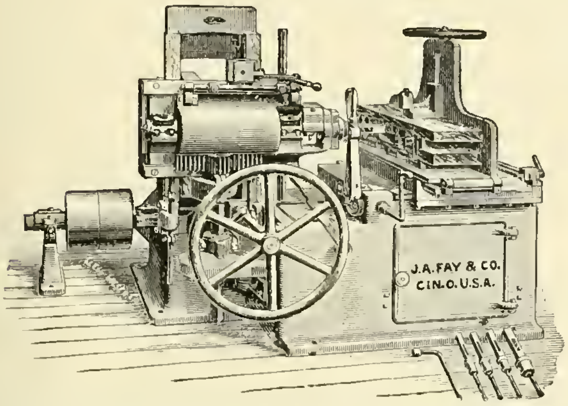


Movement no connection to back of case.





WOOD WORKING MACH'Y FOR CAR BUILDERS.



The No. 3 AUTOMATIC HOLLOW CHISEL MORTISER AND BORER shown herewith, is designed for use in all kinds of timbers, heavy and light, used in Car and Bridge Construction. It can be used for Single or Double Mortising, for Gaining, Countersinking, End Tenoning, and Boxing. The chisel has a travel of 10 inches in depth, and a vertical range of 13 inches. Mortises up to 2½ inches square can be made.

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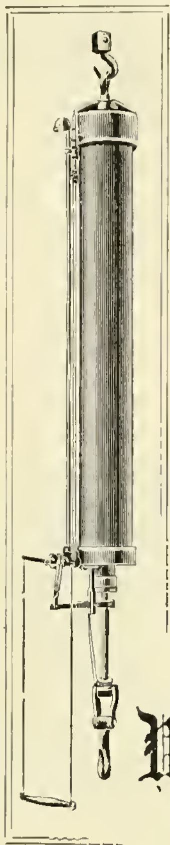

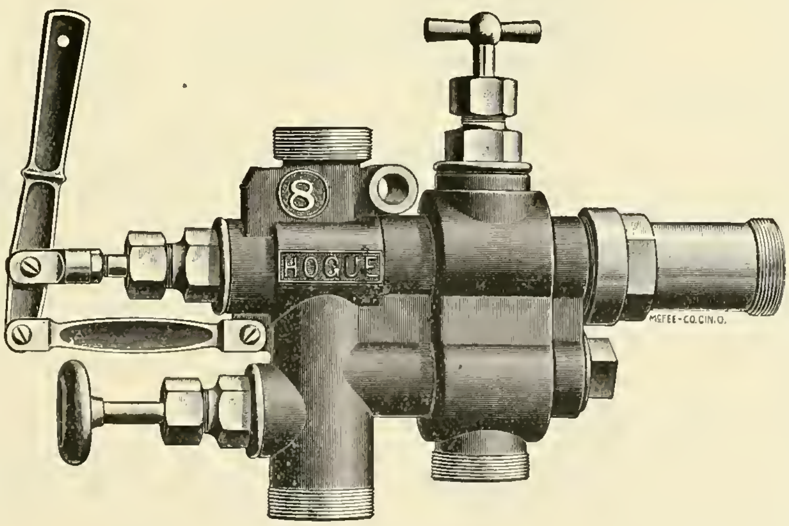
8
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Electric bells and every convenience that can possibly be crowded into a hotel-room are in these compartments. The prices are the same as in the standard open sleeping car, and our patrons have the choice, as we run one car of each pattern on every night train of the **C. H. & D. and Monon**, between Cincinnati and Chicago, both to accommodate those who do not know the advantages of the new car and prefer the old style on account of familiarity with them, and to enable us, except in great rushes, to give every one a lower berth.

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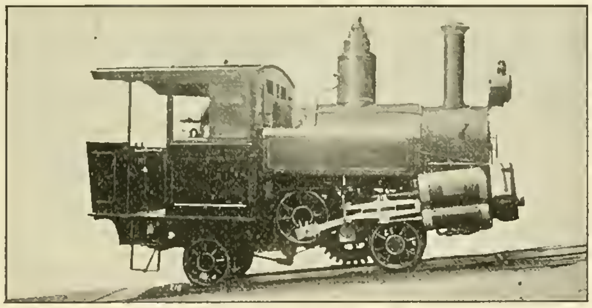

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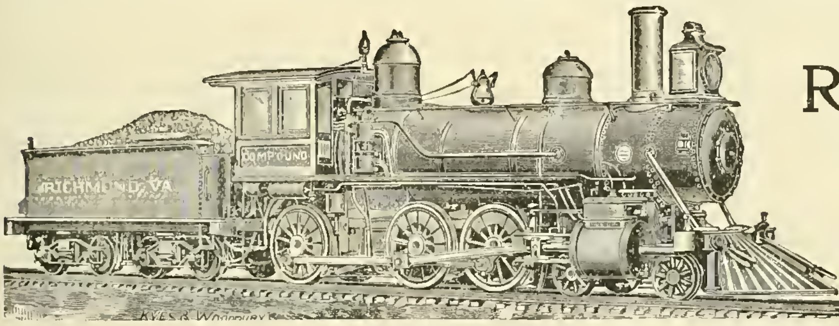

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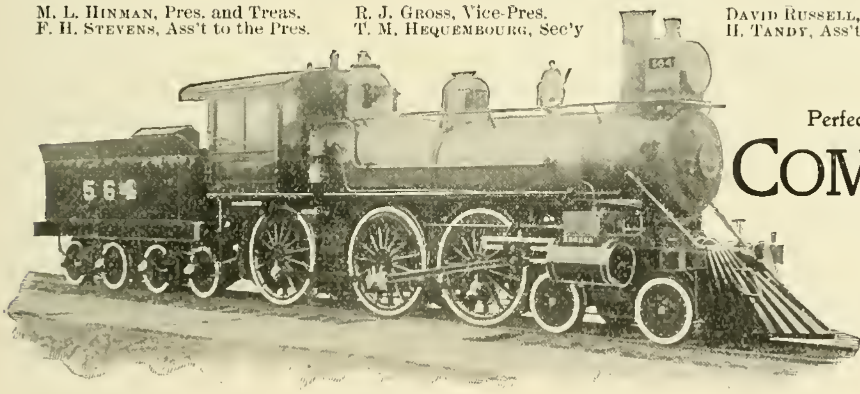

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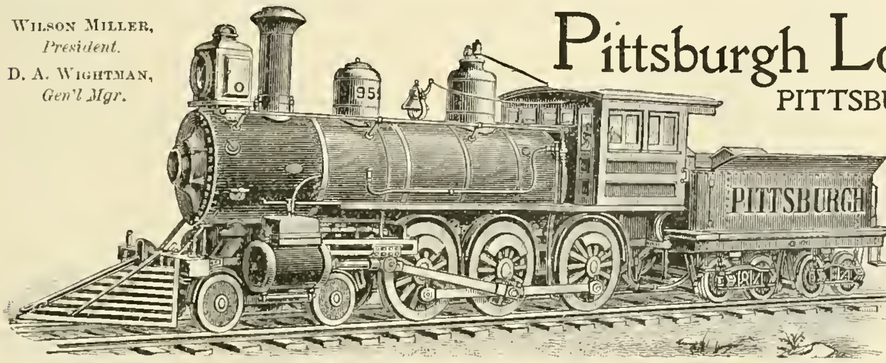

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Air-Brake Catechism. Conger. 1895. This is Conger's "Air-Brake and Signal Instructions" rewritten and improved, containing the air-brake and signal instructions approved by the Master Car Builders' and Master Mechanics' Associations; also the standard list of questions for air-brake instruction. This is the latest and best book on air brakes. Issued November 1, 1895. Price...25c.

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Car Builder's Dictionary. A complete illustrated encyclopedia of car construction. Nearly six thousand illustrations....................$5.00

Car Lubrication. Hall. Ought to be read by every one interested in keeping journals running cool....................$1.00

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Compound Locomotives. Wood. 1894. Enlarged. Tells the history and explains the principles of all the kinds of compound locomotives in use....................$3.00

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LOCOMOTIVE ENGINEERING
A PRACTICAL JOURNAL of RAILWAY MOTIVE POWER AND ROLLING STOCK.
[Trade-Mark Registered.]
Vol. IX. NEW YORK, MARCH, 1896. No. 3.

Ten-Wheeled Compound—Southeastern Railway of Russia.

Our half-tone of the Vauclain compound for Russia, represents a lot of seventy-two ordered by that government; it is a good illustration of breed-crossing, combining prominent features of both parents.

The drivers, having steel centers, have a beautifully light appearance; and so with engine and tender trucks, which have wrought-iron centers. The method of securing the driving-wheel tires to the wheel centers will take many of us back to early practice: they are held by shrinkage against a shoulder, and also by tap bolts through rim into the tire. All tires of the engine and tender trucks are held by retaining rings.

The little bull's-eye lamps, and the murderous-looking, scythe-like extensions just under them, are so distinctively foreign that it carries the observer miles away—only to return again when the eye takes in the familiar lines of our American engine.

A hand rail like the two-story structure shown, is new to most of the present generation on this continent, and it may be a revelation to them when we say that there was a time when every engine running in this country had something like this fence for a hand rail. It looks odd on a modern engine.

This engine is designed to burn naphtha; and the tender, which is of the six-wheeled type, is made in two compartments, the lower of which has a capacity of 486 cubic feet for water, and the upper a capacity of 236 cubic feet for naphtha. It will be noted that each tank wheel has a brake shoe on both sides.

General dimensions are as follows:

Fuel, naphtha.

Gage, 5 feet.

Cylinders, high-pressure, diameter and stroke, 14 x 26 inches.

Cylinders, low-pressure, diameter and stroke, 24 x 26 inches.

Driving wheels, 72 inches diameter.

Driving-wheel centers, steel, 66 inches diameter.

Driving-axle journals, 8 inches diameter, 9 inches long.

Driving-wheel base, 14 feet.

Total wheel base of engine, 26 feet 3 inches.

Weight on drivers, about, 99,000 pounds.

Total weight of engine, about, 139,000 pounds.

Material of boiler, homogeneous cast steel.

Thickness of material in boiler, 5/8 inch.

Form of boiler, straight.

Diameter of boiler at smokebox, 60 inches.

Working boiler pressure, 180 pounds per square inch.

Kind of seams in boiler, double-riveted.

Tubes, of iron, 2 inches diameter.

Number of tubes, 223.

Length of tubes, 14 feet 3 inches.

Firebox, length, 80½ inches.

Firebox, width, 36 inches.

Firebox, material, red copper.

Firebox sheets, sides and back ½ inch thick.

Firebox sheets, crown, ½ inch thick.

Flue sheets, 7/8 inch at back, ½ inch at front.

Staybolts, copper.

Smokebox, extended.

Smokestack, straight.

Frames, material, hammered iron.

Truck wheels, number, four, steel-tired.

Truck frame, wrought iron, swiveling bolster.

Truck wheels, 35½ inches diameter.

Truck-axle journals, 5½ inches diameter, 10 inches long.

Cylinders, each cast with half saddle.

Pistons, heads and followers, cast iron.

Piston rods, steel.

Piston packing, approved steam.

Guides, material, steel.

Crossheads, cast iron.

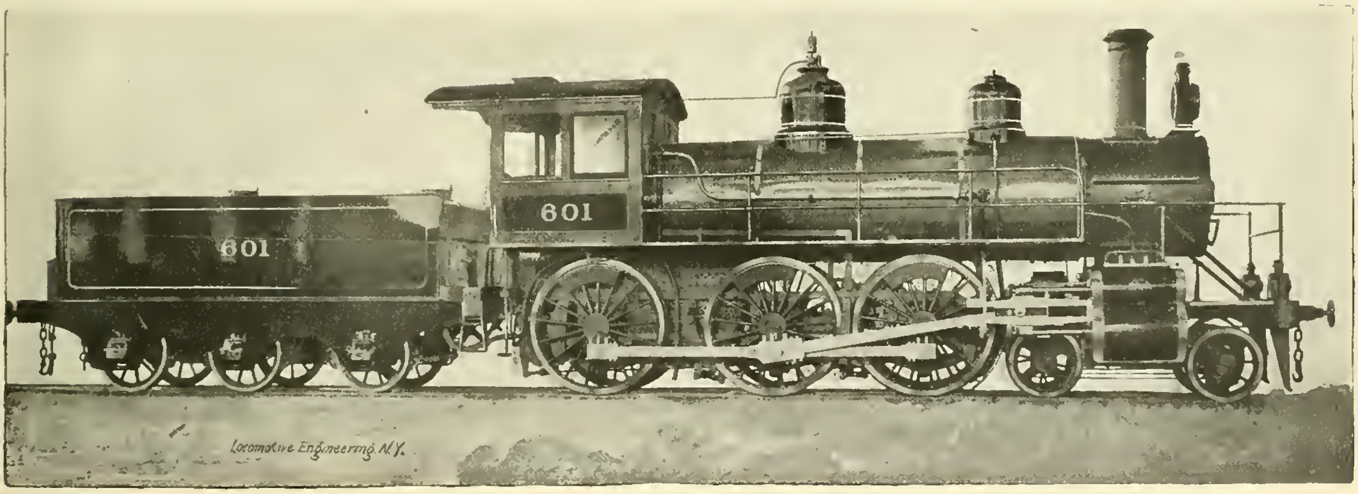
Piston rod and valve-stem packing, metallic.

Valve motion, shifting link.

Driving tires, cast steel, 3 inches thick.

Driving tires, front and back flanged, 5½ inches wide.

Driving tires, middle plain, 6½ inches wide.



COMPOUND OIL BURNER FOR RUSSIA.

Driving boxes, steel.

Driving-wheel hubs lined with brass.

Main and side rods, No. 1 hammered scrap.

Injectors, two.

Cab, wood.

Tender wheels, $41\frac{1}{2}$ inches diameter.

Tender-axle journals, $6\frac{1}{4}$ inches diameter, 10 inches long.

Westinghouse automatic brake on engine and tender.

A recent return of the Russian Government gives the length of lines now working in that country as 21,947 miles, of which about two-thirds belong to the State, and are worked by it. A further length of 8,556 miles is either in course of construction or about to be commenced. Account should also be taken of 1,656 miles in operation in Finland. The Russian Minister of Means of Communication has just made a tour in Siberia for the purpose of inspecting the works of the Siberian. A line has been authorized from Vologda to Archangel, and 7,000 men are now employed upon the works. The length of this line will be about 600 versts. The Moscow, Kiew and Voronege has been making surveys for two new lines, the first to run from Briansk to Lgoff, parallel with the Koursk and Orel, and the second from Woroshba to Seredinaja-Buda. The Smyrna and Cassaba has commenced the works of a line from Ala-Chehir to Kara-Hissar; the new line will be $156\frac{1}{4}$ miles in length.—"Railway World."

Roanoke Machine Shops.

About thirteen years ago, when the Norfolk & Western Railroad Company was formed by the consolidation of a variety of old railroads, a number of capitalists interested in the company organized what was known as the Roanoke Machine Co. This company built shops at Roanoke for the purpose of repairing and building rolling stock for the Norfolk & Western, and for doing a general manufacturing business. What was considered the best engineering talent of the country was engaged to design and equip the shops, to make them models of their kind for doing the work in every department expeditiously and cheaply. There are several impressive object lessons to be learned from a study of these shops to-day.

The first of these is, how quickly facilities which are considered away beyond foreseen needs are overtaken by current requirements. These shops were expected to do all repair work of the N. & W. for many years, build all the locomotives and cars that the company would have call for, and sell locomotives and cars sufficient to meet the demands of nearly all Southern railroads for two decades; yet to-day they are overcrowded with the repair work of the Norfolk & Western alone.

The next object lesson is, how rapidly tools, methods and manufacturing facilities become antiquated. These shops, with their overhead traveling cranes and all the tools that were considered the best of their kind thirteen years ago, are not now run to good advantage, compared with many modern shops; because cranes are too light and too slow, while manufacturing tools possess the same drawbacks. A large volume of work is, however, turned out, considering the facilities; but success is due in a great measure to the personal efforts of the men in charge.

The erecting shop and boiler shop occupy one long building, which is traversed by two traveling cranes. Three tracks are laid longitudinally in the building, the intention having been to use the outside tracks for the locomotives and boilers undergoing repairs, and the middle track for service. The original capacity of the erecting shop was twelve or fifteen locomotives a month. At present they are getting out one locomotive for every working day. All the tracks are occupied by locomotives and boilers, and cranes manage somehow to lift out those that are finished; but they are operations done on small margin. They have a few new tools, but the principal part of the increased output is due to improvement in pushing the work along systematically, by the better arrangement of tools and the speeding up of others.

Piece work is largely followed in all departments, except the boiler shop, and the men are evidently satisfied with it, for labor unions are strong in all the shops. Piece work was abandoned in the boiler shop after it had been put in operation.

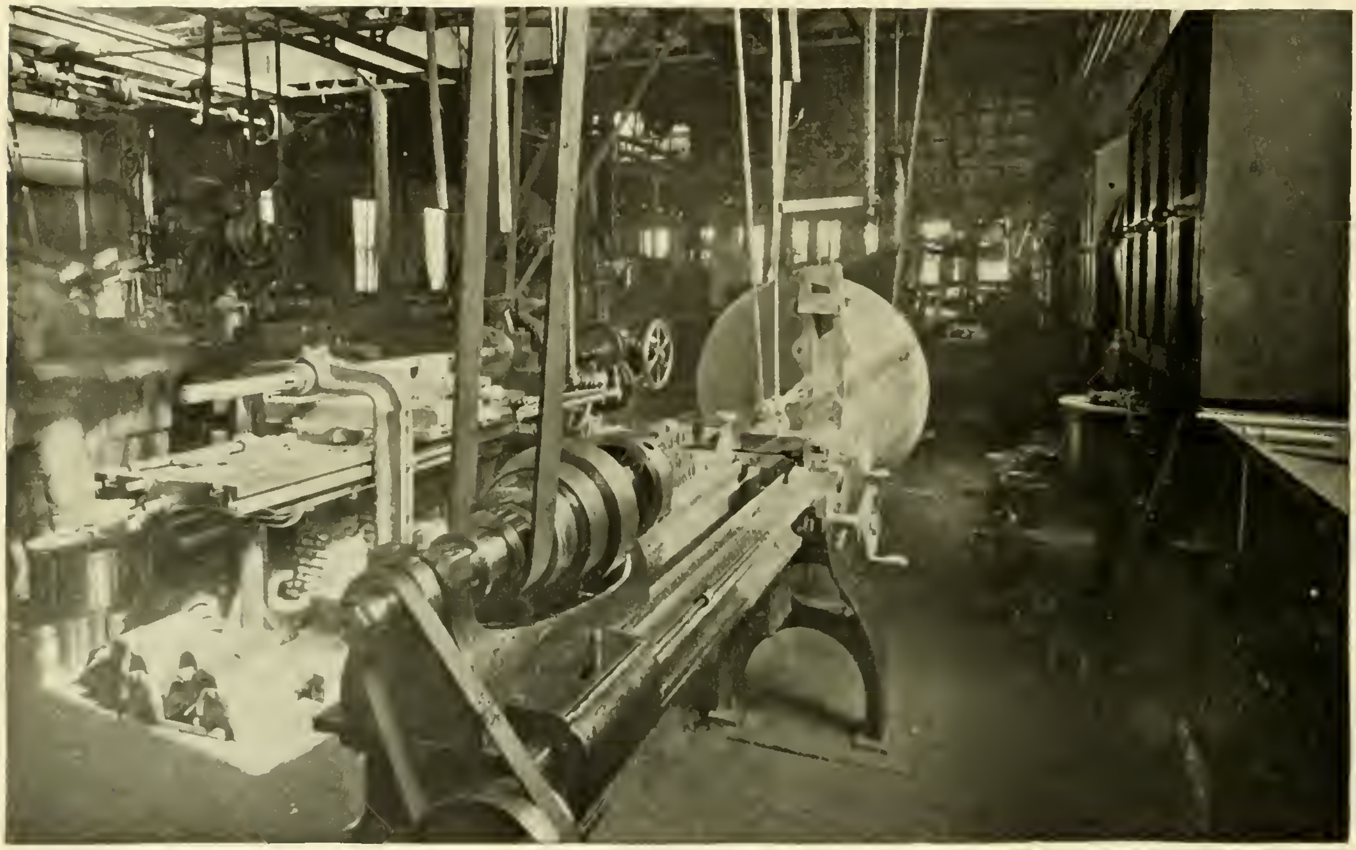


Fig. 1 EMERY WHEEL GRINDER FOR HARDENED BUSHES.

The success of piece work in these shops appears to result from mutual confidence between the workmen and the officers in charge. The officers are not sitting up nights figuring on how they can cut down prices on the men who are making good wages.

They have a fair variety of small labor-saving devices, but they have done very little with air. They expect, however, to put in an air-compressing equipment soon, and to pipe all the shops and put in all the leading air-operated tools that are so economically employed in many other railroad shops.

They have not yet got to the length of grinding all the tools on a special machine; but they have done the next best thing — put small tool-grinding emery wheels at short distances apart all over the shops, which prevents the men from wasting time walking long distances to grindstones. A great many of the finishing operations are done on grindstones and emery wheels. All car bearings are ground on emery wheels before being lined with soft metal. The tool shown on Fig. 1 is an attachment put on a lathe for truing up the bushings of links by a small emery wheel. The policy followed throughout the shops in the finishing of work is: Make the rubbing parts true, but waste no time on brightening outside appearances.

What to me was a new arrangement of vises is in use here. They have no vise bench proper, but attach the vise to a post about 3 feet high, away from the wall. A man at work can go all around the vise. With rods and similar long work, one end is supported on a trestle. Each vise-man has a small, portable drawer bench, in which he holds the articles necessary for his work. It needs no rhetoric to show the advantages of having no vise benches attached to the walls of a shop. Let any man of observing habits recount the objectionable uses made of the hiding places provided by common vise benches, and all men not hidebound by bad habits will acknowledge that he who made provision for abolishing the vise bench was a genius worthy of the gratitude of shopmen. The vise arrangement is illustrated in Fig. 2, which shows the rod department.

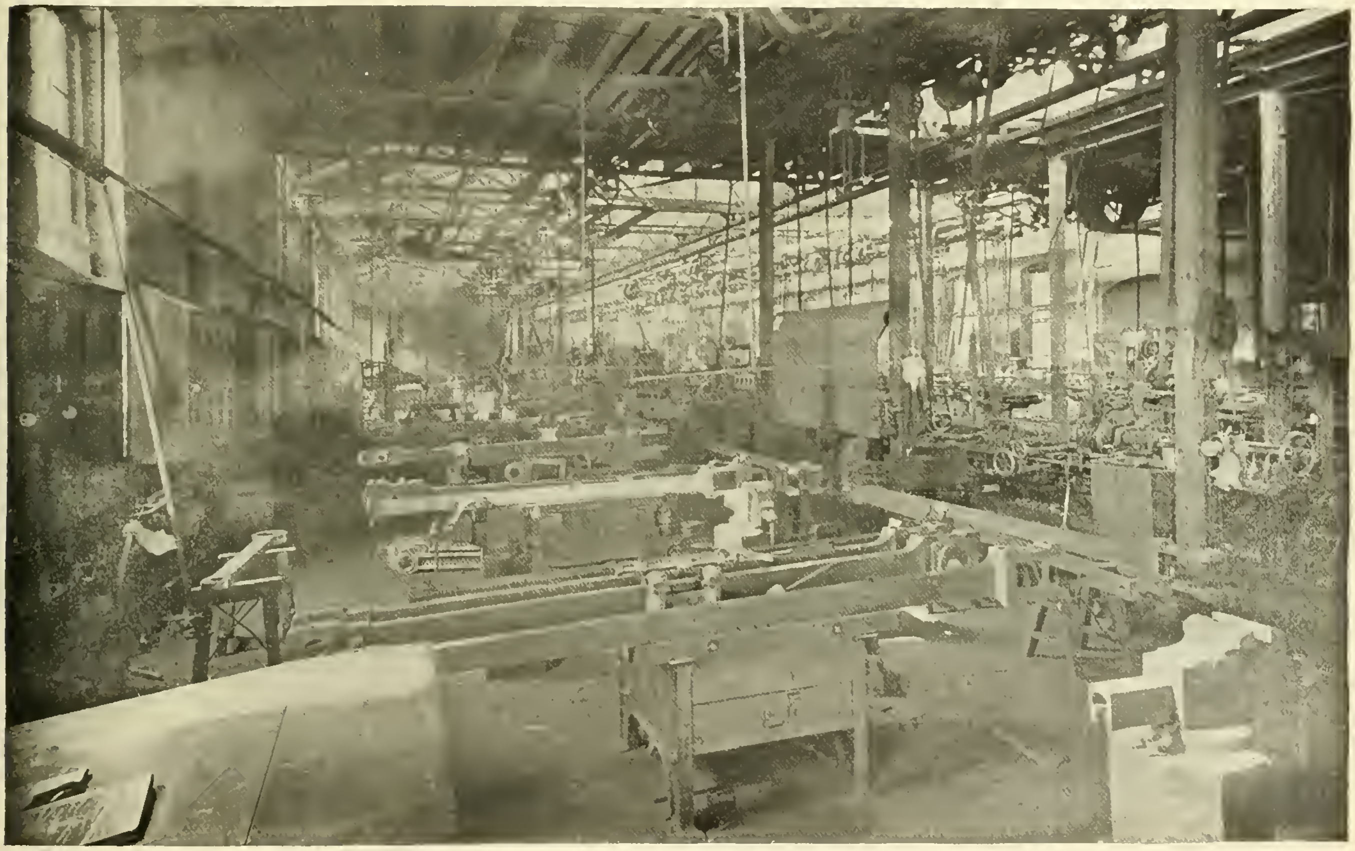


Fig. 2. A SUBSTITUTE FOR THE VISE BENCH.

The work in the shops for both locomotive and car work gave proof that the mechanical department is pursuing a systematic and intelligent policy of keeping down the weight of rolling stock, at the same time maintaining the strength necessary. Malleable iron and steel are largely displacing cast iron in car construction. Apart from the lightening of parts which results, they find the stronger material much more reliable. Those who make common castings have pushed their cheapening process so far that any kind of iron is considered satisfactory for a common casting, and the natural result has followed. Common castings, as turned out at many foundries, are dear at any price.

Among miscellaneous notes taken were:

For some classes of locomotives they are using cast-steel driving-wheel centers, and for others they use gun metal. The latter metal is found very satisfactory for driving-axle boxes.

They employ bronze for driving boxes; and when the bearing gets worn, slot out the box and put in a new bearing.

They true all crank pins on the quartering machine. Broken crank pins and side rods are rare.

Nearly all the shops of the system have adopted the practice of butt-welding flues, as recommended by "Jim Skeevers."

They are making all new ashpans of ¼-inch iron, and fitting the dampers to be nearly air-tight. The next move necessary is a handle with good leverage that can be set in graduated notches.

They have fitted up a number of locomotives with solid wedges, as an experiment. There was complaint at once from some of the engineers, but others like the change. The engines are under careful supervision, and on the results obtained will depend the decision in favor of or against solid wedges.

In connection with the visit to these shops, I wish to acknowledge the kindness received at the hands of Mr. R. H. Soule and his assistants. Mr. H. A. Gillis, master mechanic in charge of the shops, was tireless in his attentions, and I am indebted to Mr. G. R. Henderson, mechanical engineer, for the photographs from which the engravings were made, and for many other favors. A. S.

Southern Railway Shops at Knoxville.

During the war time, a controversy was carried on in Northern papers concerning the wisdom of the Government taking and keeping military possession of Knoxville, Tenn., the contention being made that the place was not of strategic value. A peaceful question of the same character has been raised lately as to the strategic value of the place as an industrial center for railroad work. That city has always been the mechanical headquarters of the East Tennessee, Virginia & Georgia Railroad, and for that system it was a perfectly satisfactory distributing point. The company had miserable shops—dark, dismal, scattered and overcrowded—and they determined five years ago to build new ones. A fine site was selected about two miles from the city, and building was begun. Before the new shops were finished, the depression in business came on, work was abandoned, and the road went into the hands of a receiver. It came out as a part of the Southern Railway. That great railway system was reorganized on the basis that the whole property should be put in first-class order and kept in that condition. The management soon discovered that the repair shops in operation were inferior and behind the requirements, so they pushed forward the finishing and equipping of the Knoxville shops that there might be effected the repairs of the locomotives and cars on adjacent divisions. The management did the best they could under the circumstances, but there is a feeling as in the war situation, that Chattanooga would have been a stronger strategic position.

GENERAL ARRANGEMENT.

If the loss in this move is with the Southern Railway, the gain is with the fair city of Knoxville; and the people of the place are wonderfully proud of the fine shops which give employment to a large number of men. To be placed in a convenient location which did not entail extra labor to prepare the ground, the Knoxville shops have as beautiful a location as anything we have ever seen. The appearance of the shops and the character of the surroundings can be well understood from an examination of the annexed engraving, which was produced from a photograph taken from a hill overlooking the shops.

As these shops are the most recent in construction and equipment, railroad men will be interested in learning details about them. As can be seen from the engraving, the buildings stand parallel with each other; and engines, cars, supplies and material are taken to and from the various shops by transfer tables that are served by tracks at each end. For a few years there was a tendency to disparage the use of transfer tables in connection with repair shops; but I have never seen anything tried that was so convenient. The only serious objection to their use has been that the pits are apt to get filled with snow in winter, but this drawback has no force in Tennessee.

The shops are all substantial brick buildings, well lighted and drained, and warmed throughout by the Sturtevant system. Even the roundhouse is heated in this way. The intention is to keep the fans at work in the hot summer months, keeping up a circulation of fresh air.

As we make a general survey of the buildings, it strikes us that there is too much space between each building and the transfer table; but a little consideration convinces us that the first impression was wrong. The space is utilized for holding locomotives or cars to be stripped before they enter the shop, and also for doing finishing work before they are taken away. The arrangement increases the capacity of the shops, and it keeps the buildings well apart, which is a useful safeguard in case of fire.

A CORDIAL RECEPTION.

On reaching Knoxville early one rainy morning in the beginning of February, I met with a pleasant surprise. The sleeping-car conductor recognized the writer, and told some of the railroad men that the S. P. of "Locomotive Engineering" was in the dining room, and in a few minutes he was receiving a cordial welcome from Traveling Engineer M. J. Reams, Air-Brake Inspector Broadnax, Master Car Builder Corinth, and a string of others whom I failed to recognize. They were all interested readers of the paper, and were delighted to welcome one of its representatives. It is pleasant to record that, during my visit to Knoxville, nearly every railroad man I met was a subscriber to the paper, and most of them were prepared to express likes or dislikes for what appeared in the various departments.

Escorted by a pleasant company, I lost no time in getting out to the shops. The greater part of two days spent there enables me to judge pretty fairly what they have got.

A MODEL ROUNDHOUSE.

The reader will see by the picture of the shops, that after paying our respects to Master Mechanic Michael in his convenient office, which is part of the storehouse building, the natural starting-point was at the roundhouse. That building has been laid out for fifty stalls, but only a half has been built. It is 70 feet between walls, and is the best-equipped engine-house I have ever been in. It is well lighted, and the Sturtevant system of heating makes it the best-ventilated engine-house in the country; for the incoming air forces out any smoke that may escape past the smoke jacks. There is one slat ventilator on the top of the roof for every two stalls. The house contains all the best appliances that have been designed for washing out and firing up engines promptly, except an oil lighting plant. Air pipes encircle the house, and are employed for testing brakes and for stimulating fires when engines are wanted in a hurry.

The air blower used in the smokebox was a novelty to me. A long pipe is bent, with an opening wide enough to span the top of the smokestack, and attached to the end which goes down the smokestack is a tapered socket which goes into the exhaust pipe. Putting this in the nozzle insures a jet through which the air is passed central with the smokestack, and therefore it does the maximum work in creating draft. An air connection is made with the outside pipe, and no drilling of smokebox connecting with permanent blower pipe is necessary.

Careful consideration was given to the best kind of floor for this and other buildings, and vitrified brick laid on a substantial foundation was selected. It promises to give entire satisfaction.

Much attention is devoted to cleanliness and prevention of fire. The oil and dope buckets are in iron tanks, and all greasy waste is kept in iron boxes. Mr. Dunn, the roundhouse foreman, has a decided taste for cleanliness and order, and the fine condition of the place is no doubt due to his care. He has in his office a novelty in the shape of a large board with slides which hold names. The names of all the engineers and firemen are on these slides, and they are arranged in the order of seniority.

DROP PITS.

A conspicuous thing about this roundhouse is the drop pits, there being no less than seven of them, some of them for driving wheels, others for trucks. The repair work is wonderfully facilitated by these appliances.

In connection with this, it is only fair to mention that Mr. W. H. Thomas, superintendent of motive power of the Southern Railway, under whose supervision these shops were equipped, is really the father of the drop table operated by hydraulic machinery. When he was roundhouse foreman of the Pennsylvania Railroad roundhouse at Renovo, in the '70's, he designed and put in a drop pit of this kind, and it was the first of the kind tried. It is in use to-day. Nearly all the patentees of drop pits have followed Mr. Thomas' ideas.

A useful thing posted in this house is a drawing showing details of the intercepting valve of the Pitkin compound locomotives. Mr. Dunn gives profitable instruction to the engineers by the use of this drawing.

Air brakes are tested by the pressure in the roundhouse air pipes. Connection is made with a nipple at the bottom of the main reservoir. Taking the cap off this nipple lets any accumulated water escape. As the brakes of all engines are tested every time they come into the house, there is not likely to be much accumulation of water in the reservoir.

The sandhouse is a model of its kind, and the sand is elevated by compressed air. The coaling station and the cinder pit are also models of convenience.

THE MACHINE SHOP.

The machine shop and erecting shop are under one roof. The capacity of the shop is now about eight locomotives a month, but they expect to nearly double that output. The engines stand in stalls at right angles to the line of the shop, and the tools occupy the other side. The weak point of this shop is that it is not provided with overhead cranes, but the shortcoming has been to a great extent obviated by the use of numerous air hoists. It is a question if overhead traveling cranes are profitable in a shop that turns out only seven or eight locomotives a month; but where that volume of work is doubled, the case is different.

The machine tools are grouped to suit the ideas of Mr. Thomas, and they could not well be improved upon. The arrangement has been made with the view of doing work with the least possible handling. The number of labor-saving appliances found in this shop indicates that Master Mechanic Michael has made a wise selection in appointing Mr. R. J. Farrell foreman of the erecting shop, and Mr. T. P. Roberts foreman of machinery.

The shops are equipped throughout with Sellers shafting and Gilbert splitwood pulleys. The machine tools are not numerous, but they are worked for all that is in them. There is a Jones & Lamson special turret-head lathe which is held in great esteem by the foremen. They say that it will do as much work in turning out bolts, studs and similar articles as three ordinary lathes. Bement & Miles tools appear to be in the majority, and it goes without saying that they are in high favor. Most of the other tools are from Pond, Sellers or Niles. The equipment is as select as anything to be found in any railroad shop.

Compressed air is supplied to all the buildings by an Ingersoll-Sergeant air compressor. The demand for this power has been so great that the compressor has been overworked, but they are preparing to relieve it by the storage of a large tank. For this purpose they are building a cylindrical tank 58 inches by 16 feet. feet.

Several Player tools are used for cut-

CURVED BRIDGE ON NORFOLK & WESTERN, NEAR PULASKI.

ting staybolts, and a rotary engine for drilling staybolts, driving boring mills, valve-face planers, and a variety of other work.

THE TOOL ROOM.

The tool room is outside the middle of the shop, and has a good equipment of small tools, gages, measuring instruments and templates. The tools required for keeping this equipment in order are in the tool room. Part of the place is partitioned off as an air-brake testing and instruction room, and it has been well arranged for this purpose under the direction of Mr. Broadnax, air-brake inspector. All tools and blueprints are checked out, and all must be returned on Saturday. Arrangements are making to introduce the messenger system for distributing tools to the workmen.

TO PREVENT FLANGE CUTTING.

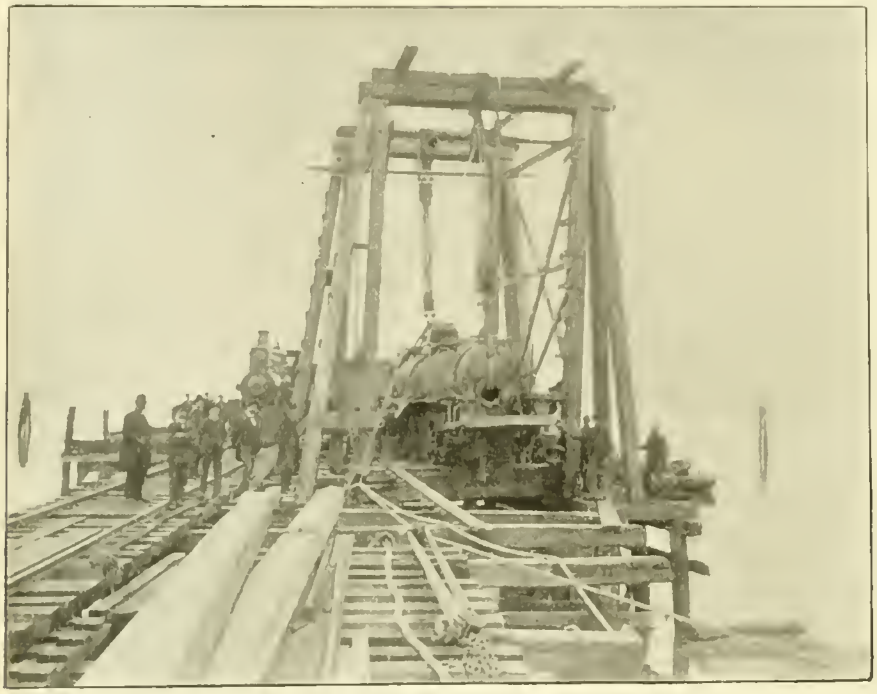
Most of the locomotives that run into this point, or are sent here for repairs, run on very crooked track, and the problem of keeping down wear of wheel flanges, and hubs, has received serious attention. The ten-wheel engines had mostly swing trucks and the bald tire in the middle. Decided improvement has been effected by blocking the trucks and putting the bald tire in front. They have tried soft metal to some extent to take up hub wear, and also cast iron disks. They are now using brass disks exclusively, finding that they wear better and are more reliable than cast iron. They are applied to the hub in two half-round sections and held by brass screws.

INCREASE OF LAP.

They had a somewhat unusual experience with a lot of consolidation engines that were received with ¾-inch lap. They were extremely wasteful of fuel, and one was tried with 1-inch lap and it did not display any loss of tractive power. The result was that all the engines were given the longer lap, and they all do the work as well with considerable saving of fuel.

BIG PIPE TO SOFTEN AIR-PUMP EXHAUST.

They follow a practice here with the air-pump exhaust which is worthy of imitation. With the small exhaust pipe usually employed, the exhaust steam from the air pump escapes with so much velocity that it stimulates the fire like a strong blower, and causes much waste from steam blowing off at stations. These people use a 2-inch pipe in the smokebox for the air-pump exhaust, and the escape of steam is so slow that it has scarcely any effect upon the fire.



RESULTS OF BATHING OUT OF SEASON.

CLEANING EXHAUST PIPES.

They have a novel way of cleaning the exhaust pipes of the heavy incrustation of oil and soot that accumulates inside. Scalding in the cleaning vats had been tried without doing much good. When an engine comes into the shop, they now take the exhaust pipe outside and start a wood fire inside of it. Burning a few handfuls of pine strips cleans off the incrustation completely.

STOPPING BREAKING OF PISTON RODS.

Breakage of piston rods has been almost entirely prevented by a novel method of fitting the rod into the crosshead. The outside of the opening in the crosshead is made slightly bell-mouthed, so that the rod will be free to move. The end of the fit is turned conical and is keyed up against the end of the hole. This appears to relieve the concentration of stress which makes most piston rods break at the neck of the fit. At all events, the practice prevents the breaking of rods.

Their experience with the Leach sander has been so satisfactory that they are putting it upon all engines as they pass through the shop.

They are putting five braces from tube sheet to tube sheet of all boilers, and find that the practice is a valuable preventative of leaky tubes.

THE BLACKSMITH SHOP.

Mr. Michael is very proud of his blacksmith shop, which is a clean, well-ordered establishment, with side draft forges which are models of compactness and have a frame attached where the blacksmith hangs the tools mostly in use. The foreman, Mr. C. L. Ruderley, is intelligent enough to be an interested reader of "Locomotive Engineering," and he expressed himself as having got valuable information from the articles on formers and other blacksmith subjects. He has a very good assortment of formers himself, and is hankering after more; but his ruling ambition is to get a bulldozer and a heating furnace. A few other tools and appliances put into this shop would help to cheapen its product.

THE CAR SHOPS.

The passenger-car repair shop has a capacity of 150 cars a year, and is well provided with appliances for handling material. This and the paint shop are as well-designed and properly-kept buildings as I have ever been in. Like the other shops, they are heated by hot air and lighted by electricity.

They are working a large force of men in the freight-car repairs shops, and are putting on air brakes on sixty cars a month and automatic couplers on 100 cars. They are putting the Janney-Buhoup coupler and platform on all passenger cars as they come into the shop.

The planing mill is remarkably well-arranged, and has fine working exhaust pipes for carrying away chips and shavings. There are three lines of main shafting across the shop, power being transmitted by ropes. Any line can be thrown out of action when the tools are not in use. The tools in this shop are very good. Among the new ones are an end-sill mortiser, a hollow chisel mortiser, a 4-spindle borer and several saws. Most of the tools are from J. A. Fay & Egan Co. Cincinnati, and from Berry & Ortton, Philadelphia.

Steam is conveyed by an underground conduit from a central point to the various shops, and every shop has its own engine. Most of these are Philadelphia Corliss. The exhaust steam passes into the Sturtevant heating coils.

A feature about these shops which deserves special notice is cleanliness. Neatness prevails in every department. There is no greasy waste, dilapidated castings, abandoned shoes or worn-out hose to be perceived anywhere. The appearance of the men is also unusually good, which might be expected of an establishment where the majority of the men are readers of technical papers. A. S.

Burning Coal Dust.

The problem of burning the untold tons of refuse coal, the dust and unmarketable accretions of years, lying in great heaps at every coal mine, is nearing a solution, if the accounts of experiments made in Germany are correct.

This refuse is first passed through a pulverizing process, to bring it to a uniform degree of fineness. The first experiments with this fuel were made by introducing it into the furnace by means of a light air blast from a fan, the dust being mixed with air upon entering the firebox. Results were so flattering that continued effort developed the fact that natural draft was sufficiently strong to take the dust into the firebox.

No grate bars are required; the combustion is said to be perfect, and the saving in cost of fuel is said to be 20 per cent.

No fireman will be needed with this device, it will be noticed, as the dust is taken into the firebox automatically with the draft. If that fact had been kept dark, the scheme would have had a certain plausible look that would invite the good opinion of everyone interested in the demolition of the dumps.

The automatic stoker will never displace the fireboy; the best it ever has or can do is to make life a little easier for him, and when that is done its mission is filled.

A Record Breaker.

The Balanced Locomotive & Engine Company is engaged, we understand, rebuilding the locomotive "A. W. Darwin," that has a record (?) of 61 miles in 60 minutes, with a ten-car train; and when it is put in shape, it is expected to "accomplish more wonderful feats."

Four cylinders, two high-pressure and two low-pressure, are to be harnessed up (although just how, it is not stated), but it will be in such a way as to "give the power-producing properties of two ordinary locomoives;" and "if it can be successfully operated," the promoters say, "it will be the greatest work ever accomplished in railroad engine building." We are also to be "astounded at the speed, fuel economy and strength of the new reconstructed engine."

This assurance of wonderful things from the old steam standby is a timely one, for it revives a confidence that has been badly shaken by the reported big things we were going to have from electricity. It is pleasant to be awakened from this nightmare, in which the idol of our thoughts was seen to be relegated to the scrap heap, and supplanted by a hideous black thing with a pole like a dorsal fin, extending from its back to an electrically-charged wire. It is indeed good to know that the locomotive of our youth is about to be given a new lease of life, "if it can be successfully operated."

It will be too dead to bury before turning a wheel, if such stuff as we have quoted is allowed full play in cold type. The best use they can put the author of it to, is to fire up with him.

Five years ago nearly all boilers having radial stays to support the firebox crown sheet, were reported as giving trouble from the cracking and bulging of the back flue sheet. The subject came up for discussion in the mechanical associations and clubs, and the assertion was made that the trouble could be obviated by putting sling stays in the front row. Many people ridiculed this idea, but there are very few radial-stay boilers built nowadays that do not have the front stays put in so that the flue sheet can expand without obstruction.

Central Railway of Brazil.

BY LEWIS GLEASON.

The United States of Brazil, the second largest republic in territory and population on the American Continent, has not a very extensive railway mileage. Statistics as to the exact mileage are not easily obtained. It is estimated at 6,000 miles.

The most important system is that owned by the Government, under the official title "Estrada de Ferro Central do Brazil." This translated into English reads, "Road of Iron Central of Brazil." It is not now a road of iron, but a road of steel. In this article we will call it Central Railway of Brazil.

The system consists of about 800 miles, main line and branches. This apparently small number of miles of railway, for a country of the size of Brazil, does not seem so strange when its coast line of upwards of 4,000 miles, and the many large navigable rivers in various parts of the country, are taken into consideration.

The most thickly inhabited portions of Brazil are along the coast, and adjacent to the large rivers, which afford transportation from one point to another by water.

The Central Railway of Brazil was built and has always been operated by the Government, except a few small roads that were built by English companies, and afterwards bought by the Government.

The control of the railroad department is vested in a Cabinet officer, titled "Minister of Industries." He, in turn, appoints the Director, an officer whose duties are about the same as those of a general manager on an American road. The Director appoints the general officers of all departments—engineering or maintenance of way, operating and mechanical—and they, in turn, their subordinate officers. The Chief Engineer has for assistants a corps of resident engineers,

RESULT OF NOT SUPPORTING AN OLD BRIDGE WHILE PUTTING A NEW ONE UNDER IT.

each one having a division of about one hundred miles of roadbed, with bridges, buildings and everything pertaining thereto in his keeping. Roadmasters, supervisors, etc., report to and receive their orders from the resident engineers. Those officials have neat houses and well-kept grounds, provided for them by the Government, free of charge.

The Chief of Traffic has charge of the operating, and all matters pertaining to the passenger and freight departments of the system. He has a large official staff to assist him. There are no superintendents nor train dispatchers. There are minor officials, however, who discharge a portion of the duties of a superintendent of our home roads. The absence of train dispatchers from the list of minor officials will be explained further on. The Chief of Traffic has also under his immediate supervision all station agents, telegraph operators, train crews, and all employés in any manner connected with the traffic department. It is an office of much responsibility, ably filled for many years by the present incumbent, Dr. George Rudamaker Greenewald, a courteous gentleman and thorough railroad man, beloved by all the employés. He is a Brazilian.

The Superintendent of Locomotives—or, to give him his official title, "Chief of Locomotion"—has charge of all locomotives and other rolling stock, and the entire mechanical department devoted to the construction and maintenance of same. He is assisted by a corps of division master mechanics, in charge of the shops, located at various points of the system. Those officials also have very neat residences, provided by the Government.

The road runs through portions of the States of Rio de Janeiro, Minas-Geraes and Santo Paulo, the important city of Rio de Janeiro being the terminal point.

The Central station in Rio is an imposing structure, two stories high, and of a style of architecture peculiar to the country. The ground floor, as is customary in all buildings of like nature, is occupied by the ticket offices, telegraph office, waiting and refreshment rooms. It is a busy place. The road does a large suburban business; trains for this service are run at intervals of thirty minutes. The second floor of the station building is occupied by the offices of the managing and transportation departments.

If the reader will now kindly accompany me, I will take him on a trip, by the "Minas Express," over the Central Railway of Brazil, and point out objects of interest along the route:

Our train makes an early start, 5 A. M. Previous to that hour, there is a busy scene in and around the station. "Tilburys" — a two-wheeled vehicle, much used in Rio, for the transportation of passengers—are dashing up and unloading their passengers; street cars are also contributing their portion; wagon loads of newspapers; also the very important mail car, which is run by the Street Railway Company over their lines from the General Post Office, and which draws up alongside of the mail car in the train. The transfer of the mail from the one conveyance to the other is quickly made.

Around the two ticket offices—one for the sale of first-class, and the other for second class tickets—is a packed mass of humanity, kept in order by uniformed officers. As we were aware of this crowd, we went early and got our tickets in good season, for which we paid a sum of about two cents a mile. A second-class ticket costs just half that sum. As the cars are generally crowded, we get to the train as soon as possible to secure our seats. Before we can pass into the train shed, we must show our tickets to the uniformed door-tender; he punches them and allows us to pass on; we enter the car, secure our seats, by placing thereon an umbrella, bag or any other article, to show that the seat is taken. The railroad hog is not unknown in Brazil, although the bristles don't stick out quite as far as they do on his Northern brother.

Now that we have secured our seats, and having some time to look around before leaving time, we get out on the platform and find that the train shed is about the same as a well-regulated train shed at home. There are two platforms, each long enough to accommodate a train of fifteen coaches; there are four tracks under cover. The platforms are of equal height with the car platforms. This system is observed at all stations; therefore there is no climbing up and down the car steps. It also does away with the pleasant duty of the trainmen, helping nice-looking young ladies on and off the car; and also the necessity of their having to look the other way when an old lady with a few bundles heaves in sight.

Our train is composed of engine and eight cars, consisting of mail car, combination baggage and train-crew car, three first-class and three second-class coaches—all American type and American built. Engine and cars are equipped with the Westinghouse air brake. No bell cord is used nor other signaling device from train to engine, except by conductor's valve, which can be used to stop the train if necessary. This valve, as is the common practice, is located in toilet room, with a lever projecting through partition. This lever is protected by a glass case, to keep the curious from interfering with it. There is a notice printed over the case, reading: "In case of accident, break the glass and pull the button."

Our engine is a standard American eight-wheel passenger engine; cylinders 18 x 24, and drivers of 5 feet 10 inches diameter; equipped with all modern improvements, such as extension front, air pump, driver brake, sight-feed lubricators, injectors, and one pump on left side. Engine crew consists of three—engineer, fireman and oiler. This number is found on engines in all classes of service, except the large mountain engines, which have an extra fireman. Train crew consists of conductor, two ticket collectors, baggage master, and three brakemen. No free baggage allowed; whatever goes in the baggage car has to be paid for; every piece is weighed, and has to be prepaid. There is no express system like that in use on American railways; all such business is done by the railway direct, without the intervention of another company.

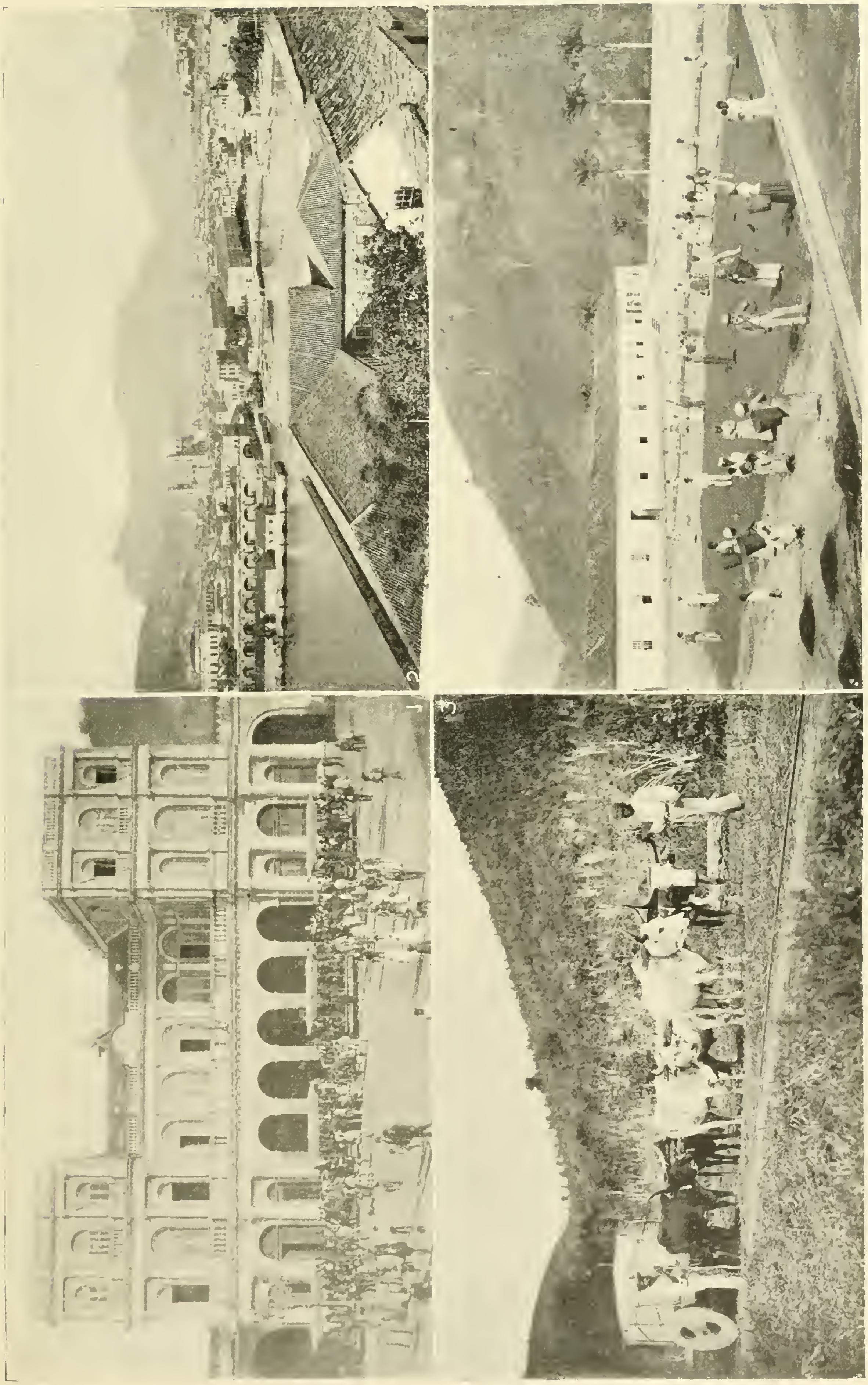
Re-entering the car, we find all the racks, and every available space in the aisles, occupied with bundles, small tin trunks, traveling bags, etc. On account of having to pay for checked baggage, the passengers bring into the car as much small baggage as they may have. The cars are wide and roomy, (the gage of the track is 5 feet 3 inches); the seats are arranged like those in Pullman cars. Cane seats and cane backs; no upholstery whatever—it would afford too good a hiding place for insects and dust. The toilet and wash room is in the center of the car—a roomy apartment, furnished with a mirror, towel and wash basin. There are two water tanks—one for washing, the other for drinking purposes; no ice furnished.

Punctually on time, the collectors blow their whistles, the conductor waves a little green flag which he carrries, the engineer gives one toot of the whistle and pulls out.

As we pass through the yard, we notice they have an interlocking switch system. In looking to the right, we see a tunnel; this is on the short branch that goes down to the bay. All ships with coal or other merchandise come alongside the pier, and by means of traveling cranes have their cargoes transferred into the railway cars.

One mile out from the Central station, we pass through to the freight yards at Santo Diago. Here all freight trains are made up and received; here is also located the principal roundhouse of the system, and a large repair shop. The buildings are modern and present a neat appearance. There is also a plant here for the manufacture of Pintsch gas, with which system all the coaches are equipped; also many of the passenger engines use it for headlight and cablight purposes.

As we are now passing over that portion of the road on which the suburban service is operated, we find the stations close together. As our train is an express we make no stop until we reach the end of the suburban system. We find at all stations a block-signal system in use; this system extends over the suburban portion of the road only. We run along over a splendid rock-ballasted track, a 70-pound steel rail, principally supported by steel



1. STATION OF THE CENTRAL RAILROAD OF BRAZIL AT RIO JANEIRO. 2. RIO JANEIRO FROM CENTRAL RAILROAD TRACKS. 3. BULL TRAIN IN THE INTERIOR, A FEEDER. 4. DRYING GROUNDS OF A COFFEE PLANTATION.

tie plates; for there is no improvement in track or equipment, with a few exceptions, but what you find on this system. We notice as we pass that the stations and grounds around them are neat and well-kept; every one has its little flower garden.

Eight miles from the Central station we pass Engenho do Dentro, the principal shop of the system and headquarters of the mechanical department. The office building is very handsome, between which and the main line is a beautiful little park, filled with trees and tropical plants, fountains and well-kept walks. The shops are large and spacious, and very well provided with tools for the repair of engines and cars. No engines in road service are kept at this shop; it is exclusively for general repairs. They build no new engines; it is cheaper to buy them. They build many new coaches, however, the beautiful hard woods of Brazil being very well adapted for that purpose. Mounted on a pedestal in the pattern shop, we find the first locomotive engine run in Brazil, a little inside-connected affair built in 1852 by Braithwaite, of London. It is a good model of the English engine of that date.

There are eight hundred employés. They never have a reduction in either working hours or pay. The working hours are from 7 A.M. to 9.30, breakfast hour from 9.30 to 10.30, and quit at 4 P.M.—very sensible working hours, indeed, in a country more especially where the people only eat two meals a day. The mechanics of all classes are principally natives and Portuguese. Strikes are not frequent, but not wholly unknown; an unpopular official will get up a strike quicker than any other cause. The quantity of work turned out at these shops may not be as large as that of an equal plant on American railways, but the quality of the work will bear favorable comparison; more especially is this true of the machine and blacksmith work. There is an electric light plant, but no necessity for artificial heating of the buildings; a refrigerator system to keep them cool, at least nine months in the year, would be an improvement.

Our first stopping place is Cascadura, the end of the suburban service, ten miles out from the Central station. So far, we have been traveling through the pleasant suburbs of Rio de Janeiro. A few words more in regard to the suburban service, which is very well managed indeed. The cars are of American type, first and second class; an equal number of each in a train, which consists of from eight to twelve coaches, with a small four-wheeled baggage car at each end, drawn by powerful six-wheel coupled engines, suburban type, built specially for this traffic. The rate of fare for the ten-mile journey is two hundred reis (ten cents) for first class, and half that sum for second class. The only difference between the first and second-class coaches is the first class have cane seats and backs; the second have a hardwood board seat and back. The style of couplings used in all cars of the broad gage system is the screw shackle; all cars and engines are provided with spring buffers. There is a screw attachment between the shackle, for the purpose of taking up the lost motion; between the buffers there is a safety chain coupling on each side of the screw shackle arrangement, for additional security in making up the trains; the couplings are not at all times tightly screwed up, which causes some bad jarring in stopping and starting. It seems strange that a road which has adopted most of the modern improvements has not long ago discarded the screw shackle coupling.

Leaving Cascadura, we get out of the city. We are now in a valley; looking in every direction, we see mountains. At Sappopemba we come to the end of the double track, four miles west of Cascadura; we also part company here with stone ballast, and will have to make the balance of the journey over a dirt roadbed. It is the practice to completely bury the ties; this is done for the purpose of preserving them from the hot sun, which checks them—in the rainy season the water enters these openings, and rots them out in a short time. This system of burying or covering up the ties is observed on all roads in Brazil that use wooden cross ties. This station is a junction for the branch line that runs to Santa Cruz, eight miles in length. At Santa Cruz are large slaughter houses, where all cattle for the supply of the Rio de Janeiro meat markets are slaughtered; they generally have from four to five thousand head of stock on hand. A large number of live stock is brought from the Argentine Republic and Uruguay for this market, the home article not being sufficient to supply the demand.

We now pass through a sparsely-settled country, as will be the case until we get to our journey's end. In Brazil you see no well-cultivated farms, nor neat country homes; an occasional mud cabin is seen; or a large plantation house, with its usual accompaniment of small buildings for the employés. A church is generally provided for the spiritual welfare of the employés.

We now reach Belem (Bethlehem), a small village at the foot of the Serra do Mar (Mountains of the Sea) chain of mountains, the end of the first freight division. From this place to Barra do Pirahy, heavy mountain engines are used for freight service; they are of a type known as "twelve-wheelers"—four pairs of drivers coupled and four-wheel truck. The grade for twenty-five miles is three per cent. Passenger engines are changed here also, for the purpose of cleaning the fire; the engine which brought our train from Rio is cut off, fired, cleaned, and is ready to take the next passenger train up the mountain. The claim for this is, they want a good clean fire to start up the mountain with.

We are now on our way up the mountain; at one place we get a glimpse at an embankment, high up on the mountain side. It is high up; but after passing around many curves and through a few tunnels we get up there, and keep on rounding curves and popping through tunnels, getting higher and higher. Finally we come to a tunnel two miles long, in the center of which we get to the highest point. From here to Barra do Pirahy the road is down hill, but not quite so steep as that which we have just ascended. From Belem to the summit we passed through eleven tunnels; from this point to Barra do Pirahy we find four more, making fifteen in all—in a distance of thirty-six miles. It is a very fine piece of engineering; the tunnels could have been avoided had the engineers who made the original survey known the country a little better. There is another road now under construction between Belem and Barra do Pirahy, which will have an easier grade and only one tunnel, this road is being being built by a private corporation, which has not quite as much money to build tunnels as the Government had when it built the Central, more especially when they can get along without them.

Barra do Pirahy is a nice little town on the Parahyba river, and is the most important junction point on the system. At this point the branch to Santo Paulo intercepts the main stem; this branch is three hundred miles long from here to Santo Paulo. Here we find a very neat roundhouse and repair shop; the buildings are substantial brick structures, neat-looking and conveniently arranged for the keeping-up of the running repairs on the large number of engines, for which the place is headquarters.

Leaving Barra do Pirahy, we cross the Parahyba river on a substantial iron bridge, in fact, all bridges are of this material—no wooden structures used. We followed the course of the Parahyba to Entre Rios—next division point, eighty miles distant — over a level roadbed; subject, however, to washouts during the rainy season.

On our arrival at Entre Rios we find a town of five thousand inhabitants. A branch road of twenty miles runs from this point to Porto Nova. This being a division point, there is a small engine-house and shop, with a very few tools, of a very ancient build.

Once more we leave the valley and get amongst the mountains. The road follows the Parahyba River, and follows its course, more or less, to Juiz de Fera, the most important and progressive city in the State of Minas Geraes. This city has several manufacturing establishments and a very good electric light plant, all driven by water power.

After passing Juiz de Fera, we have a

fairly level piece of track for twenty miles, to the foot of a mountain known by the name of Serra de Mantiquera; the road winds up this mountain in a snake-like manner for twenty miles, the grade ranging from 2½ to 3 per cent. There are three tunnels on this mountain, all of short distance. On getting up near the summit and looking downward, you can see the roadbed at three different places on the mountain side. At a station called Sitio, on the mountain top, there is a junction with a road of thirty-inch gage; it is a part of quite a large system called the "West of Minas," which is a meter gage (3 feet 3⅜ inches), with the exception of the branch from Sitio to St. John del Rey, which is fifty-six miles long and, as before stated, thirty inches wide. At this point we are 4,000 feet above the level of the sea, in a beautiful climate; during the months of June and July heavy white frosts are quite common, and sometimes a thin coat of ice forms on the water.

From here to Lafayette the road is uphill and down; the country is dreary and uninteresting. At Lafayette we come to the end of the broad gage system (5 feet 3 inches) and the commencement of the narrow or meter gage line. Here we have to change cars, if we want to continue our journey. We are now 320 miles away from Rio, and twelve hours and twenty minutes in the journey. At Lafayette there is a small engine shed and shop, with a few tools—very few, indeed—to keep up the running repairs on the thirty-six engines in service on the meter gage line. This line is 125 miles long, with a branch of forty miles to Ouro Preto, the capital city of the State of Minas Geraes. They keep on extending the meter gage line, and expect in the near future to connect with the railway system of the State of Bahia.

The Santo Paula branch is a very important line, over which a double daily express service is operated between the cities of Rio and Santo Paulo. From Barra do Pirahy to Cruxeiro is broad gage, from the latter town to Santo Paulo it is meter gage, 158 miles in length, built by an English company and operated as such for a number of years—finally purchased by the Government, and added to the Central system. I understand it is the intention to widen the gage from 3 feet 3⅜ inches to 5 feet 3 inches; this will give a broad gage line from Rio to Santo Paulo, do away with transferring at Cruxeiro, and make it possible to send trains from Rio to the interior of Santo Paulo by way of the Santo Paulo and Paulista Railway systems, which are of equal gage. At Santo Paulo there is a very good shop, which employs four hundred men.

Now that we have gone over the system, a few remarks in regard to its traffic and method of running trains may be of interest. The traffic from Rio to the interior consists of general merchandise, coal, lumber, etc.; from the interior to Rio the traffic is coffee and other plantation products, live stock and numerous other articles. The road does a large business, being the only trunk line from Rio to the interior. Outside of the regular passenger or express trains, they run a number of mixed trains; the passenger business is large. The water on all parts of the system is excellent for boiler use; it forms no scale. A boiler can be run for three months without washing out; I have known cases where they have run for six months. Flues will last for years. Expenses for boiler work are very light; leaky flues or fireboxes are almost unknown. The largest item of expense is the coal; this all comes from England—semi-bituminous, a very small percentage of smoke; a very good thing on account of the many tunnels. Coal at Rio costs about eight dollars per ton.

The road at one time was laid with iron rails; these have all been replaced with steel. As there is no market in the country for old rails, they use them for various purposes; the entire system is fenced with old rails; they are also used for columns for the station and warehouse buildings, telegraph poles, etc.

The big bell found at all stations plays an important part. The bell is generally suspended near the telegraph office; a cord connected with the clapper leads into the office. The approach of all trains is made known by two strokes for west-bound and three for east-bound trains; these are given after train has left next station; one stroke is always given before a train leaves a station. There are a certain number of strokes for calling the different employés; by this means the telegraph operator does not have to leave his office to deliver messages. All engines have bells, but they are very rarely used; the whistle is kept busy, however—it more than makes up for the silence of the bell.

The station agents are virtually the train dispatchers. Each conductor carries a small green flag attached to a short staff by day, and a hand lamp, square in form, with white, red and green glasses, at night. The green flag and green glass are for signaling the engineer to start. Conductors and collectors are provided with whistles, to notify passengers that the train is ready to start; all freight brakemen are also provided with whistles, for signaling purposes in switching around stations and yards. In addition to this they have a code of hand and lamp signals. The whistles are used when enginemen can hear the sound, but cannot see the party making it. Conductors and enginemen all carry a train book; the engineers have one to use when running without a conductor. This book is arranged in form for the purpose of agent entering the arriving and departing time of a train from his station, to which he signs his name. No train is supposed to leave a station without receiving permission in this form from the agent.

We will suppose the train to be a regular, with its time and rights specified on the time card. Previous to leaving a terminal, the conductor goes to the agent and presents his book; the agent signs it; then the train has permission to proceed. In case it gets behind time, it must not leave a station without permission from the agent; no train is allowed to leave a station until preceding train has arrived at next station.

In the case of an extra train, previous to leaving, the agent from whose station it takes its departure notifies all agents over whose territory the train is to proceed, so that they may be on the lookout for it. He then advises his telegraph operator to ask agent at next station if the train has permission to come to his station. The agent replies yes or no, as the case may be; if in the affirmative, the agent signs the conductor's book, and this gives the train permission to proceed.

All communications between the agents and telegraph operators are set down in a book kept for that purpose, with their signatures to the questions and answers. The same formality has to be gone through with between all the agents along the route as passed between the agent at first and second stations; in case the train does not have to stop at way stations, when agent finds out that road is clear to next station, he will give the train a white signal, which is sufficient clearance. In the absence of a signal, or if a red flag is displayed, of course the train comes to a stop and cannot proceed until it gets permission by the agent signing the conductor's book; if there is no conductor, he signs the engineer's book. By this system the trains are virtually run from one station to another, each agent acting as dispatcher. This works very well when the telegraph line is working all right; if it is interrupted, no extra trains can be run, neither can delayed schedule trains proceed. The idea of not permitting one train to proceed until preceding train has arrived at next station is a good one where the stations are close together. Where business is heaviest, if stations are over five miles apart, they have a telegraph office half way; it is a block system with semaphores left out. The system of moving trains may seem complicated, but it works very well.

On passenger trains the conductor has nothing whatever to do with the tickets; there are collectors for that purpose. He receives and distributes all letters and packages relative to railway service; he has a space fitted up in one end of the baggage car for his use. No markers are used on last car of train; in fact, no flags are used for any purpose, except a red flag for danger and a white for safety.

All American-built freight cars are equipped with air, but never used; the reason for which I do not know. On the mountains there are from five to six brakemen to a train of twenty-five cars;

they do good work, and a runaway train is a rare occurrence. No matter what the condition of the weather, the brakeman has to stay on the cars. On freight trains there are no caboose cars. One red flag by day, one red lamp at night, attached to rear end of last car, are considered a sufficient safeguard to protect hind end. The engines are all equipped with the water brake; this is another device never used. All freight trains have a bell cord extending from rear car to engine. Brakemen do not have to change switches at stations. There are two switch tenders at all stations, one at each end of passing track; they have to attend all switches nearest their respective positions. As the road is Government property, and employés are supposed to be in uniform, their respective employments and their classification is known by their caps. In most all grades of the service there are from two to three classes; for instance, there are two classes of firemen and three of engineers. The third-class engineer has two gold bands on his cap, the second-class man has three, and a first-class man four. They have to pay a certain sum for every promotion; this money goes into a mission fund. Firemen are paid by the day, engineers by the month. A second-class fireman receives three and a half milreis per day, a first-class man gets four and a half. A third-class engineer is paid two hundred and fifty milreis per month, a second-class man receives three hundred, and first-class four hundred. In addition to this, there is a certain sum paid monthly, as a premium, to those who have no fines levied on them during the month.

A milreis at par or gold value is equal to fifty-four cents; but owing to the fact that no gold or silver is in circulation, and the paper money very much depreciated - worth at this writing only one-third of the gold value—it makes their pay look very small when figured up on a gold basis. Assuming that three milreis in paper are equal to one in gold, we find that a first-class fireman would receive the munificent sum of eighty-one cents per day, and a first-class engineer seventy-seven dollars and forty cents per month. On the other hand, if the money was at par value, the first-class fireman would receive two dollars and forty-three cents per day, and a first-class engineer two hundred and thirty-two dollars and twenty cents per month.

The first-class men enjoy many privileges. Their commission is signed by the Minister of Industries; consequently, the commission cannot be revoked by any other official. Heads of departments can, of course, recommend the dismissal of a first-class employé to the Director; he, in turn, to the Minister. A first-class employé, however, has to commit a very serious offense indeed to be dismissed from the service, more especially if he has any political backing. Employés are advanced very slowly to the grade of first class, while a long term of service on the road is a good recommendation. Many other matters are considered; a political pull is an excellent thing to have. First-class men receive the same pay, no matter what service they may be assigned to, freight or passenger. When an employé is sick or disabled, his pay is not stopped.

The usual system adopted for the discipline of employés who violate the rules and regulations, or the destruction of property through ignorance or carelessness, is by the infliction of a fine in proportion to the seriousness of the offense.

The employés are all, with few exceptions, either native Brazilians or Portuguese. There is no color line; the pure black or mulatto stands on equal footing with his white brother; his color is no impediment to his filling the highest position his abilities may entitle him to. I find amongst the trainmen—and the same is true of all classes of employés—much more sociability amongst themselves, and a more courteous bearing toward the traveling public, than is commonly found on our home roads. Taken as a whole, the Brazilians are naturally polite.

We have within our borders a much larger supply of practical railway men than can find employment, who would be glad to go to other countries, provided they could find employment at remunerative wages. To this class Brazil offers no encouragement; there is no difficulty in finding natives to fill every position in railroad service.

The workingmen of Brazil do not know or enjoy as many comforts as do the working class of the United States. Their wants are few and simple; their pay is so very small they can never possess a home of their own—at least such are very few. They are smart and industrious, not by any means illiterate, and of very temperate habits. I cheerfully bear testimony to the fact that during an experience of several months' duration on various parts of this system I never saw an employé under the influence of liquor—not for the want of means or opportunity; for every little grocery store and hotel, or eating house, keeps wines and liquors for sale. Rum is very cheap, also very intoxicating; some of the people use it, but never get drunk. Honesty and sobriety are two excellent features of the Brazilian character. In conclusion, the writer will always bear in grateful remembrance the many acts of kindness and courtesy extended him by the officials and employés of the Brazilian Central Railway.

This is the season when committees appointed to make reports to the mechanical conventions ought to get actively to work. Those who have not answered circulars ought to look them up and communicate with the chairmen of the various committees without delay.

The Motocycle.

What is practically a new form of locomotion is making rapid progress among all the nations whose people are much inclined to travel. Few of our readers are probably familiar with the word "motocycle," but we are greatly mistaken if it does not soon become as well known as the word "bicycle." A motocycle is a self-propelling carriage used on common roads. In nearly every large city, vehicles of that kind are beginning to be seen on the streets, and it is certain that they will rapidly increase in number.

Various kinds of motive power are employed for driving the motocycles, but up-to-date gasoline has been used most successfully. French inventors have done the most to develop the motocycle, but Americans are taking it up, and the indications are that they will perfect and push it into popularity in a very short time. There are said to be scores of factories in this country preparing to build motocycles.

Last summer there was a race of motocycles from Paris to Bordeaux and back, and one gasoline motor made the journey of 730 miles in 49 hours—an average speed of 15 miles an hour. On Thanksgiving Day a motocycle race took place in Chicago under very unfavorable conditions. There were about 4 inches of slush and snow on the ground when the start was made, and the weather was very bad; but one gasoline carriage made the run of 54 miles in 10 hours and 23 minutes.

To Straighten a Rolled Blueprint.

There is perhaps nothing that will make the nerves tingle with exasperation any more than the tendency of a blueprint to curl, after it has been rolled up for some time. Paper weights are no good to hold the thing flat. Pulling the print over a sharp edge is only a measly subterfuge, for it will not effect a cure until the paper is at the tearing point—and it won't do to mutilate some prints. A sure relief from this trouble is to put the print in water and let it become thoroughly wetted—it can't be harmed by this process —and after the wetting, lay it out flat to dry.

No matter how unruly, or how badly creased if folded, the print will be as submissive as any shrew ever handled by a Petruchio. This is a point worth noting by anyone who has to consult rolled or folded prints. It takes the kinks out of the paper just as soon as the water gets in its work.

Loose deadwoods striking the angle cock, and loose train pipes which vibrate against the deadwood or other parts of the car, are dangerous things, as they will sometimes cause the cock to close.

Gage for Squaring an Engine.

A gage for squaring shoes and wedges from lines through center of cylinders, illustrated herewith, is used by Mr. Jno. Tonge, master mechanic of the Minneapolis & St. Louis road, and is a creation of General Foreman Fred Williams, who has perhaps devoted as much of his time to devising short cuts to results as any other man holding a like position. We have shown up many of his labor-savers in the past, and he is therefore no stranger to our readers.

This tool is made up of a 3-inch T-bar long enough to reach across engine frames to outside faces of shoes; attached to the web of this T-section is a pair of ½-inch adjusting bolts, secured to the web by a pin and jaw connection, and knurled nuts with steel points or centers.

At each end of the T-bar is secured, parallel with its flange, an extension 1 inch in diameter, on the end of which is an arm at right angles to the T-bar, and therefore parallel with the center line of cylinders. These arms are secured to the 1-inch extension by a split joint closed by a slotted screw, which allows the arm to be revolved through a complete circle and clamped at any point, a collar behind it preventing any change of adjustment endwise.

The opposite end of arm has a gage point, with a milled head, and this is also clamped after setting. The longer points shown in the details are for engines having varying distances between centers of cylinders; their position is shown at *A*, Fig. 1, where all the details are given on a comprehensive scale.

Fig. 2 shows the practical application of the device, in which *C D* represent lines through the center of cylinders, in the plan view; the T-bar extending across frames, with its flange bearing against the shoe faces, and the whole thing secured in position by means of the adjusting bolts with their steel points, which enter the wedge faces and hold the gage rigidly in place.

A trial of the gage points on the center lines in the two positions (front and back), shows what is to be done with the shoes—where a liner is to be removed or one applied. In the plan view, the job is shown completed and the shoes square with the cylinders on top of frame, with the inner edge of the blade at the original center line of jaw, scribed on the side of frame, to show that the shoes are square with the center lines, and also prove the accuracy of the old centers.

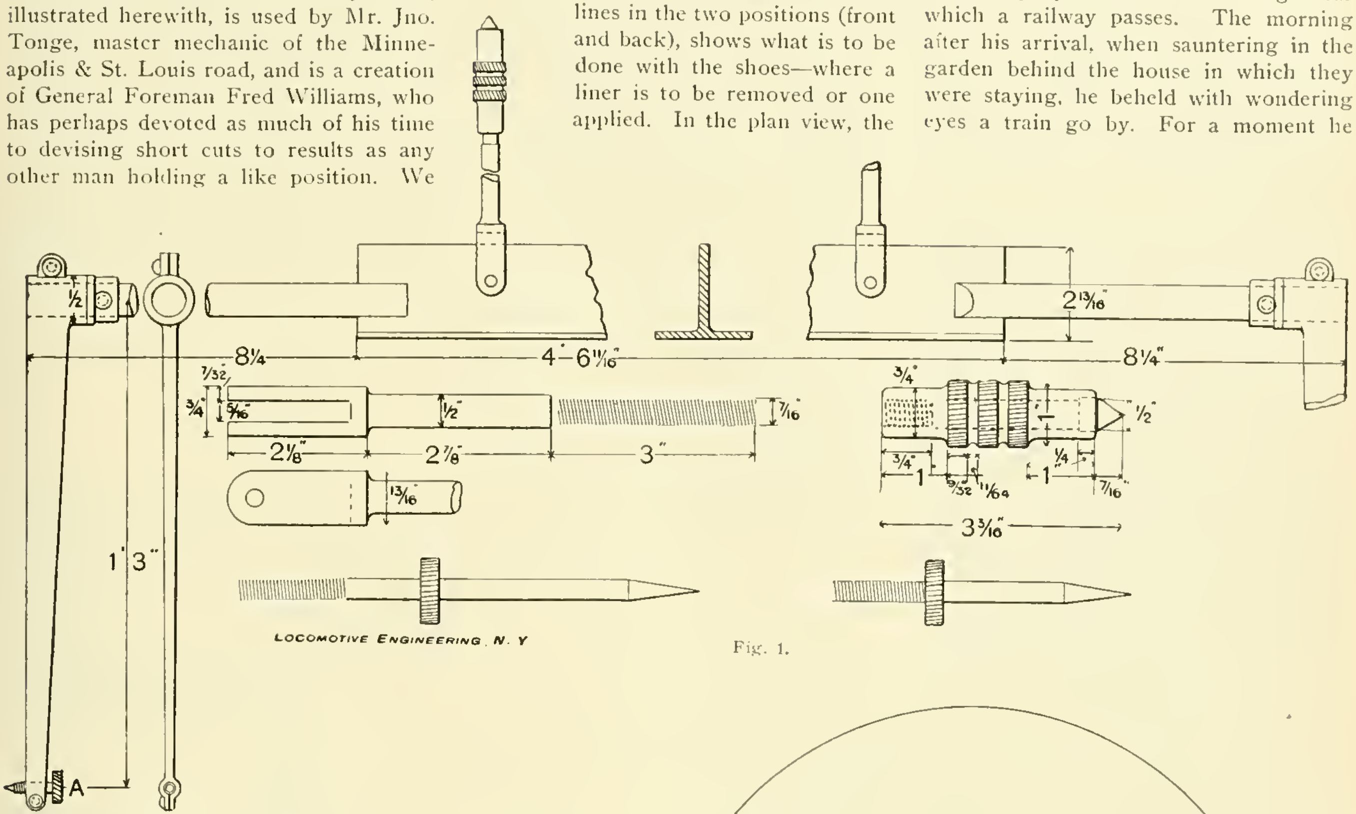


Fig. 1.

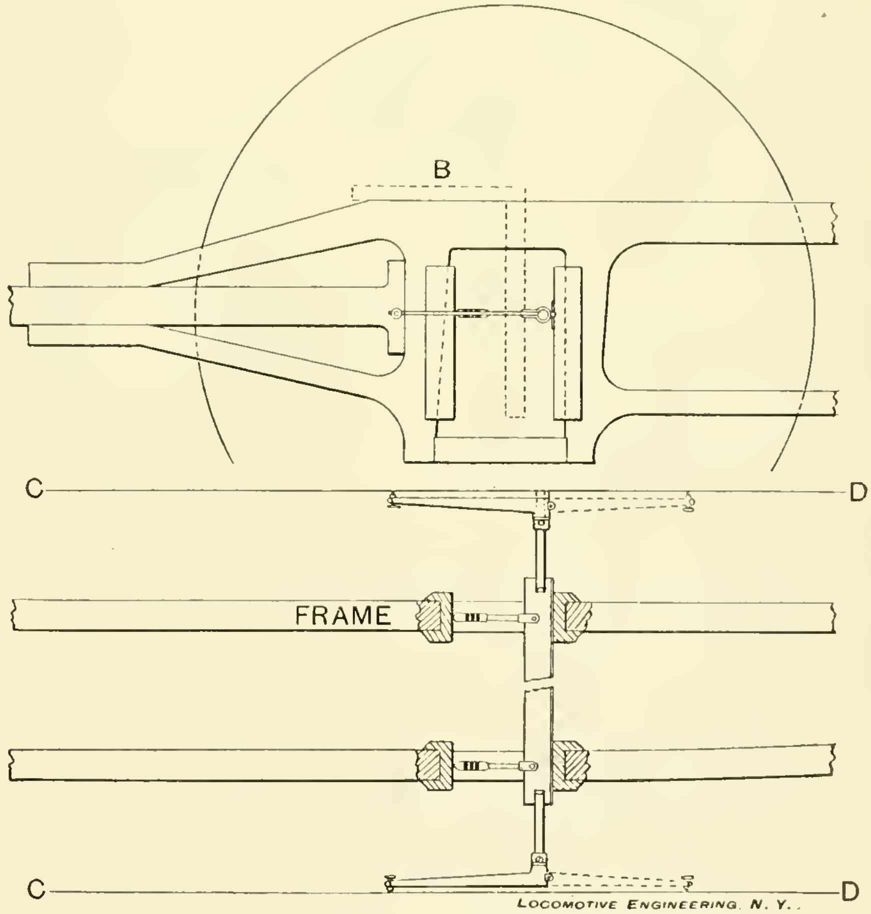


Fig. 2.

A country boy who was brought up in a remote region of Scotland had occasion to accompany his father to a village near which a railway passes. The morning after his arrival, when sauntering in the garden behind the house in which they were staying, he beheld with wondering eyes a train go by. For a moment he stood staring at it with astonishment, and then running into the house, he said, "Fayther, fayther, come oot! There's a smiddy ran off wi' a row o' hooses, and it's awa' doon by the back o' the toon like mad!"

Tire Indicator.

A device for making an accurate outline of the tread of a driving-wheel tire, showing the amount of wear at every point, is herewith illustrated, by permission of Mr. John Medway, superintendent of motive power of the Fitchburg Railroad, where it was created and has done excellent work in recording the wear of tires.

Fig. 1 is a top view, showing the stylus, or marking point, in contact with the paper; and Fig. 2 is a side elevation, showing the application of the contour point to the wheel's periphery. The frame is made of thin steel, and consists of a U-shaped piece ⅛ x ⅞ inch, having feet turned at one end, to which is secured a piece of wood. On this frame is made to slide a crosshead *E*, of the same material as the frame, and pivoted to this head are two links having a parallel motion, which are also pivoted to the contour arm; this arm carries the stylus *F*, or marking point, the point being controlled by a spring to insure contact with the paper on which the record is made.

We quote the method of its operation from the description kindly furnished by Mr. Medway: "Press, with the hand, the straight-edge *A* firmly against the face of wheel center *B*, moving the point *C* up to the base of tire.

"With the pointer *D* resting on flange of tire, draw crosshead *E* outward, when the pointer will follow the periphery of the tire, and the steel point of the stylus *F* will inscribe a corresponding impression on the paper *G*.

"When the outer edge of the tire is reached, the stylus is withdrawn to its normal position, the stylus liberated, and the crosshead again drawn outward. This will produce the base line of tire section, from which the thickness of tire may be measured at any point.

"With the use of carbon sheets, duplicates or manifolds may be secured, and thus give a permanent record of the condition of tires at all times."

This looks like a practical and inexpensive way to make a record of tire wear, and commends itself on the score of accuracy, which we have never heard claimed for many other devices for doing this work.

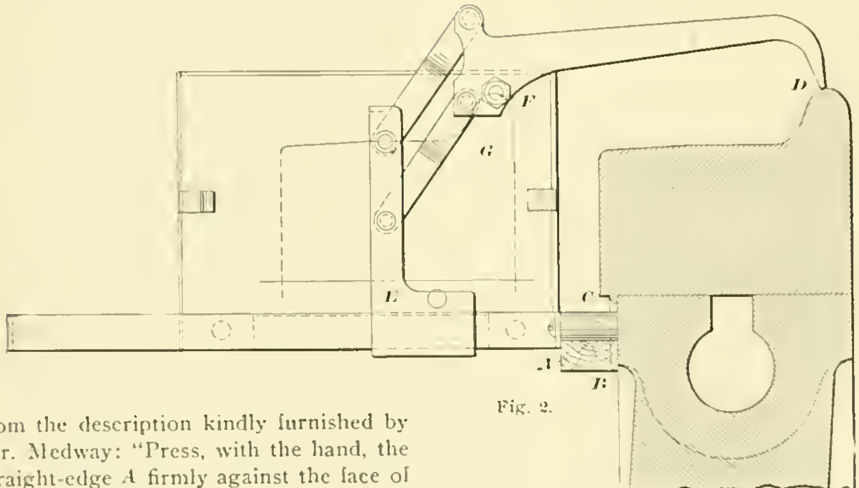


Fig. 2.

Nozzles.

BY GEO. S. HODGINS.*

The prevalent use of water during the summer months, for outdoor purposes in cities, has, among other things, developed two very different kinds of water sprinklers. The form of the aperture of discharge of water so used, plays a most important part in determining the results obtained. The name "nozzle" is given to the spout of pipe for discharge, commonly tapering, and placed at the end of a flexible tube or hose. For want of more definite description, they may be called, respectively, the "fire-engine nozzle" and the "garden-sprinkler nozzle." The essential difference between them may be stated more exactly by regarding the first as the one which throws a concentrated stream, and the second as spreading or spraying the water. The object to be gained by the use of the fire-engine nozzle is the throwing of a quantity of water over a comparatively long distance, and delivering it as much as possible in bulk where it will do most good. A fireman is enabled, by the use of a properly designed nozzle, to reach, if need be, the roof of a high building with a powerful stream of water, or to throw it over an inaccessible area to a point where fire is raging. The object sought by the use of the nozzle of the garden-sprinkler kind is, on the other hand, to cover the largest area possible by a diffused and not very violent jet of water.

The construction of the fire-engine nozzle, or one best adapted for the production of a concentrated jet, is that of a gradually tapering tube, through which water under pressure is forced. The tip or extreme end of this nozzle is partially blocked with a square-shouldered ring of metal. An illustration of this form might be given by supposing an ordinary plain finger-ring of square section forced into the end of an inch pipe. Another rough approximation to the fire-engine nozzle might also be had by screwing on the end of an inch gas-pipe a cap, such as is used by plumbers to close the end of a pipe not required for immediate service, and drilling a three-quarter inch hole in the end of the cap. Either of these illustrations presents an abruptly contracted aperture very similar to that of the fire-engine nozzle, and in some degree not unlike the form of exhaust pipe used in many locomotives at the present time.

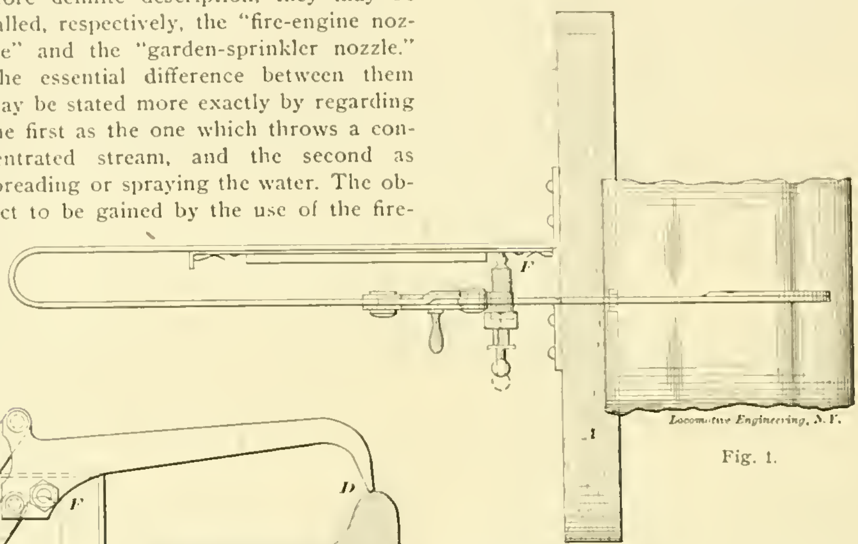


Fig. 1.

When water under pressure is forced down the gradually tapering fire-engine nozzle, its speed is uniformly increased, so that at the point of exit it has attained a very much increased velocity. This speed of exit is still further augmented by the partial obstruction of the square-shouldered ring at the extremity of the nozzle. A theory which may possibly help in the understanding of the principle upon which this mode of construction is based, may be tentatively stated thus: The moving body of water passing through the nozzle encounters a certain amount of frictional resistance offered by the sides of the tapering tube. The particles of water which come in contact with the walls of the nozzle are rolled along, over and over, thus forming an indefinite series of minute water rollers, upon which the central stream passes with comparatively little frictional obstruction. The square-sectioned ring placed at the nozzle receives the pressure of the numberless little rollers as they progress down the tube, and it has therefore, from its position and form, a tendency to turn their direction of motion to one at right angles to the general line of motion of the whole body of water. These rolling particles are pressed upon by those behind, and are at last forced to move inward from all sides, towards the center of the circular aperture. This inward and toward-the-center motion imparted to the

*Canadian Pacific Railway, Windsor, Ont.

film of water which had passed down along the sides of the tube, and given just at the moment of escape, has probably the effect of neutralizing, in a certain degree, any tendency which the main jet would otherwise have to spread. The sharp ring at the opening makes what hydraulic engineers would probably call the "orifice" in a thin plate or wall. This kind of aperture through a thin plate—thin in comparison to the diameter of the jet—produces a still further slight contraction of the steam just after it has left the pipe; this further contraction being technically called the "veina contracta," or contracted vein. The tendency of the water to spread is therefore delayed by the use of the fire-engine nozzle, and a powerful concentrated and solid stream of water for a considerable distance is the result.

In the garden-sprinkler jet the result is almost completely the reverse. The water moving down this tapered nozzle has its velocity increased as it nears the muzzle, as in the other example. The same phenomena, which for the purposes of illustration have been outlined may be supposed to exist here also. The exceedingly minute and infinite series of water "ball-bearing" roller particles reduce the friction of the central mass, but at the muzzle the aperture opens out slightly, and in a direction different to the gradual tapering of the nozzle walls. It may be said to resemble in shape the old-fashioned, bugle-mouthed blunderbuss. The direction of the emerging particles of water is therefore outward and away from the center line of motion of the whole, and a spraying, scattering jet or cone of water is thus produced.

If this tentative and roughly-sketched working hypothesis be admitted as approximately true, it may be interesting to apply a similar line of reasoning to the consideration of the effect produced by the abruptly contracted nozzle or tip in use on many of the locomotives in service on our various railways. The ordinarily-used exhaust-pipe is a rough copy of the fire-engine nozzle. The tapering pipe bears a close resemblance to the water tube, and the contracted tip presents a close analogy to the sharply-defined partial obstruction of the fire-engine nozzle. The steam from the cylinders is shot out at each exhaust, almost, if not quite, without touching the sides of the smokestack, and in a measure resembles the concentrated jet thrown by the fire-engine. The intermittent character of the exhaust, however, renders it capable of expelling a certain amount of air each time it passes out of the stack. It is able to throw out, at each pulsation, a quantity of air which, for sake of illustration, may be supposed roughly to equal in volume that ocupied by, say, two or three bottle jacks standing on end. The quantity is not relatively great with reference to the volume contained in the whole smokestack; but the fact that the concentrated jet of steam is capable of causing a draught, and so stimulating the action of the fire, is, to a large extent, dependent upon the violence with which it expels the air. The more rapidly a relatively small quantity of air is driven out at each exhaust, the better will be the draught. The "sharpening" of the draught by the further contraction of the exhaust tip is evidence that the rapidity with which the expulsion of the air is effected is what is most fully relied upon to produce a satisfactory and powerful draught. As each separate exhaust removes a definite quantity of air from stack and smokebox, a further supply of fresh air enters at its only mode of ingress—through the grates. Various means are employed to cause the concentrated jet to suck air out of the smokebox: but the high velocity of the jet, and its ability to pass out without striking any obstruction, is the end sought.

An innocent, though instructive, experiment may be made by anyone who happens to possess the requisite qualifications. The experimenter should be one who takes pleasure in watching the improved appearance of a small plot of grass about his dwelling, after successive applications of water from the garden hose. He should also have a garden nozzle capable, as many are, of alteration from what will give a spreading or spraying jet, to one which will throw a comparatively solid and compact stream of water, when it becomes necessary to reach the more remote portions of the lawn. Above all, the experimenter should be a devotee of what Mr. J. M. Barrie playfully calls "My Lady Nicotine;" and he should smoke, as all good smokers do, the famous Arcadia mixture—said to be made only by one redoubtable firm in London. If such an exceptionally blessed experimenter will turn his garden nozzle so that it will throw, as nearly as may be, a solid jet, he will find that the water issues from the nozzle with little or no disturbance to the surrounding air, to a considerable distance from the mouth of the nozzle. The rapidly moving and compact stream of water will pass through the atmosphere as a rod or arrow shaft might do. If he now smoke so that a few puffs from his briar-root pipe will pass toward the jet, he will find the smoke blow over or under the jet, and that very little will be absorbed by the water. If, however, the nozzle be transformed so as to give a spreading and spraying jet, the smoke blown gently toward the water will be readily caught up and disappear in the sparkling cone. This seems to show that the spray has the power of producing a certain slight current of air in the direction of the jet, which the other does not seem to possess.

An examination of the steam nozzle of almost any injector will reveal the fact that it has no obstructed tip; its function being to pick up, if one may so say, the water which lies behind and around it, as the spraying jet from the lawn sprinkler did with the smoke.

Mr. W. H. Thomas, assistant superintendent of motive power on the Southern Railway, contributed a most interesting paper to "Locomotive Engineering," which appeared last March. In it was given the result of experiments with a nozzle or exhaust tip which was certainly designed to spread or spray the jet of steam, and which purposely caused it to strike the sides of the smokestack in passing out. Such an exhaust takes out, at each release of steam, a stackful of air. This is presumably a much greater quantity than that expelled by steam from the concentrating tip. A large diameter of tip, and consequently a less violent action on the fire, was said to produce most beneficial results. If these facts are as stated, may it not be that the advantage gained by the less violent exhaust is in large measure due to the greater air-drawing quality of the spreading or lawn sprinkler jet.

For sake of illustration, it was supposed that the exhaust from the contracting tip threw out of the stack a quantity of air roughly approximating in volume to, say, that of two or three bottle jacks standing on end, as compared with the entire stackful removed by the steam from the spreading tip. It appeared that the draught on the fire was produced by the very rapid expulsion of the relatively small amount of air, which was driven out almost explosively. The exceedingly rapid removal of the air produced a greater rarefication, not to say vacuum, in the smokebox, and particles of air from without moved with great rapidity to take the place of those driven out. But here another fact becomes apparent. The movement of air from without toward the firebox, though rapid at each exhaust, is nevertheless over only a short distance each time. This rapid but small movement of air toward the grates is due to the relatively small but violently expelled volume from the smokestack. If the smoker above referred to were to occupy the fireman's seat on a locomotive, running at a high speed, he might have ocular demonstration of this fact. The windows of the cab being shut and the back curtain down, if the damper in the firebox door be slightly opened, the experimenter might watch the behavior of a puff of smoke from his briar. He would probably notice the smoke first float off in a cloud which would hang motionless for an instant. It would suddenly descend a short distance, perhaps one or two inches, and again remain suspended in the atmosphere for a moment, until the next exhaust drew it rapidly down through a second short distance, the smoke just pausing before again quickly sinking in response to the pulsations of the locomotive. The successive beats of the engine would, through the medium of the puff of smoke, be rendered visible in their effects, until the fragrant cloud disappeared through the opening of the damper.

With the use of the spreading tip, a stackful of smoke would be ejected more slowly, though the larger quantity passing out would require a similarly large quantity to come in to replace it. It would enter at a relatively slower velocity, and would blow in through the grate bars and play on the fire with an even, more continuous, slightly prolonged, but perhaps more bellows-like effect.

A short time ago one of the leading railroad companies purchased axles for 150 cars, which they were building in their own shops. One of the axles broke before the car got out of the yard; several others broke in quick succession. The result was that all the cars were called in, until a thorough examination of the axles could be made. They were, finally, all rejected and better axles put in. The scientific men who investigated the cause of failure attributed it to what they called "segregation of metals," which has a very bad effect on a certain part of the mass of matter in the very large ingots which are now almost universally used in rolling mills. A segregation of metals is the tendency of certain elements to concentrate at the spot which solidifies last. In ingots, this spot is in the center of the ingots, towards the top: to this point moves a large percentage of phosphorus and other elements that are drawn to the hottest spot, and act to delay solidification of the metal. Railroad men, familiar with this subject, are protesting against the use of large ingot molds that have come into use. It seems a source of danger which ought to be very carefully watched by the interests responsible for the safety of railroad rolling stock.

Experts with alloys have long been able to judge to some extent the quality of brass by its color. A system has lately been introduced by a British chemist, which enables the quality of the brass to be very accurately judged by a color test. Drillings of brass of a known quality are sealed in a glass tube, which is perfectly air-tight. Drillings of any other sample are put into tubes and compared with the color of the known sample. After a very little practice, a man can tell in what particular the brass to be tested varies from the sealed sample.

The Westinghouse Company recently furnished four of the electric lighting machines used at the World's Fair, to the United Electric Light & Power Company, of New York City, and they are furnishing current for lighting a considerable portion of the metropolis.

The Holt Slide Valve with Cut-off Plate.

A cut-off designed for a locomotive slide valve by Mr. Albert Holt, of Holt & Sons, engine builders and machinists, England, is one of the mechanical products of 1895. The inventor says the device has been in use for many years on stationary engines built by the firm; and believing the same fuel economy could be effected on a locomotive as was found in stationary practice by its use, he has

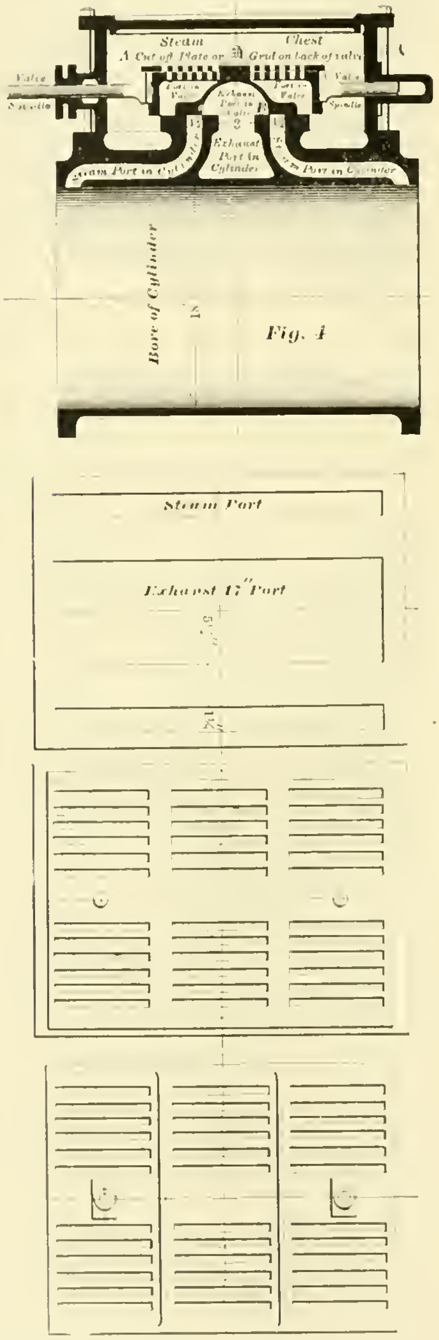


Fig. 4

devised the arrangement for locomotives shown in our illustration.

The working face of the valve is made exactly similar to that of a plain slide, as shown in Fig. 1, but the whole valve consists of a box, shown in section in Fig. 4, the top of which is perforated by a series of slots $\frac{7}{8}$ inch wide, having an area greater than that of cylinder steam port Fig. 2 shows slotted top of valve.

The cut-off plate, shown in section in the elevation, and in plan in Fig. 3, is also slotted on its face, and secured to top of main valve by two studs with a spring washer under the nuts; the plate having slotted holes to allow of free movement on the studs, while the faces are in close contact. The plate and box valve are both fitted to the valve yoke in the usual way, with the difference that while a moving fit is made at the sides, there is a space of ⅜ inch between the yoke and valve at the end; the yoke having that amount of movement ahead of the valve at each reversal of motion, this being sufficient to blind the ports or slots at one end of the valve, and at the same time give full opening through the ports at opposite end. Fig. 4 shows the cut-off plate and valve, with the ports opened at forward end and closed at the back.

This is the action on which the claim of economy is based, since when the slide valve has opened the port full, the eccentric is reversing its motion and instantly begins to cut off steam by the ⅜-inch movement of the cut-off plate; or in other words the cut-off takes place with a return movement of ⅜ inch, against one of 1¼ inches, or the width of steam port—saving the steam that would be used while the valve would travel across the steam port to cut-off, as in the old way. This action is constant, no matter what the travel of the valve.

Mr. Holt is now in Providence, R. I., with the view of introducing his device on American engines.

Mr. G. W. Rhodes, superintendent of motive power of the C., B. & Q., told some of his friends at the New York Railroad Club, lately, that he is now getting more information from people who come to visit the shops than he formerly did. He has adopted a change of tactics which was suggested by a visit of our "J. P." Mr. Rhodes had been in the habit of going about the shops with visitors, showing them the labor-saving appliances and methods of doing work expeditiously, and they were generally looked at without comment. Not so with Mr. Hill. If he had previously seen a more convenient tool or a better method than that seen in the "Q." shops, he told about it, with the result that Mr. Rhodes acknowledges having received useful hints. Then he made up his mind that a condition would be put on all visitors, to not only look at the tools and methods, but tell if they know of any better. The plan works to mutual advantage.

The Rand Drill Company, makers of compressed-air machinery, have moved their offices to 100 Broadway, this city.

Improved Inside Checks for Locomotive Boilers.

Editors:

Presuming that you might be interested in the accompanying print, illustrating the safety boiler check, which has become the standard, and now being applied to all new locomotives on the Pennsylvania Railroad Co.'s system, I have taken the liberty of sending it to you.

As you are no doubt aware, this company has been using inside checks for a great many years, of the hinged valve type; but their tendency to remain open, owing to deposits of sediment on the hinge, has always been a source of trouble, and their inaccessibility for needed repairs created a demand for an inside check valve that could not be rendered inoperative on this account, and one that could, in case of needed regrinding, be removed for that purpose without disturbing the joints on the boiler or removing the jacketing, as was necessary with the old type.

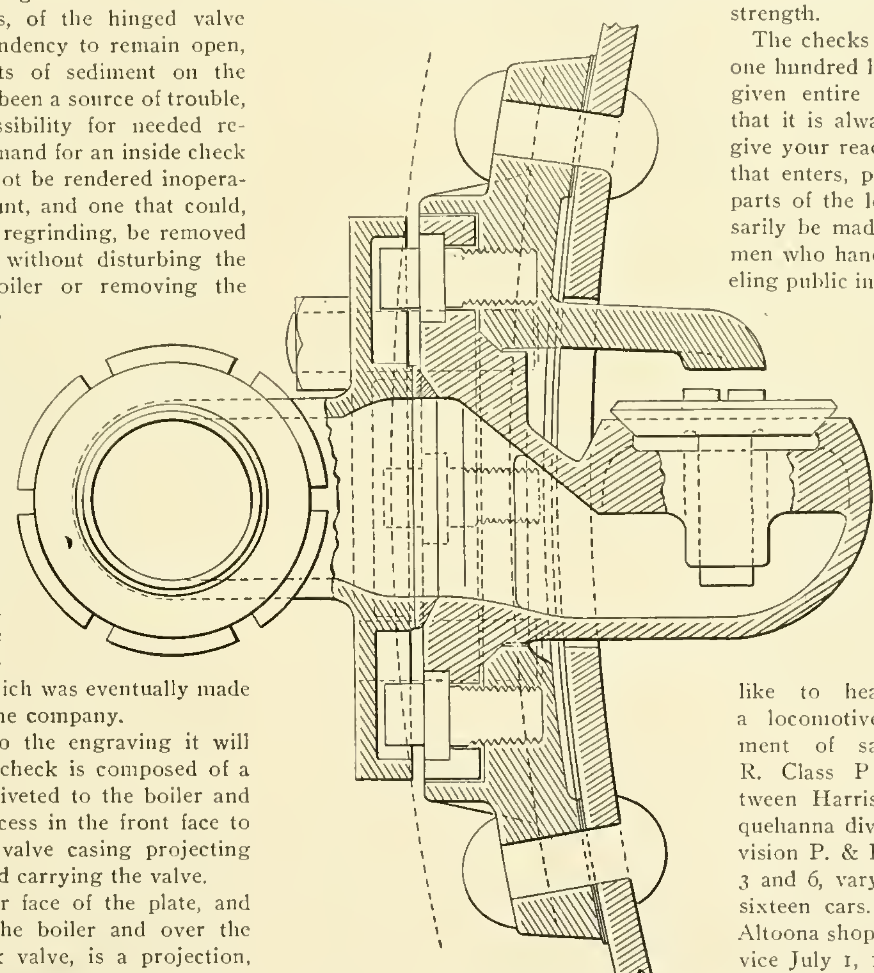
The writer, while general foreman of the P., W. & B. R. R. machine shops at Wilmington, saw the necessity for a check valve of this kind, and devised the one shown on accompanying print, which was eventually made the standard of the company.

By reference to the engraving it will be seen that the check is composed of a flange, securely riveted to the boiler and calked, with a recess in the front face to receive a flange valve casing projecting into the boiler and carrying the valve.

From the inner face of the plate, and extending into the boiler and over the top of the check valve, is a projection, or finger, which acts as a stop to the upward motion of the valve, which operates in a vertical direction, allowing the water to enter all around the valve opening, washing the seats thoroughly in its passage.

The valve casing is securely fastened to the riveted flange by four tap bolts, over which is placed the elbow to which the feed pipe is attached, also secured to the riveted flange by four studs. That portion of the check that could cause any trouble in case of a rear-end collision is therefore very securely fastened to the boiler, is all under the jacket and as close to the boiler as possible, the only projecting portion being the pipe elbow, which is made very light at its junction with the flange, so as to give way at that point in case of its being struck in an accident.

The flange on the elbow projects partly into the jacket to make a good finish; and on being removed, the valve casing can



be drawn out through the hole in the jacket, made for the flange of this elbow, without disturbing or removing it, as was formerly required.

As stated before, the valve acts in a vertical direction, which is a very important point, from the fact that the valve is not seated by pressure after the injector is shut off, as is generally supposed, but by gravity alone, as will be readily seen, when we consider that the pressure is the same on both sides of it at the moment of closing, owing to there being a check valve in the injector.

This fact was the cause of the old type of hinge valve failing in so many instances, when but a small quantity of sediment had deposited on the hinge.

The flange and elbow, as shown, are malleable iron castings, the valve and casing being of brass; and, as will be seen, all superfluous metal has been discarded that could be done, consistent with strength.

The checks have been applied to about one hundred locomotives so far, and have given entire satisfaction; and knowing that it is always your aim and desire to give your readers the benefit of anything that enters, particularly, into any of the parts of the locomotive that must necessarily be made safe so as to protect the men who handle them, and also the traveling public in case of accident, I send you the print and description of the check valve, so that you may be able to place it before your readers if you so desire.

William Wright,
Chief Draftsman,
P. R. R. Co.

Altoona, Pa.

Long Mileage.

Editors:

Thinking you would like to hear of good mileage for a locomotive, I will give you statement of same as made by P. R. R. Class P engine 2106, running between Harrisburg and Renovo on Susquehanna division N. C. and Eastern division P. & E., on passenger trains Nos. 3 and 6, varying in length from four to sixteen cars. This engine was built at Altoona shops, June, 1893, and put in service July 1, 1893, and was in continuous service until January 31, 1896, when engine was taken out of service and sent to Renovo shops for general repairs. This engine made during this time the following mileage:

For 1893, 47,956 miles; 1894, 101,214 miles; 1895, 102,175 miles; and January, 1896, 5,075 miles; making a total of 256,420 miles. This engine during this time gave us no trouble with leaking flues.

Sunbury, Pa. L. J. Guyon,
Road Foreman of Engines.

The Westinghouse Air-Brake Company versus The Boyden Brake Company.

Editors:

The issue by the Boyden Brake Company of a circular, dated December 31st., 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 brakes 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.

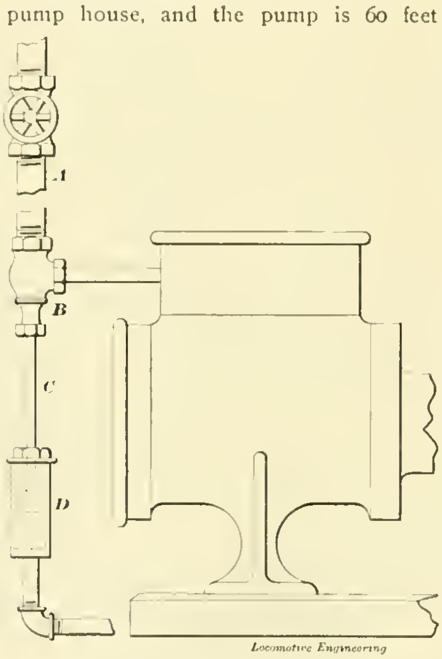
THE WESTINGHOUSE AIR-BRAKE CO.
H. H. Westinghouse, General Manager.
Pittsburgh, Pa.

Water Pump Regulator.

Editors:

I send you sketch of a regulating device, as I applied it to a Smith & Vaile duplex pump, at the Great Northern Railway shops, Spokane, Wash.

The roundhouse is 1,200 feet from the pump house, and the pump is 60 feet



from the engine room, therefore I found it necessary to put on something to regulate the pressure, and the device shown did the business in good shape.

At the turn of the steam pipe *A* into the steam chest, is applied a 1½-inch angle valve having a stem without a thread; on the bottom of this valve is a stuffing box made to admit a small rod *C*, which is an extension of the piston rod from cylinder *D*, and which reaches the threadless stem in valve *B*. The cylinder *D* is 2 inches in diameter and has cupped leather packing; the bottom of the cylinder connects with a ½-inch pipe into the discharge.

The operation of the device is as follows: The valve *B* is opened wide and the pump left to govern itself; as the pressure of the discharge increases its communication with the cylinder *D* raises the piston and its extension *C* against valve *B* and closes it, thus shutting off steam from pipe *A* and slowing down the pump.

The same company has a deep-well artesian engine of the same make as the pump, with cylinder 11 x 36 inches, which raises water from a well 205 feet deep, and delivers it into a tank 75 feet high, making a lift of 280 feet. This engine requires 60 pounds pressure to do its work.

Davenport, Ia. A. G. RAMSEY.

Didn't Know It Was Loaded.

Editors:

Joe Smilax was an old-time engineer on an Iowa railroad. He was evidently one of that class of unfortunates who are born tired, as his natural instincts seemed to eschew work when by any possibility it could be avoided. Following Joe's promotion, his name had been placed on the extra list—not a bad job, by the way, as the pay was by the day, work or play. These extra men were sometimes called upon if there was more repair work than the roundhouse men could attend to, and delegated to help the machinist, or put at some job not requiring special tools or expert workmanship. Joe liked running extras, for it was not often that he was called upon for roundhouse work, and one trip, more or less, constituted a week's work; while on pay-day his wallet was inflated with a sum of money equal to that of the regular men, who were almost daily trying to pull one or more cars up the grades more than the engines were capable of. One morning the "Powesheik" came in with steam pipes leaking, and the "old man" sent for Joe and assigned to him the task of grinding in the recalcitrant rings which formed the joint between the pipes and saddle. The front-end door was open, the petticoat already removed from its moorings, and the steam pipes had been relegated to the floor below.

Joe surveyed the situation, put on his overalls and jumper, and prepared for the inevitable. First he procured a board which was placed across the base of the arch for a seat, and another for a backboard; then some pieces of bagging which were arranged for cushions over them; next a can of oil and a box of emery, and the preliminaries were all arranged, and Joe looked forward to a long, soft snap. Seating himself on his improvised divan, he began grinding one of the ball-joint rings, the manipulation of his long arms partaking of that slow, graceful movement so natural to a lazy man. Time wore on much faster than did the ring; and as the shadows of evening were about falling, Joe concluded to indulge in a quiet smoke. About the walls of the roundhouse, at divers places, signs were displayed, "No Smoking Allowed," this being one of the inexorable rules of the "old man" which must be respected.

Now Joe knew that the M. M. made

frequent trips about the house and grounds, so he decided to take advantage of a quiet nook (he had been there many times before) where he could enjoy his pipe with no fear of discovery; but that was where Joseph made one of the mistakes of his life. He got up, walked back to the cab, threw a large chunk of wood into the firebox, and, gliding in after it, lighted up. Pretty soon the M. M. dropped round to see how everything was progressing. Mounting the front end, he observed Joe's absence; then picking up the ring, he examined it closely and found that after five or six hours' work (?) Joe had got some of the rust off the joint. As he laid down the ring and started to leave, he noticed smoke issuing from the flues; and divining that Joe was playing "possum" at their other end, quietly stepped into the cab and closed and latched the firebox door. Meantime several of the boys loitering about seated themselves on a convenient bench to await the outcome. The M. M. dismounted and walked away.

A few minutes elapsed, when from the inside of the engine came a report like a small-bore Gatling gun, immediately followed by a succession of unearthly yells; then a long, ghastly groan and all was still. Several of the boys—the writer among them— scaled the cab, pulled open the firebox door, and Joe's head and shoulders were thrust through the aperture; then he fell limp across the door ring. We pulled him from the firebox and set him up on the quadrant. His face was black with soot and oil, but striped like a Pawnee Indian from the perspiration which was streaming down his forehead, while his drenched clothes fitted like a tailor-made bathing suit. After a time he revived, but in his excited state was at a loss to determine whether his consternation was the result of a practical joke or a supernatural visitation.

This incident happened in the early days of experimenting with steel sheets for fireboxes. A side sheet had cracked from contraction, making the loud report —Joe, of course, getting the full benefit of it, incased as he was inside the closed box.

It is needless to add that while the incident did not, in the future, stimulate Joe's avidity for work, it did break up his habit of utilizing a firebox for a private smoking room.

Chicago, Ill. S. J. KIDDER.

A Useful Tool for Locomotive Work.

Editors:

Send you a full-size sketch of an adjustable tool, made at the N. C. R. shops, Elmira, N. Y., expressly for drilling different sizes of holes in cylinder form of boiler sheets or in round corners of fireboxes.

Say, we want a hole, 4 inches diameter, underneath in the boiler. We drill a ¾-inch hole first—this will receive bit *A*; now we put a ratchet on shank *D* and set up screw in ratchet, tight, so when turning will act much like a shaft between centers; we now feed cutter *E* with screw *B*, gently, and in this way will quickly drill a good hole.

We also use this tool on drill press, for different sizes of holes in boiler sheets. Of course, in such case we screw up the three set screws *c c c*, and let the drill press do the rest. For small size of holes, and where there is not much space, we use the tool as shown in Fig. 1, and for larger holes like Fig. 4; this will keep cutter from scattering.

The body is made of cast steel, and the plate of axle steel. We also have a tool of the same style, but larger in proportion, which we use for drilling and beveling dry pipe holes in flue sheets.

We have used these tools for over five years, and they have given very good satisfaction.

Elmira, N. Y. J. A. EISENAKER.

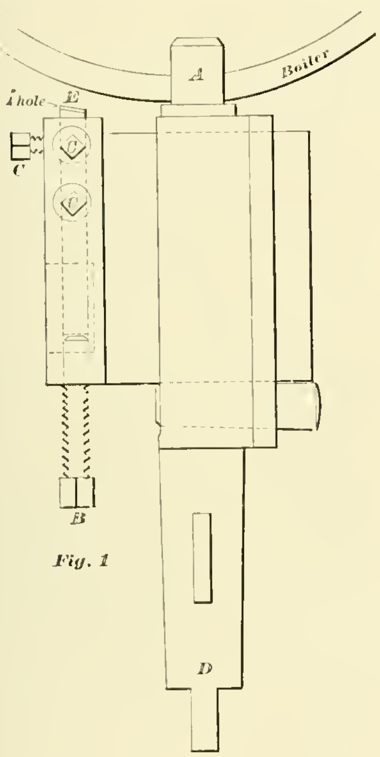


Fig. 1

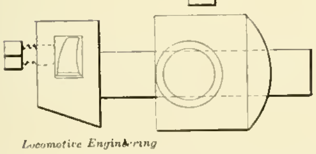


Fig. 2

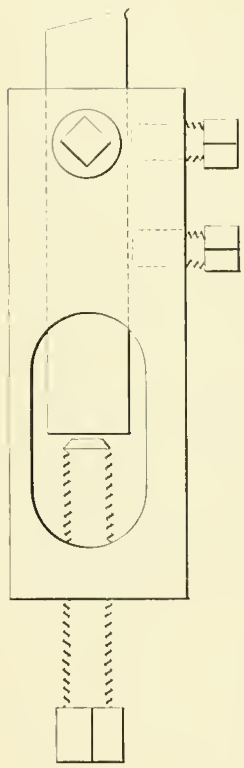


Fig. 3

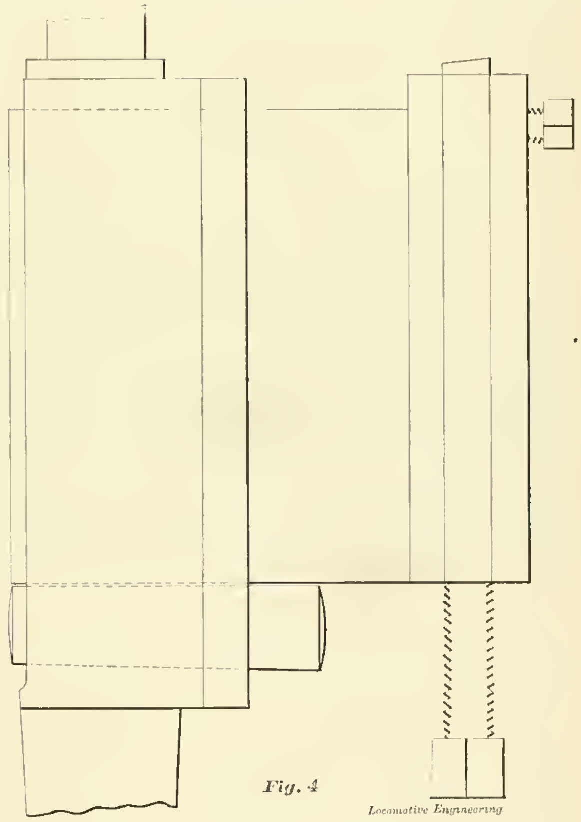


Fig. 4

Weight of Rails Per Mile of Track.

Editors:

In your last issue of "Locomotive Engineering" there was a rule given for finding the number of tons of rail required in a mile of track.

The rule given was to multiply the pounds per yard by 1⅓. Now, taking a 75-pound rail, we would find that the number of tons per mile would be 100 tons.

As there are 5,280 feet to the mile, there would consequently be 1,760 yards; and allowing 75 pounds to the yard, we would find that one line of rail would be 132,000 pounds, or 66 tons, and a double line would be 132 tons.

A better rule, however, would be to multiply the pounds per yards by 1.76; or, if the number of English tons are desired, multiply by 1.57.

STODDARD P. JOHNSON.

Dallas, Tex.

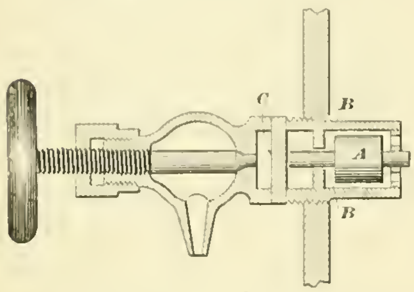
Safety Device for Gage Cocks.

Editors:

Having been a close reader of your valuable paper for a year or more, and having obtained some useful information from the same, I take the liberty to send you herewith a sketch which I think would probably interest, if not benefit, some of your readers; depending, of course, on your generosity to publish it.

The sketch represents a gage cock in the boiler head, with appliances attached for protection against an outburst of steam in the cab, in case of an accident causing the gage-cock body to break at the boiler head.

The valve *A*, shown inside of the cage,



will, in case of breakage, close up and seat itself at *B B*, thereby cutting off the flow of steam and water; the bridge or stop *C* preventing closure of the steam passage, except in case of accident.

I think this appliance can be used successfully on boiler-head fountains, air-pump throttles, water-glass cocks and boiler checks. If you can see enough merit in this to give it space in your journal I shall be greatly obliged, and will cheerfully furnish any other information concerning it that may be desired.

Georgetown, Ky. HERBERT MUIR.

Uniform Reports of Locomotive Performances—Authorized Standard Forms.

Editors:

At the January meeting of the Western Railway Club, the subject of Uniformity in the Reports of Locomotive Performances was incidentally discussed by several speakers, resulting in the adoption of a motion, offered by Mr. W. Forsyth (C., B. & Q.), to submit the matter to the next association meeting of master mechanics, proposing that the tons hauled be the basis of a standard report, to be agreed upon.

This move is in the right direction, and is one which may be so handled as to result in more important benefit than would ordinarily be expected, as it will bring into view certain facts in transportation service in which the average master mechanic has no voice or influence, and which really now serve to make up a good share of the differences which exist in the earning capacity of engines in tons hauled.

An ideal situation is one where, no matter how hard or variable the service may be, the heads of departments are harmonious and combined in action, interest and understanding for the best results in train service; and this will be, within reasonable limits, for a maximum amount of engine service at the least cost practicable per ton hauled. But will the statement of tons hauled place the reported performances upon an equal basis for general consideration of the merits of engine work? I am of the opinion that there are numerous instances where it will not give a good understanding, except there are given with the tonnage statement other data of equal importance. Frequently the motive-power official has very little insight, other than of the mechanical department, in this connection; as, for instance, no one acquainted with the road departments would expect equal results in hauling capacity from the same size and class of engines when considering statements made by the Baltimore & Ohio and the Lake Shore roads, respectively, as there is not a common ground for comparison of work done in the tonnage hauled.

What, then, is desired is to give uniformity in reports, showing the results on an understandable basis for the proper information of interested officials; for it must be acknowledged that the master mechanic is not alone in interest, and this fact will be quite evident when information is properly presented.

As a matter of personal experience in this direction, the writer recalls his own situation some fifteen years back, and the means then taken to show up the work done by his engines. This may interest others, as illustrating the points considered important to be stated—in addition to a tonnage statement—in locomotive performance reports. About the time stated I was engaged as master mechanic with a Southwestern road, where the organization was nearly an ideal one; and during six years of service with them, the hauling of trains was the frequent subject of conference between the officials, and the engine capacity had increased, on the main line of road, to an extent seemingly the maximum of efficiency in freight service on that road. Desiring to make a better showing, however, than seemed practicable with the engines then used, one of the chief items of an annual report by the master mechanic was an argument for heavier engines, with higher steam pressure and increased cylinder area, rather than for any increase in the number of engines on the main line. In this report was stated the average size of the freight-engine cylinders, wheels, weight thereon and the steam pressure; and, with the help of the engineering department, a statement of grades of road was also given in as brief form as then seemed practicable; as will be seen in the table following:

LOCOMOTIVES—MAIN LINE.

Average diameter of freight-engine clyinders, 16.92 x 24 inches.

Average diameter of freight-engine drivers, 4.85 feet.

Average weight on drivers (eight-wheel engines), 49,848 pounds.

GRADES—MAIN LINE.

	Miles.	Per Cent.
Total length of ascending grades going South.....	223.55	38.8
Total length of descending grades going South.....	221.05	38.04
Total length of level, practically so..............	131.31	22.8
	575.91	100.

Maximum ascending grade going South, 74.40 feet per mile.

Maximum descending grade going South, 72.20 feet per mile.

Longest heavy ascending grade going South, 68.6 feet per mile for 9,200 feet.

Longest heavy descending grade going South, 70.2 feet per mile for 9,500 feet.

Average ascending grade going South, 34.97 feet per 223.55 miles.

Average descending grade going South, 34.41 feet per 221.15 miles.

This information is, of course, of the ordinary character, easily obtained, usually from road profiles, available to officials, and may as easily be stated by divisions of road for local information and comparison. But, as above stated, it is of a road apparently not severe to work, as a whole; nor would the engines now be considered as within the ordinarily heavy class. The report served its purpose as intended, viz., decided the management in favor of an increased engine capacity as circumstances permitted to be supplied. It settled more than this, as preparations were instituted by the engineers for improvement in the roadbed and structures, as a preparation for heavier engines.

The average work done on the main line in train service at this time was, for one year's work, 18.4 loaded cars, rating, as was then the custom, two empty cars to one loaded; and, from the data given, it could readily be determined whether the average was good or bad, provided the tonnage statement was also available, which, at this time, it is not.

A more recent experience enables the writer to present examples in tabular form from the equipment of a large system of roads, showing the variety which may exist where engines were purchased as the best of their respective sizes within a period covered by a score of years—scarcely an official lifetime. This table shows the advance made from light to heavy power within that time; and it will be noticed also that a good number of the light engines are much too light for even the theoretical duty, which is less than is now practicable with the increased steam pressure used on engines to-day, and also used on the heavier engines of the table, although all are there on the same bases for the sake of uniformity of statement.

This table is not a practical one to present with locomotive reports, as is the first one given, but serves to illustrate the subject:

TRACTIVE CAPACITY OF ENGINES.

Average capacity on grades on tangents, speed 10 miles per hour.
Average weight of engine and tender, deducted steam pressure 140 pounds.
Cut-off, half stroke, mean effective pressure 116 pounds.

Engine Class.	Type.	Cylinder.	Driving Wheels.	Weight on Drivers, lbs.	Total Weight of Engine and Tender.	Necessary Weight for Proper Adhesion.	Tractive Power in lbs. for each lb. of Effective Pressure.	Per cent. of Deficit in Weight.	Grade in ft. per mile......	10	20	30	40	50	60	70	90	100
									Resistance due to Gravity in lbs. per ton of 2,000 lbs..	3.8	7.6	11.4	15.1	19	22.7	26.5	34.1	37.9
									Total Resistance in lbs. per ton of 2,000 lbs.......	10.3	14.1	17.9	21.6	25.5	29.2	33	40.6	44.4
Tons.			Inch.					%	No. of Engines Affected.	Capacity in Tons.								
C² 23	8-wheel	17 x 24	64	46,000	145,000	43,920	108.4	16	32	1139	820	630	510	420	358	309	237	211
D² 19	8-wheel	18 x 24	69	44,000	153,000	53,643	112.7	18	10	1194	851	654	529	437	371	320	246	218
E 31	8-wheel	18 x 24	62	62,000	170,000	68,716	135.9	9.7	170	1440	1039	796	645	534	455	393	304	270
H 26	10-wheel	18 x 24	57	58,000	156,000	68,995	136.4	15.9	124	1460	1045	807	655	545	464	402	312	279
I¹ 45	Consol	20 x 24	51	84,000	161,000	95,200	188.2	11.7	3	2040	1468	1139	924	775	660	580	456	416
I² 53	Consol	20 x 24	57	106,000	187,000	85,179	168			1805	1293	1001	811	673	576	499	586	346
J 48	10-wheel	19 x 24	62	96,000	192,000	70,674	139.7			1478	1074	810	655	540	460	395	304	272
K 49	10-wheel	20 x 24	62	97,000	194 000	78,309	154.6			1648	1178	907	735	608	519	448	346	308
L 69	Consol	22 x 28	51	138,000	224,000	134,373	265.7			2882	2076	1611	1316	1096	944	823	648	585

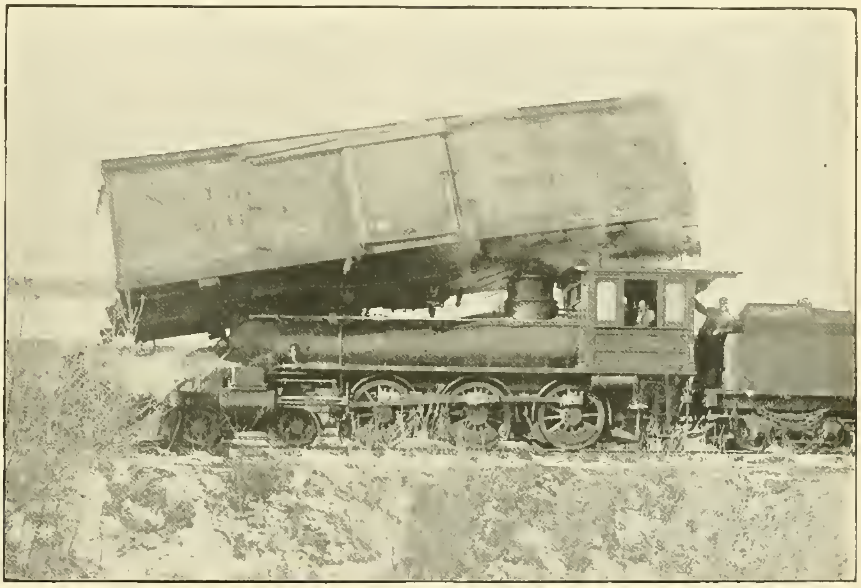
The intent of this paper is to ask attention to the necessity for something more than tonnage hauled in a standard report of locomotive performance; which, of course, to become so must receive the indorsement of the Master Mechanics' Association; and if such action is decided upon, there is no question, I think, but it will become the general report of roads of the country—by action, also, of the leading officials, who will benefit by the information, as also by the removal of the present indefiniteness in form of reports. Comparison will become useful, because easily understood.

GEO. W. CUSHING.

Evanston, Ill.

Scooping Up a Car.

The wreck shown on the annexed engraving occurred on the Barckley Railroad, between a switch engine and a regular train. The switch engine was out near the yard limits and coming toward Towanda, pushing two or three cars—an empty box car ahead. The regular train was going out, a few minutes late, and was running a little faster than the time allowed. The engine of the regular train had two long bumpers extending out over the pilot, and, when striking, they turned back against the front of the engine, forming an incline, so the box car was raised



up on end, knocking the headlight and stack off of the engine, then falling back on top, the king bolt going through the top of cab, leaving the sandbox, bell and dome all right, bending the whistle stem back. In this position the engine was run back to the side track, a distance of about three-quarters of a mile; so the car was pretty well balanced on the engine. The engineer and fireman remained in the cab. No one was hurt.

There is a tender on the East Tennessee, Virginia & Georgia divisions of the Southern Railway which has had a set of Fox steel trucks for five years. In that tender the truck has required very little repair—merely the tightening of some rivets that got loose. The divisions where the tender has been running are very crooked, and there has been a great deal of trouble from worn wheel flanges. The men in charge say that the wheels in the Fox truck have given extraordinary service without flange wear.

One of the latest standards of the Pennsylvania Railroad which applies to all lines east and west of Pittsburgh, is the painting over of all bright work on locomotives. There is to be no more energy directed to keeping hand rails, cylinder casings and other parts brightly polished, the sombre black being considered good enough for all locomotives. We understand that some of the engineers are disgruntled about the change, but the firemen are not complaining. The black covering will save lots of work, but we are not certain that the work was by any means wasted. Anything which is calculated to increase the pride of enginemen in the locomotives they are working has a money value that cannot be easily calculated. Utilitarianism is the death of sentiment, but sentiment has a wonderful influence in cultivating "esprit de corps" and love of any business.

The new managers of the Atchison, Topeka & Santa Fé are evidently not partial to extravagance, or to having the revenues of the road eaten up by any fat corporation. In the ten-year contract with the Pullman Palace Car Company, a 1-cent mileage basis, instead of a 3-cent basis, was obtained. This offer was too much for the Wagner Company.

The Union Pacific overland flyer broke the record for fast running from Omaha to Cheyenne, one day last month. The distance, 519 miles, was made in ten hours and thirty minutes, including twenty-one stops and three changes of engines. The actual running time was one mile per minute for the entire distance.

During the six months ending December 31st, the West Shore Railroad did the greatest volume of business in its history.

The Southern Pacific has dropped 1 000 names from the pay-roll.

Management of Locomotives.

At the last meeting of the Railway Superintendents' Association, Mr. W. F. Potter, general superintendent Flint & Pere Marquette road, read a report on the management and handling of locomotives. It was rather an odd subject for the Railway Superintendents' Association to discuss, but Mr. Potter made a very good report and handled the subject very judiciously. He did not attempt to discuss the subject from a mechanical engineering standpoint. The following remarks were made under the heading, "How to Obtain the Maximum Service from a Locomotive During the Whole Extent of Its Life."

"True economy demands that a locomotive should exhibit its maximum service and be worked to the limit of its full earning capacity throughout its entire life. It is not possible, of course, to arrive at this perfect requirement of economical service, but an effort should be made to approximate it as closely as possible. The first condition to such approximation are shops of sufficient capacity to meet all demands which may be made upon them for repairs, equipped with such modern tools and machinery as will enable work to be done with the highest economy. When this condition is satisfied, in many cases there should be a shifting of the standards of economy. The first consideration with many officers is to keep a locomotive out of the shop as long as possible; in other words, to make it show the greatest possible number of miles run between shopping. That is one standard of economy, and much energy is devoted to that end, regardless of whether engines are performing economical service for the company, and regardless of track, roadbed and structures. Mileage thus attained, during which time locomotives have actually been losing money for the company, is entered as one of the factors of economy.

"It is needless to point out that the real interests of the company are thus frequently sacrificed in the effort to maintain a false standard of economy. It is, of course, desirable to have engines show as large a mileage between shoppings as possible, but the other highly important factors of economy should not be sacrificed to this end; the end should be conceived only within the limits of economical mileage. The factors of economy in all departments must harmonize and correspond in order that the best interests of the company may be served; they cannot conflict with each other. What is true economical practice for the company in one department must be true in all others, so far as the particular item to which it relates has a bearing on the achievement of economical results in other departments. These discordant facts should be harmonized as far as possible. General results are what should be considered. Superintendents and mechanical officers must work hand in hand with a perfect understanding. In the present state of the railway business no detail of economy which promises, however slightly, to add to the net revenue derived from operation can be neglected."

A Money-Saving Drop Pit.

The annexed engraving illustrates a drop pit used in the Burlington & Missouri River Railroad shops at Edgemont, S. D. They have considerable trouble with cut flanges of driving wheels on that district, which is mountainous; and this pit was put in so that they could lower a pair of driving wheels and turn them round in quick time, without the labor of jacking up the

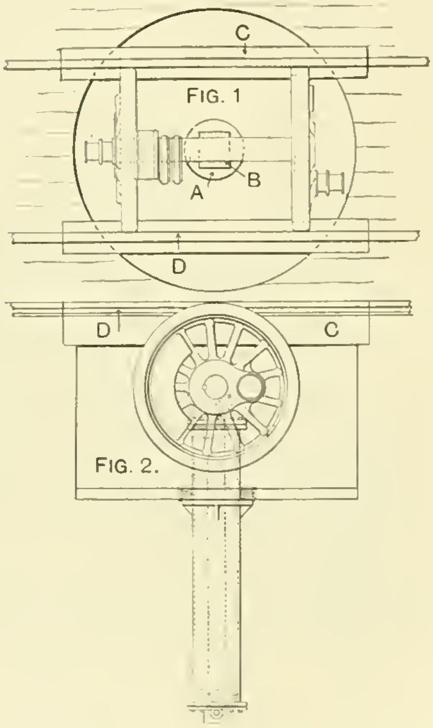


FIG. 1

FIG. 2.

engine. The foreman of the shop, writing to us about the pit, says that changing two pair of wheels paid for the expense of building the pit. The work can be done so expeditiously that they are able to get considerably more mileage out of the engines. A hydraulic ram is used for doing the work of lowering and lifting the wheels. In the engraving, *A* is the hydraulic ram, *B* the cylinder, and *C* the turning pit.

Locomotives for Russia.

The last order which the Baldwin Locomotive Works obtained, for thirty-two locomotives for Russia, was given on the condition that they would be ready for shipment in seventy-five days. The builders expect to ship them in about forty-five days after the order was received, which is an extraordinary performance in view of the fact that the locomotives had to be built according to rigid specifications. One requirement is that the boilers must all be tested by the municipal authorities of Philadelphia, and certificates given that they are capable of carrying a high steam pressure safely. The test requirements are very rigid. There is no other locomotive building establishment in any country which could have built these engines in the short time given to the Baldwin Locomotive Works.

The reason why the order depended upon an extraordinarily prompt delivery of the locomotives was, that they will be required to haul the passenger trains that will transport the immense concourse of people expected to visit Moscow in May next, to witness the coronation of the Czar and Czarina. This is to be a most imposing event, and will draw visitors from every part of the empire.

Secure Rooms for the Mechanical Convention.

Persons who expect to attend the railroad mechanical conventions at Saratoga, N. Y., in June next, ought to lose no time in securing rooms at the Congress Hall Hotel, which will be the headquarters for both associations. We notice efforts making in some quarters to influence visitors to stay at other hotels, which is scarcely fair, considering the efforts that have always been made by the proprietors of Congress Hall to make the guests comfortable and satisfied. To advise people to go to other hotels is also unfair to the Committee of Arrangements, which settled the headquarters at the place where they were able to secure the most satisfactory terms. A few years ago, when the two associations decided to meet in Saratoga, a committee visited all the leading hotels to ask for terms, and the proprietors of all the hotels except Congress Hall displayed no inclination to be accommodating, and they would not grant rates that could be accepted. When they discovered afterwards how big a thing the conventions were, they were anxious to secure the business; but we consider that it would not be fair for guests to desert the hotel where they were always well treated to satisfy rival proprietors.

The Pennsylvania Railroad Company has awarded contracts for 31,000 tons of steel rails at $28 per ton; 23,000 tons for the lines east of Pittsburgh, and 8,000 tons for the Western lines. The contracts have been divided among the following companies: Carnegie, 9,000 tons; Cambria, 6,000; Pennsylvania Steel, 6,000; Lackawanna, 2,000, and Illinois Steel, 8,000 tons.

The Welsh tin-plate manufacturers are agitating to raise a fund of $100,000 to be used for missionary purposes. They propose sending agents to foreign countries to advocate the increased use of tin plates for packing and domestic purposes.

CAR DEPARTMENT.

Conducted by ORVILLE H. REYNOLDS, M. E.

Norfolk & Western Railway—60,000 Pound Box Car.

In harmony with the demand for a car to satisfy the conditions imposed by heavy traffic, and in direct compliance with the phase of it that looks to a construction embodying modern practice, the Norfolk & Western Railway has produced the 60,000-pound car shown in our illustration.

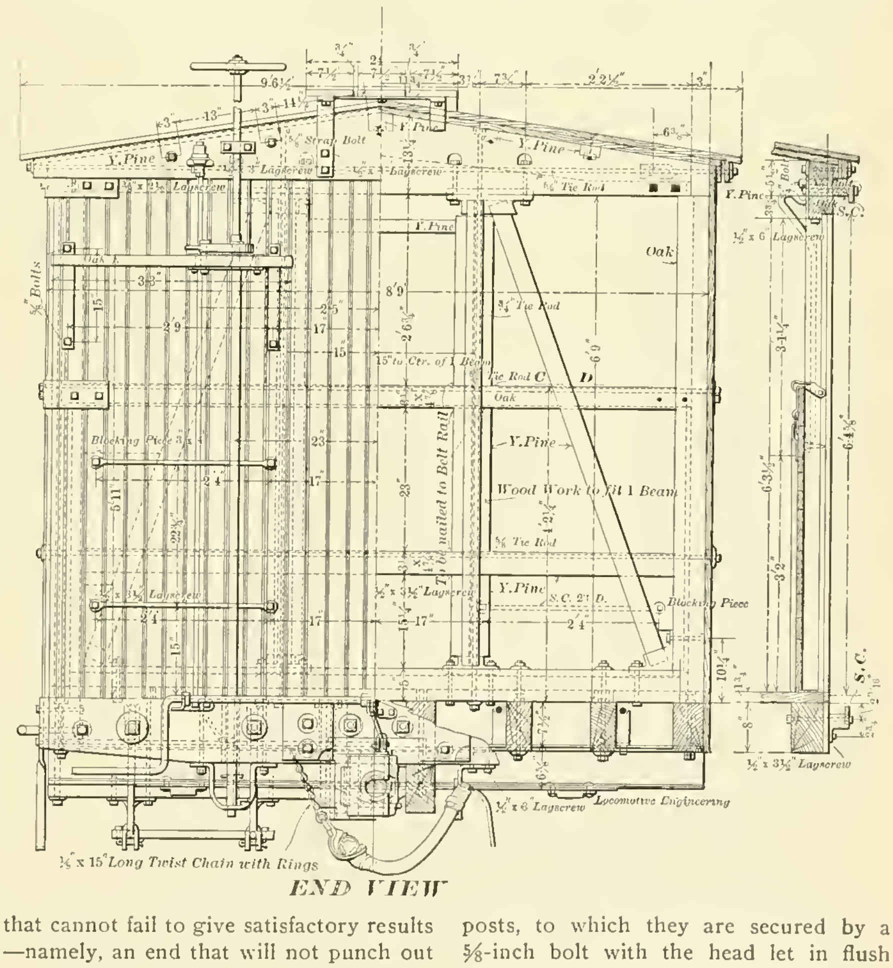
Originality in the working out of details is prominently in evidence in this car; and the fact that it had its baptism in the struggle for trade, only within the closing of the year just passed, lends additional interest to all whose thoughts turn lightly, or otherwise, to the large-car problem, than which there is nothing of greater import for the carman to wrestle with at the present time.

The length of this car outside of end sills is 36 feet 1 inch; the width over side sills is 8 feet 9 inches; the length inside of lining is 33 feet 8¼ inches; the width inside of lining is 8 feet 2¼ inches, and the height under carlines is 6 feet 9¾ inches. With these figures we have 1,880 cubic feet capacity, and from which it is seen that the owners build their faith in a car that will likely be loaded somewhere near its capacity in both directions of haul; or, in other words, it is evidently designed to haul average loads at a cost far below that possible with the larger and heavier cars.

That light construction has received its proper share of attention is proven by the double-board asphalt roof—the side plates only 3 x 5½ inches, the side door posts 3⅜ x 5½ inches, the intermediate posts 2½ x 4 inches and the braces also 2½ x 4 inches. These dimensions all tell of a determination to cut down the weight of the superstructure to a point that is lower than usually found in cars of a lesser capacity, and is a practice that may be profitably followed by others who are seeking an opening to reduce the weight of a car without impairing its strength.

The side posts are tenoned 1½ inches into sills and plates—no cast pockets for either posts or braces. The corner posts are 5 inches square, rabbeted on the inside for the lining; the sheathing passing over both outside faces.

Measures have been taken to produce an end in this car that is exceptionally strong, and one that has, in a marked degree, points that are unique in freight-car design, vieing closely with the best recent passenger-car work in respect of the introduction of steel at the weakest place in the car; and it is certainly a matter for commendation when the old methods, that have been found so sadly wanting, are cast aside for a construction that cannot fail to give satisfactory results—namely, an end that will not punch out from ordinary causes.



END VIEW

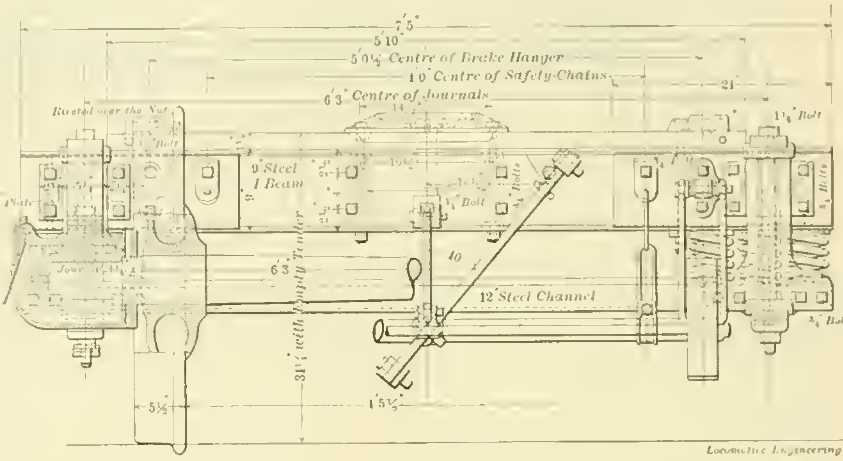
As the illustrations show, there is a sub-sill, 5 inches deep and 7⅛ inches wide, on top of the sills and resting one inch on the outside sills; it is rabbeted on the underside 2 inches, leaving a beveled lip on the inner face to lap over the flooring, and is secured at the crossing of each long sill by a ⅝-inch bolt with cast washers. This is the timber on which is built up the complete end, and which takes the place of the end sill as a foundation for the posts and end braces; it will be noted as a heroic departure from the old weak end, so long and piously adhered to.

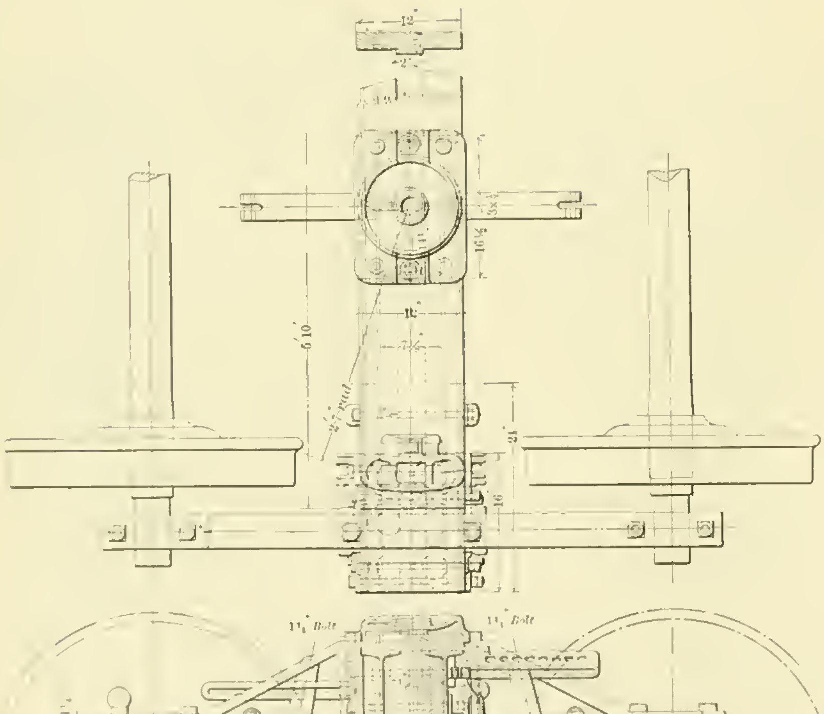
Resting on this sill at the corners are cast-iron pockets for the 3 x 4-inch end braces, the pockets having a flange which extends up on the inside face of corner posts, to which they are secured by a ⅝-inch bolt with the head let in flush under the sheathing; the pockets are also secured to the sub-sill by a ⅝-inch bolt; the whole forming an angle iron stiffener at the corner, in addition to its function as a pocket for the end brace.

The end intermediate posts are of a composite character, made up of 4-inch, 7-pound I-beams, to which are secured 3 x 4-inch wooden posts fitted between the flanges. The I-beams rest in cast-iron pockets, which are secured to the sub-sill by ⅝-inch bolts passing through the base; these pockets are provided with a lip on the under face, which locks into the sub-sill and acts as an additional stay against any forces from the inside. At the top of post there is a combination post and brace pocket, to receive the I-beam and end brace; this pocket is secured to the end plate by two joint bolts through the base.

While the side of car has but one girth 3½ x 3½ inches, the end has two 3½ x 4⅞ inches; and these are tied by two ⅝-inch rods passing across the car on the inside, flush with the lining, the lower rod passing through the sheathing with a cast washer under nut. The side girth has a strap bolt through the upper girth and corner band, with a lug let into side girth.

Corner bands are at the plates, in the usual way; but they are missing at the sills, being replaced by the ⅞-inch strap bolt with lugged ends into side sills. The ¾-inch post rods, one at each corner and one at end post, tie the end vertically and contribute to making an ideal end for a box car.





The mechanical progress shown in the development of the strength of these ends will stand as a live object lesson to car designers for some time, and as an incentive to renewed effort in strengthening other weak points that have been battled with to no purpose thus far. And while shocks from the inside are taken care of so admirably, the outside has also been looked after, as can be seen by a reference to the sectional elevation, which shows an end sill 8 inches wide and 10 inches deep at the center, tapering to the ends from the front and bottom; this sill projects 1½ inches beyond the outside face of side sills; and, standing with its inner face ¾ inch forward and clear of the end sheathing, there can be no fear of a smash from ordinary external sources.

A body bolster made up of two 6-inch steel I-beams placed 7 inches centers, to which is riveted a steel plate 5-16 inch thick and 14 inches wide at both top and bottom, constitutes a design both strong and light. The location of the outer truss rods nearer the center of the bolster than is usual, assists greatly in relieving the latter of deflection; since the stress at the center of bolster from these rods is proportional to the load deposited there by the rods, multiplied by its distance from the center, or its lever arm, the nearer the center of bolster that the load can be left, the less will be the fiber stress at that point. These facts are evidently plainly understood in the case under consideration.

A stiffener, made of one piece 9½ inches wide and 7 feet 6 inches long, is placed centrally over the bolster and between the center sills, to which it is secured by six ¾-inch bolts; this is a good method of getting strength at a point usually weak from overhang.

The draft rigging is also reinforced by a solid block extending from the rear draft-lug to the bolster; and from this point there is a piece of 3 x 4-inch material running to the cross-tie timbers, bolted to under side of center sills. A block of the same size is placed at the inner face of each cross-tie, to relieve these members of shock.

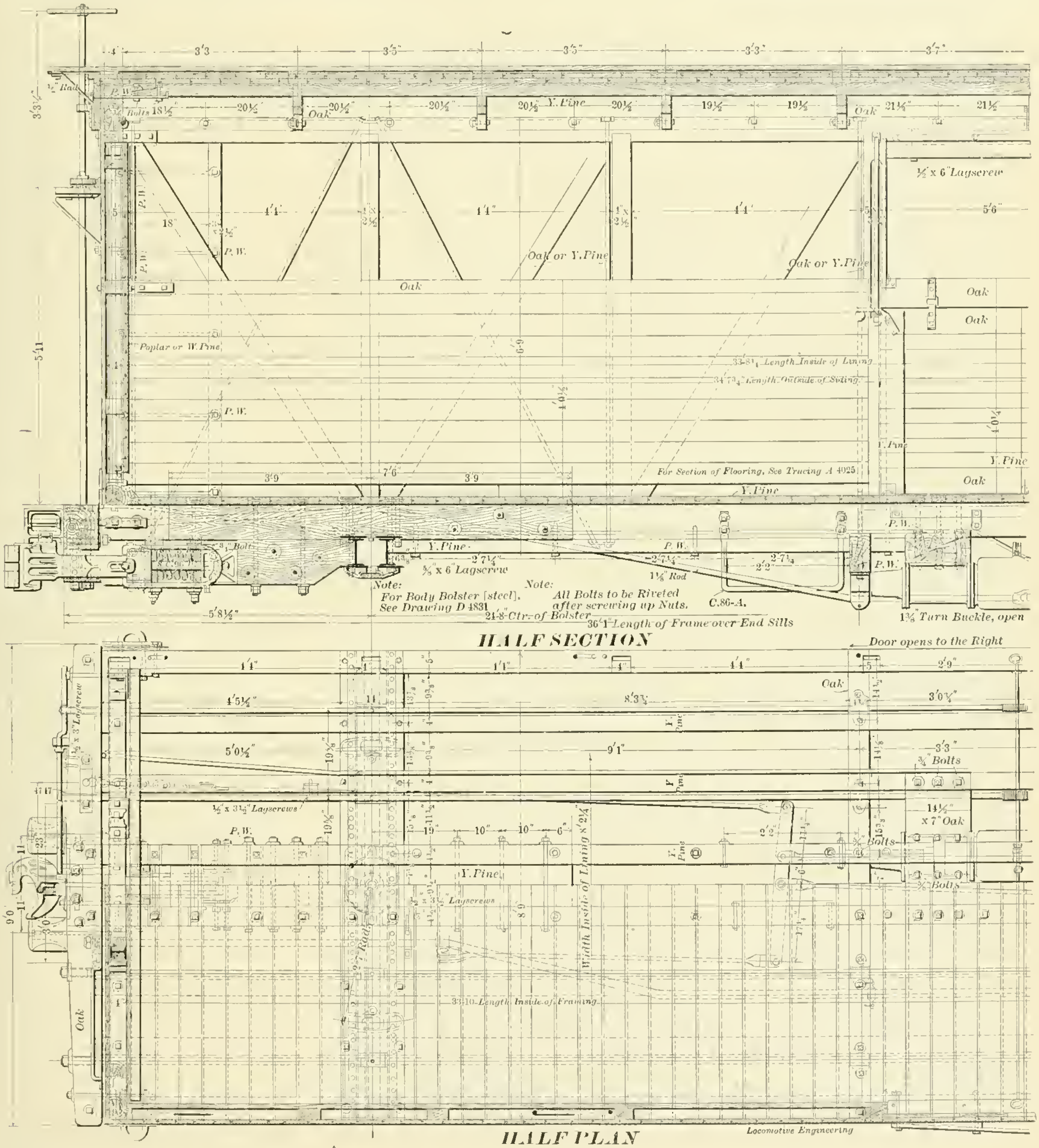
The truck carrying this car is of the diamond type, but has some novelties in its design not common in freight-car work, among which may be noted the collarless journal 4¼ x 8 inches, and 6 feet 3 inches from center to center. The old stop wedge, so long the companion of this type of journal, is conspicuous by its absence. The lateral motion is kept within bounds by means of a bar carried in recesses cast in the walls of the journal box, in which it is rigidly held in all directions except at the top, at which point it is secured in position by a bolt passing through the box, making a neat mechanical job, and at once and forever ridding the car department of a long-standing eyesore.

Another of the uncommon features is the composite bolster of two 9-inch steel I-beams, filled with oak between webs and flanges and securely bolted. A simple calculation will show this bolster to be one of the strongest in service to-day—as it shows itself the simplest.

The tie strap is offset upward ¾ inch, and the arch bars are spread 18 inches at the center, making an arch of exceptional rigidity; and with the steel channel spring seat, and inside-hung metallic brake beams, the whole thing has a business-like appearance.

Taken in the concrete, there are many points about this car that entitle it to a position in the front rank with the best; and in some particulars cited it stands alone, in our estimation, as an example of advanced car practice, simply because the designer had the courage of his convictions and refused to perpetuate all the glaring defects of the past.

We are indebted to Mr. R. H. Soule, superintendent of motive power of the Norfolk & Western Railway, for his drawings, from which our illustrations were made.



How to Make an Easy-Riding Car.

A contemporary informs the world that "most of the private cars in which the prominent railway officials of the United States travel are weighted down to make them ride easy." It goes on to say: "In the compartment between the floors of all the private cars of the Pennsylvania lines, a large number of rails and old car axles are so carefully distributed that the irregularities of the roadbed and the effect of the sharp curves are obviated."

This is a detail of dead-weight practice not generally understood by car men; but it would doubtless be in evidence in the event of a collision, when those rails (presumably T-rails) and axles shot from their moorings and mowed a death-dealing swath—not in the car, but outside of it. It seems to us that this catapult principle would not be a good thing to emulate by builders of private cars.

The supposition has gotten abroad

among the knowing ones, that a private car, or in fact any other car, would be heavy enough to insure an "easy motion" without any artificial aids, when the springs were correctly designed for their loads; because there is a certain definite relation between the elasticity of a spring and the load it carries. It therefore looks strange to some people when they read: "It is not generally known that the weight of some of these private cars exceeds that of the heaviest Pullmans," and "The ordinary day coach is divested of all superfluous matter; but the practice of modern mechanics is to keep enough weight on the frame and trucks to make the cars ride easy, and at the same time preserve the necessary degree of equilibrium with safety."

This is a strange state of affairs in car construction, and will be recognized as something new, even by the most cranky advocate of heavy weights. For the information of those who are likely to be deceived by the above quotations, we will say that, while there are some few cases of heavy private cars, their weight is due primarily to the immensity of their proportions, together with the heavy kitchen and storage attachments, rather than to the junk-shop features between the sills.

Day coaches, it is well understood by those interested, are always heavy enough, without any extraneous additions by the "modern mechanic" to make them so. As a matter of record, it may be said that a 50-foot coach has a wide range of weight, going from 50,000 pounds to 65,000 pounds—all due to the amount of material in their make-up; and the difference in weight is traceable directly to the stronger construction, vestibules, etc., while the cars will have the same seating capacity. No one can claim that any attempt has been made to make these cars ride easier by the addition of dead weight for the purpose.

No; the "modern mechanic" is not busying himself just at present with schemes to increase the dead weight of coaches to make them ride easy. He is resting secure in the knowledge that they have been heavy enough for some time without any assistance from him.

An English Sleeper.

The "Transport," of London, Eng., has an account of a new sleeping car just placed in commission on the east coast route to Scotland, by the Northeastern, Northern, and North British companies, of England, which are said to have many improvements over old practice. It says: "Heretofore the cars used have been of the ordinary Pullman pattern, and the compartment car with British modifications. The latter necessitates the possibility of sharing the apparent seclusion with a fellow passenger. In the car referred to, each passenger has a room to himself, this result being accomplished by placing the berths crosswise of the car. The beds are unusually wide, and each room is equipped with a mirror, a double rack for heavy and light articles, a table, a paper and letter satchel, a watch pocket, a water bottle and glass, and a good supply of pegs for hanging garments. The car is 52 feet long, mounted on four-wheeled bogies, and weighs 25 tons. Next to the sleeping compartments, which are four single and two double, is a smoking compartment which can be converted into a sleeping room when necessary. The car is heated by the Gold system, and each section is supplied with a valve by which each passenger may regulate the temperature to suit. The car was designed by Mr. David Bain, and constructed under the direction of Mr. Wilson Worsdell, the locomotive superintendent of the system. The interior finish is in white sycamore, with panels in teak moldings."

Our English friends are setting a pace in sleeping-car design that, it seems to us, would be a profitable thing for American roads to copy. It took some little time to educate them to the need of a sleeper; and now that they find it a necessity, they have built on lines that indicate a true appreciation of how to fill the want. The weight of 25 tons, or 56,000 pounds (less than our day coaches), shows plainly that they do not propose to haul the 100,000-pound affairs we have on this side. Sound judgment!

California Redwood.

The ideal material for car-building is California redwood, which is almost universally used for that purpose on the Pacific Coast. The indications now are that car builders will soon have to content themselves with a less desirable and durable material, for the redwood is going the way of the buffalo and of the Red Indian. The immense trees which have been long the wonder of tourists are growing scarce. Since 1856 the commercial value of these trees has been steadily growing, and in spite of the protests of the lovers of nature the demand has been met with a ready supply. A wood that will not rot, is hard to burn, easy to work up, of a rich mahogany color, and not difficult to procure, holds out too many inviting inducements to expect any mercy from the human race. Redwoods have been found prostrate, in perfectly good condition for lumber, over and around which another redwood had grown that is between 500 and 600 years old. In clearing the ground after the lumber has been taken off, the roots have to be cut and dug out, for they will not burn on account of the amount of water they absorb. Fires, which are almost an annual occurrence in the spruce and pine forests, stop on the borders of the redwood groves. The absorbent nature of the lumber and the absence of resin and pitch make it of the highest value in building in case of fire. A redwood fire will die out in a gale of wind. Added to these virtues are the facts that it will not warp, is impervious to the effects of fresh water, and sustains a high polish. It is little wonder, then, that only State laws and personal philanthropy can preserve these giants from total extinction.

At the last convention of the Master Mechanics' Association, arrangements were made to remodel the Master Car Builders' Rules of Interchange; the Arbitration Committee and delegates from the various railroad clubs having been given the work to do. Meetings were held last November, and the rules as remodeled, were published for discussion by the various railroad clubs, as a preliminary for their consideration at the next Master Car Builders' Convention. The rules sent out are not much different from what they were before, so far as the text is concerned, but the spirit is radically different. In the old rules the teachings seemed to be impressing upon car inspectors excuses for refusing to accept cars. The spirit of the new rules teaches that cars must be accepted unless under exceptional circumstances. It seems that the new rules will greatly facilitate the movement of cars.

There is said to be at the present time a revival in England of the subject of ridding themselves of their old bob-tailed passenger coaches, and replacing them with the American type of car. Cutting through the crust of conservatism is an uphill operation among our cousins across the water, and this step is, on that ground, a tribute to their good sense, which, though stifled by a reverence for old-time practice, has at last asserted itself. The short time that Pullmans have been in service over there has had much to do with this change of sentiment, and we believe that when the beauties of our system are well understood that they will never care to return to the temptation-traps that laid low a Valentine Baker.

The Chicago, Peoria & St. Louis Railway has adopted the Brown System of Discipline, as developed on the Fall Brook road. We are pleased to note that the officials on this road, as well as the Columbus, Sandusky & Hocking, call the system by the originator's name.

The Lehigh Valley has purchased control of the Elmira, Cortland & Northern from J. Roger Maxwell, Henry W. Maxwell and Austin Corbin. The road is 140 miles long, and runs from Elmira to Camden, Oneida County. It will give Lehigh Valley more good territory and add a valuable feeder to the main line. This purchase may mean the extension of the road to Watertown, and possibly to the St. Lawrence.

British Locomotive Designers are Slow.

"In our last issue," says the "Railway Herald," of London, "we commented upon the tardy progress made in locomotive engineering in this country, and attributed it to the jealousy exhibited by by superior officials. But this is only one cause of the state of affairs we were complaining of. The unconquerable conservatism and the unbounded conceit which too often characterize the relations between the British employer and employé have also much to do with the stagnant state of this branch of railroad engineering. Save one or two noteworthy exceptions, no experiments are being carried out to ascertain the best proportions of locomotives. It is lamentable to find that the United States engineers are much ahead of us in this respect, for on that side of the Atlantic there are already at least two plants for experimenting with locomotives; one at the well-known Purdue University, Lafayette, Ind., and the other at the Chicago shops of the Chicago & Northwestern Railway.

"A long study of and comparison of the working details of locomotives made in this country for home and colonial railways, has revealed the fact that the branch of railway engineering relating to the designing of locomotives is still in a most unscientific and chaotic state. It seems as though personal fancy had more to do with design than judicious reasoning. For instance, while one engineer, designing an engine with 18-inch cylinder, will adopt a 3½ to 4-inch steam pipe, another will make the same 5 inches. On one line, large engines will have a small dome—say 1 foot 9 inches inside diameter; but on another well-known line the same will be made 2 feet 6 inches. On the other hand, one or two engineers would not hear of domes at all. Most engines have conical chimneys, tapering so that the large end is at the top; but there are lines where the chimney is perfectly straight, and a few where it tapers the opposite way! Many of our engineers will, perhaps, be surprised to hear that the cylindrical chimney is the best. This is the result arrived at in Hanover, after prolonged experiments embracing over 30,000 readings! There have, indeed, been experiments in this country, and the results arrived at have been, and are still, most valuable; but to-day the conditions of railroading are changing so rapidly that the lack of fresh data about locomotive construction will soon make itself severely felt.

"Another and no less important aspect of the question is points of design, which have more to do with practical daily working than theoretical considerations. It is here that conceit and jealously come into play. Every locomotive engineer cannot nowadays afford to spend a few years on the footplate of a locomotive. Many of our engineers are, indeed, talented men. They design locomotives which are more or less successful, but which, in minor details, show a lack of practical knowledge of the requirements of daily working. The public may not know this, but there is one class of railway servants who do know it, and have for years put up with it. It is no disgrace for the designer that he does not know all these little points; he cannot know everything; but he has in the engine driver a guide whom he could consult with advantage. The comfort of enginemen, and the easy handling of the various parts connected with the driving of an engine, are too often ignored. Why? Because our engineers won't give themselves the trouble, when they are designing a new type, to ask their trustworthy enginemen how such and such a thing works, or whether it is easy to handle, or examine, etc. Look at the diversity of practice in reversing gears; engines which ought to be fitted with a reversing screw have a lever, and vice versa. Look at those abominable structures which, under the name of cabs, disfigure some of our best locomotives, owing to a want of consideration or of sense; the roof, which should extend over the tender footplate,

SCENE IN TENNESSEE NEAR NORFOLK & WESTERN RAILROAD.

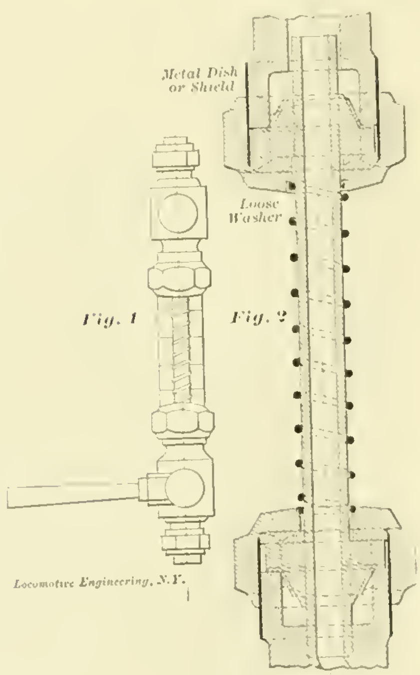
does not frequently protect more than half that on the engine.

"Engine drivers and their firemen are the best judges of these matters. The narrowness of the limits within which the European, but more especially the British, locomotive must be kept is not an excuse for our engineers to ignore the comfort of their enginemen. Both in the States and in Germany seats are provided for engine-drivers. What plausible argument can be brought against their much-needed introduction in England? We think that only a question of temperament, and difference in education, can account for these discrepancies in the practice of our locomotive engineers. But to the men who day after day have to ride on an uncomfortable engine in all sorts of weather, the question is a vital one."

Machine-Shop Practice One Hundred and Thirty Years Ago.

One of the oldest and most famous engineering establishments in Great Britain is the Soho Foundry, at Birmingham, which was built by Boulton & Watt in 1762. Here most of the famous engines turned out by the firm were built, and the methods employed were imitated for many years by other firms ambitious to attain business success. There appear to have been very few changes made, even to the present day. The "Engineer," in an article on this old establishment, says:

"The tools are in certain respects unique. They form part and parcel of the place. They have been made where they stand. They are an integral part of the premises. We do not say that they could not be moved; we do not say that they were made without any idea that they would ever have to be moved. At every turn, too, we meet with devices which have been brought out time and again as new, and we feel that master minds have been at work—the minds of men who thought very clearly, who knew exactly what they wanted to do, and then did it in the best manner; and all the while we note that the influence of the millwright made itself felt, and that things were done as mechanical engineers would not do them now, but as they could have been done in Murdoch's day, or not done at all. There are square-threaded screws, for example, two inches in diameter, ten or a dozen feet long, four threads to the inch, and these have all been cut with hammer and chisel! What would the average modern fitter think if he was asked to undertake such a job? One of the foremen who has been for more than thirty years at the works told us that he very well remembers seeing some of the old hands cut screws with a chisel, and he was when himself an apprentice taught the art. The bar was supported in a triangular wooden trough, and the screw cut bit by bit to a template. It is easy to see that under these conditions screws would be used sparingly, at first, at all events. * * * In the principal machine shop, one end of which is an erecting shop, are two heavy vertical planing machines. The frames are secured to the wall by stout braces, and the carriage holding the tool travels. The work to be planed is secured on a table at the ground level, and the planing is done on the side next the wall. The system was adopted because very heavy castings were made and had to be handled—castings weighing as much as nine or ten tons, and in later years as much as twenty-five tons, as, for example, the oscillating cylinders of the Irish Channel mail boats. There were no planing machines that would carry such a load, and even if there were it was thought much more economical of power to drive the tool along the work than to drive the work under the tool; and in the present day it is beginning to be found out that the moving tool is more economical than the moving casting. The principle has long been employed in plate-edge planing machines.



WEBB'S SAFETY WATER GLASS.

Webb's Safety Water Glass.

One of the most absolute wants of the locomotive to-day is a safety device to prevent the pieces of a water-gage glass from flying like parts of a burst shell, to the injury of the enginemen. Many devices have been tried in this country for that purpose, but none of them have proved satisfactory. We are therefore glad to reproduce from "Engineering" the following illustrations and description:

"The widespread use of steam, at what would a few years ago have been considered an extremely high pressure, has made the breakage of a gage glass anything but the trivial affair it was in days gone by. The fragments of glass become in such cases regular projectiles, and may inflict nasty injuries on the fireman. It has also to be observed that the solvent action of water on glass is considerably increased at high pressures, so that gage glass fractures have also increased in frequency. In Figs. 1 and 2 herewith we illustrate a simple form of guard, designed by Mr. F. W. Webb, the chief mechanical engineer of the London & Northwestern Railway, which has been used on the locomotives of the line with very great satisfaction. As will be seen, the safety device consists in incasing the glass. In the case of a breakage, the wire by the ends, which rest in grooves formed in the buts at the top and bottom of the glass, holds the fragments of glass together. Once the steam and water have been shut off, the broken glass is easily replaced by compressing the spring, which can then be removed. Another point of interest about the gages is the method by which they are packed, a dish or shield of metal being placed over the india-rubber washer, and preventing it from getting out of shape. The shield, it will be seen, is flanged out, so as to rest on the top of the glass gage fitting. This device is said to increase the life of the rubber very considerably."

The boiler plates for twenty of the thirty two locomotives, under construction in the Baldwin Locomotive Works, for Russia, were made at the Paxton Rolling Mills, Harrisburg, Pa. The plates were all required to stand very exacting tests, and the physical inspection was unusually rigid. The steel was required to show a tensile strength of 35 to 42 kilograms per square millimeter (about 50,000 to 60,000 pounds per square inch), and an elongation in 8 inches of 25 per cent., both longitudinal and transverse. With the exception of twenty plates 5/8 inch by 87 inches wide, the material varied from 1/4 to 3/4 inch thick by 74 inches wide and under. Of the 104 plates rolled, three failed in tensile and one on gage. In elongation the remaining 100 plates averaged 27.46 per cent. in the longitudinal direction, and 27.90 per cent. in the transverse—the latter result not generally looked for. All the steel slabs were furnished by the Pennsylvania Steel Co., made in open hearth basic furnaces, and showed an average analysis as follows: Carbon, 0.165; phosphorus, 0.014; manganese, 0.37, and sulphur, 0.27.

We understand that the Chesapeake & Ohio people are experimenting with an electric train signal in place of the ordinary air signal, and that it works very satisfactorily.

Where First-Class Machinists Are Trained.

Speaking of the individual skill developed in men trained in jobbing shops, "Chordal," in a letter contributed to the *American Machinist* fifteen years ago, says:

RESOURCEFUL MECHANICS.

"You go into one of these rough-and-tumble shops and watch a man at a lathe. He whistles and sings, and skylarks, and smokes, maybe, and does a hundred other things which the high and mighty think ought to send a man to the penitentiary for. But don't that chap do the work, though? Don't he earn and get good wages, and don't the proprietor make more off of him every day than the high and mighty do off of three men who were brought up to use every modern facility, and who are stumped if one of the aforesaid facilities happens to get broken? Watch the *outre* machinist as he works. He runs an 18-inch lathe, perhaps, and the work brought to him might well be, and in a better fixed shop would be, distributed among big lathes, little lathes, Fox lathes, planers, slotters, milling machines, cutting machines, drilling machines, screw machines, bolt cutters, gear cutters, etc. But this chap does everything which is laid to his lathe. Some he does tip-top, some he leaves slouchy, but all of it is done as well as is required. He does this all the time. Every job he does is something he or anybody else never did before, but he does it all the same. This man is no mere machine wound up and set to running every-day routine work.

"This is one of my Simon Pure machine shops, doing job work new and old; and this fellow we see is a lordly lathesman, a real machinist. You may set him down in any shop in the world where there's a lathe and a job to do and he can do it. He will jump at new and better ways. but he is not helpless in the meantime. Oh, ye puny chaps who claim to be lathesmen! You know only one way of doing things, and that's the way you were *taught* to do it. You only know how to do one job, and that's the job you worked on while you were being taught; and you can't do that job when you get in another shop away from home. Ain't you ashamed to ridicule a poor one-horse machine shop, when every man in it is immeasurably your superior? Ain't you ashamed to claim fellowship and equal wages with these sharp fellows, full of mechanical wit, who do work every day which you don't even dare to undertake? You say they can't do it well. You can't do it at all.

USING A LATHE ON PLANER WORK.

"Look at the job this lathesman gets. He is sitting on a casting and handling a connecting-rod strap. It's a rough forging for a strap to hold square boxes. You can't see a bit of lathe work upon it anywhere or a chance for any. Pretty soon he gets his present job done. Now he puts a miserable-looking angle plate against his face plate and sets this strap in some shape. He fishes a dirty piece of paper out of his tool box. This paper contains a memorandum of sizes which he took down verbatim as the foreman gave them. He goes to work, and in two hours lays two hours of planing on the floor. He has surfaced that strap nicely and squarely all over the outside. There's but one planer in the shop, and that is too crowded to be doing any work that can be done in any other machine. That planer will stand idle six months in the year, so it would be folly to get another, and thus be ready for the rush which never comes when you are ready.

"Here goes for the next job. Twelve stubs about two feet long one and three-quarters diameter to have thread cut eight inches on one end. No turning—simply a thread to be cut. They belong to a bridge job, and the bolt cutter has no dies for this size. When this job is done, he puts on a chuck and proceeds to chase out twelve hot-pressed nuts for these bridge bolts. It's a nasty job, but it has to be done, and it is done well.

"Next comes some nice lathe work; a couple of valve stems and three small wrists. They are finished to the sizes given and nicely polished. He gets them done and feels proud of them. Bless him, any latheman can do such work.

NUMEROUS WAYS OF TURNING A TAPER.

"Here's a brass casting for a 2-inch stop cock, and by it lies the old one. It is a repair job. The old one is bursted wide open. The plug is swelled, but not broken. Does a foreman come around and instruct this man how to do this job? No, sir. His orders were to 'rig up that cock.' He takes the casting, chucks it, and in half an hour has a 2-inch pipe thread chased in each end. Now he chucks crosswise, and you suddenly notice that this cock must be bored tapering. How is this fellow going to bore this hole? Will he go and get a nice taper reamer? Not in this shop. Will he fit up some kind of a reamer? Not he. He is fitting up an old water cock, not making reamers. He'll set the head of the lathe over, won't he? No, he won't. Thank God the head of the lathe can't be swiveled! Will he set the Slate taper attachment over? Guess not, seeing as he never heard of Slate; and don't know what a taper attachment is. Will he use the compound rest? He may some day when such a thing gets into the shop. Will he stick a wedge under the back wing of the carriage? No. He never heard of it, and is not so deep an inventor as to think of it just when he wants it. Will he wrap a cord around his cross-feed screw handle, and tie it to his tail stock and thus get the taper? No, he has no time to invent this ingenious plan. Will he find a fancy little sliding-head boring bar somewhere? Not a bar. Has he a mandrel which he can screw his chuck on, and thus do the job on the steady rest? No, sir. He won't do any of these smart things, and he won't tell you that the shop ought to have a Fox lathe for such work, and he won't tell you how the Metropolitan Cock Company bore them out, for he don't know and don't care. All he cares for is to finish that cock as well as the job is needed.

"He whistles a very peculiar air in a very soft manner, and turns his cross crank slowly to keep time. The result is a hole which is tapering, if it is nothing else. It would have taken him just about as long to bore it straight. He takes the job out, puts on a face plate and puts the old cock back in the lathe. He chalks it and hammers the swells in. Then he sets his lathe over and takes a light cut over it. Then he makes a close fit in the cock, but keeps the plug large. Now he goes to the lathe and *files the hole*. The tapering was all right, but the sides were not straight. He files carefully but boldly, watching the tool marks in the hole and trying the plug. Soon he is done with the filing, and, returning to his lathe, completes the fit of the plug. Now he guides it in, and soon there ain't a file mark or a tool mark in the hole or on the plug. It is a first-class job quickly done in a third-class manner."

Americans on First Russian Railroads.

During the month we enjoyed a most interesting visit from Mr. Fred. C. Weir, the well-known president of the Weir Frog Co., of Cincinnati, Ohio. Mr. Weir is a Connecticut State man, and when railroads were in their infancy in New England he entered the mechanical department of the N. Y., N. H. & H. R.R., and rose to be general foreman of locomotive repairs at New Haven. That was early in the fifties, in the time when American railway men were devoting considerable attention to railroad matters in Russia.

When the Russian Government first determined to commence the building of railroads, about 1845, they concluded that the cheap system of railroads, which had been built in America, were the best adapted to their needs. With this idea in view, a commission of Russian engineers came to this country to investigate the methods of building and operating our railroads. The result of their investigations was, that Major Whistler, who built what is known now as the Boston & Albany R.R., was engaged to go to Russia to supervise the construction of the Moscow & St. Petersburg Railroad. When he was in consultation with the Emperor concerning the route to be followed, the head of all the Russias drew a straight line between Moscow and St. Petersburg and said, "There is the route I want you to follow." Major Whistler followed the directions as closely as the nature of the country would permit, and a very satisfactory survey was the result.

When the question of the most suitable machinery for this railroad came up, American engineers were naturally consulted. Ross Winans, the well-known American engineer, obtained the contract to build the railroad rolling stock required for the Russian railroad. One of his sons, familiarly known as Tom, went out to Russia and had active charge of all the work agreed on. While he was there, Mr. Fred. Weir was engaged to go out and take charge of the repair and maintenance of the rolling stock. After the engines and cars were built, the Winans obtained a contract from the Russian Government to maintain the rolling stock at the following prices: For every empty freight car 3½ cents a mile was paid, and for every loaded freight car 4 cents per mile; for keeping the passenger cars in running order 7 cents per mile was paid, and 20 cents for every engine and tender. Among the items of repairs was the painting of freight cars and engines twice a year. As this drain of frequent painting was considered rather heavy on the contractor, $18.75 extra was allowed every two years on every freight car, and $93.75 on passenger cars.

During the time of the Crimean war the passenger equipment was wholly inadequate to the demand for transportation of troops, and the greater part of the freight equipment was converted into vehicles for carrying soldiers, rough seats being placed in each car. When this was done, Mr. Winans claimed the allowance of passenger car maintenance, which was 7 cents per mile, for all the freight cars that were used in transporting soldiers. The claim for this aggregated 6,000,000 roubles or about $4,500,000. The Government objected to paying this extra charge, and the case had to be decided by the courts. When Mr. Winans was preparing to sue the Russian Government, he learned that Mr. Benjamin Latrobe, the well-known American civil engineer, was in Paris. Mr. Latrobe had originally been educated for a lawyer, but had ended by following the profession of civil engineering. Mr. Winans sent an inquiry to Mr. Latrobe, asking what he would charge to come to St. Petersburg and take charge of the case against the Russian Government? Not wishing to go there, Mr. Latrobe answered, $50,000, and his offer was at once accepted. Under his management, the case was won for the plaintiffs, and they felt so well satisfied that Mr. Latrobe was given a present of $5,000 extra to cover incidental expenses.

Mr. Weir talks quite enthusiastically about the treatment which he received from the Russian officials, and of every one he came in contact with while staying in that country. He wishes to go over next year and pay a visit to his old friends.

It will be news to many of our readers that Russian railways were the first to use exceptionally heavy locomotives for freight service. In 1851, Winans built mogul engines with cylinders 18 x 22 inches, and a few years later he built a pair of passenger engines for pulling the royal trains which had cylinders 22 x 22 inches.

Attributing Boiler Explosions to Unnatural Causes.

A writer in the *Locomotive Engineers' Journal*, who gives his views on the subject of boiler explosions, finds fault with LOCOMOTIVE ENGINEERING because the editors had failed to publish an article on the same subject contributed by the complainant. The article consisted principally of a theory that boiler explosions were caused by some mysterious agency which suddenly generated an irresistible gas pressure that rendered steel or iron plates useless. Theories of that character have frequently been advocated, but those who are best able to judge of the causes of boiler explosions all agree that they are dangerous fallacies. Boilers explode because some part is not strong enough to withstand the pressure put upon it by natural causes. We decline to publish irrational theories about boiler explosions, because they do not have a place in the gospel of sound engineering, and we are apprehensive of our readers falling into heretical beliefs on a subject so important to their worldly welfare. Our motto is: Keep the steam gage correct, do not meddle with the safety valves and see that vigilant inspection is made for broken stay-bolts. It is also a safe plan to see that there are two gages of water in the boiler. Believing that boiler explosions are due to the act of God or to causes beyond human control does no harm to a minister or lawyer, because their habits are not going to be influenced by the belief; but when ideas of that kind get into the head of an engineer they are likely to have a bad influence, since they may lead him to neglect the precautions necessary to prevent accidents to boilers.

As a rule, injustice is done to the man in charge when a boiler explodes. A worn-out boiler that has received no systematic inspection, and has held together with mysterious persistency, goes to pieces one day, and all those who are really responsible for a death-trap being where it could do harm, at once shout, "The water must have been too low." This cry of low water is nearly always raised as a fog to hide the real culprit. Hot sheets are weaker than cool ones, and boiler explosions have resulted from overheated furnaces; but cases of this kind have been very rare compared to those that have resulted from broken stay-bolts and corroded sheets.

There is a good deal of excuse for people thinking that something mysterious must have been at work to tear a boiler into pieces. The boiler has been working under the same pressure day after day without showing any sign of distress, and it suddenly goes to pieces without any warning. That seems strange when the whole bearing of the case is not understood. Although no weakness has been apparent, there have been stay-bolts breaking gradually, or there may have been a crack in some sheet, working deeper and deeper with every infinitesimal bend due to change of pressure. A time comes when the stayed surface or the cracked plate becomes too weak to resist the pressure within, and the explosion is too sudden to give warning. Unexpected and inexplicable failures or breakages are quite common in all lines of industry; but they do not attract so much attention as boiler failures, because the effects are not so destructive. A link in the chain of a crane breaks under a lighter load than the same chain lifted two hours before. A crank shaft breaks, not with the engine working at its maximum power or speed, but under comparatively light duty. A locomotive axle breaks when the engine is jogging along at a quarter of the speed made the day before. Every man handling tools, or familiar with appliances subject to shocks and severe strains, remembers some case of unaccountable breakage. These things are strange, but few people think that Satan or some other evil power had any hand in the failure. It is only when a boiler explodes that the mysterious agency is aired. The most careful investigation may fail to identify the broken stay-bolts, the cracked sheet, corroded seam or brittle plate, but those who are given to reasoning between cause and effect will certainly abide in the faith that one of these, or some other natural cause, has led the boiler to grief.

The unreasoning terror that a boiler short of water excites in the average individual was amusingly illustrated in a news item in a morning paper. The fireman in charge of the heating plant of a large hotel had a pet monkey which made headquarters in the boiler room. One morning there was no heat in the house, and on investigation it was found that the monkey had opened the blow-off cock of the boiler, having imitated an act the fireman was in the habit of doing. When the guests complained about the cold, the landlord assured them that they were fortunate in not having been all blown into eternity, for it was a miracle that the boiler did not explode when the water was run off!

When Courting Was a Crime.

There is in the possession of Mr. Charles J. Gould, president of the Gould Coupler Co., a curious deed executed by one of his ancestors in 1686. It is written on faded parchment, and is addressed to all Christian people to whom this present deed of gift shall come, that certain lands were deeded by John Gold to his sons John and Thomas.

From a pamphlet on mining, quarrying and smelting ores in Boxford, by Sidney Perley, we learn that one of the first iron works established in America was built on land owned by this John Gold, and that he was a leading man in the enterprise. His descendants remained in the business, and Mr. Charles J. Gould, who is principal proprietor of the largest forge in Buffalo, is direct in the line of descent, his side of the family having always followed the iron business since it was first begun.

From the same pamphlet we note that the first iron smelting was carried on by Henry and James Leonard, who had learned the business in England. The iron was made from bog ore for which about one dollar (four shillings and sixpence) an ox-cart load was paid. When the bog ore was exhausted, New England lost its hold as an iron-producing State.

The new industry established among the rustic settlers seems to have stirred up some discord, for Daniel Black, a Scotchman employed in the works, was fined five pounds for making love to Edmund Bridge's daughter Faith, without her parents' consent. The prosecution did no good, for the Scot was persistent, and, of course, eventually married the girl, and became one of the principal owners of the works.

It is recorded that about twenty years afterwards Daniel Black took part, with his wife's father and two others, in taking forcible possession of the works leased by Henry Leonard.

These Leonards were unfortunate in New England, and they moved to New Jersey, where they established iron works and prospered. They deserve to be remembered by those interested in the American iron trade, for they were the first to introduce the infant industry on this continent. The American colonies of England were prohibited from engaging in the manufacture of iron up to 1645, when the Leonards got the restriction removed. They opened the first foundry in Lynn, Mass., but remained there only a short time before they removed to Rowley Village, which was afterwards named Boxford. The pamphlet referred to says that the Leonards were descended from a noble English family. This is probably a mistake, as the headquarters of the family used to be in Perthshire, Scotland.

The ironmaster, John Gold, was one of the leaders in a revolution that happened a hundred years before Washington's time. In 1686, the agents of James II treated the New England colonists with cruel tyranny. Captain Gold commanded a company of militia, and was so outspoken in opposition to the tyrant that he was arrested and imprisoned in Boston jail. When the tyrannical king was chased from his throne, Captain Gold helped to turn his agents out of America.

A Wonderful Machine.

BY SAM SHORT.

This story was told by one of the boys at the Junction, as we sat round the hall stove in the Mogul Hotel.

"When I first came to the Junction," said Charlie Foster, one of the gang bosses, "I went to board in the Commercial House, which was crowded with engineers and firemen. They were the top roosters there, and a shop man could seldom get a bite from a dining-room girl till all the enginemen were served.

"All these fellows were bursting with talk about fast runs, narrow escapes, and stupendous feats in getting over certain hills without doubling. Ed. Woods would hold the table in silence while he told how he kept her going on No. 3, with one car extra, and made up forty minutes between here and Albert Lea. Al. Towne had a thrilling tale of how he and Billy Brant were coming back over the Coal Division with a snow plow, at night, and forgot about the short rail at Elmira. Both engines and plow were out in the country a quarter of a mile before they stopped, and never a rod broken or axle bent. Such talk as that made the machinists silent ciphers.

"When an exciting story was not on, the smaller lights would get in records of minor incidents. Long John would tell the narrow escape he had on the Pacific division, when Dave De Gear stopped with his passenger train between stations to have a shot at some prairie chickens. By superhuman efforts, John succeeded in pulling up so that his engine just touched the hind car. Tom Myers would tell how quickly he got the '36' disconnected and going, when she broke her back-up eccentric; and Tom Jones would report the story of how near he escaped from having his checks called in when the '42' broke her side rod going down Morse Hill. Then Harry Walbrandt would give more particulars of how he hooped up the '92' to make West Branch against the 'Cannon Ball,' and how she rushed past like a flash a minute after he got on the side track.

"We had got tired of this kind of monopoly, and the machinist side was determined to have an inning. George Dorward, who ran the big engine lathe, sat opposite me at the table, and he made up his mind to take the first share of the talk. He posted me to help him out with a story.

"The table seats were hardly filled, when Fatty Flint began the story about his thrilling experiences bucking snow with the 'President' at Reinbeck. He said:

"'You see the cutting was about fifteen feet deep and as hard as my head. They cut the face of the snow square, and we went back two miles to take a run at it. By the time we were a hundred feet off the bank, we were going seventy miles an hour, and the snow loomed out like a mountain. I shut off steam, but Sam kept his throttle open. He said to me after, 'Why did you shut off before you struck the snow, Fatty?'

"'Shut off!' said I, 'I was so scared that I would have jumped off, if I had time.'

"'Frank McConnachie was conductor, and ——'

"'Well, I went over and saw that machine to-day,' broke in Dorward with a voice that said, I can tell you something better than Fatty's oft-told quarrels with McConnachie.

"'I tell you it's a dandy. It's astonishing the fine work it does and the quantity of steel it can slice off.'

"'How does it do the work?' I inquired, pretending breathless interest.

"'Well,' he said, 'the apparatus must be seen to be properly appreciated. Won't all you boys come round in the morning and see our newest tool?' he inquired, and a chorus of 'Certainly' was the answer. George had got the house.

"'On what principle does it work?' I inquired again.

"'It is difficult to give a clear explanation,' replied George. 'By means of a fulcrumed attachment, the reciprocating power of the prime motor is converted into circular movement. The power in this form is transmitted through connected arbors and pulleys to the main shaft of the machine. The principal member of the machine is a disk, which revolves upon a vertical plane. Power is applied through the axis of this disk. When the speed of the arbor is moderate, the periphery is moving at great velocity. All work is done on the periphery of the disk. Hardened steel and chilled iron are by mere impact reduced to any shape the operator may desire. I tell you, it eats away a piece of tool steel in great shape.'

"'What in thunder is the machine, anyhow?' demanded Tom Meyers, acting as spokesman for his crowd.

"'Oh, it's our new grindstone,' said George, with a serious face, and a chill of melancholy struck the crowd. Then Ed. Woods, with a look of disgust, called upon Fatty to tell about McConnachie's meanness.

"The machinist side took turns after that. There was seldom a day that a story was not told about some lathe that had run away and smashed things, a planer that was noted for collisions, or a boring mill given to queer tricks. Our yarns were about as true, and more original than those that came from the enginemen."

That the product of the Westinghouse Electric & 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, the little island, near the coast of Ireland, which has been made famous by Hall Caine, the great novelist; another order for electric railway apparatus for the city of Coventry, England; and a third order for electric motors and railway generators for Capetown, South Africa. The company is also about to ship an order for electric railway apparatus to Bangkok, Siam, India.

The Interstate Commerce Commission have sent out advance sheets of their annual report, intended for the use of the press. The sheets give the most salient and interesting parts of this report, and contain over six thousand words.

The Colorado Midland is out of the Atchison system, having completed the deal with the Denver & Gulf.

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SINCLAIR & HILL.

Operating Locomotives with Different Crews.

When from any cause the traffic on a railroad is beyond the capacity of the locomotives operated in the ordinary way, the men in charge will resort to any practical method for securing more mileage from the engines. The most convenient and satisfactory method of operating locomotives is to have every engine assigned to a regular engineer and fireman, and confine the mileage to the physical endurance of the crew. When they need rest, the proper way is to lay the engine up until the men are able to go out again. There has never been a question among master mechanics and enginemen of that plan being the best way of operating a locomotive, in order to secure the greatest possible mileage between periods of shopping for repairs, and for doing the work with the least possible consumption of fuel and supplies. The only question has been, Does it pay to keep a machine worth ten or twelve thousand dollars standing idle while the crew are resting?

The subject of operating locomotives with different crews has been investigated several times by committees appointed by the Railway Master Mechanics' Asociation, and it has been very exhaustively discussed. The advantages of operating locomotives with more than one crew might be summarized in a short paragraph to the effect that it saves a large investment of capital in power, decreases the amount of fuel wasted in housing, banking fires and restarting them, and saves roundhouse room, fuel and plant for warming them in severe weather. Where there are an unequal number of trains in opposite directions, the pool system gives the men equal hours of rest and equal work. Against these advantages there have been objections raised almost as long as the Moral Law. The old objections and several new ones have been very well summarized in a paper read by the veteran master mechanic of the Pittsburgh, Cincinnati & St. Louis, Mr. William Swanston. Mr. Swanston is one of the most experienced and sagacious mechanical men in this country, and his views are always well worthy of consideration.

In the paper referred to, Mr. Swanston stated that, after two years' trial, the Pittsburgh, Cincinnati & St. Louis had abandoned what is known as the "chain-gang" system of running locomotives. The cause that led to the change was the additional expense of running locomotives on the first-in-first-out system. They were not able to do the work with fewer engines, and the cost for operating and repairs was increased. The engines not being assigned to any one crew, none of the men took any special interest or care of them, nor was this expected of them. It was therefore necessary to employ additional men in the roundhouses to do the work that was formerly expected of the crews. This additional help increased the roundhouse expense per engine handled a little over 11 per cent., or $5,000 per year. This included light repairs which are done in the roundhouse to engines in service or that may be laid up for a few days. They also found that, by comparing the two years of service in the "first-in-first-out" system with the two years next preceding its introduction, 20 per cent. less mileage between shoppings had been obtained in passenger service, and 24 per cent. less in freight service. With this reduction of mileage between shoppings for general repairs, they had a corresponding increase in the cost of repairs. In theory, it is said that two engines of the same build, in the same service, the repairs made and looked after with the same care, should give the same service, leaving accidents out of the question; yet they found that such results had not been obtained, and the only reason was that the personal interest which the crews take in engines that are assigned to them in the extra crew system is left out in the others. To make up for the work done by the crew, they added to the roundhouse expenses; but this did not balance the loss created by taking the responsibility of the condition of the engine away from the crew and placing it on the men employed in the roundhouse. Efforts were made to have the enginemen report work needed on engine at the end of each trip, and discipline applied for not reporting; but with all, the reports were not carefully made, because of the lack of interest in the engine on which they had just made a trip, and because the same crew may not have the same engine again for several trips; and thus the duty of reporting work is left to the next crew or to the engine inspector to find out.

Some railroad officers who incline to look upon enginemen as merely animated machines which ought to be compelled to do their duties faithfully, no matter how their engines are operated, ignore a very important force in all human affairs—that is the tendency towards excellence promoted by sentiment. Like a wise man, Mr. Swanston gives the human equation full consideration, insisting that personal interest in the performance of any duty is of the utmost importance, and no work is well done that ignores this principle. It applies not only to engine crews, but to all branches of railroad service, to the officers as well as to the other grades of employés, and no discipline will take its place. The principle which stimulates men to take a personal interest in the tools they work with, or the duty they are called on to perform, makes better men of them. The engineer and fireman who cares only for the trip and not for the engine, who only oils round starts and stops, or to keep up steam, and who feels that his responsibility ends with the trip, will make but little progress toward improvement; but with the responsibity for the condition of the machine comes a personal interest in it, which must result in advancing their knowledge of the engine, and thus making them more valuable men. Railroad companies which went into the pooling system have not been logical concerning results. They will not put pooled engines upon trains that they are anxious to get through promptly. If the practice does not succeed in one case it fails in the other.

When the circumstances which tend to saving with single-crewed engines, and to waste in those operated in chain gangs, are considered, and the results estimated, it is very doubtful if the saving of the capital that would supply a locomotive for each crew is profitable. In fact, we are assured that there are very few companies operating the chain-gang system that would not find the spending of money to purchase enough engines to provide one for each crew a highly profitable investment. Of course, railroad companies which cannot raise the increase of capital to purchase all the locomotives they need are excusable for doing the best they can with the engines they have got; but it is every day becoming more apparent that running locomotives without regular crews is an expensive policy.

Shop Rules and the Selection of Shop Foremen.

Americans, as a people, do not enjoy the dictation of "rules and regulations" displayed to regulate their walk and conversation. It is noticeable that many men resent the notice "No smoking allowed," and incline to prove by practice that parties putting up such notices have no legal authority to prohibit smoking at the particular places indicated.

This sentiment which moves men to resent gratuitous "rules" causes bad feeling in the shops conspicuous for the exhibition of prolix and minute details as to how workmen shall conduct themselves in the establishment. To post up rules of behavior for workmen is to assume that they do not understand how to conduct themselves as men, and occasionally the rules also tell them, in more or less plain words, not to steal. This is supposed to be complimentary to the ninety and nine honest men in every hundred, but somehow these dull-headed fellows look upon the injunction as a standing insult. When trouble arises, the managers cannot understand the lack of loyalty among the workmen. People who understand human nature are sparing in the display of shop rules. They understand that many trifles exert more galling effects than serious hardships, and leave their marks over a greater surface.

Proprietors, master mechanics, or managers who attempt to regulate the conduct of workmen by posted rules, imply want of confidence in the foreman. There is frequently conspicuous want of judgment displayed in the selection of foremen, which causes confusion which the head of the shop is really responsible for. The framing of strict shop rules is then resorted to as a remedy.

An impression is widespread that the first requisite for a good foreman is that he should be a first-class workman. This is a grave mistake. One of the most successful foremen we have ever known was promoted from the position of time clerk, and he was no mechanic at all. But he possessed in an eminent degree the faculty of managing men—no driving. The men believed that they were splendidly treated by this foreman, and they very quickly got over the resentment at having a man put over them who was no mechanic; but they all turned out more work than they did under the old foreman, who had the name of being a hustler and a driver.

There is a weakness on the part of some managers in favor of the noisy man for foreman. They think he will make things rush, and he breeds only clamor. If the same man's methods as a workman were quietly observed for a few weeks before experimenting with him as a foreman, the promotion would nearly always be indefinitely postponed. Everything else being equal, a good workman should be selected for promotion to the place of foreman; but more important than manipulative skill is the possession of executive ability. It is more important that he should have the capacity of seeing ahead, and of knowing how to keep work moving from the rough to the finish without a hitch, than it is that he should be able to show a workman the best way of doing a job, although that is a capability not to be despised. Personal habits ought to receive the first consideration. No matter what a man's mechanical abilities may be, his influence will be bad if he is not honest, honorable, sober and of good habits. We have known many human brutes who came, through mismanagement, to be foremen, and even went higher; but we never knew a case of the kind where the employer was not a sufferer.

An incompetent foreman always keeps a shop in a ferment and the workmen irritated. He does not know how to keep the work going systematically, and he complains and scatters blame around when he himself is the only culprit. If employers will follow a strict rule of appointing only good moral men as foremen, and if they will select persons thoroughly competent, they need not trouble themselves about the printing of shop rules. The precept and example of those in authority will be a good enough law for every member of the establishment.

Why Railroads Cling to Antiquated Machinery.

Between the fierceness of competition that keeps transportaton rates too low for living profit, the burdens laid on by unfriendly legislation, and the injunctions from Wall street to keep down expenditures, railroad companies are what we might call chronically hard up. When a mechanic accustomed to the high-class tools employed by the manufacturers of railroad machinery, examines the tools in a railroad shop and finds them slow, inaccurate and antiquated, he naturally exclaims, "There is bad management here, or most of these tools would be sent to the scrap heap."

The truth is that the men in charge, from the president of the company downward, appreciate that it would pay in the long run to purchase new and modern tools; but stockholders are not willing to have their dividends reduced for the benefit of future owners of the property, and so they inspire the directors to refuse appropriations for expenditures that can be postponed. The root of many evils which afflict railroad management may be traced to the fact that the ownership of railroad stock is so transitory that the holders are interested only in what they can make at present. The future prosperity of the property is nothing to them. This is why rolling-stock trusts are so common, and it accounts for the scarcity of first-class cars and locomotives on many railroads.

Cathode Rays for Detecting Defects in Machinery.

When the announcement was made that Professor Roentgen had discovered a method of photography which would picture the inside of bodies, engineers at once perceived a line of practical usefulness in applying the process to the discovering of hidden flaws in metal. Surgeons have lost no time in employing the cathode rays for indicating the position of fractured bones, and we now learn that several engineering establishments are preparing to make the best possible use of the process for examination of metal. If the cathode rays will reveal hidden flaws in shafts, axles, crank pins, etc., it will be the means of preventing numerous accidents.

The whole process, even in its present elementary state of development, is so strange and wonderful that the mind is opened to accept almost anything as possible for its revealing power. To expect that the rays may yet be made to show the inside of a steel ingot as clearly as the unaided eye sees through a glass of clear water, is not nearly so improbable as it was to suppose six months ago that a photographic process might be discovered which would make a picture of the position of the bones in a human hand. We should not be surprised in a few years to find cathode-ray photography employed in all repair shops to examine the internal condition of the working parts of engines, and to see the photographic laboratory looked upon as a necessary part of every well-ordered repair plant.

There is a movement among general passenger agents to abolish the use of unlimited tickets entirely. On the other hand, public sentiment inclines to demand that no tickets shall be limited. People say that when railroad companies are paid for a ticket, it is their plain duty to carry the passengers no matter what time the transportation may be demanded. The claim is made that selling unlimited tickets encourages "scalping." The public have little sympathy with the abuse of "scalpers" by passenger agents, for they are well aware that there would be no "scalpers" if it were not for the aid and comfort given to them by railroad companies. In this connection, it would be well for railroad men to reflect that every move made to take away privileges from the traveling public results in helping to bring about restrictive legislation.

The report of the Kansas Railroad Commissioners for 1895 makes the total income for the year show a net decrease, as compared with 1894, of nearly $10,000,000, while operating expenses were reduced less than $6,000,000. Only two of the twenty-six roads making reports paid a dividend. Thirteen roads were in the hands of receivers.

Reform the Performance Sheet.

Under the caption, "The Deceptive Performance Sheet," we published last month some remarkably good reasons given by Mr. J. H. McConnell for reforming the existing methods of making out performance sheets. The remarks on the subject have excited widespread discussion, and intimation has been given that the question will be brought up at next Master Mechanics' Convention with a view of having standard methods established. This is a very good idea, as it will bring out renewed pressure in favor of a much-needed reform; but we are under the impression that the Master Mechanics' Association recommended in 1892 a uniform locomotive performance sheet which would have eliminated the misleading figures which many of these sheets now contain. Apart from anything that can be done to make performance sheets uniform, there are almost insuperable difficulties in the way of showing a fair comparison of work done on a straight, level system of railroads, with that done on a road traversing mountainous districts, where gradients are heavy and curves numerous.

In the correspondence pages of this issue Mr. George W. Cushing discusses in an interesting manner the subject of "Uniform Reports of Locomotive Performance," and, incidentally, the important intimation is given that something more than an account of tonnage hauled is needed in a standard performance sheet. As now made out, performance sheets are valuable only in providing the means of making monthly comparisons of the work done by locomotives operating under fairly uniform conditions —that is, for engines which are hauling the trains they can handle over the same road day after day. If the cost of operating varies to any extent, the performance sheet gives warning that something is wrong. It is manifestly unfair, however, to make the performance sheet of one road a basis of comparison for the cost of operating on another road, where the conditions are entirely different, and the methods of making out the reports are different.

The varied methods of making charges against locomotives constitute, however, the great difficulty, and enable some roads to make a much more favorable showing than others that are really dong the work more economically. On some roads, all new engines purchased are charged to capital stock; while on others, they are charged to repairs. Some companies charge the cost of new appliances, such as air brakes, to the repair account; while others charge it to a betterment account. On some roads, the damage caused by wrecks is charged to locomotive repairs; while on others a separate account is kept, and repairs made necessary by accidents not due to engine failures are not charged to operating expenses. The method of charging a variety of other expenses differs materially on different roads. On some roads allowances of mileage are made for delays, for switching, etc.; while on other roads, merely the mileage between terminals is allowed. The mechanical departments cannot effect the necessary reforms in this diversity of practice, without receiving the co-operation of the accounting departments.

This confused condition of making out performance sheets does real harm sometimes. The general manager of a crooked, hilly road, that charges every source of locomotive expense to the cost of operating, and allows no mileage except what is actually run, has been known to take the performance sheet of another road and make complaints because the other seemed to be operated at considerable less expense per mile run. The other road was level and fairly straight, had light engines, charged the expense of betterments, wrecks, etc., where they belonged, and allowed engines mileage for delays. He was not familiar with the methods of making out items for the performance sheet of the other road, and his complaints seemed reasonable because they were based on false information. We know of a case where a superintendent of motive power was invited to resign because he did not keep his engine expenses as low as that of another road which was bent on making the best possible showing. We know of general managers who are keenly interested in the postal card summaries of performance sheets sent out by other companies, and who use them to make odious comparisons for the spiritual edification of the heads of their mechanical departments. The cards that have the Ananias stamp impressed most plainly upon their countenance are the most cherished.

A thorough reform of the delusive performance sheet is not practicable, for it would require to show the foot-tons of work done by the engines. A reform that would be of great value is merely to follow the recommendations of a committee which reported to the Master Mechanics' Convention in 1892. That committee, of which Mr. George F. Wilson was chairman, made a series of recommendations which, if followed, would insure uniformity in the methods of making charges. We question if a single railroad company changed their methods at the instance of that report. The subject, however, deserves to be agitated. Every word publicly expressed against the existing want of uniformity of performance sheets helps the cause of reform, which must come sooner or later. Meanwhile we would advise every man interested to get a copy of the Master Mechanics' report for 1892, turn up page 124, and read the report on "Uniform Locomotive Performance," also the discussion that follows.

Utility of Small Driving Wheels.

When consolidation and other powerful freight locomotives first came into use, there was a tendency among designers to make the driving wheels as small as possible consistent with the speed required. This was done with the view of making the engines as powerful as possible for the weight and size of cylinders. Engines with unduly small driving wheels were found to be costly for maintenance, and they were nearly all hard on fuel. On account of these admitted objections, the tendency for the last ten years has been to make the driving wheels larger. Mr. McConnell, of the Union Pacific, contends that this is a wrong policy. At the Western Railway Club he said:

"About five years ago, in 1890, the company purchased 130 new locomotives, and since that time there have not been any locomotives purchased. A number of them were designed for fast freight service, and on the mountain divisions, with an ordinary light train, they gave good service for fast freight, but we had more locomotives of that character than were necessary for the service. We changed the wheels on those engines from 62 inches outside of the tire to 51 inches in diameter, and the result was it increased the train haul on those engines from 16 cars to 22 cars to the train. The company had some consolidation engines with Wootten boilers, and they gave very unsatisfactory service. We built some new consolidated engines in Omaha to take their place. The cylinder was the same size, but we reduced the size of the wheel from 56 inches down to 51 inches. The other engine pulled 22 cars over the road, and the new ones 30. They are doing it without any more coal and without any more expense."

BOOK REVIEWS.

"Shop Kinks and Machine Shop Chat." By Robert Grimshaw. Published by Norman W. Henley & Co., 132 Nassau Street, New York. Price $2.50.

This is a book 5½ x 8 inches, bound in cloth, and the 379 pages contain what its title indicates. There is much between the covers that will be of interest to the younger generation of shop workers; and some of the older ones might profit by it also, for that matter. The old-timer will find many of his pet schemes and shop secrets brought to light, and the "cub" will see many things on which to exercise his thinking machine. There are old kinks and new ones—all of use in the shop or out of it—for which credit is given where due; which, by the way, is not an old kink. The index is arranged so that it is a useful adjunct to a useful work.

There is talk of operating the St. Louis tunnel by electricity. Since the Baltimore & Ohio people began operating the Baltimore tunnel with electric motors, the St. Louis people have discovered the gases in the tunnel that extends from the Union Station to the bridge to be more intolerable than they were before.

PERSONAL.

Mr. M. V. Meredith has been appointed general manager of the South Haven & Eastern Railroad, with headquarters at Lawton, Mich.

Mr. John Purcell has been appointed assistant mechanic of the Atchison, Topeka & Santa Fé at Argentine, Kan., in place of Mr. J. Forster, promoted.

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. Harvey Middleton has resigned as general manager of the Pullman Car Works. He has held that office for five years—a long time, considering the difficulties of the position.

Mr. R. B. Agnew has resigned as division superintendent of the Chicago, Rock Island & Pacific at Colorado Springs, Col., to become manager of a new hotel at Cripple Creek, Col.

Mr. Frank C. Smith, trainmaster of the Chicago, Rock Island & Pacific at Horton, Kan., has been appointed division superintendent of that road, with headquarters at Colorado Springs, Col.

Mr. Frank George, heretofore assistant superintendent, has been appointed superintendent of the Spokane Falls & Northern and Nelson & Fort Sheppard roads, with headquarters at Spokane, Wash.

Mr. S. A. Faulkner, formerly general clerk, mechanical department of the Wheeling & Lake Erie Railway, has been appointed general storekeeper of the same road, with headquarters at Norwalk, O.

Mr. T. R. Wadleigh, road foreman of engines of the Norfolk & Western, has resigned to accept the position of Southern Inspector for Messrs. Castner & Curran, general agents of the Pocahontas Coal Co.

Mr. V. E. McBee, heretofore superintendent of the Third division of the Seaboard Air Line, at Atlanta, Ga., has been appointed general superintendent of the entire system, with headquarters at Portsmouth, Va.

We are requested by Mr. Allen Cooke to mention that notwithstanding his resignation from the Chicago & Eastern Illinois, he is not inclined to retire permanently from railroad life. He feels too active for that.

Mr. J. B. Swan, formerly of the Indianapolis shops, more recently in the shops of the Pan Handle at Dennison, as foreman of the car department, has been appointed foreman of the Pan Handle shops at Columbus, O.

Mr. J. Forster, assistant master mechanic of the Atchison, Topeka & Santa Fé at Argentine, Kan., has been appointed master mechanic of that road at La Junta, Col., a position heretofore held by Mr. I. Conroe.

Mr. Peter Maher has been appointed master mechanic of the Indiana, Illinois & Iowa Railroad, with headquarters at Kankakee, Ill. He will have charge of all matters pertaining to motive power, machinery and cars.

Mr. A. L. Moler has been appointed general foreman of the Cincinnati, Hamilton & Dayton Railway, with headquarters at Hamilton, O. He was formerly in the employ of the New York & Northern at Tupper Lake, N. Y.

Mr. 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 & Car Co., as their traveling sales agent.

Mr. I. Conroe, master mechanic of the Atchison, Topeka & Santa Fé Railway at La Junta, Col., has been, at his own request, appointed traveling engineer of the same road. He previously held the same position before being promoted to master mechanic.

Mr. E. M. Roberts, a well-known master mechanic, who resigned from the South Carolina Railroad several years ago, has been appointed master mechanic of the Southern Iron Car Line, with office at the shops of the company at Atlanta, Ga.

Mr. Robert Tawes has been appointed master mechanic of the Toledo, Ann Arbor & North Michigan Railway, with headquarters at Owosso, Mich. He will have charge of maintenance of motive power, cars, machinery on boats, and water stations.

Mr. George Wilson, of Philadelphia, the popular agent of the Columbia Packing Co., has resigned. Mr. Wilson has been exceedingly successful with the railroad articles which he has handled for different companies. He is open for a new engagement.

Among the locomotive engineers of the Pennsylvania stationed at Harrisburg, Pa., twenty-one have been in the company's service over twenty-two years, the average of that number being 28.8 years. The oldest engineer there is Mr. John McNeil, with a continuous service record of forty years.

Mr. O. F. Nichols has resigned as chief engineer of the Brooklyn Elevated Railroad, and has been appointed first assistant engineer of the new East River Bridge at New York. He has been chief engineer of the Brooklyn Elevated road since 1881, and was also general manager from 1892 to 1894.

Mr. N. J. Paradise, general master mechanic of the Hannibal & St. Joseph, died a month ago of paralysis. He was born in Quebec, Can., and came to the United States when he was about twenty years old, and went to work for the Chicago, Burlington & Quincy Railroad, where he steadily rose to the position he held at the time of his death.

Mr. Edmund Berkeley, formerly superintendent of the third division of the Southern Railway, has been appointed superintendent of the Third division of the Seaboard Air Line, with headquarters at Atlanta, Ga., to take effect February 1, to succeed Mr. V. E. McBee, promoted. Mr. Berkeley resigned from the Southern Railway last September.

Mr. William O'Herin, superintendent of motive power and machinery of the Missouri, Kansas & Texas, has been appointed superintendent of machinery and equipment, and will have charge of the locomotive and car departments, with headquarters at Sedalia, Mo. The office of superintendent of car department has been abolished.

Mr. Oscar G. Murray has been elected first vice-president of the Baltimore & Ohio Railroad, and has resigned the position of second vice-president of the Cleveland, Cincinnati, Chicago & St. Louis. Mr. Murray has been a remarkably successful traffic manager, and it is understood that he will devote his energies principally to that department of the Baltimore & Ohio.

Mr. J. H. Sample has been temporarily released from the duties of general superintendent of the Northern Ohio, and has been appointed acting general superintendent of the Cleveland, Akron & Columbus, to succeed Mr. J. H. Barrett, resigned. The authority of Mr. D. S. Hill, general superintendent, and Mr. G. T. Jarvis, assistant general superintendent of the Lake Erie & Western, has been extended over the Northern Ohio.

Mr. C. P. Krauth, the genial secretary and treasurer of McConway, Torley & Co., Pittsburgh, Pa., is said to be the best philatelist, or authority on stamps, in America. He collects stamps and exchanges with some of the best experts in Europe, and is also a celebrated writer on the subject. He also collects or produces very amusing anecdotes, and we have exchanged a good many stamps for his stories, with the impression that the best of the bargain was on our side.

Mr. C. H. Hudson, chief engineer of the Southern Railway, has had conferred upon him the additional title of mechanical engineer of the road. He was for years general manager of the East Tennessee, Virginia & Georgia, and was one of the most eminent civil engineers in the Northwest before he went to the road mentioned. It is understood that the superintendent of motive power will consult with Mr. Hudson on all important matters relating to the mechanical department.

President Hill, of the Great Northern, is one of the best financiers in America. There is talk all the time that he covets control of the Northern Pacific. If that is true he will get it eventually. No one understands better than Mr. Hill what has brought the Northern Pacific to grief and the real difficulties in the way of reorganization. In a recently published conversation he is said to have asserted that the mortgages are bigger than the property. When that is the case the bondholders must agree to make concessions.

Mr. W. L. Derr, superintendent of the Erie at Port Jervis, contributed an interesting article to the "Engineering Magazine" for February, on "Railroad Accidents and Emergency Service." Most of the paper is devoted to "Wrecking," and much sensible advice is given to men having charge of this troublesome work. Good suggestions are also given concerning the care of wounded persons. The paper is well worthy of being printed in pamphlet form for the use of trainmen and those engaged on wrecking service.

Mr. Albert G. Blair, who has been general manager of the Wheeling & Lake Erie since February 1, 1892, was on February 12th chosen president of that road, to succeed Mr. F. R. Lawrence. Mr. Blair has been with the Wheeling & Lake Erie since October, 1882, and was general freight agent until July, 1889, when he was appointed traffic manager. He held the last-named position until he was made general manager. He was connected with the Canada Southern Railway from 1875 to October, 1882, and has been in railway service since 1870.

Captain Wade, who has been superintendent of motive power of the Richmond & Danville and its successor, the Southern Railway, for fifteen years, has resigned that position. Captain Wade began railway work in October, 1857, as machinist in the shops of the Alabama & Tennessee road at Selma, Ala., and from 1858 to 1876 was connected with the Greenville & Columbia, successively as machinist, engineer and master mechanic. He was then for five years master mechanic of the Richmond & Danville, before being made superintendent of motive power in 1881.

The Kalamazoo Railroad Velocipede & Car Co., which has been doing business for the last twelve years as a co-partnership, was incorporated February 5th, 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 and promoter having large interests in various manufacturing enterprises of 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.

Mr. E. Dawson has been appointed general master mechanic of the Kansas City, Pittsburgh & Gulf Railway, with headquarters at Pittsburgh, Kan. Mr. Dawson gave up the position of superintendent of machinery of the Des Moines & Kansas City Railway to accept the appointment mentioned. He served his time in the shops of the Great Western Railway at Swindon, Eng., and came to this country in 1881. He went to work on the Chicago & Northwestern Railway as a machinist under Mr. Robert Quayle, who, finding him a progressive young man, promoted him by degrees until he was made assistant master mechanic of the Fremont, Elkhorn & Missouri Valley Railroad.

Mr. W. H. Thomas, assistant superintendent of motive power of the Southern Railway, has been promoted to be the head of the motive-power department, in place of Capt. Wade, resigned, with headquarters at Washington, D. C. Mr. Thomas was originally a Pennsylvania Railroad man, having learned the business at Renovo, where he rose to be foreman. He held positions on the Mobile & Montgomery, Louisville & Nashville and Chesapeake & Ohio. From the latter road he went to be superintendent of motive power of the East Tennessee, Virginia & Georgia, a position he held for nine years, until the road was absorbed by the Southern Railway. He has been exceedingly successful in every position he held. Though a man of few words, he is exceedingly active in the performance of his duties.

Mr. F. D. Adams has resigned as master car builder of the Boston & Albany, on account of advanced age, and will retire from active work. He was born August 30, 1822, and has been in railway service since 1859. He began as master car builder of the Buffalo & Lake Erie, now a part of the Lake Shore & Michigan Southern, and from 1868 to 1870 was superintendent of the Ohio Falls Car Company. He was appointed master car builder of the Boston & Albany in 1870. He began car work, in 1847, with the Norwich Car Company, of Norwich, Conn., where he remained until 1853, when he went to Buffalo, N. Y., as a contractor in the Buffalo Car Works. He was then engaged as a contractor in Michigan until 1859. Mr. Adams has been a conspicuous figure at the annual conventions of the Master Car Builders' Association for many years, and his absence from future meetings will cause universal regret.

Mr. C. H. Zehnder has resigned the presidency of the Jackson & Woodin Mfg. Co., after a continued service of seventeen years, having begun his business career at the age of twenty-three, as clerk to the vice-president and general manager, the late C. J. Jackson, and occupied successively the position of secretary, superintendent, vice-president and general manager, and for the last three years president. During his management of this company's business it has been greatly enlarged, their trade having been extended over almost the entire country and a new and profitable branch of business developed. Mr. Zehnder has, at the solicitation of the large and wealthy stockholders of the Dickson Mfg. Co., accepted the presidency of that old and well-established concern, and it is the purpose of the new management to greatly increase its facilities and develop some new lines of business. The success of the Jackson & Woodin Co. was in a great measure due to the business energy of Mr. Zehnder, and his friends expect great things from his new management of the Dickson Mfg. Co.

Recently, intelligence reached Barnard Castle of the death of Michael Bradley, which event had taken place in Sunderland, at the residence of a relative. The deceased was, until quite recently, an inspector of permanent way on the Northeastern Railway, and resided at Prospect Place, Barnard Castle. He was born in 1815, and, in early life, entered the service of the Darlington and Stockton Railway, long prior to amalgamation. The head officials of the Northeastern Railway Company declared that, on his retirement, the deceased was the oldest railway servant in the world. Mr. Bradley was held in the highest regard by the company for the long and faithful performance of his duties. With the exception of a fortnight's absence, occasioned through injury to his foot, which was sustained in laying plates on a new line of railway, deceased, for considerably over half a century, was daily at work. So anxious was Mr. Bradley to superintend the new work that, even in this emergency, he was conveyed to work on a stretcher, at his own request.—"Railway Herald."

A Scotch paper, sent us by an admirer of the gentleman so kindly mentioned, says: "Mr. John F. Macintosh, chief of the locomotive department of the Caledonian Railway, who succeeded the late Mr. Lambie at St. Rollox, is a man in the prime of life, his abilities are of a high order, and the employés have all a good word for their worthy superintendent. He prefers to counsel instead of drive, and as a consequence the greatest harmony prevails in the works. Mr. Macintosh is a native of Montrose, but put in his early years' work in Arbroath. While in the execution of his duty as an engine driver, he met with an accident which entirely changed the current of his life. He was obliged to leave the 'footplate,' but the company, recognizing that he was no ordinary engine-driver, gave him another situation in a different sphere. He rapidly passed through the various grades open to a railway official, and became assistant locomotive superintendent. Then the directors, on the death of Mr. Lambie, chose him as superintendent. He is a man of great tact and originality, clever both with hand and head, and many of the huge locomotives turned out from St. Rollox owe their success to his careful planning."

In the death of Mr. David Kinnear Clark, in London, January 22d, in the seventy-fourth year of his age, one of the most eminent mechanical engineers of this century has passed away. For half a century he has been a regular writer on engineering subjects, and he has been accepted as authority on every subject he wrote upon. Mr. Clark was a native of Glasgow, and learned the machinist trade in the Phoenix Iron Works there, and was afterwards draftsman in a famous engineering office in Edinburgh. From there he went to be locomotive superintendent of the Great Northern of Scotland Railway, a position which he held about three years. He devoted a great deal of his spare time while holding that position to investigating the correct principles of locomotive construction, and his researches were given to the world, in 1855, in his famous book on "Railway Machinery." That is one of the most admirable books ever written. It was published about twenty-two years after the first successful locomotive demonstrated that a new era in inland transportation had arisen. It represents the deductions of experiments made by the author to establish rules of practice in designing and operating locomotives, almost entirely founded on his own experiments and experience. It has been a guide and reference and a handbook regarding all classes of locomotives in all countries ever since it was published. Mr. Clark established the leading principles of locomotive engineering which the world has followed as standard, and his conclusions were drawn with such remarkable care and judgment that in few cases have they been questioned.

"Railway Machinery" was Clark's master work, but he prepared other engineering books that would have made any other writer famous. "A Manual of Rules, Tables and Data for Mechanical Engineers" is an exceedingly useful book, and is a trustworthy reference for mechanical engineers. Another work of Clark's is on the Steam Engine, which is very exhaustive in its treatment of the subject.

When the subject of holding the convention in the Coliseum Building, Sixty-third street, Chicago, Ill., was under discussion, it was urged that the noise caused by the exhaust from the locomotives passing that building was a decided objection. This question was promptly met by General Superintendent Sullivan, of the Illinois Central, who informed the superintendent of terminals that their company were equipping their locomotives with the Smith triple exhaust pipe, which will entirely obviate the noise from the exhaust of locomotives while in motion.

Adopt Gage for Sheet Metal, Tubes and Wire.

The following letter, which explains itself, has been sent by Secretary Sinclair, of the American Railway Master Mechanics' Association, to all the railroad companies which have not adopted the decimal gage for measuring sheet metal, wire and tubes:

"The decimal gage for measuring sheet metal, wire and tubes, made standard by the American Railway Master Mechanics' Association, has been adopted by over fifty railroad companies, some of them—like the Pennsylvania Railroad Co.—being among the largest corporations on this continent. The general adoption of the gage in the near future seems to be assured. This movement will end the inconvenience, delay and confusion that now prevail through the use of various number gages which are not uniform.

"The Pratt & Whitney Co., Hartford, Conn., have constructed special machinery for the manufacture of the gage, and they are now putting it upon the market, the cost being $5 per gage.

"I wish again to direct your attention to the advantages of adopting this gage, and urge that you will introduce it on your system, and thereby help to accelerate its progress into general use."

When a switchman is required to perform the dangerous operation of uncoupling a car which a locomotive with a pilot on is pushing in front, he had better insist that a stop be made before he attempts to pull the pin. In a somewhat famous case, where a switchman was severely injured while attempting to uncouple a car from the front end of an engine, the Supreme Court of Alabama has just decided that the plaintiff was guilty of contributory negligence in going between the pilot and the car.

The Foster Engineering Co., of Newark, N. J., have just received a large order from England for valves ranging in size from ¾ inch to 10 inches; have also shipped twenty-five of their air-brake pump governors to Vienna, and made a further large shipment of valves to Bremen.

The Norwalk Iron Works Company has just shipped a 14 x 16-inch compound air compressor to the Pennsylvania Railroad Company for use at Pittsburgh. This makes nineteen Norwalk air compressors in use on the Pennsylvania lines.

The Westinghouse Electric & Manufacturing Co., of Pittsburgh, have received a number of awards at the Atlanta Exposition for the handsome exhibit of electrical apparatus made. Several gold and silver medals are among them.

EQUIPMENT NOTES.

The Erie have ordered 2,250 box cars.

The Duluth, Missoba & Northern have ordered 600 ore cars.

The Chattanooga Southern have ordered 100 freight cars.

The Long Island have placed a contract for 50 passenger cars.

The Ohio River is reported to be in the market for 300 freight cars.

The Delaware, Lackawanna & Western are calling for bids for 1,000 cars.

The Lake Superior & Ishpeming has placed a contract for 400 ore cars.

The Central Vermont have ordered 13 passenger cars from Jackson & Sharp.

It is persistently asserted that the Cleveland, Lorain & Wheeling are in the market for cars.

The Geiser Co., Waynesboro, have placed an order for six private freight cars of 60,000 capacity.

The Adirondacks & St. Lawrence have ordered ten locomotives from the Schenectady Locomotive Works.

The Rhode Island Locomotive Works have received an order from the Boston & Maine for 20 locomotives.

The Lake Shore & Michigan Southern have, within the last month, ordered 2,100 freight cars of various kinds.

The Cooke Locomotive Works have received an order from the Wheeling & Lake Erie for 12 locomotives.

The New York Central have ordered 2,150 freight cars of 60,000 capacity. They will have Fox trucks, Gould couplers and Westinghouse air brakes.

Among recent orders received by the Baldwin Locomotive Works are five very heavy engines for the Lehigh Valley, one for the Norfolk Southern, one consolidation for the Lehigh Coal & Navigation Co., and one consolidation for the Norfolk & Western.

The Lake Superior & Ishpeming have placed an order with the Pittsburgh Locomotive Works for ten locomotives of the following character: five 19 x 26-inch six-wheel switchers; two 20 x 26-inch simple consolidations, and four 20 and 31 x 28-inch compounds.

A heavy tank engine, with eight wheels, all coupled, has been built at the Columbus, O., shops of the Pittsburgh, Cincinnati, Chicago & St. Louis Railroad, to work as a pusher on the Madison Hill grade, which rises 413 feet in a length of 7,012 feet, and this was operated by a rack rail locomotive from 1848 till 1868. The engine weighs 70 tons on a wheel-base of 15 feet 6 inches, and has driving wheels 4 feet 2 inches diameter and cylinders 22 x 28 inches. The tanks extend along the sides of the boiler, and carry about 2,000 gallons of water. The engine was designed by Mr. S. P. Bush, superintendent of motive power.

General Manager Thomas M. Campbell, of the International & Great Northern, recently visited Dallas, Tex., in his new car, the Cherokee, which is one of the most beautiful specimens of workmanship ever seen there. The thing about the car of which Mr. Campbell is most proud is that every splinter and every rivet, every truck and every truss from end to end and from top to bottom, was made right in Texas, and most of the material was grown in Texas. The interior is handsomely decorated with historical pictures, the one of Columbus discovering America being especially striking. All of the work was done at the shops of the International & Great Northern at Palestine.—"Exchange."

The Ontario & Western Fast Passenger Engine.

During a recent visit paid to Mr. J. E. Childs, general manager of the New York, Ontario & Western Railway, the writer learned some interesting facts concerning the performance of the eight-wheel passenger engine lately built by the Cooke Locomotive Works for the New York, Ontario & Western Railway, and illustrated in the February issue of "Locomotive Engineering." Mr. Childs, a civil engineer of much practical experience, favored the use of small cylinders in combination with high steam pressure, but most of the other general officers believed that reducing the size of cylinders was likely to prove an expensive mistake. Mr. Childs, however, agreed with the designs made by Mr. George W. West, superintendent of motive power, and the engine was built. A report of tests made proves that no mistake was made in the design of this engine, for she has shown a surprisingly good fuel record. It will be remembered that the boiler pressure is 180 pounds, and the cylinders 17 x 24 inches. The tests were made againt engines with cylinders 18 x 24 inches, and 140 pounds steam pressure. The report says:

"We completed the test of coal consumption on engines hauling our trains Nos. 1 and 2, Thursday, P.M., January 2, 1896.

"Engine No. 1 hauled the train fourteen days, 2,020 miles at a cost for fuel of 3¾ cents per engine mile. One of our best engines, using anthracite lump coal, hauled this train thirty days previous, making 4,050 miles at a cost of 6¼ cents per engine mile; this includes fuel used in keeping fires over Saturday night until Monday morning in both cases, as the trains are not run over Sundays.

"Our average cost for fuel for the six months ending December 31, 1893, was 8.61 cents per engine mile; for 1894, 7.52 cents; and for 1895, 6.68 cents per engine mile, showing a saving of nearly 3 cents per engine mile under the average for 1895, and 4.86 under 1893; this was a square deal from start to finish—no additions or allowances.

"Every pound of coal was weighed on both engines, which were kept under steam during the entire test, and fuel burnt while at rest is included in these figures.

"We think this is the proper way to compound locomotives."

Another report about the engine says: "No. 1 took our train No. 2 from Middletown to Weehawken, Friday night, burning pea coal exclusively, in two hours and two minutes, with five cars, and made eleven stops. Best run ever made on this road. Left Wickam Avenue Station 6:20 P.M., and stopped dead at Weehawken 8:22 P.M. Ran last thirty-four miles, including one stop, Little Ferry and Weehawken Tunnel, in forty minutes."

We noted a month or two ago an amusing account given by General Manager Hallstead, of the Delaware, Lackawanna & Western, of how the power of lies performed fast train speeds. According to the "Globe Democrat," there are men in St. Louis with great accomplishments in the manufacture of unparalleled speed. That paper says: "'You see,' said Frank Gildersleeve, the St. Louis agent of the Big Four route, to the tourist who was comparing the fast runs of American railways with those of other countries, 'although the connection you have chosen via this line is 102 miles further than the local line to the particular point to which you have just purchased your tickets, the actual running time via the Big Four is only thirty minutes longer, which, as you will see at a glance, is equivalent to traveling 102 miles in thirty minutes, or the enormous speed of 204 miles per hour; and I say, without fear of successful contradiction, that this speed has never been equaled. We make this connection daily, and only have a few tickets left.'"

In discussing Mr. McConnell's paper on "Locomotive Service," Mr. G. W. Rhodes contended that the author was not correct in making the statement that "the train expense is greater, the general expense is greater, and the entire expense of operating a railroad is greater than in 1870." He said: "In the motive power department the cost of material is very much less, the way of doing the work and cost of labor is very much less, and I believe, if the gentlemen in the transportation department will tell us what they know about their department, that they will say that the cost of operating railroads is materially less to-day than in 1870." We believe that nearly everyone who has studied railroad expenditures will agree that the position taken by Mr. Rhodes is correct.

The law requiring all cars to be equipped with grab irons and to have the drawbars a certain height above the rail went into force on February 15th, and not a few railroad companies have been caught like the foolish virgins who neglected to put kerosene in their lamps. The tracks at some interchange points have been overcrowded with cars, held that the grab irons might be applied, or that they might be raised to the required height. The matter of raising the height of drawbar has been managed in a very crude and unsatisfactory fashion by some companies. They block up the center to attain the required height, and do nothing with the side bearings. We have heard of cars raised in this way, having a space of three inches or more between the top and bottom side bearings. A car in this condition running fast round a sharp curve is very likely to tip over.

A somewhat unique folder has been issued by Mr. Stanyan, general superintendent of the Barre Railroad Co. It gives half-toned views of the picturesque country through which the "Sky Route," as the railroad is called, passes. The principal business done by the "Sky Route" is the transportation of granite, and the railroad has done a great deal to promote that industry in New England. We should judge from the view shown in the folder that the "Sky Route" has many attractions for people with a taste for fine scenery, and the mountainous nature of the country would indicate that it would be a good place for health resorts.

The announcement is made in London "Engineering" that the common objection to graphite for lubricating purposes in Britain is to be overcome by the introduction of the Dixon flake graphite. A firm in London has arranged to handle that material.

The New York, New Haven & Hartford have placed an order with Manning, Maxwell & Moore, New York, for $30,000 worth of machine tools.

The Canadian Pacific are getting out drawings for new locomotives which will soon be ordered.

AIR BRAKE DEPARTMENT

Conducted by F. M. NELLIS.

Danny Dugan's Air-Brake School.

Danny's Debut as a Fireman—Difference Between the Straight and Automatic Air-Brake Systems.

"Wot t'ell? Say, I'm as glad t' see youse as dough I tored me shirt. How's dey comin'? Say, I'm dead tired. Chust got in from a t'irteen-hour layout at Miller's. Me kittle, de ol' '84,' wot's a refrigerator, breaks a senturk strap and punches a hole in de boiler. See?

"Say, does youse t'ink steam come out o' dat punched hole? Naw; not on yer life; twuz ice. See? Wot? Well, mebbe dat's not ezackly on de level, but I says t' August, says I, dat if 'e didn't cheese draggin' uv dem links on de ties dat 'e 'ud bust a senturk strap ur sumtink, an' I calls de turn on 'im dis time, sure.

"Wot's dat? Don't dem layouts make me wish fur me ol' offus chob back agin? Naw; not on yer tintype. Wot t'ell? A chob firin' 's chust me size. Wot? I never put youse onto w'y I shakes de offus chob to go firin'? Dat's right. Well, dis is de way dat it wuz. See?

"W'en I pulls dat dinky dog wot Mrs. Agnew 's dead stuck on from under de big Adams Express truck on Broadway, an' den wants t' t'ump de driver fur tryin' t' run over de pup, wot 'as hair like waste an' looks like a Chinaman, I makes meself solid wid Mrs. Agnew. She cries an' hugs de pup wot's ugly as a camel, an' den says as 'ow I wuz a hero, an' all dat sort o' stuff, an' promises t' pull 'er ol' man's leg fur a chob fur me. See?

"Say, let me give youse de tip dat w'ile Mrs. Agnew 's stuck on dat ugly pup, she wears de bloomers in dat family, an' wot she says goes wid 'er ol' man, wot's genurl supurntendent. See? Say, she t'rowed me right in de push. I quick gets solid wid all de fellys wot's clerks in de ol' man's offus, an' wid Miss Jennie, too, wot's de typewrite. Say, dey wuz right people, sure.

"Say, now's de time w'en I begins t' lose out. W'en Van Allen comes t' take Mr. Canfield's chob as chief clerk, I goes out uv it. Mr. Canfield wuz right people, an' dat goes, but dat mug of a Van Allen wuz de biggest slob wot I ever sees come from college. Say, dat mug wuz s' green dat de horses 'ud bite at 'im w'en 'e chases hisself across Broadway, and dat's right.

"Say, Van Allen wuz de son uv some big highfalutin mug wot owns some o' de road, an' 'e wuz de biggest farmer uv a railroader dat youse ever sees. Say, dat chump wuz afraid o' de cars, so dey goes t' breakin' 'im in easy. First dey takes 'im t' Fort' avenoo t' get 'im uster de horse cars. Den dey promotes 'im t' Broadway t' get uster de cable cars. Den w'en 'e could stand in Jersey City yard w'ile a switch engine passes 'im, an' 'e doesn't fall down, den 'e comes an' tells de ol' man 'ow t' run a railroad. Wot? Stringin' youse. Nit. Cross me fingers. Dat's on de level. See? T'ell wid a fool, even dough he's only a day old.

"Say, one day I snaggs me toe in de offus carpet, an' stumbles agin Van Allen, an' 'e cusses me an' calls me names wot means fight. See? Say, dat scrap wuz a bute. We truns over de desk wot belongs t' Miss Jennie, de typewrite, an' den over goes de bookcase, buttered side down. Miss Jennie hollers awful, an' we'n de special officer pulls us apart, I wuz shy two teet 'nd me mout' hurt, but de big stiff wuz bleedin' like a stuck pig. He 'ad a black eye an' a blue one, an' 'is left ear hung on by a bit uv skin, wot I didn't bite clean t'rough. See?

"Say, dat sluggin' match queers me wid de ol' man, an' 'e fires bote me an' de big stiff, bodily. Me proud spurrit wouldn't let me go sellin' poipers agin on de Bowery, an' I gets in hard lines. Good t'ings didn't come me way s' swift wot I breaks me neck adodgin' uv 'em.

"One day, at noon hour, I meets Miss Jennie, de typewrite, chasin' 'erself across Broadway t' feed 'er face. ''Lo, Miss Jenny,' says I.

"'Lo Danny,' says she. Den she up an' tells me dat Mrs. Agnew, me side pardner, chases 'erself t' de offus dat mornin', an' not seein' 'er Ten T'ousand Dollar Beauty, axes w'ere wuz Danny Dugan.

"'Fired,' says Miss Jennie.

"'Fired?' says Mrs. Agnew. 'Who fired 'im?'

"'De ol' man,' says Miss Jennie. 'Fired 'im fur fightin.' Den Miss Jennie goes an' coughs up to Mrs. Agnew all about de scrap. See?

"'Is it straight dat de big stiff cussed Danny,' says she. Dem want just her words, but dey means de say t'ing.

"'Sure,' says Miss Jennie; an' wid dat Mrs. Agnew chases 'erself int' de ol' man's private offus, an' about five minutes later she chases 'erself out agin wid 'er nose up in de air as dough she smells somet'ink bad, an' den she takes de elevator down stairs.

"'Now don't youse give me away, Danny,' says Miss Jennie, 'fur I'll git it in de neck if youse squeals on me. Dere's sometink goin' t' drop, an' youse 'll soon be on Easy Street agin, Danny,' says she, an' den she quits me. Wot? Squeal on dat goyle, wot's a dead game turrowbred? Not on yer tintype, I don't t'ink.

"Say, de next day I gits a letter wid a pass from de ol' man's offus, sayin' dat I must chase meself to see Mr. Simmons, wot's de master mechanic, an' present de inclosed letter t' 'im. See?

"Say, I t'ought I wants t' see chust how bad de ol' man wuz stuck on me, an' 'ow de letter piped me off t' Mr. Simmons, so I holds de letter over de tea kittle till it opens up; den I reads it an' seals it agin. Dis is wot it says: 'De bearer, Danny Dugan, is too strong fur offus woick. Giv de mug a chob firin.' Give 'im de worst ol' kittle youse got wot'll boil water.' See? Dat's 'ow I falls heir t' dat cold-blooded '84' an' August. Say, wuzzent dat a dose?

"Does youse git onto de purceedin' operandi? Doesn't youse see dat Mrs. Agnew pulls de ol' man's leg fur a chob fur me, an' beats 'im wid low cards, an' den 'e wins out by beatin' me in a show down. See? Say, Mrs. Agnew's me good side pardner, an' I t'inks a heap o' her. She gives me de kind heart twice, an' wot she says goes wid me, an' dats on de level.

"Wot's dat? Air-brake school? Say, dat joint's a winner, sure. I doesn't do a t'ing but gives it de hug. An' Mr. Jennings, wot's de 'structor, 's right people, an' dat goes. See? His woick's fine, an' w'en 'e chins about dem brakes youse kin get on. Youse don't t'ink a fonygraf's buzzin' youse agin time. An' let me give youse a tip dat 'e 's got speed an' curves, bote. W'en 'e chins t' Mr. Simmons an' Mr. W'ite, 'e talks de highest falutinest langwidge wot 'ud cork youse; but w'en 'e chins to me an' de odder fellys wot trots in me class, 'e drops all dem swell gags, an' talks straight English wot wese is onto. See?

"Say, de last trip in, me an' Eddie Morris, an' two o' de gafters on Blakey's crew, chases down to de joint, an' Mr. Jennings gives us de glad hand an' welcome heart.

"'Fellys,' says 'e, 'dis time I'm not goin' t' make de t'ing s' dead easy dat youse may catch on, but I'm going t' go youse one better, an' make it s' dead easy dat youse can't help catchin' on.' See? Den he spouts like dis:

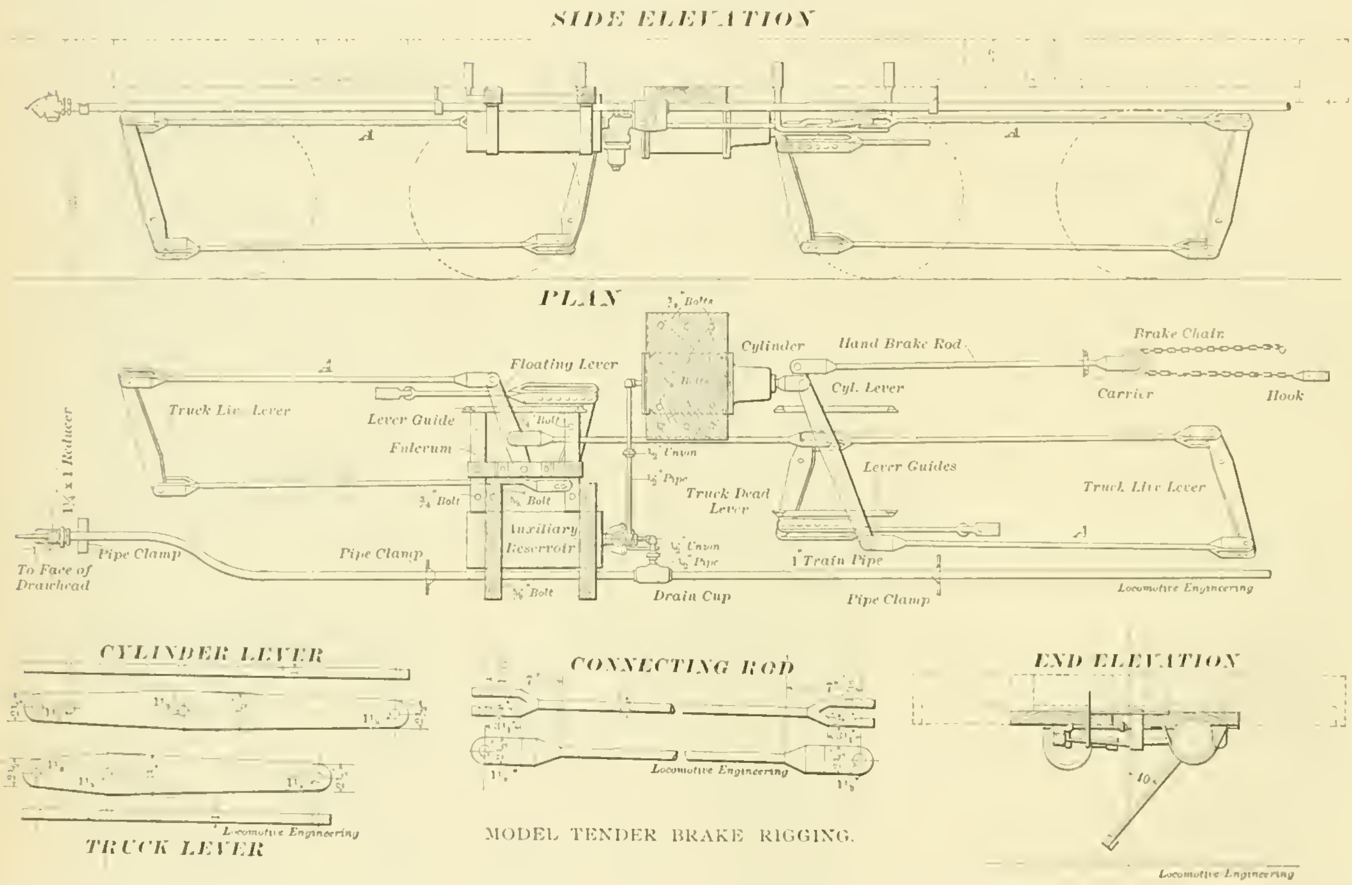
"'De straight air brake's like a brewery before dere wuz any saloons. Every time a mug wants t' wet 's w'istle 'e 'as t' chase hisself clean down t' de brewery, fur dere wuz no booze anyw'ere but at de brewery. Wid de straight air brake dere wuz no squeezed air anyw'eres but in de main drum, an' de cylinders all got it from dere. W'en de street cars stop runnin', or anyt'ing happens, den de felly can't chase down t' de brewery fur 'is booze, an' 'e goes t'irsty. W'en de train pipe busts, de main drum can't send squeezed air t' de car cylinders. See? De felly keeps 'is t'irst, an' de brewery keeps de booze. De main drum keeps its squeezed air, an' de cars keep de cylinders wot can't git air.' See? Say, dat's top notch English wot wese is onto. Den Mr. Jennings says, says 'e:

"'Fellys, de auddermadick brake is as different from de straight air as de brewery is from de saloon. De brewery and main drum is bote still in de push, but dey hasn't got dere ol' chobs. Now, every place has a saloon of its own; an' de brewery instead o' sellin' drinks by de glass, sends kegs t' de saloon, an' de saloon sells de drinks. W'en de keg runs dry, den de brewery sends de saloon more booze. So it is wid de auddermadick brake. See? Instead o' de cylinder havin' t' ask de main drum fur squeezed air, it gits it from de zallary razzerboy wot don't do a t'ing but keep squeezed air 'specially fur it. W'en de cylinder uses up all de air in de zallary razzerboy, den de main drum sends it some more, chust like de brewery sends full kegs t' de saloon w'en de drunks swally de slop all up.' See? Say, dat's as good English as I ever hears, even on de Bowery.

"Say, youse orter see de way dat 'Scissors,' dat tall, t'in, rusty-headed front gafter o' Blakey's looked at Mr. Jennings. I t'umped dat mug de second trip dat I makes fur callin' August rotten, but dem dead easy words o' Mr. Jennings knocked more into dat glass head dan I could wid me dukes. Wot, youse ain't onto 'glass head'? Say, youse is a dead green farmer, sure. W'y, a glass head is one dat's on de bum. Youse 'as heard o' dem ball players wot gits big stuff fur playin' ball? Well, w'en dere arms give out, an' dey can't t'row de ball wid plenty speed an' curves, den dey 'as glass arms. See? Scissors 'as a glass head, an' dere are odders. Wot t'ell?

"Den Mr. Jennings looks at 'Scissors,' an' den at Eddie an' me, an' says: 'Youse can all get onto how much easier it is t' chase de saloon fur yer drink, or t' rush de growler t'rough de side door, dan it is t' chase yerself clear down to de brewery. But if de keg goes dry, an' youse goes t' de saloon an' kicks an' cusses all youse like, dere'll be no drink dere fur youse till de brewery sends more booze. W'ile de auddermadick brake is safer, an' each car will set its own brake no matter 'ow many pieces de train may break into, still de zallary razzerboy only holds squeezed air enough t' set de brake one or two times, den it must get more air from the main drum. If de beer is low in de keg, youse'll have t' take short drinks. If de squeezed air is low in de zallary razzerboy, de brakes wont hold good. If de saloon license runs out, de joint is closed. Den you see de place, but no booze. If de air brake gets out o' fix, an' is cut out, you has de same t'ing as de saloon widout de license. Youse kin see de iron hangin' under de car, but it's no brake; it's scrap iron, an' won't stop de car any more dan will spittin' on de wheel. See?

"Say, I'll have t' quit youse. I'm dead tired, an' must go home an' pound me car. S'long. W'en is youse comin' again? All right. Sure!"



MODEL TENDER BRAKE RIGGING.

A Model Tender Brake Rigging.

The design shown herewith, for the adaptation of the brake apparatus and foundation brake gear to a locomotive tender, is one of the simplest forms consistent with good design, and is submitted and recommended by the Westinghouse Air-brake Co. as such for uniform practice. The proportion of the levers should be such as to develop a total force at the brake beams of 90 per cent. of the light weight of the tender, based on a force of 2,500 pounds at the cylinder when the 8-inch size is used, and a force of 4,000 pounds with the 10-inch size.

The designers believe this arrangement

is more mechanical and superior to the forms hitherto illustrated in "Locomotive Engineering." In this plan a bracket is attached to the tender frame, and is necessary in order that the tender trucks may be interchangeable, which is believed to be a most important consideration. Those forms in which a bracket is employed on the port cylinder head, involve an arrangement of truck levers that prevent the trucks from being interchangeable, as the brake beam levers of both trucks are inclined in the same direction.

As a rule, tender-brake apparatus has been applied in a rather slipshod manner, and has not been confined to the railway shops alone, as some of the locomotive works have been supplying foundation gear on new equipment that is rather startling as a mechanical paradox. Railways and locomotive builders that have not an equally efficient standard form of tender-brake gear, would do well to adopt this one, as it will give much better satisfaction than many of the forms used on their tenders at the present time.

Coming Convention of the Air-Brake Men.

The Association of Railroad Air-Brake Men will hold their third annual convention in Boston, Mass., beginning on Tuesday, April 14, 1896. Secretary Kilroy is sending the members a circular letter which contains the following information:

Headquarters will be at the American House, where the following rates have been secured: Rooms—one person in a room, $1 per day; two persons in a room, $1.50 per day. Meals are not included, but may be obtained at the hotel, or elsewhere, as desired.

The convention will be called to order in the main hall of the hotel at 9 o'clock, Tuesday morning, April 14th.

No charge will be made to parties who wish to make exhibits, but all exhibits must be closed during the hours when the convention is in session.

A large attendance is promised, and indications are that the Boston Convention will be even more successful than the two preceding ones.

A Definition.

Failure of the Air Brakes—An impossibility; a misnomer. A once popular, but now almost obsolete term used by knowing employés in making out detention and accident reports, to hoodwink innocent and credulous officials; a favorite excuse used by guilty employés to shift the real cause of certain irregularities from themselves to a defenseless but worthy servant. A phrase used by the lay press to tell how little they know about brakes, and how easily their reporters are gulled.—Air-Brake Dictionary up to date.

Mr. Kidder's sketch of a well-designed tender brake in December number has caused much interest to be manifested in tender brake gears. It goes without argument that tender brakes, as a rule, are more faulty in design and defective in condition than any other brake on the train. Persons to whom the designing of tender brakes is entrusted should make a canvass of all tenders under their charge, and see if there are not some which have no dead levers, are braking on but one truck, or what is equally objectionable, a double brake so designed that with certain wear of shoes it is possible to concentrate the entire brake power on one truck. We predict that some freaks will be found.

There is a very convenient instruction room fitted up beside the master mechanic's office at the Seaboard Air Line shops, Portmouth, Va., where Mr. W. J. Hartman instructs all classes of trainmen concerning particulars of train mechanism. There are apparatus illustrating every detail of air-brake mechanism, and everything relating to steam heating and all other mechanism which trainmen ought to understand. This includes methods of putting in various car brasses, and the best way of dealing with accidents to all sorts of running gear, including accidents to the locomotive. Most of the devices have been got out by Mr. Hartman, and some of them are very ingenious. The work done in that room is certain to make the trainmen self-reliant in dealing with the numerous disorders to which train mechanism is subject.

P. M. Kilroy, Secretary of the Air-Brake Men's Association, presents an odd problem to the readers of "Locomotive Engineering" this month. He specially advises that the car from which this brake gear was sketched was not a Cotton Belt car but was a foreigner which strayed into the Pine Bluff yards and was caught. We hope our readers will jump on to this freak, and make it give an account of itself.

That the tender brake is generally recognized to be the "weak sister" among train brakes, is evidenced by the Westinghouse Air-Brake Company's recent preparation of a model design of tender-brake rigging, which is illustrated in this issue. It is a good one, and will "wear out brake shoes."

The P. R. R. air-brake instruction car, which we understand has been out of service for some time past, is now making a trip over the Philadelphia, Wilmington & Baltimore division. Mr. Robert McLaren, locomotive engineer on the Pittsburgh division, and T. J. Mendenhall, locomotive engineer on the New York division, are in charge.

CORRESPONDENCE.

An Air-Brake Problem.

Editors:

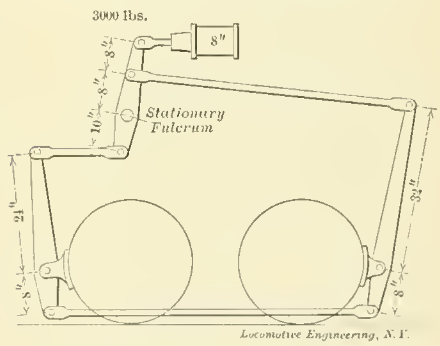
The rotary valve of a D 8 brake valve was reported leaking, and was repaired by the repairman in the roundhouse. The engineer, preparatory to taking the engine out of the roundhouse, started the air pump slowly, and then began to oil around. As he was a careful engineer, and his mind was also on oil records, some little time was consumed before he returned to the cab, where he was surprised to find the main-reservoir pointer registered a hundred pounds and the train line pointer was at zero. He opened the stop cock at rear of tender, and no air came out of the train pipe. The brake valve handle was in full release position. All stop cocks were in proper position, and there were no blind gaskets or frozen pipes. Engine was delayed about two minutes before engineer discovered what was wrong. What was the trouble?

Plattsmouth, Neb. E. B. THRALL.

Kilroy's Problem.

Editors:

The accompanying sketch of brake leverage was taken some time ago from a foreign car in our yards by Mr. C. S.



Shallenberger and is sent you hoping it may be of interest to your readers, and that it may be the means of leading to a better understanding of foundation brake gear by the general air-brake man.

The car brakes on but one truck (which, of course, is wrong), and has an 8-inch brake cylinder and quick-action triple, which gives a total cylinder pressure of 3,000 pounds. There are two live levers, and no dead levers. There is but one fixed point, which, with other details, is given in the sketch.

Pine Bluff, Ark. P. M. KILROY.

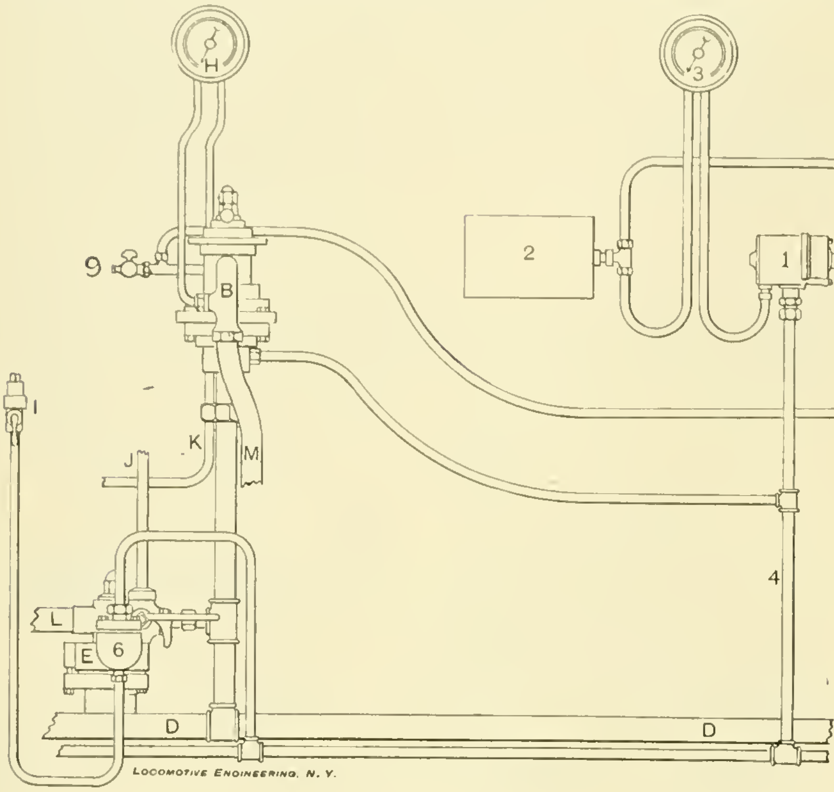
The Hurst Pressure-Retaining Attachment.

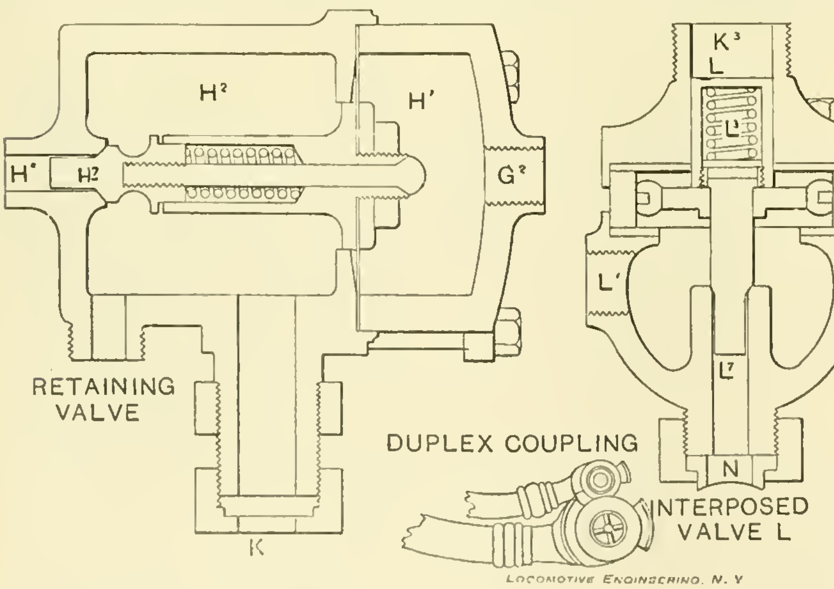
Editors:

Under separate cover I am sending you a blueprint of an appliance patented by John M. Hurst, master mechanic of the Great Salt Lake & Hot Springs Railway. This device has been used for nearly two years on the Utah Central Railway, which has some four and six per cent. grades, and has done its work perfectly. It gives the engineer complete control of the train, and he does not have to release brakes to recharge the train pipe and auxiliary reservoirs.

The operation of the appliance is as follows: Immediately after making an application of the brakes, the brake valve handle is placed in full release position to recharge the train pipe and auxiliary reservoirs. The Hurst pipe holds the brakes on until time to release. The release is made by opening the cock, Fig. 9. When making an application of the brakes, the air pressure coming from the preliminary exhaust port is carried in pipe running from engineer's brake valve to Hurst retaining valve (Fig. 1) and supplemetary reservoir (Fig. 2), and registers on gage (Fig. 3). The pressure released from the train pipe at the brake valve is carried to the Hurst retaining valve (Fig. 1) by the Hurst retaining pipe (Fig. 4), and registers on gage (Fig. 3). When air is released through cock (Fig. 9), reducing pressure in chamber H 1, the pressure in chamber H 2 raises valve H 7 and releases air from Hurst pipe through H 11, reducing pressure at K 3, interposed valve (Fig. 6) allowing triple to release L 1, L 7 and Westinghouse pressure-retaining valve 1.

An application of the brakes can be made, showing ten or fifteen pounds on the gage (Fig. 3); then it can be run up to twenty or thirty pounds more, increasing or diminishing as the judgment of the engineer dictates. If it is necessary to cut out any brake in the train on account of broken brake beam or other cause, the device does not interfere with the working





of the other cars. This device does not require a large main reservoir, and could be worked without one, for that matter, for the reason that it is not necessary to release brakes to recharge the train pipe and auxiliary reservoirs. It saves the air pump and pump repairs, as the pump does not have to be run fast to keep up the supply of air. It is especially adapted to long trains and high speeds, as it is possible to recharge immediately after an application for use in case of an emergency or accident. It save the brakemen from running over the train to turn up or down the pressure-retaining valves, as they can always be left turned down.

Cars with this appliance work in harmony with the plain automatic cars in the train, which use the retaining valve the same as other cars. The automatic cars work behind cars with this device the same as if the whole train was automatic. In place of the interposed valve piston L 2, we use a diaphragm the same as in the Hurst retaining valve (see sectional view). Patent provides for either piston or diaphragm. The cut of the duplex hose coupling shows for itself.

W. A. LANGFORD,
Conductor Utah Central Ry.
Salt Lake City, Utah.

[The general idea of a brake system having two lines of pipe started almost with the first conception of the automatic brake, and is probably described as clearly in patent No. 144,006 as in any of the later ones. No. 235,922 contains a description of this mode of operation, that was designed by the W. A. B. Co. and was given a practical test on the Denver & Rio Grande road. There was absolutely no trouble with any of these plans working all right. The objection seemed to be that they all cost more than they came to. It is a matter of record that the maintenance of the hose is by far the largest expenditure in keeping brakes in order, and any proposition that would look like doubling this item is not apt to be received with any great amount of ardor by people who have to pay for keeping up brakes.

So great was the prejudice against the automatic brake by those who had but little faith in the new system, that the first trains equipped with it were also fitted with the straight air brake; and, by the interposition of a check valve on each car, either brake could be used at the pleasure of the engineer.

In fulfilling the exacting requirements of heavy mountain service through the West and other sections, the lack of faith had in the automatic system in early days has been supplanted by the absolute confidence of the many who daily place their lives in its keeping.

The design is ingenious, and, doubtless, performs its work creditably and effectively as stated by our correspondent. But it is hardly probable that any double-line system will become popular and marketable at this stage of the art.—Ed.]

The Knowles Slack Adjuster.

Editors:

Inclosed herewith please find a sketch of the Knowles brake adjuster; also a mechanical description, etc. The adjuster has been in service upwards of one year, and is now running between St. Paul and Boston, giving perfect service in all kinds of weather.

The advantages claimed for the device are as follows:

First—It is simple, reliable and positive in action, and is well calculated to meet the requirements of an automatic brake adjuster.

Second—It will keep all levers at right angles to the rods which operate them, when the brake is set, dead levers included.

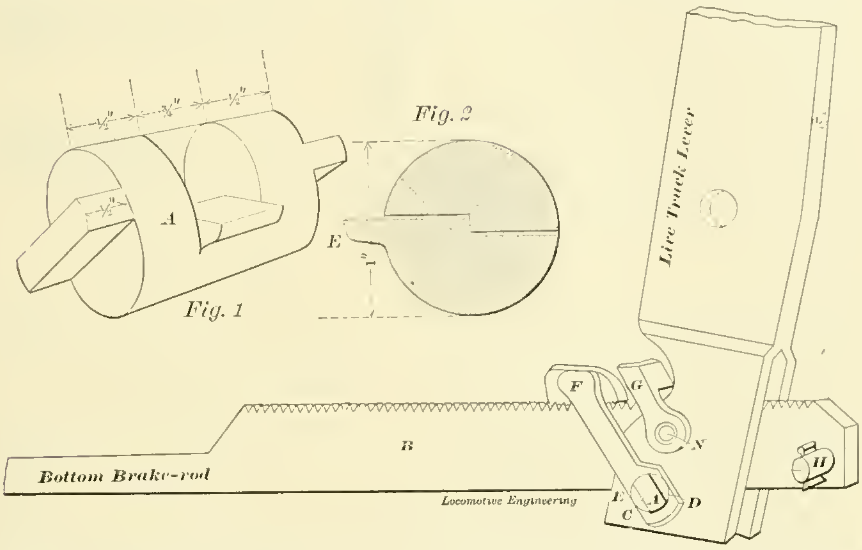
Third—With this system the thickness of the brake shoes is not limited to the capacity of the dead levers for taking up the wear; consequently, thicker shoes may be used.

Fourth—It will compare favorably with any similar device now on the market in point of durability and cost.

The mechanical description is as follows: The live lever terminates in a fork or jaw of the size and shape shown in the sketch. Two holes are drilled through the jaw; the bottom one is 1 inch in diameter, and the top one ⅝ inch. A pin, of either dropped or forged steel, is made to fit bottom hole. On the top side of pin *A*, and midway between its ends, a depression is made wide enough to receive the tooth bar *B*, and of a depth nearly to its center, as shown at *c*. The back half of pin *A* is further depressed as shown at *d*, so as not to come in contact with tooth bar *B*. By reason of a lip or projection on pin *A* (shown at *e*), the tooth bar *B* has a bearing on pin *A* between the point *c* and *e*. The draw pawl *F* is made of drop-forged or cast steel, with slotted holes in lower ends, and is heated and closed over tenoned ends of pin *A*. The pawl *G* is attached and held in place by two pins *N*, one on each side, driven or screwed into holes in forked end of lever. A common brake pin *H* is placed in hole at back end of tooth bar *B*.

When the live lever exceeds its proper travel, the pawl *G* will drop over another notch. In releasing the brake, the pawl *G* holds live lever at *N*, and causes pawl *F* to advance a notch. The pawl *G* also holds the tooth bar down firmly on pin *A*, and as the pawl *F* rises to advance a notch, the bearing is thrown more at *e*, which holds the pawl *F* firmly in place.

Fig. 1 is a perspective sketch of pin *A* removed from its place in hole *M* in the lever jaw. Fig. 2 shows section through longitudinal center of pin *A*. Dotted lines show the angle to which the ends of pin *A* are tenoned. A recess is cut in hole *M* for the purpose of admitting the lug *e*.



LOUIS KNOWLES.

Minneapolis, Minn.

[Mr. Knowles incloses a letter to us from E. A. Williams, mechanical superintendent of the Minneapolis, St. Paul & Sault Ste. Marie Railroad, complimenting the device for the satisfaction it has given on his line in service trials.—Ed.]

Quick Action Triples on Engines and Tenders—Graduating Springs.

Editors:

In reply to the editorial comment on my communication regarding the advisability of using quick-action triples on engines and tenders, I should like to say a few words.

It cannot be denied that the various conditions of brake-shoe friction, etc., encountered on long trains have much to do with the numerous break-in-twos which occur on emergency application of the brake, and it is not for a moment contended that the lack of a quick-action valve on the engine is the sole cause of such trouble; but it seems to be an incontrovertible fact that, if the engine brake sets after the car brakes are fully applied, there must be a very severe strain on the drawbars as a result. Considering the difference in the size of the quick-action port and the service port, it is very evident that there must be quite an appreciable difference in time between the attainment of full pressure on the first cars and full equalization in the engine-brake cylinders.

The point made in the comment referred to, i. e., that break-in-twos generally occur near the end of the stop, certainly seems opposed to the writer's theory; but it is not hard to explain, on the ground that on neither engine nor cars do the brakes shoes take hold very violently at high or moderate speeds. It is also a matter of record, based on tests almost too numerous to count, that the friction of brake shoes varies as the shoe becomes heated; but this does not always result in increased friction, but sometimes, although not very often, in a decrease of holding power.

It is to be noted further that emergency applications are often made when the train is at low speed; and as the brakes then take hold much more violently, it is reasonable to suppose that the slower action of the engine brakes must produce a severe strain on the drawbars.

The danger of too frequent use of the emergency application on the lone engine, in case it were equipped with quick-action brakes, must, of course, be acknowledged to be an objection to their introduction in such equipment; but it could be readily overcome, as suggested, by the use of a stiffer graduating spring, and this would not make a difference in emergency pressure sufficient to be material (not, in any event, over a couple of pounds); and it is, after all, not so much the small proportionate added pressure as the quickness of action which is the great consideration in emergency braking.

The statement that the present degree of sensitiveness of the quick-action valves would result in emergency applications on the lone engine, even in service position of the engineer's valve, is another thing which inclines the writer to the belief that the present standard of graduating spring is not heavy enough. This belief has been growing on me for quite a long time past, and it may not perhaps be inopportune at this time to start a discussion on it.

The present position is this, i. e., to secure the very minutest gain in time of application on a fifty-car train—a gain which can only be expressed by the use of fractions of a second as small as hundredths—the triple-valve mechanism has been made so sensitive that, with a long train of brakes in operation, what might be called a reasonably rapid service application is impossible. The preliminary and service discharge ports must be made so small that accurate stops for water or coal can only be made with the very greatest difficulty, skill and loss of time. The use of the emergency application is forbidden the engineers; and yet the service ports are so proportioned that, with a long pipe to operate, the graduated increase in braking force comes so slowly that it is difficult sometimes to make even respectable station stops without coming into a station at a snail's pace.

I have heard many engineers say that it is very strange that with the plain automatic brake they could make accurate stops with comparative ease and without shock or violence; yet with the quick-action brake, limiting themselves to the service application notch in the engineer's valve, they find it almost impossible at times to stop a long train with reasonable accuracy without loss of time.

It is very common for the officials to make comments on the engineer's work with the brake, damning him for loss of time or damage due to violent applications; but when I hear anything of this kind, I always think of the engineer's position, and wonder how the official, if placed in the same position, would make out. Goodness knows there are careless engineers without number, but there are also many careful men amongst them, and these ought certainly to be given fair play. The men are not always alone to blame.

Chicago, Ill. PAUL SYNNESTVEDT.

[Experiment has proven that an application of the brake from the time air enters the cylinder until the maximum pressure has been developed, is but little different in the plain and quick-action triples, as the emergency port of the quick-action triple is in play but an instant, during which the desired portion of train-pipe pressure is vented to the brake cylinder; then it closes, and the service port finishes the application with pressure from the auxiliary reservoir. The service port of the plain triple, which is considerably larger than the service port in the quick-action triple, is wide open during the entire application; hence the slight difference in time of applications. The comparison between the size of the emergency port of the quick-action triple and the service port of the plain triple, is liable to mislead, and is not applicable to the point under discussion.

Should the brakes be applied from some point a considerable distance back in the train, then the strain on the draw-bars would be great, indeed, and the train would play "crack the whip" with the engine; but as the application is begun at the engine, and the time of full application of brakes on engine and head cars is so nearly simultaneous, the strain on the draw-bars at time of application is not nearly so severe as later on, when all brakes have attained full pressure, and the break-in-twos occur.

The belief that the graduating springs are being made lighter, in order to shorten the time of emergency application on a fifty-car train, is an erroneous one, as the lighter springs which have been replacing the heavier ones for the past two years, are the springs originally used in the first quick-action triples, and which were temporarily abandoned until such time as the older forms of brake valves should give way to the equalizing discharge type. The latter form of brake valve has been so generally adopted by railways that the original graduating springs are now being replaced.

The charge that the service application has been sacrificed, in order that a few hundredths part of a second's time might be gained in the quick-action application on a fifty-car train, is entirely speculative, and is without any foundation whatever. A train of fifty cars, running at a speed of thirty miles per hour, recently was stopped by a continuous service application in a little over a half a train length. A five-car passenger train, running thirty miles per hour, was likewise stopped in 335 feet. Fifty-car freight trains are not required to make milk-platform stops, neither are they supposed to make Empire State Express speed into a water-tank stop.

Better judgment and greater skill is unquestionably necessary to successfully operate air brakes on long freight trains now than was required some years ago, when shorter trains were equipped with plain triples. The engineer must be brought up abreast of the times. The brakes cannot be retrograded to suit old-time practices. If we were to go backward by replacing the quick-action triples with plain ones, or equivalently stiffen the graduating springs to a degree that would permit the resumption of old-time recklessness and familiarity with the emergency position of the brake valve, we would be back to the M. C. B. brake trials at Burlington in 1887.

If our correspondent would trouble himself to acquire a little closer personal acquaintance with the requirements and governing practices of actual service, instead of permitting a few back numbers to play upon his credulity, he would recognize the fact that we are to-day faced by conditions different from those of fifteen or twenty years ago, and whose requirements must be met by suitable means, even though the means supplied, while fulfilling their purpose, do not receive the approval of a few who have not advanced with the times.

In meeting with the many railway officials throughout the country, we have yet to hear one begrudge an engineer all the time necessary to make a creditable stop; and we have yet to hear the first one curse an engineer for consuming time necessary to make a smooth stop. However, there are some officials, and many passengers and train crews, too, who have used strong language when roughly handled. The latter paragraph of the article is so heavily diluted with politics that nearly all trace of logic and fact is lost.—Ed.]

The New Twelve-Inch Brake Cylinder.

When the Westinghouse Air-Brake Co. designed their 10-inch automatic brake apparatus, it was properly adapted to such cars as were then built, and which to a considerable extent are still constructed. In order to meet the need of a more powerful brake for sleeping cars and unusually heavy passenger equipment cars, they designed, and have been furnishing for several years past, a 14-inch brake equipment therefor; but the prevalent practice of building passenger equipment cars weighing from 50,000 to 70,000 pounds, makes a brake apparatus of intermediate power desirable for the latter class of these weights; and that company will hereafter manufacture for such cars a schedule of quick-action automatic brake apparatus with a 12-inch cylinder, which will be known as "Schedule R."

The introduction of this new schedule will enable three different schedules of air-brake apparatus for passenger equipment cars to be furnished, as follows:

Schedule C[1] (10-inch cylinder, 12 x 33-inch auxiliary reservoir and Plate E 24 triple valve), for weights over 30,000 and up to 50,000 pounds.

Schedule R (12-inch cylinder, 14 x 33-inch auxiliary reservoir and Plate E 27 triple valve), for weights over 50,000 and up to 70,000 pounds.

Schedule P (14-inch brake cylinder, 16 x 33-inch auxiliary reservoir and Plate E 27 triple valve), for weights over 70,000 pounds.

In attaching this apparatus to cars, the levers of the foundation brake gear should be so proportioned as to exert a braking pressure of 90 per cent. of the light weight of the cars, based on a total cylinder pressure as follows: For Schedule C[1], 4,700 pounds; for Schedule R, 6,800 pounds; for Schedule P, 9,200 pounds.

An unusual amount of information may be expected in the report of the proceedings of the Air-Brake Men's third annual convention. The committee reports, now in the hands of the printing committee, are the combined contributions of the best-known and authoritative air-brake men in the business; and if bound and sold over the name of any single one of the contributors, would bring five times the price which will be asked for a copy of the report. Look out for a pleasant surprise.

Correspondents should send in their communications as soon as possible after reading "Locomotive Engineering," and not wait until later. Several correct solutions of Conger's problem were received too late to be given credit last month.

Orange Pound sends a description of a badly designed tender brake, but neglects to inclose sketch as he intended.

QUESTIONS AND ANSWERS

On Air-Brake Subjects.

(13) E. M. J., Indianapolis, Ind., asks:

Is the high-speed brake used extensively anywhere yet, and how does the price compare with that of the ordinary quick-action brake? A.—It is practically limited as yet to use on the Empire State Express trains on the New York Central road, and on the Congressional Limited on the Pennsylvania line. It has not yet been placed for sale on the general market.

(14) W. K. B., Albany, N. Y., asks:

Are there any E 6 brake valves which should have the air pump governor attached to the train-pipe pressure? A.—Not if the brake valve has the regular feed-valve attachment, in which case it should be connected to main-reservoir pressure. But if the excess-pressure valve, such as was temporarily furnished in some instances while the feed-valve attachment was being perfected, is used, then the connection to train-pipe pressure is all right. Where any of these old excess-pressure valves are found on D 5 or E 6 valves, they should be sent to the manufacturer in exchange for a feed-valve attachment, and the governor connection changed accordingly.

(15) J. B. D., Arkansas City, Kan., asks:

What causes a D8 brake valve to release brakes after they have been set and brake valve handle is brought back on lap? Brakes would release every time with this particular valve. A.—You do not mention whether the application is an emergency or service. If it is the former, the leakage of pressure from the equalizing reservoir past the packing ring in the equalizing piston, raises the pressure in the train pipe higher than that in the auxiliary reservoirs. If it is the latter, the leakage of pressure from the main reservoir past the rotary valve or the excess pressure valve into the train pipe. Try the leaky rotary valve test for the latter.

(16) J. R. T., Buffalo, N. Y., asks:

If cars equipped with 1-inch train pipe, or 1¼-inch hose, fitted with one inch couplings, as is being found on many cars of late, are mixed in with cars in train equipped with 1¼-inch train pipe and the standard quick-action automatic brakes, would the 1-inch pipe and couplings in any way interfere with the proper working of the quick-action brakes in the train? A.—Tests have proven that there is but very little difference in favor of the 1¼-inch train pipe when all cars are cut in, so far as time of application is concerned; but when certain cars are cut out, the large pipe has an increased advantage over the inch pipe in being able to let quick action pass through the cut-out cars, when the inch pipe would not be able to do so. Inch couplings do not fit well in 1¼-inch hose, and should not be used.

(17) T. L. J., Chicago, Ill., writes:

I had an 8-inch pump overhauled. The top head was given new reversing-valve bush, valve and stem; also new reversing piston and bush, new main-valve rings and bushings. When steam was turned on, the upward stroke was made slowly and laboriously, while the downward stroke was made rapidly, and with a "chug." As the pump did not work satisfactorily, the new head was removed and replaced by one which had been in service for some time. Where and what was the trouble? Air valves were O. K. A.—As the exchange of top heads removed the trouble, it is safe to say that the irregularity existed in some part of the reversing gear which would not allow the main valve to give a full supply of steam to the lower end of cylinder. The trouble should be looked for in the obstruction of ports (probably due to fitting), in the admission port to reversing-valve bush, ports leading to and from reversing-piston bush, in the fit of bushings, and in the fitting of the reversing piston and its stem.

(18) W. H. C., Rocky Mount, N. C., writes:

We have an engine here whose signal blows correctly with engine and tender alone, but when coupled to train it will blow incorrectly—say, when the conductor pulls cord it will blow four times when it should blow three. I have cleaned the diaphragm in signal valve, cleaned the reducing valve attached to main drum, and have blown out the pipes and drained the drum; but all to no avail. Please inform me what is the cause of the trouble, and how to remedy it. A.—The manner in which the conductor pulls the signal cord probably has considerable to do with the case. The pull should be of about a second's duration, with two seconds interval. If you use the angle cock in making your roundhouse test, you are following a misleading practice which is no test whatever. You should get up a testing device as illustrated on page 704 of November "Locomotive Engineering," and follow out the instructions as given on that page. A little practice will enable you to locate and correct any trouble arising with the signal apparatus.

(19) T. B. J., Chicago, Ill., asks:

What is the cause of air-signal whistle blowing after reducing valve and signal valve have been thoroughly cleaned, pump started, forty pounds or more in the main reservoir; and when brake-valve handle (D 8) is moved from running to full release position the whistle will blow? 2. What is the reason the whistle on same engine will blow, when it should not, when the engine has a train of coaches; and will not blow on the light engine, except when the angle cock is opened to try it, or when coupling is being made to train? A.—1. It is probable that the supply valve does not seat, and permits signal-line pressure to return to main drum. Perhaps the bottom part of reducer has been screwed so tightly into the upper part that gasket 11 has been thinned at the edges and allows more than 40 pounds in the signal line. Test with a gage. A.—2. Stem in signal valve too tight. Pipes on engine tight, but those on coaches leak. Stop "trying" your signal with the angle cock. Get a testing device as shown on page 704, November number, and you can make these things give an account of themselves.

(20) C. W. P., Netcong, N. J., writes:

Please explain why the triple valve is so called. One of our boys claims that because it equalizes the three pressures—auxiliary reservoir, train pipe and brake cylinder—it so derives its name. I claim it is because it does three acts with one move of the valve. When the train-line pressure is reduced for an application of the brakes, it moves down and closes the feed port, closes the exhaust port, and opens up the graduating port to the brake cylinder. When the brakes are released, the valve again performs three acts with one movement; for when the train-line pressure is increased by pressure from the main reservoir, the triple valve goes to release position, and opens the feed port, opens the exhaust port, and closes the graduating port. Please decide this question for us. A.—Any one of the foregoing set of triple functions might be sufficient to give the valve its name. Another one might be added. Pressure passes through it three times—in going from the train pipe to the auxiliary reservoir, thence to the brake cylinder, and then to the atmosphere. But the name is derived from the three great functions which the valve performs—viz., applies brakes, releases brakes, and recharges the auxiliary reservoir.

(21) P. K. S., St. Paul, Minn., writes:

A train of seven or more cars left one of our terminals the other day, equipped with mixed quick action and plain Westinghouse brakes. The Inspector made a test in the yard, and pronounced the brakes all right. The first stop was eight miles out of town, on a heavy down grade, where there is a railroad crossing. The engineer made an application, but the train did not stop, and the hand brakes were called into use to bring the train to a standstill after running by. The angle cocks were examined and found all right. The brakes were tried once more, but would not apply. The train was brought to the depot, and a mail car was taken in, and the brakes then worked all right. The engineer says that after coupling up, the pointer on his gage in the cab fell to sixty pounds. The driver and tender brakes worked all this time. What was the cause? A.—These apparently mysterious actions, and alleged brake failures, are the most difficult to handle satisfactorily at long range. The only way to settle the matter effectually is to be on the scene at the time of the occurrence, and there locate the cause. Evidence coming second or third handed is known by air brake men to be not only unreliable, but sometimes is badly perverted. The "O. K." which is given at the end of one of these examinations, and especially if the cause remains undiscovered, is self-condemning, and carries more harm than good. The trouble no doubt occurred while the train was en route from your coach yards to the city depot. The examination was doubtless made by a switch crew, and in face of the facts that the cause was not found, their "O. K." was of no value whatever. The mere taking of the mail car into the train could have no good effect on the remaining cars, except what was had from manipulating the angle cocks. That a benefit was obtained by such a manipulation is evidenced by the perfect working of the brakes thereafter; this, with the additional evidence of the gage dropping to sixty pounds when the coupling was made, and the fact that the driver and tender brakes worked all right through the entire time, is strong circumstantial evidence (and the only evidence of any value to be had in this case) that an angle cock was wholly or partially closed, despite the declarations of the men who claim to have tested the brakes at the terminal, and those who pronounced everything "O. K." after the examination at the crossing. Sometimes shifting obstructions get into the train pipe, but their symptoms are different from those in this case.

Light Weight, Middle Weight and Heavy Weight may be convenient designating terms for the classification of different weights of passenger cars, which will henceforth use ten, twelve and fourteen-inch brake cylinders, respectively.

A Full Train Load Not Always Economical.

We find that there are very few railroad mechanical men who are inclined entirely to agree with Mr. McConnell in his assertion that a "locomotive should haul every ton of freight it is capable of doing, regardless of cost of fuel or repairs." In discussing this question, Mr. E. M. Herr, of the Chicago & Northwestern, made some points that are worthy of consideration. He said:

"It is true that the more tonnage an engine can be made to haul, the less cost per ton-mile it is to the company for fuel burned on this engine. While the cost of the fuel per engine mile is increased, if it is figured, as is undoubtedly the most correct way to figure it, on the car mile, or, still better, the ton-mile basis, it will always be found that a reduction in cost per ton-mile has been made by increasing the average load. It does not, however, follow that the engine should be loaded heavily to produce the most economical results, or that the cost for repairs and fuel can be entirely neglected, although there are other conditions that enter in, which will bring down the economy of this kind of operation still more than the increase of repairs.

"As you increase the tonnage that each engine is expected to haul, you necessarily decrease the ability of that engine to make the time over the road, and it is quite possible to increase the tonnage that is put upon the engine to such an extent that, owing to the longer time that it takes for this engine to get over the road, you will show an actual increase in the cost of operation, and a consequent detriment to the service, instead of a gain.

"I know this was the case in an experience I had one time when I was in the transportation department. We had a heavy run of business in one direction. Anxious to move as much freight as possible, we loaded the trains heavily, kept adding cars to the trains as we thought the engines could pull them, and they did pull them, but the reports showed that we were not getting more tonnage over the road. On analyzing the reason for this, it was found that the trains were largely delayed at meeting points (I will say that our passing track facilities were not adequate), and it was decided to reduce the trains. They were quite largely reduced in the number of cars hauled, and the amount of tonnage over the division was very largely increased by doing so. The increase came about from the fact that, while the engines were not hauling as many tons of freight per train, and, figuring from the standpoint of the engine economy, and from the standard of fuel burned alone, the engines were not showing an economical operation; yet looking at it from the broad standpoint of the amount of tonnage that could be moved over that division with a certain amount of power, we were able to make a much better showing, and a consequent gain in revenue for the company, by reducing the trainload instead of increasing it."

Nearly all the speakers who discussed the paper took a similar position. Among them were J. N. Barr, G. W. Rhodes, A. E. Manchester, S. P. Bush, William Forsyth and others.

THE OLD "FRANKLIN," SEABOARD AIR LINE.

The Old "Franklin."

One of our readers, Mr. John G. Justice, of Waycross, Ga., sends us a very old photograph of a very old engine that is of some interest. Our engraving shows this engine as she appeared in 1876, after many rebuildings.

The "Franklin" was built by Richard Norris at Philadelphia, many years ago. Her cylinders were 13 x 26 inches, with 4 feet 4 inch driving wheels. She originally had an independent cut-off, six eccentrics, four rocker arms, two levers and a two-story steam chest, but these superfluous parts were all removed at one time or another, in her different wrestles with the back shop.

The "Franklin" was kept for use by the

Seaboard Air Line, principally for breaking in her young engineers; and many of the men in the West and Southwest, who are now running fine machines, had their first experiences on the "Franklin." Mr. Ben. Lacy, who is now Labor Commissioner for North Carolina, put in a good many quiet days hauling gravel with this old engine, when he was a kid runner.

The photograph shown was an amateur affair taken at Manly Station, on the R. & A. R.R., nearly twenty years ago.

"The Chicago Drainage Canal" is the title of an illustrated pamphlet issued by the Ingersoll-Sergeant Drill Co., for the purpose of showing the machinery they have in use on the Chicago Drainage Canal. There are interesting illustrations of the work on different sections of the canal, and the various methods of doing the work. The Ingersoll-Sergeant drill and their channeling machines have performed important work in the excavation of that great canal. The pamphlet, by means of fine engravings, gives a very good idea of the stupendous work done and of the machinery employed to do it. Those interested should send for the pamphlet, which is of the standard size.

The Capital Machine Tool Co., of Auburn, N. Y., are out with a new catalogue and price list of their vises, jack screws, etc. The list of vises includes every style required by railroad mechanics; also a full assortment of ratchet screw and lever jacks, including special makes of the latter for loaded cars, heavy wrecking, etc. Diameter of screw, height and lifting capacity are given. This company also manufacture the Tornado bicycle pumps, which are described in their catalogue.

We are informed by the Smillie Coupler & Mfg. Co. that the motion of the Gould Coupler Co. for a restraining order, before the United States Circuit Court, was not opposed by them, as they had only made a few couplers for experiment of the kind that the Gould people object to. The Smillie Coupler Co. manufacture quite a variety of couplers, but the Browning patent does not apply to them.

Although "Locomotive Engineering" has not the name of being a car builder's paper, the car department is rapidly gaining repute as containing the most valuable information about cars to be found in any paper. One of the principal superintendents of motive power in the country recently wrote: "I read your paper with interest and pleasure, and have noted the publications in the car department, which are certainly practical and good."

On February 4th last the Chicago Pneumatic Tool Co. received an order from London for ten more of their pneumatic hammers—the size used for beading flues and calking boilers. They had received several orders previously from London for hammers to be used for same purpose.

The Star Headlight Co., of Rochester, N. Y., recently secured an order for 196 locomotive headlights, to go to Russia. The Star headlghts are being used by many other foreign railroads and are highly thought of.

The Kalamazoo Railroad Velocipede & Car Co. shipped last month one each No. 9 "Special" steam inspection car and 2 horse-power gasoline motor car to Australia. They shipped also one 8 horse-power gasoline motor car to Mississippi, and one No. 9 "Special" steam inspection car to Buenos Ayres, South America.

The committee of the Traveling Engineers' Association appointed to report on the "Standard Form of Examination of Firemen for Promotion, and New Men for Employment," have sent out a circular asking for information. The circular contains ten questions, which, if answered, will bring a great deal of useful information about the practice followed in promoting firemen to engineers and hiring new men.

An illustrated circular has been issued by the Sams Automatic Car Coupler Co., of Denver, giving a few facts about the coupler. This coupler is of the link-and-pin type, operated automatically. A great many roads in the West are using it, and it seems to be growing in popularity.

The paper by J. H. McConnell, read at the Western Railway Club, on "Locomotive Service," stirred up one of the liveliest discussions ever heard at any railroad club. Many of the members criticised severely the statements made, but somehow most of them veered round to acknowledge that the paper took sound ground concerning railroad operating.

On February 15th, the principal locomotive and car repair shops of the Mexican International Railroad at Ciudad Porfirio Diaz were burned down. The loss is estimated at $200,000.

The talk is that the New York, New Haven & Hartford, having swallowed nearly all the railroads in New England, is now gaping for the Boston & Albany. The bait is said to be $230 per share for the stock.

During the month of January, 113 sets of the Leach sanding device were sold for locomotives.

The Tribulations of a Reformer.

BY SAM SHORT.

Guy Andrean was a machinist runner, and was celebrated on the Prairie Central as the neatest dandy that ever made overalls appear graceful adornments of the form divine. Cleanliness and neatness were something of a craze with Andrean, and woe to the fireman who did not keep everything in apple-pie order. After many changes he got a fireman after his own heart, a Swede, who, having been a sailor and accustomed to pumice-stoning decks twice a day, proved a success. The boys used to say that twice a day Gus scrubbed the deck of the "54," the engine run by Andrean, but that was an exaggeration.

Andrean was as particular about all parts of the engine being kept in the best working order, as he was about her being kept clean. There was not a pin, bolt or bearing that he did not know the exact condition of as accurately as he knew the condition of his clothes. He used to rail about the filthy condition of the roundhouse pits, and say they were not fit for a hog to wallow in—they were not clean enough—but all the same, he never came in from a trip without descending into these nasty pits and examining every part under the engine. Every nut and bolt was felt, every oil hole was scanned, and the oil cellars were taken down regularly and the waste cleaned or stirred up.

The other enginemen had not abounding love for Andrean, and called him a crank. But no engineer got over the road with so few delays, and he never had any accidents to his engine, or detentions on account of hot pins or bearings. The others said this was because he had a fool's luck.

As will happen with a man who makes his meeting-points every time, Andrean became a favorite with the train dispatchers, and they talked about him without guile. Before long, the trainmen came to understand that Andrean got there more regularly than any other engineer on the road, and these men shouted their admiration, although he had several times kicked brakemen off the engine for bringing loads of Missouri real estate to the holy deck on their boots. Before people knew it, Guy was the hero of the road.

Master Mechanic Worth was a neat man himself, but by force of circumstances he had the slouchiest lot of foremen to be found in the State of Missouri. Every shop and yard about the place had the finger-writing of these slovenly foremen written all over, in the shape of dirt and misplaced material. Worth had periodical fits of storming about the need for more order and cleanliness, but little good came of them. There would be a brief move to clean up; then, in a day or two, all hands would drop back into their old careless, comfortable ways.

Jonah Wesley was roundhouse foreman. He had a great affinity for filth, and did not believe in hiring extra help to clean up things that did no harm lying about. One night he fell over an abandoned oil box that was lying near the turn-table pit—fell into the pit head foremost and fractured his skull. The position of roundhouse foreman was vacant three days afterwards, and Worth offered it to Andrean. After much persuasion, Andrean was prevailed on to try the job for a month.

He got permission to hang about the roundhouse for a day or two before he took hold. Business was rushing on the road, and an engine no sooner reached the yard before the train dispatcher was asking how soon she would be ready to go out. The feed-water was bad, the track was in wretched condition and the engines were badly run down, so the main roundhouse was not a seat of idleness.

The morning Andrean took hold he found that three of his machinists, two helpers and four wipers were out sick. They had the shakes. He had expected to inaugurate his rule by starting to clean up; but getting inavoidable work done to the engines took all his attention, and he went home, long after quitting time, feeling that he had doubled the road with a way freight. This experience was repeated for several days, and between times he was cogitating over the cause of so much sickness among the men. At first he laid it to the accumulation of greasy waste, abandoned overalls, worn-out hemp packing, dilapidated oil cans, fragments of lunches and other rejected material that littered every hiding place about the roundhouse. One day he started every wiper and laborer under his charge to clean out this litter, and got it all piled up outside to wait for cars to carry it away; but still the heavy stench, which he thought came from that rubbish, greeted his nostrils in the morning. Then he proceeded to search farther, and discovered that the inside of the house was encircled by a sewer which held eighteen inches of selected filth that could not escape because the drainage pipe had been set on the wrong level.

Next day, Andrean put in an urgent request to the master mechanic that the escape drain should be opened forthwith and the pipe lowered two feet. Worth was anxious to have the work done, but it did not belong to his department, and he did not propose to be saddled with expense that belonged to the engineering department. He would make a request for the work to be done.

Ten days passed and nothing had been done with the drain, and cars had not been furnished to carry away the dirt collected from under benches and other hiding places. The general superintendent happened round, and Andrean thoughtlessly complained about the difficulty in getting things done that were necessary for the health of the men. The G. S. went and blamed the master mechanic for neglecting work that ought to have been done years ago, and the master mechanic intimated to Andrean that he had not been put into the roundhouse to boss the whole road. Andrean regretted leaving the "54," although she was getting very loose in the joints.

Andrean did not feel that his life's happiness was bound up in his holding the job of roundhouse foreman, but he inwardly admitted that he had no right to complain to the G. S., and took Worth's growl without proest.

Next day was Sunday, and he went to the engine house, dressed in his church-going garb, intending to start up a little cleaning that he felt was badly needed. The floor of the engine house had been originally stout oak planking, but it was so thickly enameled with grease that a visitor was in doubt whether it was asphalt or congealed tar. Andrean wanted to try an experiment of scalding off the coating of grease with hot water. There were very few engines in the house, and it was a good chance to get the work done well.

An engine had just come in with a full head of steam, and her boiler would supply any quantity of boiling water. The three boiler washers were in attendance, ready for business. Andrean told Tim Walsh, the head boiler washer, to go below and connect the wash-out hose to the blow-off cock. When this was done, he called to the hostler to open the blow-off cock gently. He held the hose to show how the stream of hot water should be applied.

"Why don't you open that cock," he shouted to the hostler.

"Shure, I have turned the lever, sur," called back the hostler, "and the wather won't come."

"Tap the cock," he called to the boiler washer, "it is choked up with mud."

The boiler washer tapped the blow-off cock, which was full open, and the water rushed through the hose with terrific force. The hose began slashing about like a huge boiling flail. It threw Andrean headlong into a pit, and wiped the floor with a party of visitors who had come to pay their Sunday morning visit to the roundhouse. Then it swiped over the boiler and brought down the fireman who was polishing the bell, and it swung in all directions, seeking more victims; but all had fled, some of them falling into pits as they ran through the blinding steam.

When the hose ceased to flail around on account of the boiler being empty, four men were picked out of pits, two of them badly scalded. Andrean was in the worst condition. They carried him home very tenderly; and he lay in the house for four weeks, prominent parts of his person done up in cotton batting, anointed with sweet oil and lime water.

When the master mechanic came to pay a visit of sympathy Andrean intimated that he was done with running roundhouses. The "54" was good enough for him. He kept to this resolution.

The "American Machinist," among the best-known of American technical papers, has changed owners, a controlling share of the capital stock having been purchased by Angus Sinclair and John A. Hill, editors and proprietors of "Locomotive Engineering." Twelve years ago Mr. Sinclair, who is author of the well-known book, "Locomotive Engine-Running and Management," left railroad life to become associate editor of the "American Machinist." Four years later the "American Machinist" Publishing Company started a monthly magazine called "The Locomotive Engineer," and Mr. Hill was engaged as editor. That paper had a rather feeble existence, so far as the business end was concerned, till four years ago, when Messrs. Sinclair & Hill purchased it, changed the name to "Locomotive Engineering," and made it an eminent success. The same energy will, no doubt, exert a good influence on the "American Machinist." Several improvements are already apparent. The size of page has been greatly reduced and a cover put on. An electrical department for mechanics has been introduced, and we understand that a variety of other changes are contemplated which will make the paper more valuable.—"Engineering."

Mr. W. E. Willetts, a conductor, has just recovered $1,750 damages from the East Coast Railway of Florida, and they have given him a "clearance" from the black-list, besides paying his attorney's fees. Mr. Willetts left the road to take service with another line, when one of the officials wrote a letter putting him on the black-list. Mr. Willetts is now suing for salary during the time the black-list kept him out of a job. We believe this is the first case where damages have been recovered for black-listing—we hope it will be the last crime of the kind that needs punishment.

The Monterey & Mineral Belt Railroad, of which J. A. Robertson, formerly general manager of the Monterey & Mexican Gulf road, and Baltimore capitalists are the owners, is to be extended to Matehuala, Mex., a rich mining camp. The objective point of the road is the city of Mexico. The road is now in operation for twenty miles, and is doing a heavy traffic in ore.

An editorial article appeared recently in the Sedalia, Mo., "Star-Sentinel," on compound locomotives, which said a great many complimentary things about the Richmond compounds in use on the Missouri, Kansas & Texas. It stated that the working of these engines is giving general satisfaction, and that they are the most successful compounds in use.

The Hydraulic Jack and Press.

A correspondent asks us who was the inventor of the hydraulic jack, and what is the principle it works on, which calls for a longer answer than can be put in our "What You Want to Know" Department.

The hydraulic jack which all railroad men are familiar with is a special form of hydrostatic press, and was designed by Mr. Richard Dudgeon, a Scotchman, who settled in New York and built a business of making various forms of hydraulic machines. A variety of other jacks were afterwards designed on the principle of the hydrostatic press.

The inventor of the hydrostatic press was Joseph Bramah, a Yorkshire, England, mechanic, born in 1749. Bramah was the son of a farmer, and was prevented from following his father's business by an accident which lamed him for life. Owing to this apparent misfortune he was sent to learn a mechanic trade, for which he had a strong natural ability. He established a business in London, and was soon distinguished for the number of ingenious apparatuses which he invented. The hydrostatic press was the most valuable of his inventions. He lived till the end of 1814.

The hydrostatic press was applied to various industrial purposes soon after its invention, as it provided a compact and convenient means of applying enormous pressure when speed was not essential. But it remained for the last two generations to properly develop its utility.

The pressure exerted by a hydrostatic press depends upon the relative areas of the small pump plunger, which forces in the water or liquid, and that of the ram, which transmits the work. The pressure on the ram exceeds that on the plunger inversely in proportion which the area of latter bears to that of the former.

Human ingenuity was not the first to invent a hydrostatic press. According to Ewbanks, there is a beautiful illustration of the principle of Bramah's hydrostatic press in the contrivance by which bees store their honey. The cells, open at one end and closed at the other, are arranged horizontally over each other, and in that position are filled with liquid treasure. Now, suppose a series of glass tumblers or tubes, laid on their sides and piled upon one another in like manner, were required to be then filled with water. It certainly would require some reflection to devise a plan by which the operation could be performed; but whatever mode were hit upon, it could not be more ingenious and effective than that adopted by these diminutive engineers.

At the further or closed extremity of each cell they fabricate a movable piston of wax, which is fitted air-tight to the sides, and when a bee arrives laden with honey (which is contained in a liquid form in a sack or stomach), she penetrates the piston with her proboscis, and through it injects the honey between the closed end of the cell and the piston, and then stops the aperture with her feet.

The piston is, therefore, pushed forward as the honey accumulates behind it, till at last it reaches the open end of the cell, where it remains, hermetically sealing the vessel and excluding the air. As soon as one cell is thus charged, the industrious owners commence with another. It will be perceived that the piston is propelled precisely as in the hydrostatic press; the liquid honey being incompressible (with any force to which it is there subjected), every additional particle forced in necessarily moves the piston forward to afford the required room. Without such a contrivance the cells could no more be filled and kept so than a bucket could be with water while lying on one side.

Were the organization of bees closely examined it would doubtless be found that the relative diameters of their proboscis and of the cells, and the area of the pumps (bellows) in their bodies, are such as are best adapted to the muscular energy which they employ in working the latter. Were it otherwise, a greater force might be required to inject the honey and drive forward the piston than they possess. In the case of a hydrostatic press, when the resistance is too great to be overcome by an injection pump of large diameter, one of smaller bore is employed.

Invention of the Locomotive Whistle.

There is a "cock-and-bull" story in "Cassell's Magazine" about how the locomotive whistle came to be invented. It goes on to say that in 1833 a farmer with a load of eggs having been struck at a crossing, the expense to the railroad company was so great that one of the directors went to George Stephenson and got him to invent the locomotive whistle.

Stories of this kind merely excite the ridicule of people fairly well informed about the history of inventions. A steam whistle, something in the form of a letter-carrier's whistle, was in use about the beginning of this century; but the cup whistle was not invented till about 1830. It was first used at the Dowlais Iron Works, in Wales, and is supposed to have been the invention of a workman named William Stephens. It was first applied to a locomotive in 1835 by Bury, a well-known locomotive builder in England.

Only a few years ago, the loss in the foundry of steel castings was so great that many concerns, otherwise well equipped, hesitated to attempt that kind of work. The improvements that have been made in this respect in the last five or six years, may be inferred from the fact that, in casting 386 driving-wheel centers lately, the Pennsylvania Steel Casting & Machine Co., of Chester, Pa., only lost four castings. The castings turned out were also noticeable for solidity and exemption from defects.

WHAT YOU WANT TO KNOW.

Questions and Answers.

(16) J. B. D., Arkansas City, Ark., asks: Is emery a product of the United States? A.—It is found here and in other parts of the world, but the chief supply comes from the Grecian Archipelago and Asia Minor.

(17) P. R. H., Bristol, Vt., asks: 1. If either, when does an engine start the easier, on the top quarter or on the lower quarter? A.—There is no difference in the power developed on the quarters; therefore, a locomotive will start with equal facility when the crank is on the top or bottom quarter. 2. Will an engine run easier with the pin on an arm than as they are on the driver? A.—They would both be crank arms, with no advantage in either case.

(18) J. D., Covington, Ky., writes: In "Locomotive Engineering" of August, 1895, you state that the new Class P engines built by the Pennsylvania Railroad Co. have ¼ inch inside clearance. Does this mean ¼ inch on each side when the valve is in center of seat, or does it mean that when the valve is in its central position it has ⅛ inch clearance on each side, making the sum ¼ inch? A.—The valves have ¼ inch clearance on each side when in their central position.

(19) G. L., New Orleans, La., writes: Will you be so kind as to tell me the price of one of the largest locomotives? A.—The cost of locomotives, large or small, is dependent on the cost of material and labor, and will average about 10 cents per pound of engine alone. Thus, putting the weight of engine, without tender, at 114,500 pounds, the cost would be $11,450 for engine and tender complete. This cost will be variable, of course, with the amount of detail on the engine, and may reach as high as 12 cents per pound.

(20) E. R. S., Angus, Minn., asks: 1. Does water in the ashpan help to form clinkers on the grates? If so, why? A.—Never knew that it would do so; the quality of fuel has more to do with clinker formation than any other cause. 2. I have read about sudden disappearance of oil in lubricator when engine is shut off; please explain the cause. A.—We are assured by the builders that this can occur only when the valve from the boiler to the condensing chamber is closed. 3. Will the Detroit lubricator "cross-feed"? A.—No; if all passages are kept unobstructed.

(21) F. K. C., Watertown, N. Y., writes: A friend of mine, a machinist by trade, claims that if a locomotive would hold its boiler pressure and maintain it at 150 pounds, it would run faster at full stroke and wide-open throttle than it would by working steam expansively. I claim not. Which is right? A.—It can be shown that when a cylinder is filled with steam at 150 pounds pressure per square inch, the steam will do three times as much work as a cylinder filled with steam at 50 pounds pressure, provided there is no back pressure; and the engine would have, in a given time, velocities proportional to the work done by the respective pressures; therefore, your friend is right.

(22) E. R. S., Angus, Minn., asks: 1. What is a stretcher? A.—Assuming from what follows that the stretcher referred to is a part of the valve rod, it may be defined as a long nut having a right-hand thread in one end and a left-hand thread in the other, into which are fitted the valve stem and valve rod, respectively. A movement of the nut in either direction will lengthen or shorten the distance from center of rocker arm to center of valve face. 2. Can the stretcher be taken down when the valve is in the forward end of steam chest? If not, why not? A.—In many steam chests there is not room between the valve and inside of chest to disconnect the stretcher when the valve is in the position noted; since any movement to remove the stretcher tends to lengthen the rod and stem, the valve should not be forward of its central position on the seat when it is necessary to remove the stretcher.

(23) F. K. C., Watertown, N. Y., asks: 1. Why is it an injector will work so quietly at times, then again it will work just the opposite, when conditions are just the same? A.—The sound given out by a working injector is caused by the condensation of steam used in its working, and also the friction of the water; the colder the feed water, the louder the singing, and the greater the volume of water passing through the instrument. Any variation in sound from the injector, therefore, implies a change of conditions. 2. Why do locomotive builders place injectors on the inside of cab, instead of outside, where they belong? The noise and heat are a nuisance, besides having the windows covered with frost in the winter. Will you not advocate placing injectors outside of the cab, where they should be? A.—The question of convenience in handling will govern in this case, as in many others; although there is no doubt that the instrument would do as well in one place as another.

(24) E. R. S., Angus, Minn., asks: 1. How do you find the capacity of an injector? A.—Take the builder's delivery rating in gallons per hour, or apply the injector to a boiler and find its capacity by a practical test under the required conditions. 2. How do you find the horse-power of a locomotive boiler? A.—The horse-power of a boiler is measured by its steam-generating efficiency; and since this must necessarily be a variable quantity, owing to the number of influences which affect it, as heating surface, ratio of grate to heating surface, quality of fuel, rate of combustion, etc., any formula that gives correct results in one case will be wide of the mark in another; therefore, it is plain that no reliable rule can be laid down to determine this question. The great diversity in ratios of heating and grate surfaces is shown in the case of two 19-inch engines of recent build, now running on Western roads: In the one case there is 1,580 square feet of heating surface to 44.5 square feet of grate; and in the other we find 1,904 square feet to 26.5 square feet. Tests are now under way at one of the testing plants, which will tend to give us some reliable information on this subject; and when completed, we shall publish the results.

(25) E. R. S., Angus, Minn., asks: Is there any rule by which to find the amount of water used by a locomotive? A.—To determine the quantity of water passing through a locomotive boiler, it will be necessary to know how much has been received in and discharged from the tank, and in order to find this amount we must know the capacity of tank. A simple method of finding the capacity is to fill the tank and draw off the water in weighed quantities into a barrel on scales, which are located in the pit under the tank, and at the same time noting the amount of fall of water in the tank by means of a graduated stick or rule about 6 feet long. Each inch of fall will have its corresponding weight of water, and from this the weight of water per inch of rise is deduced. The difference between the inches of water at start and finish is the total number of inches used by the

boiler, and multiplying these inches by the known weight per inch will give pounds of water evaporated; dividing this amount by 8.33, the weight of one gallon of water, the quotient is the total gallons used. A water meter that will give correct readings under the rough conditions of road service, is the best medium by which to measure the water consumption of a locomotive boiler.

(26) W. J., Forsyth, Mont., writes:

1. Will you kindly tell me, through your columns, what the hole on top of a balanced valve, through to the exhaust cavity, is for? A.—See Answer No. 11 in the February issue. 2. Why will an injector working, say, at its full capacity, supply a boiler as long as the water is kept near the top of water glass, but when allowed to get down to, say, half a glass or lower, will then steadily lose water, the throttle and reverse lever being in same position? I have noticed this phenomenon for years, but could not figure out whether an engine used more water when the water was low in the boiler, or whether the injector threw more water when the water line was higher above the delivery line. A.—The steady loss may be more apparent than real, for this reason: When water shows in the top of the glass with a given pressure, the boiler is working at its greatest efficiency, because it then has a large volume of water heated to a temperature due to the pressure, and this volume furnishes a storage or reserve to draw on; therefore, the supply does not diminish rapidly as when the volume is less. The steam space in a boiler is comparatively small when water is carried at the maximum height, and it is correspondingly large when carried half-glass high; any alteration in the height of the water comes slow, for that reason, and may lead to the belief that it is falling, because the injector is a longer time in filling the greater space. 3. Why will an engine with balanced valves "pull" so much harder on the reverse lever when you are "putting her down in the corner" after shutting off, than an engine with the plain slide valve? A.—The greater weight of the balanced valve is responsible for this.

The Jones & Lamson Machine Co. have recently received orders for 2 x 24 flat turret lathes from the following parties: New York, New Haven & Hartford R. R. Co., Hartford, Conn., two machines; Goldie & McCullough Co., Galt, Ont.; J. I. Case Threshing Machine Co., Racine, Wis.; Boston & Maine R. R. Co., Concord, N. H., two machines; Westinghouse Air-Brake Co., Wilmerding, Pa.

The Fox Machine Co., Grand Rapids, Mich., write to the makers of Mannocitin: "Our test of Mannocitin was as follows: Took a small iron pulley, finished; coated one side with Mannocitin, subjected it when dry to a steam jet, turning wheel so that all sides received equal steam abuse; placed it out in the rain and snow for five days, and at the end of this time the uncovered side was a mass of rust. That portion covered by Mannocitin was as bright as new finish; it was washed off with turpentine, and the result was simply marvelous. It will prevent rust, and we shall use it in preference to anything else.

The Standard Paint Co., at No. 2 Liberty street, New York, have samples of their Ruberoid roofing put up neatly in packages, showing the several thicknesses of the material they furnish customers. The covers of these samples tell all about the guarantee that goes with the goods, and give all information regarding its merits and uses that any prospective purchaser would care to know—except the price; the latter and samples will be furnished free on application.

The Clayton Air Compressor Works, Havemeyer Building, New York, report recent sale of 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 also 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.

On the Chicago, Burlington & Quincy road, one day last month, between Galesburg and Mendota, a distance of eighty miles, was made the fastest time ever made on that system, beating even the mile-a-minute record between the same points several months ago. The run was made by the Texas flyer with four cars. The actual running time for the eighty miles was one hour, eleven minutes and thirty seconds.

"A Third of a Century of Progress" is the name of a beautifully illustrated pamphlet recently issued by the B. F. Sturtevant Co., of Boston, Mass. It is got out in a highly artistic style, and tells a very interesting story about how the company originated and developed to its present great proportions. If we had the space to spare, we would be glad to publish the pamphlet entire, and consider that it would be found interesting reading; not being able to do this, we recommend that anyone interested in pressure blowers, exhaust fans, and the most approved methods of heating shops, should send to the company for the pamphlet. Incidentally, the pamphlet tells the story of the life of B. F. Sturtevant, the founder of the company, who started out in life as a young shoemaker, and ignored the old Roman maxim, "Ne supra crepidum sutor judicaret," which advises the shoemaker to aspire not above his last. He had brains enough to desert his last for higher pursuits, and by the force of brain power, integrity and perseverance built up one of the finest industrial properties to be found in New England.

INDEX TO ADVERTISEMENTS.

Continued on page 281.

INDEX TO ADVERTISERS—Continued.

Buyers' Finding List.

Air Brake Fittings.
Crane Co., Chicago, Ill.
Air Brake Hose.
Boston Belting Co., Boston, Mass.
Air Brakes.
Westinghouse Air Brake Co., Pittsburg, Pa.
Air Brake Gage.
Utica Steam Gage Co., Utica, N. Y.
Air-Brake Pump Governors.
Foster Engineering Co., Newark, N. J.
Air Compressors.
Clayton Air Compressor Works, New York.
Ingersoll Sergeant Drill Co., N. Y. City.
Norwalk Iron Works Co., South Norwalk, Ct.
Pedrick & Ayer Co., Philadelphia, Pa.
Rand Drill Co., New York.
St. Louis Steam Engine Co., St. Louis, Mo.
Air Drilling Machine.
C. H. Haeseler & Co., Philadelphia, Pa.
Air Hoists.
Pedrick & Ayer Co., Philadelphia, Pa.
Whiting Foundry Equipment Co., Chicago, Ill.
Arch Bars.
Cambria Iron Co., Philadelphia, Pa.
Asbestos.
H. W. Johns Mfg. Co., New York.
Axles.
Cambria Iron Co., Philadelphia, Pa.
Gould Coupler Co., Buffalo, N. Y.
B. M. Jones & Co., Boston, Mass
Krupp (T. Prosser & Son, New York).
Balanced Slide Valves.
Am. Bal. Slide Valve Co., San Frisco, Cal.
M. C. Hammett, Troy, N. Y.
Bearing Metal.
Ajax Metal Co., Philadelphia, Pa.
Paul S. Reeves, Philadelphia, Pa.
U. S. Metallic Pkg. Co., Philadelphia, Pa.
Bell Ringer.
Trumbull Mfg. Co., Warren, O.
U. S. Metallic Packing Co., Philadelphia, Pa.
Belting.
Boston Belting Co., Boston, Mass.
Shultz Belting Co., St. Louis, Mo.
Body Bolsters.
Fox Solid Pressed Steel Co., Chicago, Ill.
Boiler and Firebox Steel.
Shoenberger Steel Co., Pittsburg, Pa.
Boiler Checks Inside.
Foster Engineering Co., Newark, N. J.
Boilers.
Pittsburg Locomotive Works, Pittsburg, Pa.
Boiler Iron.
Ewald Iron Co., St. Louis, Mo.
Boiler Testers.
Rue Mfg. Co., Philadelphia, Pa.
Boiler Tools.
Richard Dudgeon, New York.
Hilles & Jones Co., Wilmington, Del.
Long & Allstatter Co., Hamilton, O.
Boiler Washers.
Nathan Mfg. Co., New York.
Rue Mfg. Co., Philadelphia, Pa.
Bolt and Rivet Headers.
Acme Machinery Co., Cleveland, O.
Bolt Cutters.
Acme Machinery Co., Cleveland, O.
Bolt Threading Machinery.
Detrick & Harvey Machine Co., Baltimore, Md.
Books.
H. C. Baird & Co., Philadelphia, Pa.
N. W. Henley & Co., New York
Locomotive Engineering, New York.
Practical Pub. Co. E. Orange, N. J.
Philadelphia Book Co., Philadelphia, Pa.
Boring and Turning Mills.
Bullard Mch. Tool Co., Bridgeport Conn.
Brake Adjusters.
Q. & C. Co., Chicago, Ill.
Brake Shoes.
Ramapo Iron Works, Hillburn, N. Y.
Ramapo Wheel & Foundry Co., Ramapo, N.Y.
Brass Castings.
Ajax Metal Co., Inc., Philadelphia, Pa.
Paul S. Reeves, Philadelphia, Pa.
Buffers.
Gould Coupler Co., Buffalo, N. Y.
Bulldozers.
Williams, White & Co., Moline, Ill.
Cab Seats
Stannard & White, Appleton, Wis.
Cars.
Allison Mfg. Co., Philadelphia, Pa.
Lima Locomotive & Machine Co., Lima, O.
Ramapo Iron Works, Hillburn, N. Y.
Car Bearings.
Paul S. Reeves, Philadelphia, Pa.
Car Couplers.
Champion Auto. Car Coupler Co., Kenton, O.
Gould Coupler Co., Buffalo, N. Y.
McConway & Torley Co., Pittsburg, Pa.
National Malleable Castings Co., Chicago, Ill.
Sams Automatic Coupler Co., Denver, Col.
Shickle, Harrison & Howard Iron Co., St. Louis, Mo.
Smillie Coupler & Mfg. Co., Newark, N. J.
Standard Coupler Co., New York.
Trojan Car Coupler Co., Troy, N. Y.
Car Door Equipment.
Q. & C. Co., Chicago, Ill.
Car Heating.
William C. Baker, New York.
Gold Car Heating Co., New York.
Safety Car Heating & Ltg. Co., New York.
Car Lighting.
Safety Car Heating & Lighting Co., New York
Car Paints.
Detroit White Lead Works, Detroit, Mich.

Continued on page 283.

BUYERS' FINDING LIST—*Continued.*

Car Roofing.
P. H. Murphy Mfg. Co., E. St. Louis, Ill.
Standard Paint Co., New York.
Warren Chemical & Mfg. Co., New York.
Car Seats.
Hale & Kilburn Mfg. Co., Philadelphia, Pa.
Car Ventilators.
M. C. Hammett, Troy, N. Y.
Car Wheels.
Boies Steel Wheel Co., Scranton, Pa.
Krupp (T. Prosser & Son, New York).
Lima Locomotive & Machine Co., Lima, O.
Ramapo Wheel & Foundry Co., Ramapo, N.Y.
Roberts, Throp & Co., Three Rivers, Mich.
Rood & Brown, Buffalo, N. Y.
Standard Steel Works, Philadelphia, Pa.
Washburn Car Wheel Co., Hartford, Conn.
Cattle Guards.
Q. & C. Co., Chicago, Ill.
Chain Pulley Blocks.
Moore Mfg. & Fdy. Co., Milwaukee, Wis.
Chime Whistles.
Crosby Steam Gage & Valve Co., Boston, Mass.
Clocks.
John J. McGrane, New York.
Coal Handling Machinery.
Link Belt Engineering Co., Philadelphia, Pa.
Coal Chutes.
Williams, White & Co., Moline, Ill.
Correspondence Schools.
Internat'l Corres. Schools Scranton, Pa.
The Scientific Machinist Co., Cleveland, O.
Corundum Wheels.
Sterling Emery Wheel Mfg. Co., Tiffin, O.
Cranes.
Manning, Maxwell & Moore, New York.
Maris Bros., Philadelphia, Pa.
William Sellers & Co., Philadelphia, Pa.
Whiting Foundry Equipment Co., Chicago, Ill.
R. D. Wood & Co., Philadelphia, Pa.
Crank Pin Gages.
M. C. Hammett, Troy, N. Y.
Crank Pins.
Cambria Iron Co., Philadelphia, Pa.
B. M. Jones & Co., Boston, Mass.
Krupp (T. Prosser & Son, New York).
Crossings.
Ramapo Iron Works, Hillburn, N. Y.
Drills.
Cleveland Twist Drill Co., Cleveland, O.
Standard Tool Co., Cleveland, O.
Ejectors.
Rue Mfg. Co., Philadelphia, Pa.
Electric Lighting and Power Apparatus.
Westinghouse Elec. & Mfg. Co., Pittsburgh, Pa.
Emery Grinders.
Leland & Faulconer Mfg. Co., Detroit, Mich.
Emery Wheels.
Sterling Emery Wheel Mfg. Co., Tiffin, O.
The Tanite Co., Stroudsburg, Pa.
Enamel.
Detroit White Lead Works, Detroit, Mich.
Engines.
St. Louis Steam Engine Co., St. Louis, Mo.
Engravings.
Bradley & Poates, New York.
Standard Engraving Co., New York.
Exhaust Pipe.
The General Agency Co., New York.
Expanding Mandrel.
Geo. L. Weiss, Cleveland, O.
Files and Rasps.
Nicholson File Co., Providence, R. I.
Filters.
A. Major, New York.
Fire Kindlers.
J. S. Leslie, Paterson, N. J.
Flexible Shaft.
Chicago Flexible Shaft Co., Chicago, Ill.
Flexible Steam Joint.
Moran Flexible Steam Joint Co., Louisville, Ky.
Flues and Tubes.
Allison Mfg. Co., Philadelphia, Pa.
Tyler Tube & Pipe Co., Washington, Pa.
Forges.
Buffalo Forge Co., Buffalo, N. Y.
Forging Machinery.
Williams, White & Co., Moline, Ill.
Foundry Equipment.
Whiting Foundry Equipment Co., Chicago, Ill.
Frogs and Crossings.
Ramapo Iron Works, Hillburn, N. Y.
Gages.
Ashton Valve Co., Boston, Mass.
Crosby Steam Gage & Valve Co., Boston.
Graphite.
Jos. Dixon Crucible Co., Jersey City, N. J.
Hammers.
Williams, White & Co., Moline, Ill.
Hand Cars.
Railway Cycle Mfg. Co., Hagerstown, Ind.
Roberts, Throp & Co., Three Rivers, Mich.
Heating System for Shops.
Buffalo Forge Co.
B. F. Sturtevant Co., Boston, Mass.
Hoisting Engines.
Earle C. Bacon, New York.
Hollow Stay-Bolt Iron.
Falls Hol. Stay-Bolt Co., Cuyahoga Falls, O.
Hydraulic Tools.
Riehle Bros., T. M. Co., Philadelphia, Pa.
Watson & Stillman, New York.
R. D. Wood & Co., Philadelphia, Pa.
Indicators.
Ashcroft Mfg. Co., New York.
Crosby Steam Gage and Valve Co., Boston.
Injectors.
Automatic Injector Co., Cincinnati, O.
Hancock Inspirator Co., Boston, Mass.
Hayden & Derby Mfg. Co., New York.

Continued on page 284.

BUYERS' FINDING LIST—*Continued.*

Injectors—Continued.
Nathan Mfg. Co., New York.
Ohio Injector Co., Chicago, Ill.
Rue Mfg. Co., Philadelphia, Pa.
William Sellers & Co., Philadelphia, Pa.
Jacks.
E. C. Boyer, Dayton, O.
Richard Dudgeon, New York.
A. L. Henderer, Wilmington, Del.
A. O. Norton, Boston, Mass.
Watson & Stillman, New York.
Laggings for Locomotives.
Keasbey & Mattison Co., Ambler, Pa.
Locomotives.
Baldwin Locomotive Works, Philadelphia, Pa
Brooks Locomotive Works, Dunkirk, N. Y.
Cooke Loco. & Machine Co., Paterson, N. J.
Dickson Mfg. Co., Scranton, Pa.
Lima Locomotive & Machine Co., Lima, O.
Pittsburg Locomotive Works, Pittsburg, Pa.
H. K. Porter & Co., Pittsburg, Pa.
R. I. Locomotive Works, Providence, R. I.
Richmond Loco. & Mch. Wks., Richmond, Va.
Rogers Locomotive Works, Paterson, N. J.
Schenectady Loco. Wks., Schenectady, N. Y.
Lubricators
Detroit Lubricator Co., Detroit, Mich.
M. C. Hammett, Troy, N. Y.
Nathan Mfg. Co., New York.
Lubricating Oils.
Galena Oil Works, Ltd., Franklin, Pa.
Leonard & Ellis, New York.
Signal Oil Works, Franklin, Pa.
Machine Tools
Bement, Miles & Co., Philadelphia, Pa.
Bullard Machine Tool Co., Bridgeport, Conn.
W. D. Forbes & Co., Hoboken, N. J.
Gould & Eberhardt, Newark, N. J.
Hilles & Jones Co., Wilmington, Del.
Jones & Lamson Machine Co., Springfield, Vt.
Manning, Maxwell & Moore, New York.
National Machinery Co., Tiffin, O.
Newton Machine Tool Wks., Philadelphia, Pa.
Niles Tool Works Co., Hamilton, O.
Geo. Place, New York.
Pratt & Whitney Co., Hartford, Conn.
Prentiss Tool and Supply Co., New York.
William Sellers & Co., Inc., Philadelphia, Pa.
Malleable Iron.
C. E. Rood, Lancaster, N. Y.
Mechanics' Tools
Armstrong Bros. Tool Co., Chicago, Ill.
Keystone Mfg. Co., Buffalo, N. Y.
Chas. A. Strelinger & Co., Detroit, Mich.
Metal Polish.
G. W. Hoffman, Indianapolis, Ind.
Metal Sawing Machines.
Pratt & Whitney Co., Hartford, Conn.
Q. & C. Co., Chicago, Ill.
Milling Machines.
Cincinnati Milling Machine Co., Cincinnati, O.
Pratt & Whiting Co., Hartford, Conn.
Mining Machinery.
Earle C. Bacon, New York.
Gates Iron Works, Chicago, Ill.
Molding Machines.
Tabor Mfg. Co., New York City.
Oil Cups
Nathan Mfg. Co., New York.
U. S. Metallic Pkg. Co., Philadelphia, Pa.
Over Clothes.
H. S. Peters, Dover, N. J.
Packing.
Boston Belting Co., Boston, Mass.
Gould Packing Co., East Cambridge, Mass.
Jenkins Bros., New York.
H. W. Johns Mfg. Co., New York.
U. S. Metallic Packing Co., Philadelphia, Pa.
Paints.
Standard Paint Co., New York.
Detroit White Lead Works, Detroit, Mich.
Patents.
John Wedderburn & Co., Washington, D. C.
George P. Whittlesey, Washington, D. C.
Perforated Metal.
Aitchison Perforated Metal Co., Chicago, Ill.
A. J. Beckley & Co., Meriden, Conn.
The Hendrick Mfg. Co., Ltd., Carbondale, Pa.
Photographs.
F. Moore, London, Eng.
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Bignall & Keeler Mfg. Co., Edwardsville, Ill
Armstrong Mfg. Co., Bridgeport, Conn
D. Saunders' Sons, Yonkers, N. Y.
Pipe Wrench
Sam'l L. Hall's Son, New York.
Piston Rods
Cambria Iron Co., Philadelphia, Pa.
B. M. Jones & Co., Boston, Mass.
Thomas Prosser & Son, New York.
Planers.
Detrick & Harvey Machine Co., Baltimore, Md.
Pneumatic Tools.
Chicago Pneumatic Tool Co., Chicago, Ill.
C. H. Haeseler & Co., Philadelphia, Pa.
Pressed Steel Materials
Schoen Mfg. Co., Pittsburg, Pa.
Pressure Regulators.
Foster Engineering Co., Newark, N. J.
Newark Regulator Co., Newark, O.
Pump Valves
Boston Belting Co., Boston, Mass.
Punching and Shearing Machinery.
Hilles & Jones Co., Wilmington, Del.
Long & Allstatter Co., Hamilton, O.
R. D. Wood & Co., Philadelphia, Pa.
Railroads.
C., H. & D. Ry., Cincinnati, O.
L. S. & M. S. Ry., Cleveland, O.

Continued on page 285.

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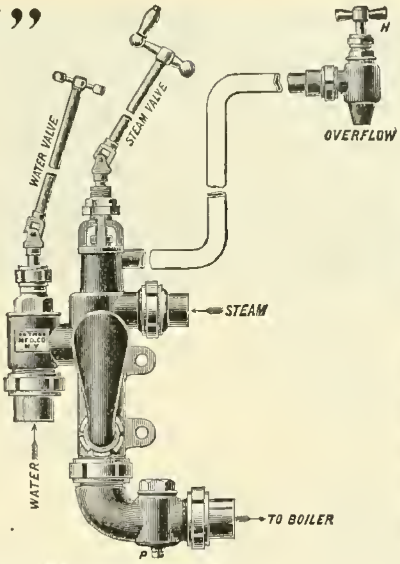

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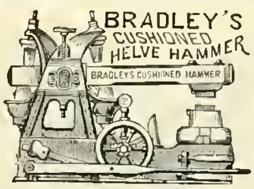

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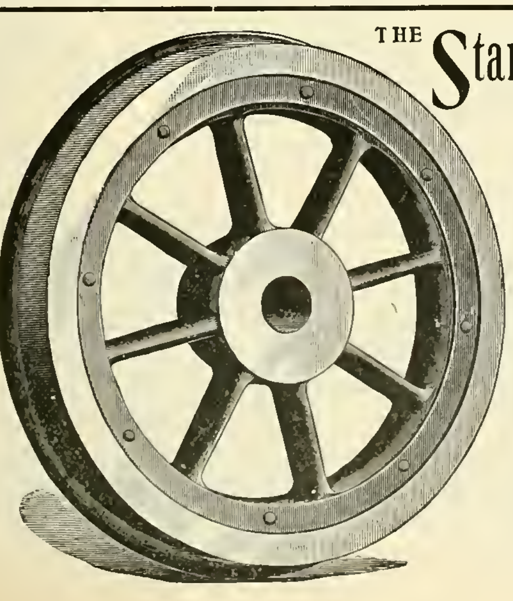

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Railroads—Continued.
B. & A. R. R., Boston, Mass.
I. C. R. R., Chicago, Ill.
Monon Route, Chicago, Ill.
Railway Fences.
Page Woven Wire Fence Co., Adrian, Mich.
Railway Gates.
Pneumatic Gate Co., Chicago, Ill.
Retaining Rings
Ramapo Wheel & Foundry Co., Ramapo, N.Y.
Rubber.
Boston Belting Co., Boston, Mass.
Rust Preventing Compound.
Otto Goetze, New York.
Safety Valves
Ashton Valve Co., Boston, Mass.
Crosby Steam Gage & Valve Co., Boston, Mass.
Sanding Apparatus
Henry L. Leach, North Cambridge, Mass.
Sherburne & Co., Boston, Mass.
Shafting.
William Sellers & Co., Philadelphia, Pa.
Spark Arrester Plate.
A. J. Beckley & Co., Meriden, Conn.
Hendrick Mfg. Co., Carbondale, Pa.
Springs.
A. French Spring Co., Pittsburg, Pa.
Spring Steel
Thomas Prosser & Son, New York.
Stay-Bolts.
Ewald Iron Co., St. Louis, Mo.
Falls Hollow Stay-Bolt Co., Cuyahoga Falls, O.
B. M. Jones & Co., Boston, Mass.
Steam Gages.
Ashcroft Mfg. Co., New York.
Crosby Steam Gage & Valve Co., Boston.
Utica Steam Gage Co., Utica, N. Y.
Steam Hammers.
Bement, Miles & Co., Philadelphia, Pa.
Steam Hose.
Boston Belting Co., Boston, Mass.
Steam Pumps.
A. S. Cameron Steam Pump Works, New York.
Steel.
Cambria Iron Co., Philadelphia, Pa.
Ewald Iron Co., St. Louis, Mo.
B. M. Jones & Co., Boston, Mass.
Krupp (T. Prosser & Son, New York).
Latrobe Steel Co., Latrobe, Pa.
Schoen Mfg. Co., Pittsburg, Pa.
Shoenberger Steel Co., Pittsburg, Pa.
Steel Tired Wheels.
Boies Steel Wheel Co., Scranton, Pa.
Krupp (T. Prosser & Son, New York).
Ramapo Wheel & Foundry Co., Ramapo, N.Y.
Standard Steel Works, Philadelphia, Pa.
Washburn Car Wheel Co., Hartford, Conn.
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Gates Iron Works, Chicago, Ill.
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Ramapo Iron Works, Hillburn, N. Y.
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Riehle Bros. Testing Machine Co., Phila.
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Q. & C. Co., Chicago, Ill.
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Krupp (T. Prosser & Son, New York.)
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Armstrong Bros. Tool Co., Chicago, Ill.
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Cleveland City Forge & Iron Co., Cleveland, O.
Merrill Bros., Brooklyn, N. Y.
Turret Machines.
Bullard Mch. Tool Co., Bridgeport, Conn.
Jones & Lamson, Springfield, Vt.
Twist Drills.
Cleveland Twist Drill Co., Cleveland, O.
Standard Tool Co., Cleveland, O.
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Ross Valve Co., Troy, N. Y.
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Foster Engineering Co., Newark, N. J.
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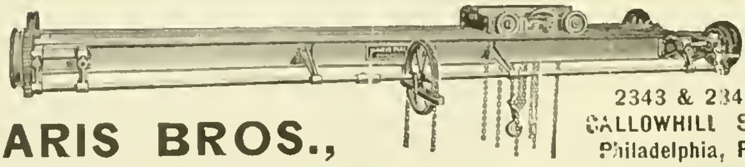

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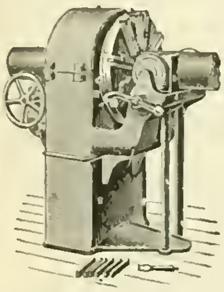

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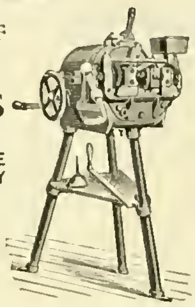

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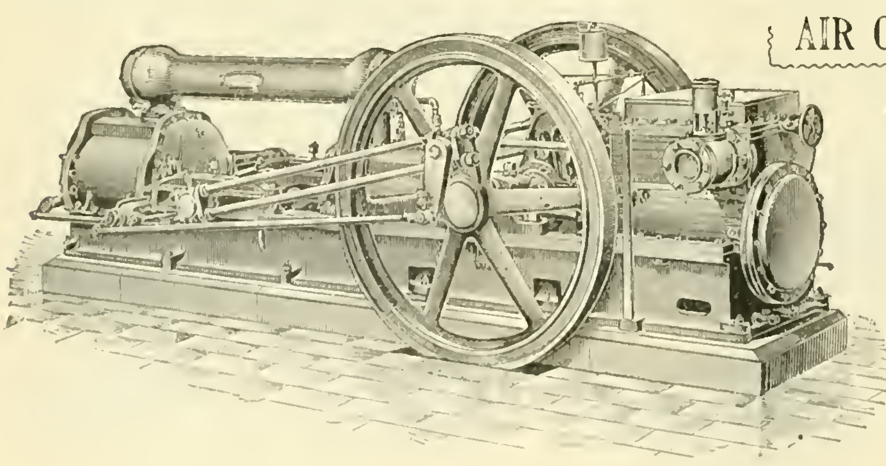

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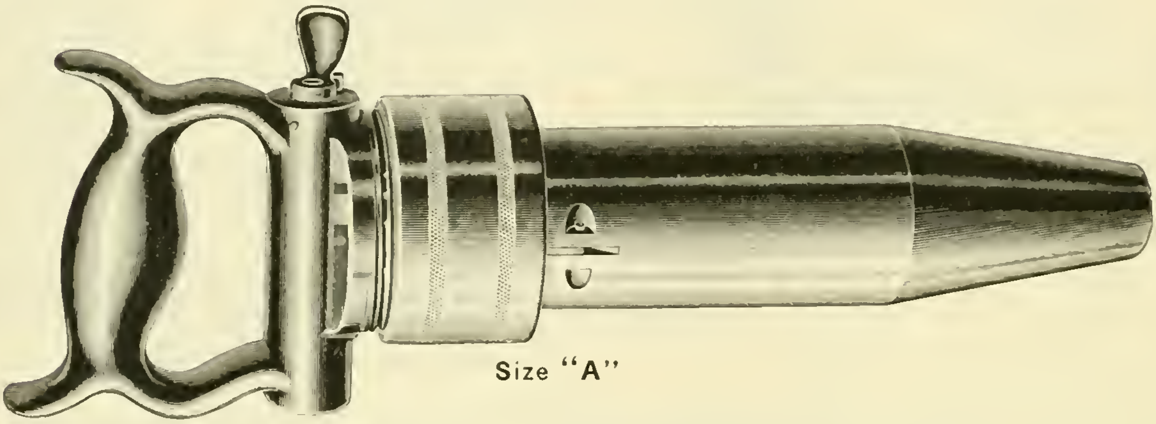

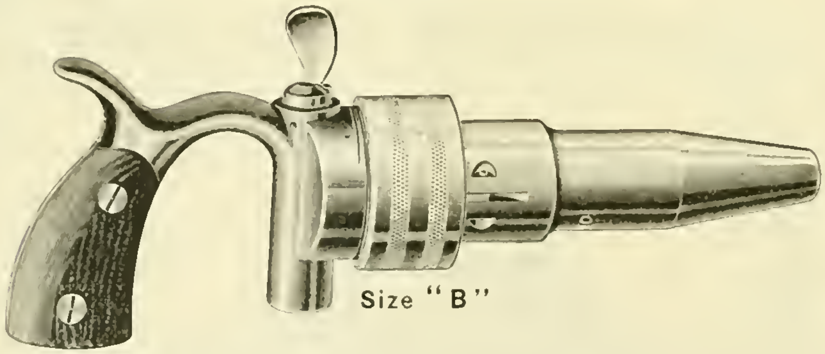


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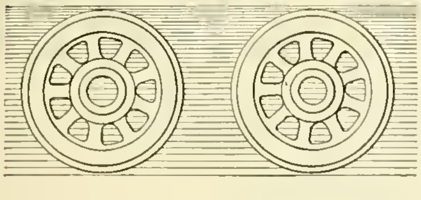

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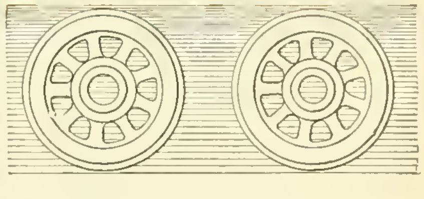

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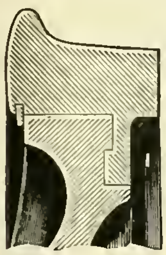

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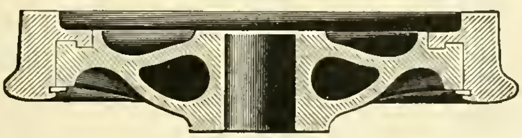

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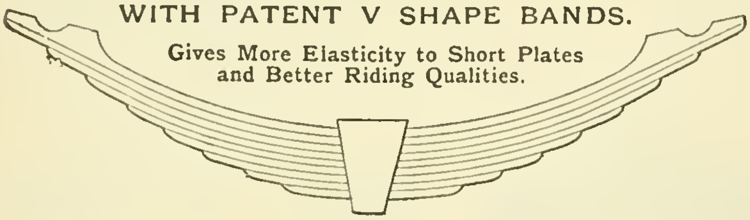

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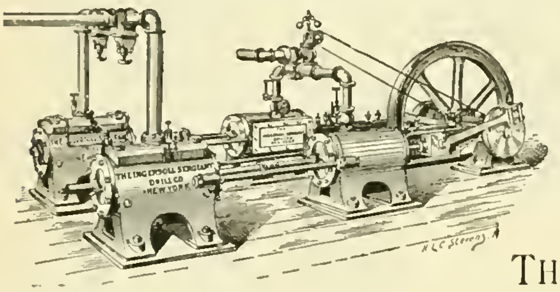

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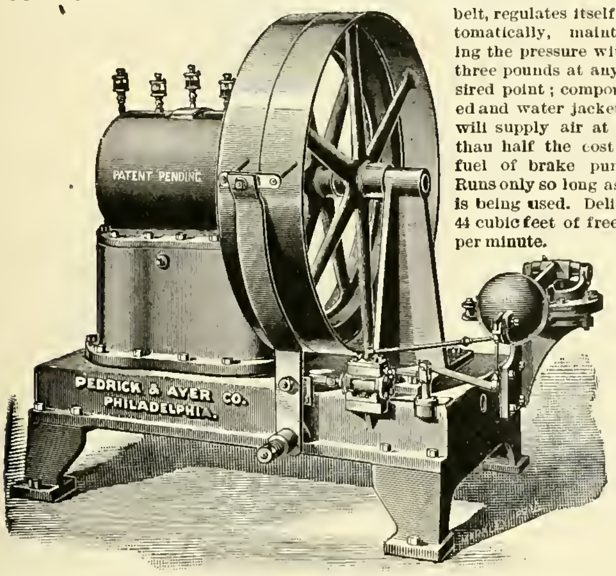

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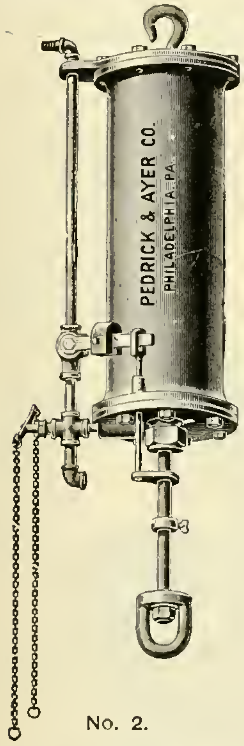

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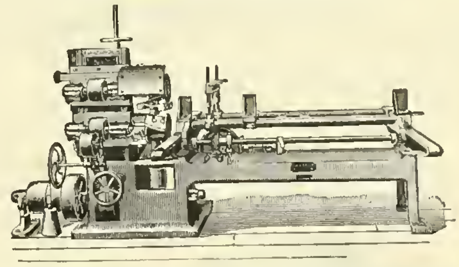

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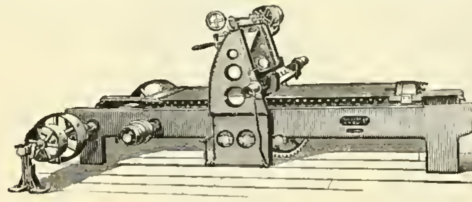

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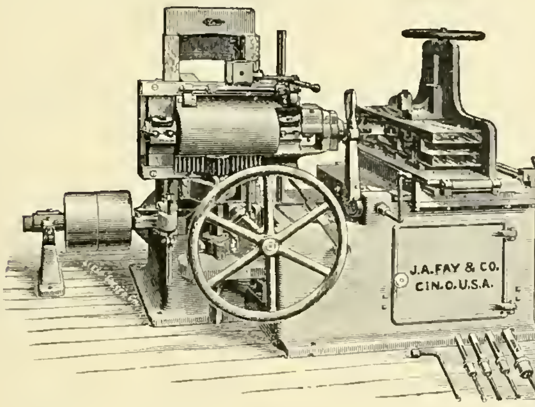

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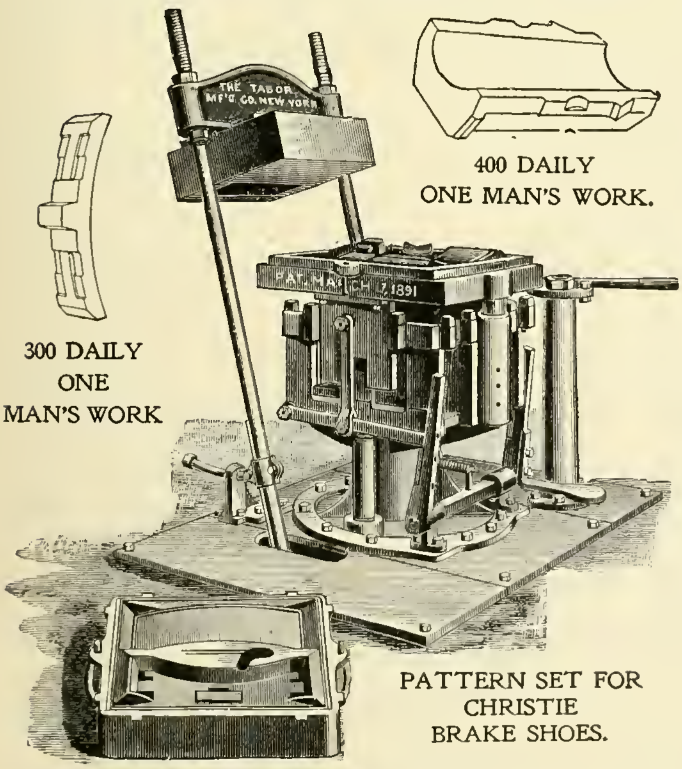

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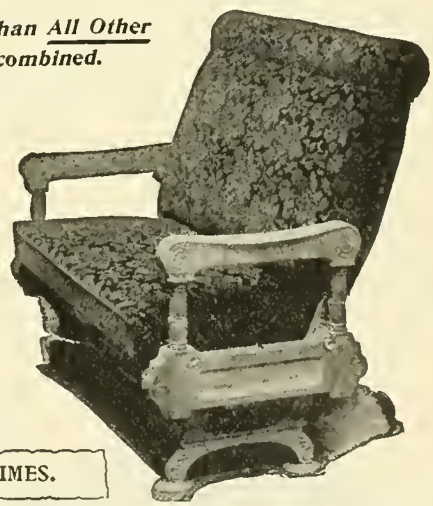

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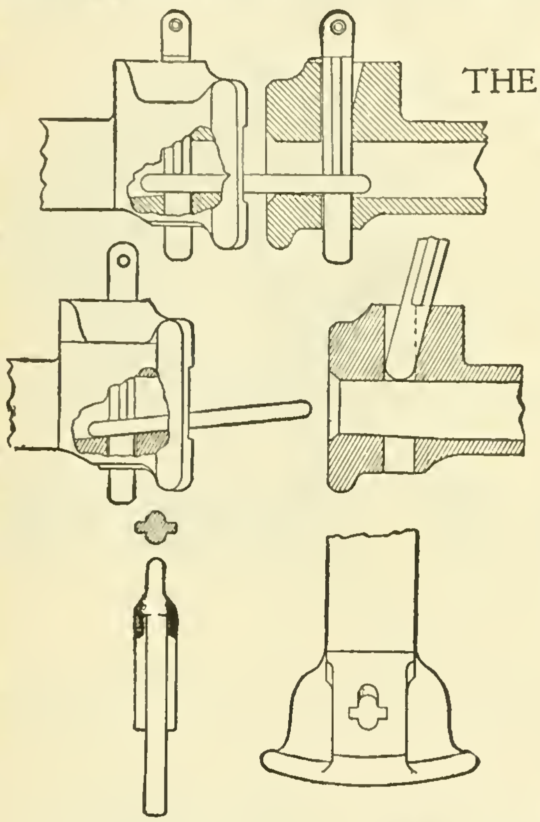

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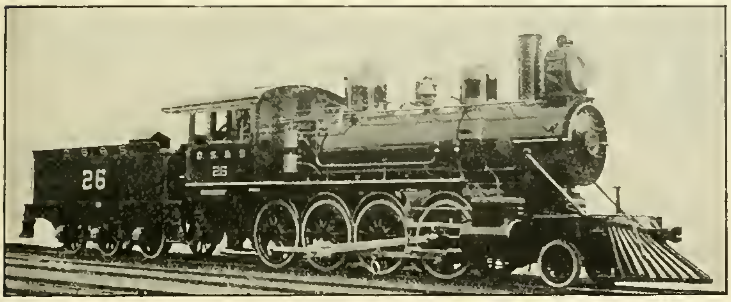

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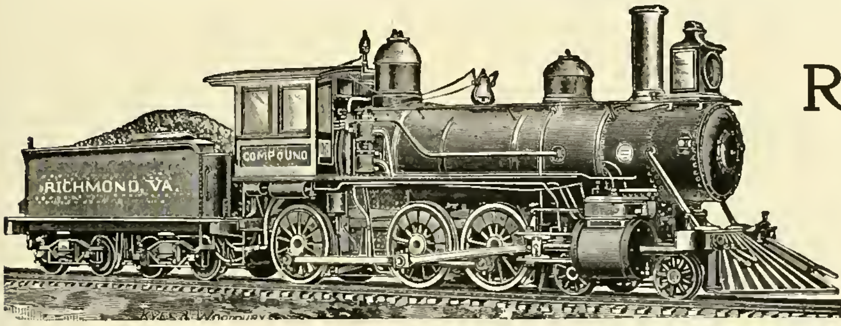

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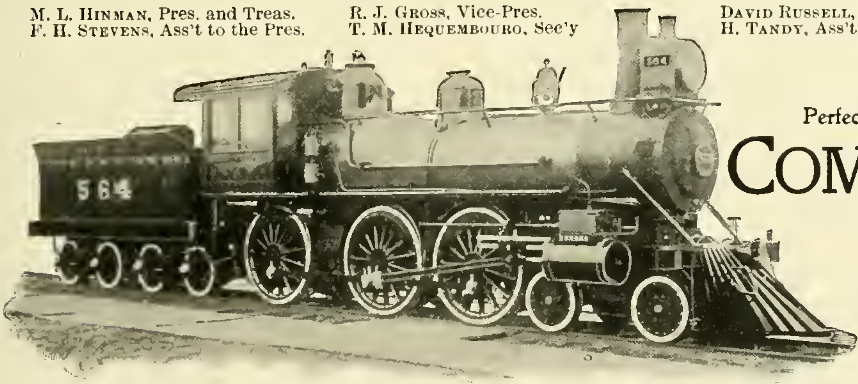

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Vol. IX. NEW YORK, APRIL, 1896. No. 4.

Philadelphia & Reading Shops.

During the first fifty years of its history, the Philadelphia & Reading Railroad Company was the most prosperous railroad corporation on the American Continent. The prosperity resulted to a great extent from exceptionally good management, which, by a most liberal policy, developed the magnificent business resources of the district traversed. Besides doing all in their power to develop the anthracite coal-carrying business, the managers pursued a most enterprising policy in the building-up of their railroad property. No expense was spared to make roadbed and machinery second to none to be found anywhere. They not only wanted the best of rolling stock, but their liberal policy brought the best personal ability into their service. This is how it came that the Philadelphia & Reading Railroad exerted such a powerful influence in developing the railroad machinery of this continent and establishing the prevailing forms.

The company was incorporated in 1833, but no part was opened for traffic till 1842. Eleven years later, when the road was still less than 100 miles long, the gross earnings amounted to $2,688,288. During the same year the earnings of the Baltimore & Ohio, with 379 miles of track, were $1,325,563. Most of the earnings came from the carrying of coal, but the volume of merchandise had increased nearly one hundred per cent. for every year the road had been in operation—a good indication of how successfully the railroad was developing the local industries of the district between Philadelphia and Pottsville, which is now an almost continuous chain of manufacturing towns.

From the inception of the company, Reading was chosen as the mechanical headquarters, and land was purchased on what was then the outside of the town, for the erection of shops that would be sufficient to build and repair all the rolling stock and other machinery necessary for operating the road. The shops are still on the site originally selected, but they are now nearly in the heart of the city.

When the first Philadelphia & Reading shops were built, the men in charge had no examples of others to guide them in designing, and they had to work out for themselves the arrangement likely to be most convenient. The original idea was to put all the shops under one roof—car building, locomotive building, repairing of the same, and the tools and appliances for doing the work. The belief was that this would make a particularly compact arrangement, and that there would be the least possible loss of time and labor in the moving of material. This company took the lead in increasing the capacity of cars and locomotives; but for many years after the road was in operation, the cars were about 4½ tons capacity and the locomotives less than 20 tons in weight. Increasing the power of locomotives was more easily accomplished than increasing the size of cars, for in 1853 they had between six and seven thousand small iron coal cars that had wonderful vitality. The capacity could only be increased as the cars wore out, and they wore very slowly. An illustration of the durability of these cars is to be found in the fact that two of them can still be seen daily conveying the ashes away from the new station at Philadelphia.

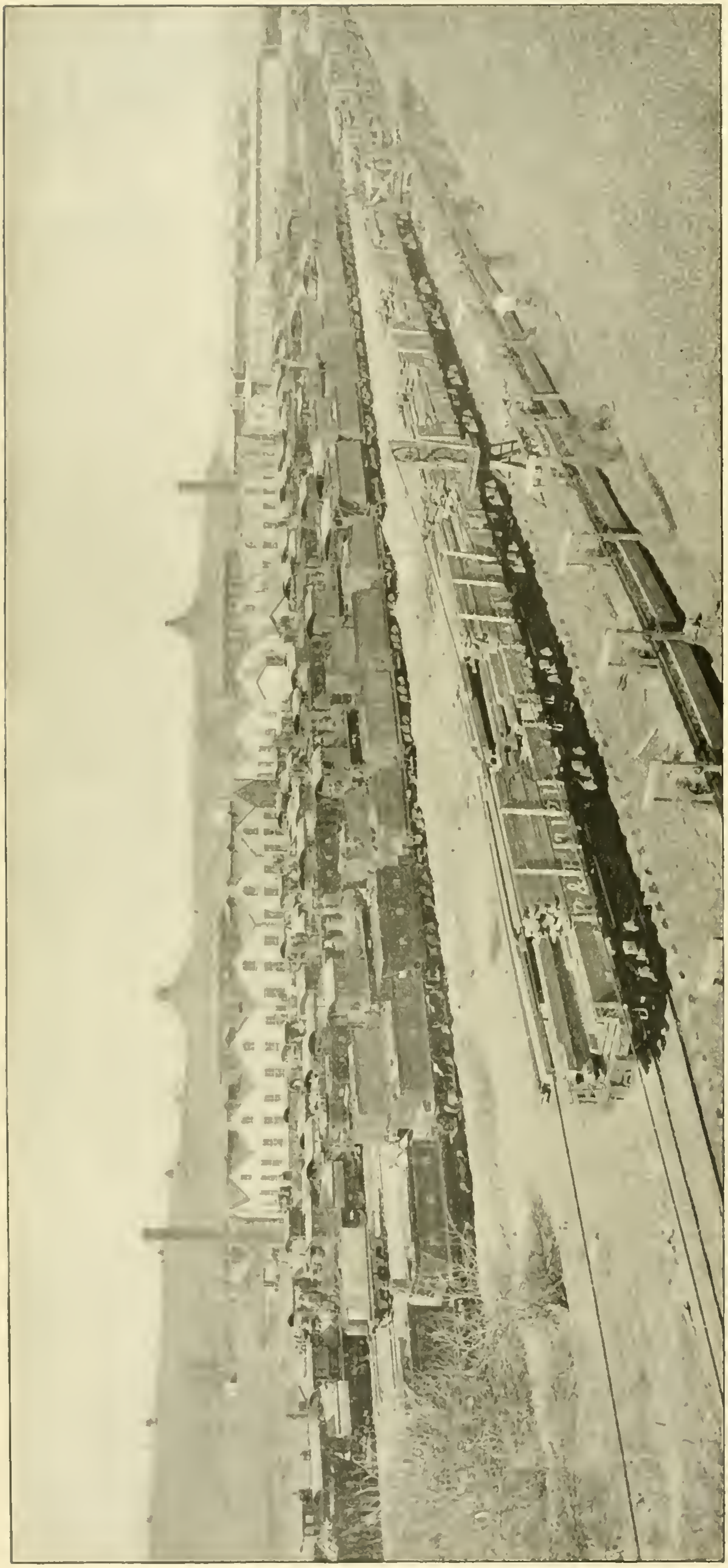
The managers of the road, who were dominated by English stock and bondholders, were always allowed to make liberal expenditures on the betterment of the property. They double-tracked the road, built the best kind of bridges, and purchased first-class appliances for doing the work in all departments. They paid the best wages to mechanics, and that naturally attracted the best men in the country to Reading. Until the policy was inaugurated which ultimately brought the company into financial difficulties the Philadelphia & Reading shops held the position of a training school for railroad mechanics—afterwards enjoyed by the Pennsylvania shops at Altoona.

The first master mechanic of the road was a Mr. Simpson, whose term of office was brief. He was succeeded by Mr. Louis Kirk, who was then considered one of the best mechanics in the country. The management were constantly urging him on to effect improvements on the rolling stock, and he did work that entitled him to be considered an engineering leader in his day; but his superiors thought that still better ability could be secured, and they engaged Mr. James Milholland as mechanical superintendent, who had made an enviable reputation while in charge of the machinery of the Baltimore & Susquehanna Railroad. Mr. Milholland did more to develop the capacity of the locomotive than any man except Ross Winans.

In January, 1854, the old machine shop burned down one Sunday night. Mr. Milholland directed Mr. L. B. Paxson, now superintendent of machinery, and another draftsman, to set to work and prepare drawings of a new shop, and have them ready by Tuesday morning, so that he could take them to Philadelphia to submit to the management. They were done in time—without details, of course. The plans were agreed to and the shop built without loss of time. It now forms the machine shop and erecting shop of the present works, and compares favorably in many respects with the most modern buildings. The structure is 184 x 480 feet, and is covered by iron truss roofs that appear as well-designed as any of the steel truss roofs now coming into favor. Engines are taken into the building by one entrance at the side, from a turntable outside. Then they are transported to the erecting track on a transfer table inside.

Viewed from a modern standpoint, the great fault of the shop is that it is not high enough to put in overhead traveling cranes. As they are turning out about one engine a day, the expense of jacking up engines is very serious compared with what it would be to lift by cranes.

A curious thing about the shops, which is no doubt an inheritance from the time when practices were established without the guidance of experience, is that they use no pits, but raise the engines high enough from the floor level to do work below. I understand that among improvements contemplated are the raising of the roof to admit of traveling cranes and the putting-in of repair pits. The whole of this building is now devoted to the repairing of locomotives and to the tools used for doing the work. As they generally have about sixty engines in at one time, it takes a good deal of room to accommodate them. The engines stand crosswise of the shop in two rows, and have the transfer between them. The arrangement is compact, and is as good as



THE "FARM" AT READING. STORAGE YARD FOR ENGINES GOING INTO SHOPS.

any plan I have seen for a shop holding so many engines. The tools are set at one side of the building, and are grouped to finish particular jobs with the least possible moving. There have been numerous changes made in the arrangement of tools since Mr. E. E. Davis, the present shop manager, took charge. For instance, in the part of the shop devoted to wheel work we find a hydrostatic press, driving-wheel lathes, key-seat milling machine and crank-pin lathe, all set so that they can be reached by one crane. When a set of wheels leaves this group of tools, it is ready to go under the engine.

The cylinders come direct from the foundry to a group of tools suitable for the work to be done. A crane lifts it on to a boring and facing machine, and, after the preliminary operations are finished, swings it on to a planer. A man then does the laying-out; and after the planing is done, the crane takes hold again and puts it upon a special form of shaper made by Bement & Miles, where the ports are planed. The holes are next laid out and drilled upon a neighboring machine, the two cylinders are bolted together, and they are then ready to go to the erecting department. Rods, frames and all other parts are fitted and finished on a similar plan with the necessary tools at hand.

Of course, I am aware that this system is followed in other shops, but I think Mr. Davis has arranged the details better than anything I have ever seen elsewhere. Mr. Davis has devoted great attention to compensating for the want of traveling cranes, by introducing pneumatic lifts, carriers and swing cranes wherever they can be employed to advantage. The shop has been piped for compressed air, a Pedrick & Ayer compressor has been introduced, and a variety of portable tools driven by air put in. More are promised, and there is about the place an air of life and enterprise that it did not always have.

The erecting department is managed very systematically, and on a comprehensive plan calculated to keep all work moving without delays and for placing responsibility of failure or of inferior work where it belongs. There are three erecting foremen who have each charge of about eighteen engines. Each erecting foreman has three track foremen, elsewhere called "gang bosses." These men are responsible for the work being properly done. The erecting foremen see that the engines are stripped as they come into the shop, send the different parts to the departments where repairs must be done, condemn what is worn out, and send orders to the storekeeper for new parts or material required in repairs. They are responsible for getting back the repaired work to the erecting shop by the time it is needed. The track foremen keep the work going on the engines, set the valves, and assign the men for doing the work generally. When anything is found defective about an engine that leaves the shop, it is reported to the erecting foreman, who opens the vials of his wrath upon the track foreman.

Sub-division of labor is carried out as far as possible. One man or set of men always labor on the same class of work. One man faces all valves and bores all cylinders for the pits he belongs to. Another trues up and lines all guides. The facing of pedestals and putting-up shoes and wedges belongs to another mechanic, who sees that the engine is ready for the wheels. The cab work is done by one man, and another sees that all piping of injectors, lubricators, heaters, gages and air connections is put in good order. The smokebox work belongs to one man, who does the work by contract, and the removing and setting of flues is paid for in the same way to another man. The same with the removing and applying of jacketing and lagging. Certain men do nothing but fit boxes to axles; others fit up all eccentrics and eccentric straps. If one man is not equal to the work to be done, he receives help. But he understands that as soon as his work on one engine is done, another is waiting for similar attention. The work throughout the whole fitting and finishing departments is conducted on the same plan. It approaches as near as possible the practice in manufacturing establishments, of keeping men on recurring operations at which they naturally attain high manipulative skill.

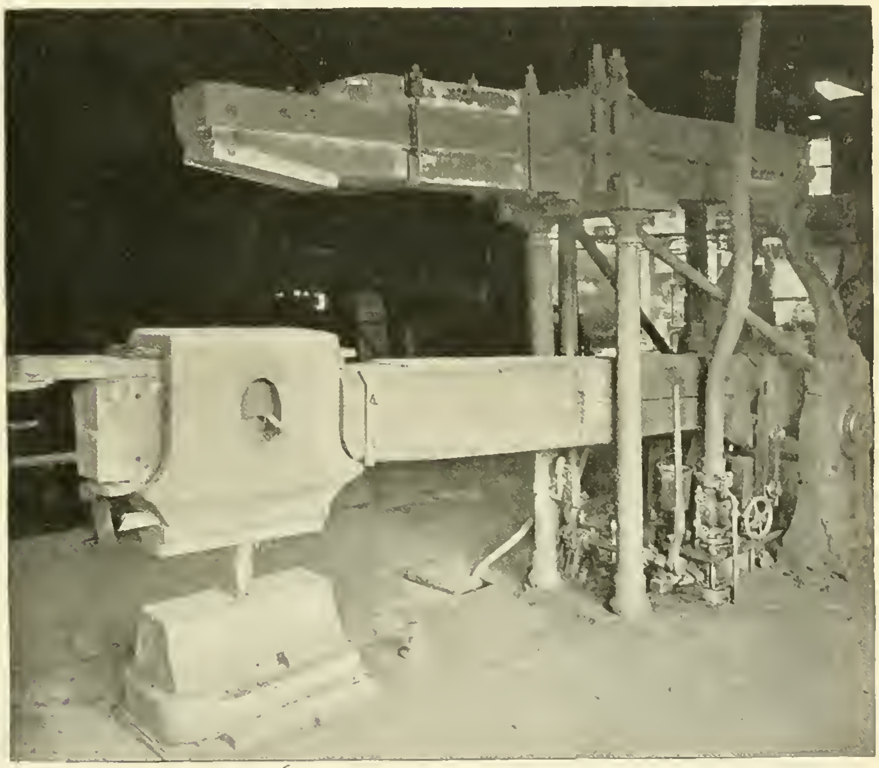
There are about 1,100 men employed in the various shops, and they turn out about thirty locomotives a month, most of them being heavy consolidated engines. They also do a good deal of iron work for cars, and turn out all sorts of articles needed by the various departments.

There is a very good apprentice system in the shops, there being one apprentice for about every ten men. Sons of employés of the company receive preference, but they must be of good character and able to pass an examination in reading, writing and arithmetic before they will be accepted. During apprenticeship they are required to attend evening classes to learn drawing or mechanical physics. Unless they do that, they will not be employed after their apprenticeship is finished. While a boy is learning the trade, he is moved periodically from one line of work to another, until at the end of his time he has had the opportunity of learning all kinds of operations in his line.

The next best shop to the machine shop is the boiler shop, where a great deal of good work is turned out. The facilities for doing work are not the best, but they are improving them as fast as circumstances will admit. They are putting into this shop a Hilles & Jones combined punch and shears, and other necessary tools will be put in soon.

They have a fine roomy iron foundry, which turns out about 5,000 pounds of first-class castings daily—and they are as fine castings as can be found anywhere. The loss of cylinder castings is as low as any foundry where castings of that kind are made. The only criticism to be made of this shop applies to nearly all foundries—no power tools are employed. It is a curious fact that the foundry is the last shop to be provided with labor-saving appliances.

The blacksmith shop is across the track from the other shops, in a very inconvenient location, and is badly in want of a fire. Nothing but a good hot fire will put some shops upon a modern basis. In connection with the blacksmith shop is the hammer shop, where the curious helve hammer shown in the annexed engraving is still to be seen at work. That hammer is of historical interest, for it is said to be one of the first steam helve hammers used in this country. It was designed by Louis Kirk, and has been hammering iron into shape for fifty-odd years. I watched it do some slabbing, and it did fair work, although somewhat wheezy in its actions.



AFTER FIFTY YEARS OF SERVICE.

Above the machine shop they have a variety of minor shops that are very good. The electrotyping establishment is one of the most perfect plants I have ever seen in connection with a railroad shop. Besides electrotyping, there is a great deal of gage and lock work done in the same place, and they have first-class appliances for working with.

The cab and pattern shops are also models in their line. I notice that they are now finishing cabs in the natural color of the wood, which is light. The enginemen like the change, and say that it is less coffin-like than the old finish and is less suggestive of coming events. Another good point about the cabs is that the windows drop down, and all of them can be dropped even with the lower sash, leaving an unobstructed opening all round.

Among tools lately put into these shops are a Putnam gap lathe, two Bement & Miles upright drills, one 36-inch Bullard boring mill, and a 12-inch Acme bolt header. In addition to these, a variety of small tools have been purchased, most of which landed in the tool room.

The car shops are now entirely separate from the iron-working shops, and occupy fine quarters about three miles farther west. A visit to them will provide matter for another story.

Mr. Davis has introduced the practice of holding weekly meetings with his foremen, to discuss matters for the good of the establishment. The practice works very satisfactorily in other places, and will no doubt do much good in Reading when those concerned get accustomed to the practice. A. S.

A writer in an English railway paper says that the inconvenience of locomotives which cause enginemen to get knocked off and mangled when performing necessary duties is in line with the Armenian atrocities. In both cases the public get accustomed to the slaughter and use no effort to get it stopped.

Some New Engines for the Great Western of England.

BY P. J. COWAN.

During the year 1895 two new classes of passenger locomotives have been introduced on the Great Western Railway of England. To the first of these types belongs the "Agamemnon," Engine No. 3032, a photograph of which is here given. As will be seen from the illustration, it has single driving wheels. The boiler has a raised firebox shell, which system is being adopted by Mr. W. Dean in all his latest engines on the G. W. R. The frames are double slab frames of the ordinary English pattern, the driving-wheels having bearings both on the inside and also on the outside frames. The front end of the locomotive is carried on a bogie. The crossbridge or connecting piece between the two bogie frames passes under the bogie instead of above, as is the usual English practice. The die, in which the ball or socket bearing the bogie is given a slight lateral movement, is held steady by very strong helical springs. The following are a few dimensions and particulars of the engine:

THE "AGAMEMNON"- GREAT WESTERN.

Two inside cylinders, 19 x 24 inches.

Diameter of drivers, 7 feet 8 inches.

Diameter of bogie wheels, 4 feet.

Diameter of trailing wheels, 4 feet 6 inches.

Weight on drivers, 18 tons.

Weight on bogie, 18 tons.

Weight on trailing wheels, 13 tons.

Total weight of engine and tender in working order, 81 tons 10 cwt.

Total wheel base of engine, 23 feet 6 inches.

Length over buffers of engine and tender, 57 feet 7¾ inches.

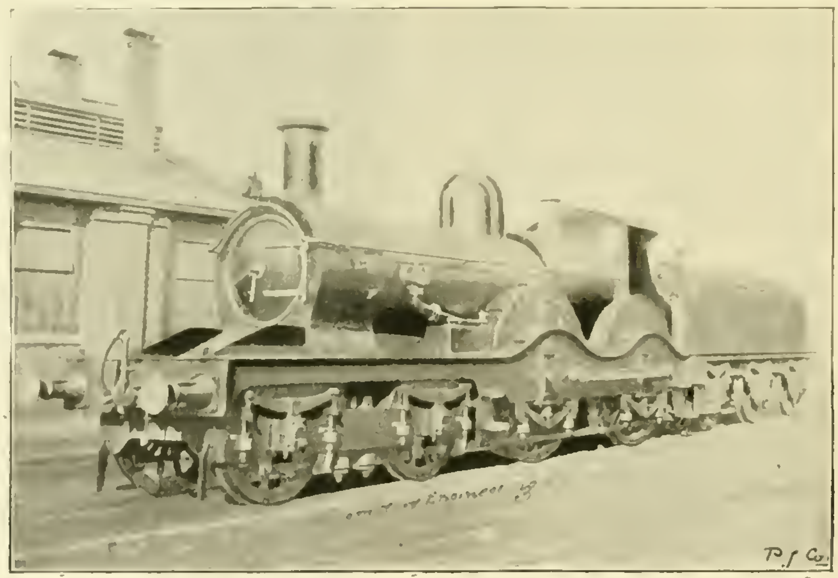
Heating surface of boiler, 1,516.33 square feet.

Working pressure of boiler, 160 pounds per square inch.

Tank capacity of tender, 3,000 gallons.

Average trainload, 200 tons.

Engine No. 7, the "Armstrong," belongs to the second type. It is a 4-coupled bogie express passenger engine, for working the fast but heavier traffic on the harder portions of the line. The main features of the construction are the same as those of Engine No. 3032, already described, except that cylinders are 20 x 26 inches and the 4-coupled wheels are 7 feet in diameter. In consequence, the weights are slightly different: Thus, on the bogie there is 19 tons 6 cwt.; on the driving wheels, 15 tons 18 cwt.; and on the trailing wheels, 15 tons 12 cwt. The dimensions of the boiler are identical with those of Engine No. 3032.



THE "ARMSTRONG"—GREAT WESTERN.

These engines burn 31 pounds of coal per mile (including lighting up) with a load of about 200 tons behind them. Between Swindon and Paddington, 77¼ miles, these engines do very good work, running at about fifty-one and a half to fifty-three and a half miles per hour.

Engine No. 3564 is Mr. Dean's latest design for a metropolitan engine to work on the Underground System. The leading wheels are given a slight amount of play, to facilitate the passage of the engine round curves. The engine is fitted with condensing arrangements for condensing the waste steam from the engine.

Engine No. 867 is a standard G. W. R. shunting or switching engine. It is a saddle-tank engine and has a small coal bunker. This is a type of engine in great favor in England; nearly all lines have engines of this design for yard work, and they are found to be much more useful than tender engines, as they occupy less space.

Through the kind permission of Mr. W. Dean, the locomotive superintendent of the line, we are enabled to give the four illustrations of engines on the G. W. R., taken by Mr. P. J. Cowan, of Hampstead, London.

We have several times lately heard the question discussed who was the first designer to put the back springs of ten-wheel and mogul locomotives between the top and lower bar of the frames. The plan came into common practice about ten years ago. As far as we can learn, that arrangement was first used on the class of ten-wheel engines popularly called "gunboats," and built by the Philadelphia & Reading in 1868.

Several have asked for the name of the fireman who fired the ten-wheeler, No. "564," on her fast run on the Lake Shore. His name is William B. Stanford, and he does not put on any extra lugs about the run either. He lives in Buffalo.

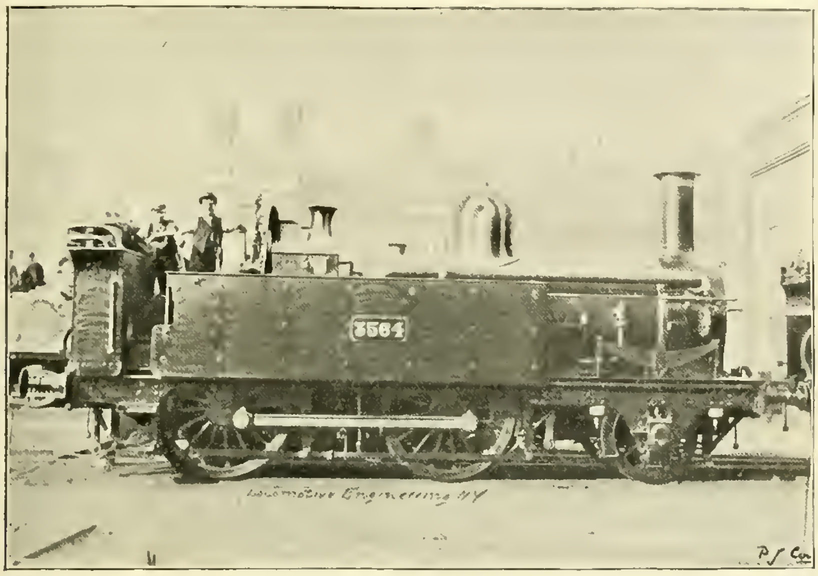
Jim Skeevers' Object Lessons.

Experimenting With Staybolts—Common Sense and Current Practice—Playing With Fire—A Simple Cure—Are We Criminally Careless.

BY JOHN ALEXANDER.

Skinny Skeevers, like Br'er Rabbit, "he la' lo' 'en say nuffin' " for six weeks—for Skinny was sawing wood.

Everything was running along on an



CONDENSING ENGINE, UNDERGROUND SERVICE.

even keel, some things a little better than they had been, nothing worse, and the men in the shop and in the office began to think that Skeevers had found his level.

Sol. Swishel, nick-named "Old Penselwany," remarked that, "His nips has bid off more as a mout'ful. He don't been no suber'dend't motif bower for a tam, yob too pig for 'im." All the members of the pessimist party in the Stove Committee agreed with Sol., but soon dropped the subject to exchange experience and tell lies about the "good old times," when they had pumps and outside oilers—and no time card.

Last Thursday the General Manager pushed open the door to Skeevers' office and asked: "Where's Jim?"

"Out in the shop, sir," replied the stenographer, respectfully. "Won't you have a chair, Mr. Wider?—I'll send for him."

"No, I'll go out. Where'll I be likely to catch him?"

"In the boiler shop, sir—he's been livin' there for three weeks or more."

"Ha, ha," said the old man, "bet you 'leven dollar bill he's got an object lesson out there."

Skeevers was looking in the door hole of a boiler set up on blocks, when the old man showed up.

"What ye got, Skeevers?" yelled the old man, pitching his voice an octave above the music of the riveting hammers.

"New firebox," answered that worthy, laconically.

"Anythin' out of the usual?"

"Yes, I rather think it is—it's the only good job on the road. I've almost a notion to say it's the only safe one."

"Tut, tut, man! What if ye was called on a jury? Such talk would send us to the next higher court—but that reminds me, Sullivan is cussin' mad about them new freight engines, and I've came up to see what ye got to say. What did ye reduce the pressure on 'em for?—they're bran new."

"I was afraid of 'em."

"Losin' your nerve, hey?"

"No, losin' crown sheets and side sheets and no end of staybolts, and awful afraid I'll lose some boilers—and some men."

"Explosions?"

"Yes."

"Look out for them—an explosion is the worst advertisement a railroad can have, and costs the most money."

Just here the shop whistle blew; the machinery stopped, and Denny Conway left his sledge in the air, just where it was, and made a bee-line for his lunch pail.

"Thank the Lord we can talk now, without shouting our lungs out," said the old man, taking a fresh chew of fine cut. "So you're afraid of 'em, eh? Well, tell me what you're doin'—what did you do to this one to make it so good?"

"Well, you know we've had trouble with broken stays, cracked sheets and endless firebox grief"——

"Yes, and I remember two years ago, when you was foreman here, you showed me what poor staybolt iron Shaver was buying, and I let you order some fancy brands—what did ye ever do with it?"

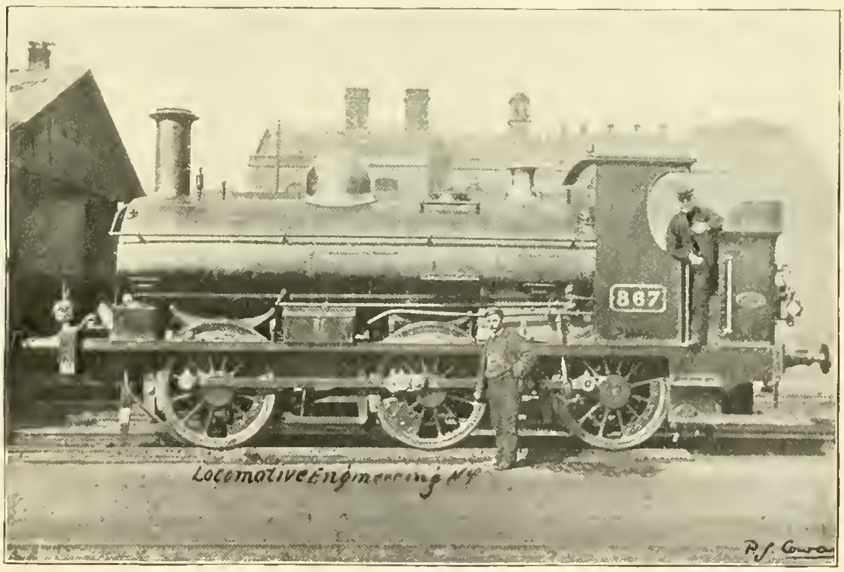
"Well, I put a set of each of three kinds in the new fireboxes in the 78, 79 and 80, the old Grants; the 78 has Taylor iron; the 79, Laurel Tennessee iron, and the 80, Falls Hollow—been in from thirty to twenty-seven months."

"Any trouble?"

"Yes; just about the same as with the cheap—less of it, that's all."

"Broke?"

"No, less breaks than usual, but stripped in sheet, cracked sheets and leaks—made up my mind it was something beside the material in the bolts. Just come over here; I want to explain to you."



SADDLE-TANK SWITCHER.

Skeevers steered the general manager up to a dust-covered boiler on another pit.

"This boiler has a new firebox half set," said Skeevers, "and it's one I've experimented with a bit, to prove how not to do staybolt work.

"It was the day the 136 blew in her side sheet at Downs, and the side-sheet and staybolt chill was on me full force, that I happened in here, and noticed the men putting in stays on this boiler.

"A big helper was screwing in stays on the side sheet—the regulation staybolts, threaded all over and squared at one end to take the wrench. I noticed that he entered the staybolt in the outside sheet with his fingers and then put on a little 6-inch wrench, running the bolt down to the inside sheet quickly, and then put on an 18-inch two-handled wrench, and threw himself on it, and jerked and grunted to force the bolt into the firebox sheet. I thought that the outside hole had been tapped out a little to straighten up the threads, and was a little larger, perhaps, until I noticed that the outside sheet at this particular point was a patch and new steel. Something wrong there, I thought; so I ordered him to take it out. He had a hard time of it, but it came out finally, and the thread that had entered the firebox was all 'chewed up,' half stripped. Then I commenced to think.

"If that stay-bolt was cut by one die, it must be practically true. But here's a place where 'practically true' is not true enough, so I measured the threads on several new bolts—they were 'out.'

"I then went and got the tap that the sheets were threaded with, took it to the tool room, and measured it carefully. It was one of the regulation kind—long reamer on one end, gradually becoming a tap near the shank, marked 12 threads per inch—it was a half a thread too long.

"I went around the other side of this boiler and watched 'em tapping out holes. They put the tap through, entered it in the fire sheet hole, and drove it through with the air motor. When the thread was being cut in the inside only the plain shank of the tap was in the hole in the outer sheet—no excuse for the threads being matched so that a bolt would screw through both sheets without trouble; the tap was not obliged to start at the same point in each sheet—I could fix that, and I did.

"I made a new tap, like this print, 12 threads to the inch, U. S. standard instead of the V. I made the thread tap proper only two inches long, and a second threaded hob behind it, and the same distance from center to center as the average distance between sheets in firebox sides—four inches.

"Now, this tap being solid, the threads are true and in line, and after the thread-cutting tap has done its work in the outer sheet, the tap drops through, and the hob, or second set of threads, enters the threads of the outside sheets and holds the tool in position to cut the thread on the inside sheet, so that these threads will match the threads in the outside sheet—do you follow me?"

"Yes, yes, go ahead."

"On the end of this tap I made a rose-bit, as you will see, and no reamer on the shank—we punch all holes in the sheets before they are rolled up; we punch these seven-eighths of an inch in diameter. This rose reamer cuts out this hole one-sixty-fourth of an inch, and trues up the inside hole with the outside one.

"Now, I have here a true thread in both sheets, and a threaded bolt ought to screw through both sheets easy—but they wouldn't.

"My tap was true, but my staybolt was wrong.

"I had provided U. S. standard 12-thread dies, but the bolt-cutter wouldn't make a bolt and maintain twelve threads to the inch, do what we would. We could screw these stays into the outer sheet easily, but it was just as hard as before to make the bolt enter the firebox sheet, and, after thinking it over, I decided that we could only succeed with a bolt cut with a lead screw machine. Then I was in despair, for I had no die machine, and to cut 'em in a lathe would make 'em as costly as silver—but Massey came to my relief.

"Massey! Didn't know he ever helped a mortal out of a hole in his life. Why, it was him that put all these staybolts in the wrong way!

"The old way, Mr. Wider, everybody puts 'em in that way, even the best makers —but Massey helped me out.

"I went over to see him the last time I was up, and he was whining about what I'd like—a lot of extra tools.

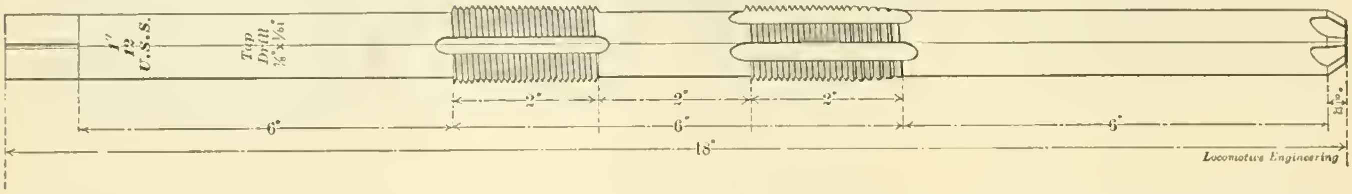
"You know the Keyser Car Works, over on their line, been shut up for two years—failure—you may know that it was a wheel within a wheel—Midland officers all in it—well, they had to take the works, and they turned over all the machinery to Massey to fit out his shops—it was all practically new, too. On a car I found an Acme bolt-cutter with a lead screw. It had been stopped with a job in its teeth, the threaded end of a truss-rod. I got this out and measured it, and it was 10 threads to the inch exactly. It had a lead screw for every pitch used, and in ordinary work the whole thread was used—no change gears, no worn screw in one place; it had U. S. standard dies, and was all ready for business. I wanted that tool worse than anything I ever asked for, but I didn't tell Massey so.

"Before I came away I bought that bolt-cutter; but Massey would not let it go unless I took the bolt-header that went with it—the header was just what I wanted, but I didn't say so. You will get a bill for these tools at half the list. I wrote Shaver about it yesterday.

"I got those tools to work day before yesterday—and here's the result.

"This firebox was put in with screw stays that fit in the thread. They were all put in with a 6-inch wrench by hand, and I watched 'em all go in. You could not tell when the bolt entered the second sheet. If there are any strains there, it is due entirely to the riveting, and is uniform and all in one direction. I believe it's the only good staybolt job on the road.

"In this half-finished job I have made some experiments. I found that the firebox sheets had to spring, sometimes in, sometimes out, to take the bolt—indeed, the boilermakers often used a sledge on the side sheets to make a bolt enter. We cut off one bolt in there with a hack saw, and when two-thirds cut through, it broke with a report like a pistol, and the ends separated about one-sixty-fourth of an inch. The second bolt from it in the same row did not snap when sawed, but when the saw blade cut it through, it pinched the blade so that we could not get it out—and it's there yet.



"That is where the trouble comes from —the threads are stripped or the bolt is under compression or tension when it is put in, and before it is asked to carry any load. If a bolt is short, and under initial strain, while those around it are normal or under slight compression, the load it has to carry is many times that of its neighbors, and it breaks. That throws its load upon those next to it, and in time these give way and cause a disaster.

"You may not realize the trouble we have. Last Friday one of our new Moguls came in for a broken rocker. Being a good chance, I had the inspector look over her staybolts and test them with a hammer. He reported seven broken. We took them out, and only five were broken. When fired up, one bolt leaked, and when tested under pressure, we found fifty-three broken on one side—that's enough to make your flesh creep.

"No one but those who are held responsible know how dangerous this staybolt matter is, especially with the higher pressures—it's a veritable powder magazine. Almost every day we hear of locomotive boiler explosions.

"Our new engines are just as bad as our old ones—the staybolts are put in in the same way. Here's one of the bolts we took out of that new mogul. Look at it. It's threaded its whole length with a sharp V thread. Now, if you wanted to break a bolt, you'd nick it. This has twelve nicks to the inch (more or less) clear around the bolt and sharp at the bottom—it would be a fool if it didn't break.

"Come over here and I will show you how I made the bolts for that firebox there in the "115." This is my bolt header—the one I got from Massey. I use staybolt iron seven-eighths of an inch in diameter, and use this header to upset the ends to one inch diameter, the firebox end an inch long, the outside end an inch and a half long. Now, my cutter threads only these two ends, does far less cutting—hence more of it and more uniform work, and leaves the center of the bolt one-sixty-fourth of an inch smaller than the root of the thread; the skin is left on the iron; it is more flexible, does not rust, and, having fillets at each end of enlargement, has no nick for a breaking point. It has seven-eighths inch of clear, straight iron for strength, with the threads put on the outside altogether.

"I have ordered a set of these taps from Pratt & Whitney for each shop on the road—when they come, I shall order in all staybolt taps of every kind on the system, and destroy them. I am going to order in all staybolt iron also, and make every bolt used on the road right here on this machine and send them out ready cut. In this way we will in time get to a standard, and I am sure we will have safer and better boilers."

"Gosh, Skeevers," said the old man, dryly, "I was goin' to ride down to the office on the switch engine—but dogged if I don't believe I'd better walk."

"I guess she's all right," said Skeevers, "I reduced her pressure to 120 this morning."

"You practice what you preach, don't ye, Skeevers?"

"Well, try to; but really this staybolt question is a serious one. It is costing railroads thousands of dollars a day to watch and repair staybolts, and I believe half of the trouble is solved by the use of the U. S. standard thread, a tap with correct lead for both sheets and a staybolt with a thread that matches the tap—all kept by gages to a standard. The trouble is not so much in the abuse of the staybolt after it's once in—it's the abuse it gets in putting it in.

"The old bolt had a drunken thread in a drunken hole; it was nicked to break; the thread was the worst form to secure even contact; the firebox end was often stripped in entering it—it is now, and always has been, a bad job.

"What we want in this country is more conscientious boilermaking—more brains and less bull strength. Go to the builder and see the piece-work rush in putting in stays, and then wonder we have trouble.

"Why are we running those boilers naked? To calk leaks in seams, because of that same rush and no care and no thought in the work.

"These builders and most of the master mechanics of the country will quote you the name and price of the boiler materials they use when disaster comes to their work, and perhaps they use the best materials. But suppose you bought a nickel-plated engine with all the latest kinks, and put her into service—wouldn't she go into the creek just as quick as a Black Maria, if you built a bridge pier on sand?

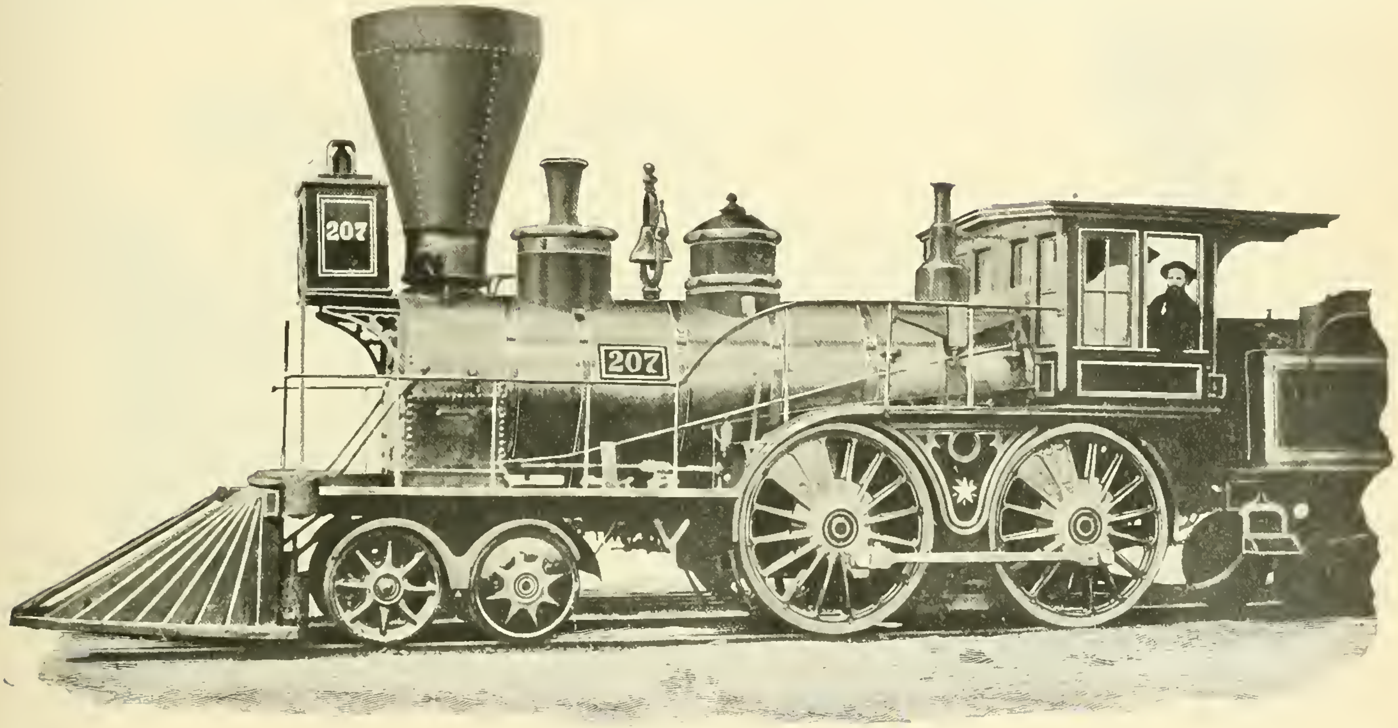
"The firebox is the foundation of a locomotive boiler, and, no matter what the material, if the work is done wrong—if there are any sand foundations—there will surely be trouble.

"The more care and pains and knowledge used to properly construct the bridge pier, the more permanent and substantial the structure.

"Every minute of good work on a firebox means hours of safety on the road. Every ounce of neglect means a pound of repairs—every atom of ignorance, an ocean of trouble.

"And if careful work will save anything on the Great Air Line, I don't propose to tolerate any 'good enough' boiler work."

"Correct you are, James," said the old man, reverently; "do so some more, from everlastin' unto everlastin', world without end. Amen!"



OLD B. & O. ENGINES—AN INSIDE-CONNECTED.

The Profitless Practice of Hunting for Lost Sheep.

Everybody who has attended Sunday school, or been drilled on the New Testament, will remember the parable, in St. Luke, of the lost sheep, which says: "What man of you having an hundred sheep, if he lose one of them, doth not leave the ninety and nine in the wilderness, and go after that which was lost until he find it?"

Since that parable was spoken, it has been a favorite text of preachers and theologians; but it is rather odd to find it taken as the subject of a paper read at a railroad club. Mr. J. N. Barr, of the Chicago, Milwaukee & St. Paul, had the courage to do this lately, and the sermon preached was probably the most practical one that has ever emanated from the text. He used it to show that certain railroad departments are constantly leaving the ninety and nine sheep to be devoured by wolves and dogs, while they go hunting after the one sheep that would better be left to its fate. The traffic department that for the one hundredth increase of business offers inducements beyond the value of the gain, is portrayed as the most expensive searcher after lost mutton. Among the expensive inducements offered are increased speed of trains, more frequent trains, special cars.

The extra expense thus entailed upon the operating department is plainly stated; and every practical railroad man not influenced by the passion for securing traffic at any cost, appreciates the loss entailed to railroad companies. Of the special car inducement, he said:

"The case of special cars is somewhat peculiar and complicated. Refrigerator cars, for example, are undoubtedly a necessity, and are demanded by the requirements of traffic. The same is true of stock cars, coal cars and a number of others which have apparently grown into the position they occupy. In the case of furniture cars, which are simply box cars too large for ordinary economic service, a number of interesting questions arise; and this is especially true in the case of furniture cars of unusually large dimensions, which have recently been placed in service. There is little doubt but that these large cars, measuring 40, 45 and even 50 feet in length, have been furnished with the intention of influencing traffic. The builders of the cars may have carefully considered the increased cost of construction and of maintenance, the certainty that nearly half the mileage made by them would be empty mileage, the probability that ordinary cars would stand idle at a point to which these new mammoths are hauled empty; and after weighing all these points it may have been determined that such a size of car is of economic value—but the probabilities are decidedly the reverse. It looks very much to the writer as if these large cars were simply built with a view of enabling the traffic official to offer a rebate to the shippers, which he does not take out of his own pocket, but which is, all the same, taken from the general treasury of the railroad company."

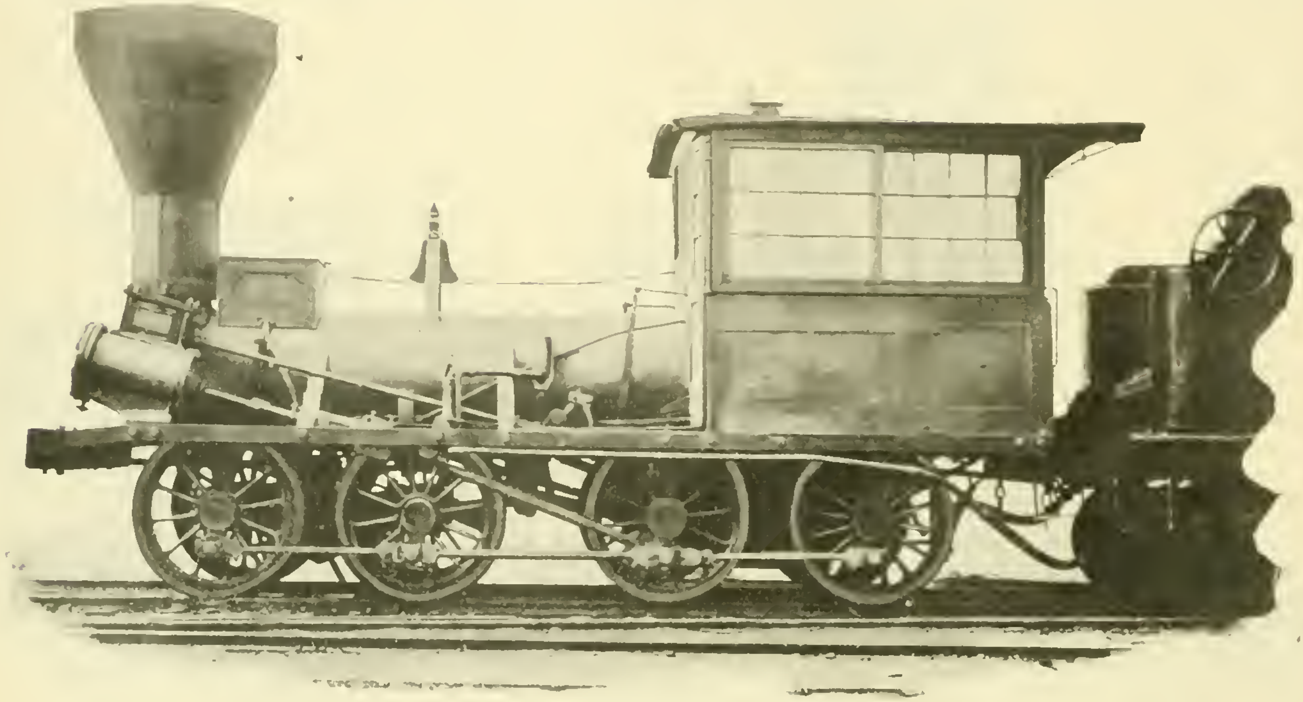
The transportation department was alleged to neglect the many for the one by demanding: 1. Increase in size of locomotives. 2. Increase in size and capacity of cars. 3. Increase in rail section. 4. Increase in labor on all the above. 5. Increase in consumption of fuel. While the transportation officials may be interested in these matters, the interest is not of the vivid character as is the case with the subject of size of trains and pay-rolls of trainmen. The responsibility for expenses in the other items rests on other shoulders. As a result, the demands for locomotives and cars of greater size and capacity, and for rails of greater weight, come from those directly, and to a certain extent exclusively, interested in the transportation of traffic. These demands have been complied with to such an extent that many close observers of to-day feel almost convinced that the economical limit in size and capacity of both cars and locomotives is exceeded in present practice.

Mr. Barr did not exempt his own department from the inclination to leave the others to their fate and go gadding after the single sheep. He said:

"In the maintenance of motive power and rolling stock a similar state of affairs exists. The cost of repairs of cars and locomotives, the cost of fuel and supplies, seems to be the paramount consideration. If a locomotive were to make daily trips without a train, the performance sheet would undoubtedly show this locomotive to be the most economical on the system, and the chances are that its performances would be pointed to with pride, while its operation had actually been a direct loss to its owners. Of course, this condition of affairs could not exist if the value of the service of the engine were based upon the actual tonnage hauled. To determine this, however, requires an increase in expenditure for clerical services, and such an increase is one that is watched with a jealous eye.

"The result is that information as to the relative economy of different classes of locomotives is generally of the vaguest character, and the conclusions on the subject are seldom more than more or less intelligent guesswork. An inspection of any performance sheet will show one locomotive performing what is supposed to be the same service as another precisely like it in construction, with a consumption of from 10 to 20 per cent. less fuel. A small expenditure for clerical labor will definitely fix responsibility in cases of this kind, and this enables the application of a proper remedy. The one lost piece of money is found, but the ninety and nine have suffered much by the saving.

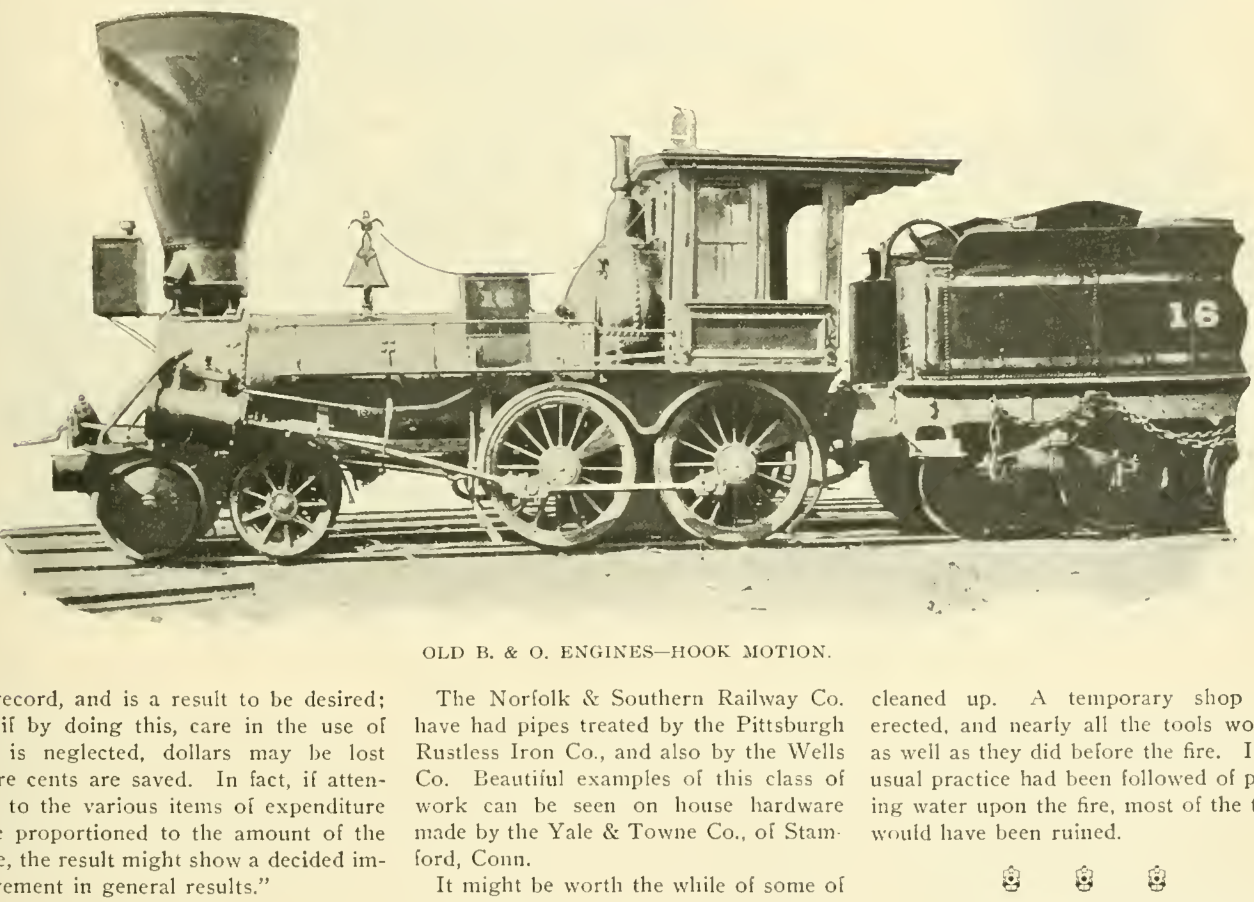
"We hear too often the complaints that locomotives are overloaded in service. The pressure in this respect by the motive-power man arises from the fact that his eye is on the repair bill and the coal pile to the exclusion of all other items. The coal pile is so large, in fact, that he cannot see the railroad. The transportation man seems to take a demoniac de-



OLD B. & O. ENGINES—WHAT IS IT?

light in wearing out the power and burning up the coal pile. This, of course, may be carried to extremes, but a locomotive should be built so as to permit working to its fullest capacity without suffering injury or undue wear of parts, whenever it may be necessary, and if it is not so built the motive power man has not done his duty. He should not look to the transportation department to help keep down his cost of repairs and fuel bill by sacrificing the efficiency or economy of a department in which he is not directly responsible.

"There are many ways in which the motive-power man may, in his search for the one lost sheep, neglect the ninety and nine. In the matter of oil consumption there seems at the present time almost as much attention paid to economizing in its use as is paid to economy in the use of fuel. This may result in making a good oil record, and is a result to be desired; but if by doing this, care in the use of fuel is neglected, dollars may be lost where cents are saved. In fact, if attention to the various items of expenditure were proportioned to the amount of the same, the result might show a decided improvement in general results."



OLD B. & O. ENGINES—HOOK MOTION.

A New Method of Preserving Dry Pipes in Locomotive Boilers.

Mr. G. R. Joughins, superintendent of motive power of the Norfolk & Southern Railway Co., some years ago tried an experiment with dry pipes that shows interesting results. They have water on that road which attacks iron dry pipes very quickly and destroys them. The first engine for the road was put in service about fifteen years ago, and the wrought-iron dry pipes were very quickly eaten through. In their place they put in copper pipes with cast-iron fittings, but the fittings were soon eaten away by galvanic action, (copper pipes should always have brass fittings).

In 1890 they put two new engines in service with dry pipes that had been treated, as an experiment, by the rustless iron process, known as the Bower-Barff Process," which leaves the article coated with black oxide of iron on the outside and inside. This is done by heating them red-hot and then treating with steam. The pipes were complete with fittings before treatment, and calked afterward. After over five years of service, one of these pipes was recently taken out and found to be in almost perfect condition. An iron dry pipe was put into an engine, untreated, in 1891, and had to be taken out within three years on account of being eaten nearly through on the bottom.

The Norfolk & Southern Railway Co. have had pipes treated by the Pittsburgh Rustless Iron Co., and also by the Wells Co. Beautiful examples of this class of work can be seen on house hardware made by the Yale & Towne Co., of Stamford, Conn.

It might be worth the while of some of our superintendents of motive power, who are having trouble and expense with pitted dry pipes, etc., to try this process. It is inexpensive, and seems to resist the corroding action of some waters.

Prevented Destruction of Tools in a Burning Building.

Reports were current in the railroad papers that the Mexican International Railroad had lost $200,000 through the burning down of their repair shops at Piedras Negras, Mex. The impression was that the fine equipment of machine tools was completely ruined. It now turns out that the damage is not more than one-tenth of what it was calculated to be. The prevention of total loss was due to a highly bold and intelligent action on the part of Mr. Wm. Jennings, the superintendent of the mechanical department.

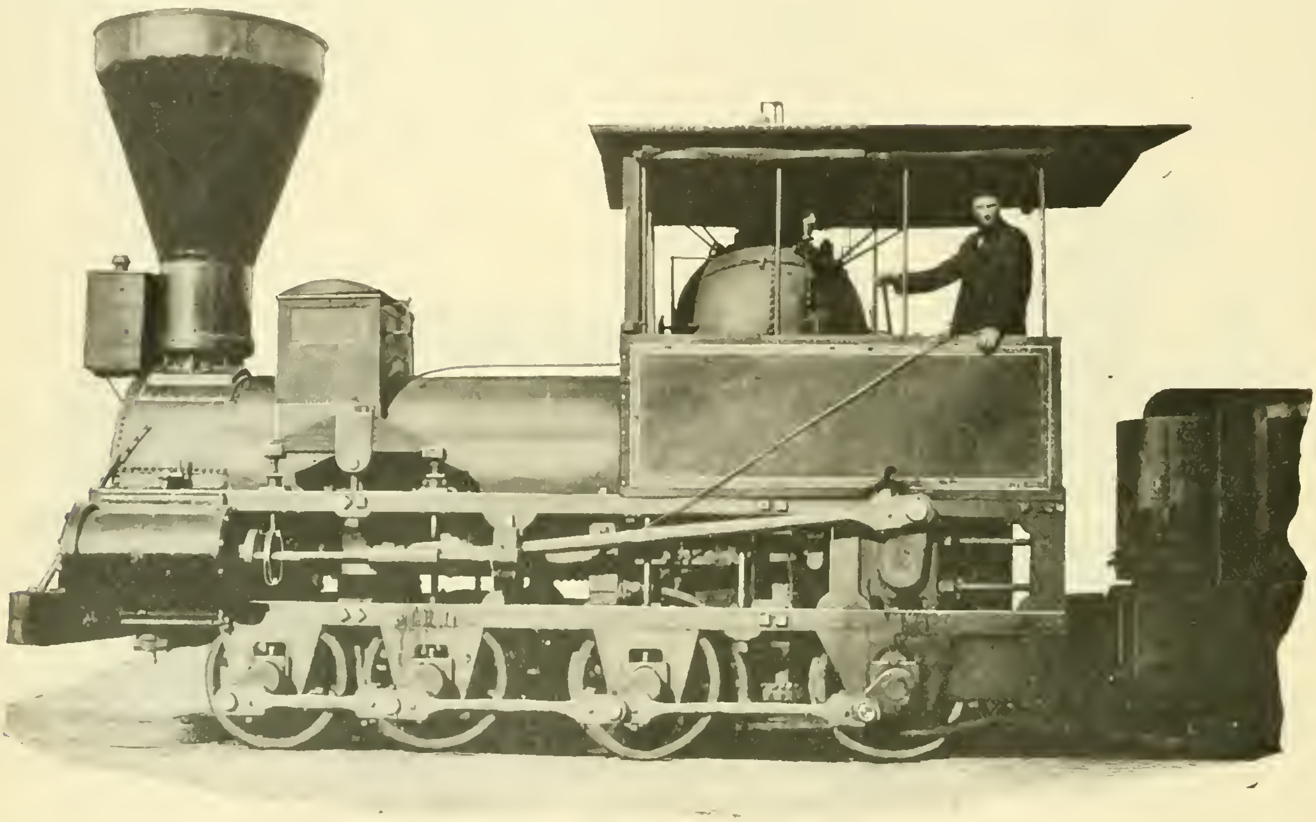
The fire had got well started before the fire department was ready to begin operations, and Mr. Jennings saw that it was impossible to save the buildings, which were of wood and very dry. So he gave orders that no water should be thrown upon the fire. He got together a good force of laborers, and as soon as they could get near enough to the buildings they were set to work shoveling sand and earth upon the glowing embers, care being taken to smother the tools. The non-conducting materials thus applied made the tools cool slowly, and very few of them were found to be warped when they were cleaned up. A temporary shop was erected, and nearly all the tools worked as well as they did before the fire. If the usual practice had been followed of pouring water upon the fire, most of the tools would have been ruined.

It is reported that New York capitalists have obtained valuable concessions from the Chinese Government to build a railroad which will be about 1,400 miles long. China long stood out against railroads, which to that conservative race seemed the superlative innovation of Western lunacy. It is said that Chinese residents of America are subscribing liberally to the new enterprise for their native land. The emperor of China has issued a decree recommending that his subjects subscribe money for the building of railroads and directing them to encourage that kind of enterprise.

The Premium System Promotes Dishonesty.

The system of paying premiums to enginemen for the saving of fuel and supplies has never been popular on American railways, and it has been abandoned repeatedly after protracted trial. The premium system is almost universal on British railways, and we were under the impression that it was highly popular and profitable to the companies and to the enginemen. It therefore surprised us to read in "Engineering," statements which seem to indicate that the boasted premium system is a delusion, a snare and very much of a fraud. In discussing the cause of Great Western express trains losing time, an editorial writer in "Engineering" says:

"We are convinced that the true reason (of losing time) lies not with the engines, which are perfectly capable of doing the work that is required of them, but is a direct result of the stupid system of awarding premiums for the consumption of coal. Theoretically, no doubt, the system is admirable; a man is awarded the sum of £10 at the end of the year if he has consumed not more than a certain number of pounds of coal per mile—provided always that his conduct has been exemplary. Now, under the head of conduct, the question of keeping booked time is considered, and the company say that a man cannot obtain his premium unless he has kept time with his train. But it is possible for a driver to account for every single minute dropped by pleading signal checks, a heavy load, a greasy rail, road slacks, and many other excuses, into the accuracy of which it is quite impossible always to inquire; and when every man in the link does the same thing, it resolves itself into awarding the premium for coal consumption alone. It is, in fact, quite impossible to combine the two conditions; and the sooner they are treated as two entirely separate affairs, the better it will be for all concerned. Not long ago, we remember losing time without any apparent cause on an important Great Western express. We applied to the driver for an explanation. His answer spoke volumes: 'Why, sir, we are paid to lose time on this line; I want to earn my premium; that's what's the matter.' This, in effect, is the result of the present system: A driver sees by the coal sheet that his consumption is too high; he deliberately sets himself to lose time. To adopt the expressive language of the shed, he becomes 'a coal dodger.' "



OLD B. & O. ENGINES—THE "MUD-DIGGER."

Mr. Clement E. Stretton, a well-known civil engineer, took up the subject and wrote to "Engineering:"

"Theoretically, it may sound admirable that the man who burns the least coal shall receive a reward; but in practice, the result is most unsatisfactory, and is not to the advantage either of the companies, the drivers or the passengers.

"Years ago, as an engineering pupil, I had the usual time acting as a fireman, and then saw and heard quite enough of 'coal dodging' and the 'tricks of the trade' to convince me that the whole system of coal premiums is a mistake, and requires a great improvement and alteration.

"The statement contained in your article, that time is lost on many occasions in order to save coal, is perfectly true. It is equally well-known that when trains are a few minutes behind time, it would be an advantage if a driver were to pick up a minute or two on the journey; but the coal premium prevents his doing so.

"A still more important point, however, comes to light with reference to double-engine running. There are very many instances daily in which the trains are made up to the exact number of coaches which entitles a driver to take a second or pilot engine, if he desires assistance. If the day be fine, and but little wind, it frequently happens that the one engine can easily convey the train; but it would require the consumption of 2 or 3 pounds per mile more coal. The result is, that if the driver is a 'coal dodger,' he will take the pilot engine to help, rather than burn the extra coal in his own firebox.

"Now let us look at the matter from the company's point of view. A pilot engine runs a distance of, say, one hundred miles with the train, and has to return either 'light' or attached probably to a train which does not require it, and the result is two hundred miles of pilot working at 1 shilling per mile in order to save 2 or 3 pounds of coal per mile; and it is a well known fact that very much of the double-engine running which is to be seen on some lines is the direct result of the coal premium system.

"Unfortunately, there are so many 'tricks in the trade' that the driver who burns the least coal very generally does not get the premium; indeed, the more honest a man is, the less chance he has of obtaining it.

"In consequence of the unfairness of the whole system, large numbers of the best drivers and firemen in the country decide to have nothing whatever to do with the 'premium.' They burn the coal necessary to do the work properly, and give no attention to the place in which they stand on the coal list. On the other hand, some men become such 'coal dodgers' that it might be thought to be their chief duty.

"A man who desires to act honestly has a great difficulty. For instance, when a man takes charge of an engine in the morning, he finds a quantity of coal on the tender. How is he to estimate how much? At the coal stage, when he takes a supply of coal, how is he to estimate that he receives the right weight?—for the boxes of coal vary considerably, and especially so in cases in which tips at Christmas are given by some of the drivers to the coal-stage men. At the end of the day a quantity of coal is left upon the tender, but the driver can only guess as to how much.

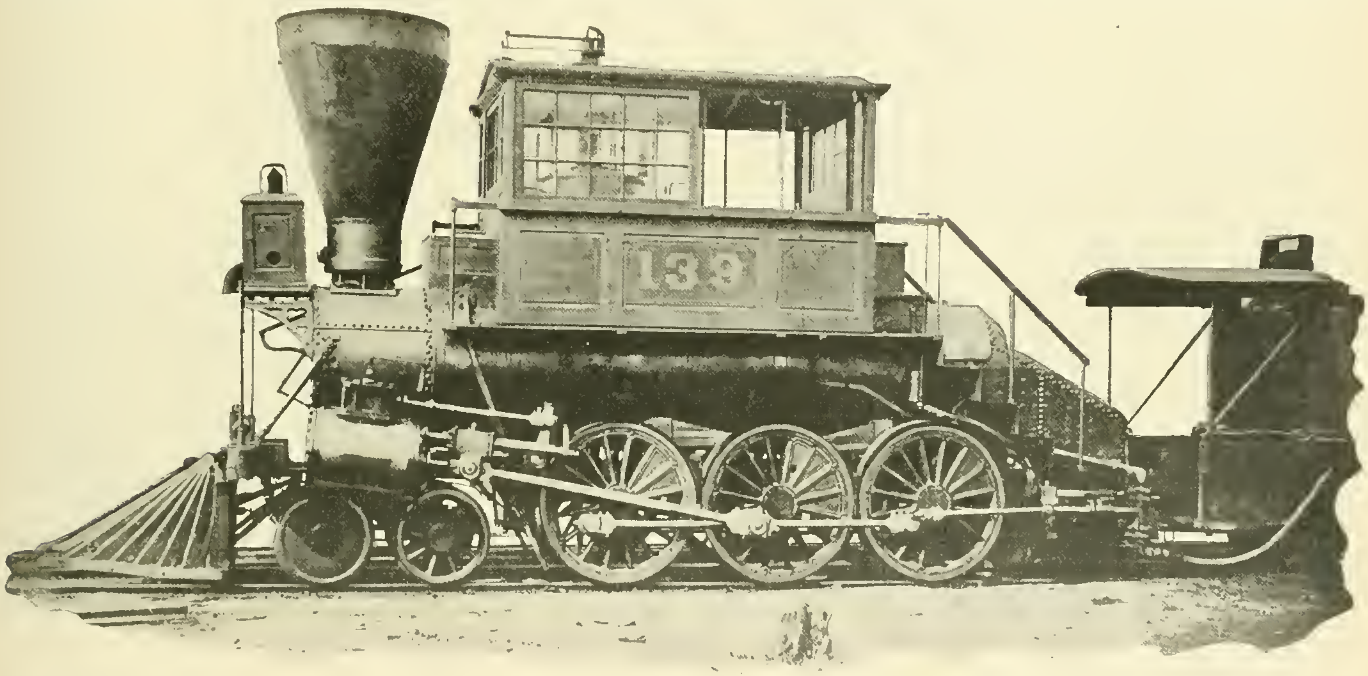
"It often happens that one man at night fills up his coal sheet as leaving a ton on the tender, but the next man who comes to take charge of the engine estimates that he takes only half a ton. What becomes of the difference? Is one or the other driver mistaken in his estimate? Is one trying 'coal-dodging'? Or are both men perfectly honest, and has some third person in the night helped himself to half a ton of coal and put it on his own tender? In other words, has some third person put in practice the well-known remark: 'If we can't beat 'em, we must cheat 'em?'

"The Society of Locomotive Drivers and Firemen, and the Amalgamated Society of Railway Servants, years ago carefully investigated the whole subject, and have always been opposed to the present system of coal premiums; and have urged that it would be far more to the interests of the companies, and also to those of the men, if the premium were to be given to the drivers and firemen for keeping time with the trains, and for general good conduct."

A modification of the baffle plate for projecting downward air passing through the firebox door has been introduced by Mr. S. P. Bush, superintendent of motive power of the Pennsylvania lines west of Pittsburgh. The baffle plate is movable, and is raised and lowered by a connection with the outside door. The baffle plate is the simplest form of smoke-preventing device in use.

When we gave particulars of the Cooke engine on the Ontario & Western, which has been making such an enviable record, we omitted to mention that it is equipped with the Smith exhaust pipe. The free release of steam that results from the use of that pipe has no doubt helped, to a considerable extent, to the success of the engine.

The Boston & Maine have adopted the Brown System of Discipline, neglecting, however, to give the author any credit.



OLD B. & O. ENGINES—"CAMEL-BACK" TEN-WHEELER.

Old B. & O. Engines.

We give in this number some reproductions of very old photographs of very old engines once used on the Baltimore & Ohio Railroad. We are unable to give any data about these engines. We found the photographs framed in the office of Mr. Harry Monkhouse, assistant superintendent of motive power of the Chicago, Rock Island & Pacific Railroad, who was many years ago connected with the Baltimore & Ohio, but he did not seem to be very full of the history of the engines. Undoubtedly there are many men living who know all about many if not all of the engines shown.

The ten-wheel "Camel-back" was a favorite engine on the B. & O. Railroad, and as late as 1870 they had one hundred and ten of these in service, and built them as late as that. The "Mud Digger" we know was one of Ross Winans' early experiments with freight engines, having the engine independent of the driving-wheels and geared thereto. The eight-wheel connected engine shown on page 314 is an old-timer, yet the B. & O. have some engines of that kind—or had a year or two ago—still in switching service. The engine shown on page 315 is probably the oldest of the lot, being a very old eight-wheeler with Bury boiler and close trucks; in fact, none of the engines having trucks, have the modern spread truck. The eight-wheeler inside-connected, shown on page 313, is a very handsome engine for her day.

We wish some of the old-time B. & O. men would give us some history of these engines. It would be interesting.

Extra copies of the colored instruction chart in this number 25 cents, in tube.

Angular Advance.

The above words are as old as the locomotive, and it would seem that some of those writers who have taken the subject in hand for the enlightenment of the learner, should have a proper respect for the age of it, to at least present it in such a way as to leave no doubt of its correct meaning under all possible conditions of locomotive practice.

There are some principles that are not clearly elucidated by the bare statement of their functions for some one set of certain conditions, and those involved in the angular advance of an eccentric are directly within the meaning of above proposition. Every expert on valve motion is fully alive to this fact; but the tyro who is pounding his mental faculties into line, trying his best to master the motion of a slide valve, is likely to be disheartened by the complexities of the thing their employment is apparent. The same letters denote like parts in both figures; the centers of both axles and pins lie in the same line; and the angular advance of Fig. 1 is equal for both eccentrics, because the line *C D* is perpendicular to line *A B*, which is the center line of motion—that is, the centers of axle and piston coincide with the center line of valve when the latter is opening the steam port to admission and the piston is at the beginning of the stroke.

In Fig. 2 the center line of motion *A B* of the valve, as laid down from actual existing dimensions, is found to be below the center line of axle, pin and piston, and is seen to be at an angle with the center line *A B* of Fig. 1. This angle depends on the length of rocker arms and also on the length of eccentric rods, and decides the position of the eccentric centers and therefore the angular advance

First, we must have the valve and piston in their proper relation to each other at the beginning of the stroke; the valve must, by these terms, open the steam port by the amount of lead decided on, when the piston is at the beginning of its stroke and the crank pin therefore on its center. Second, the center lines of the valve motion are laid down, taking for the first dimensions the horizontal and vertical distances betwen the center of rocker shaft *G* and the center of axle. Third, the length of rocker arms is laid off by drawing an arc to represent the paths of the upper and lower rocker pins when in motion. Fourth, a line is next drawn from the center of the axle tangent to the arc in which lower rocker pin travels, and this will be the center line of motion *A B* in Fig. 2. Fifth, the line *E F* is drawn through the center of the axle, perpendicular to line *A B*.

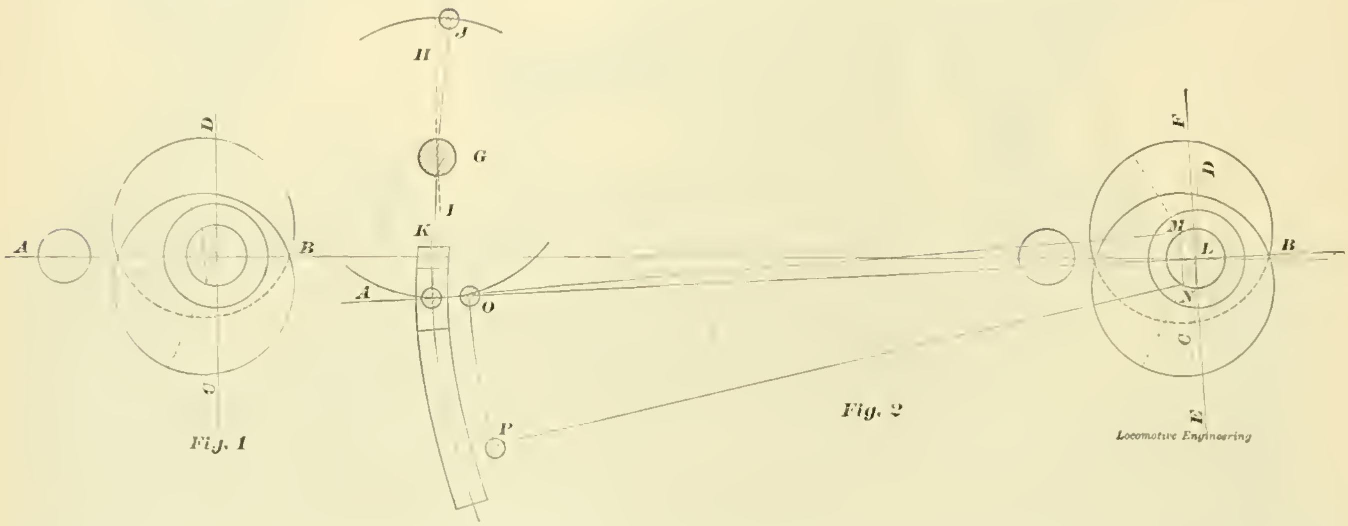


Fig. 1

Fig. 2

as he finds it, and makes a fresh start only to go down again, unless a helping hand is extended to break the fall.

Fig. 1 is the cause of much of the trouble; it is the diagram which is usually exploited as the Alpha and Omega of the whole subject, while, as a matter of fact, it can give a correct position to the valve only when the center line of the valve is coincident with that of the piston—a condition seldom or never found in a locomotive where the motion of eccentrics is transmitted to the valve through rocker arms. Here the center line of motion *A B* passes through the centers of axle and crank pin, and the line *C D*, from which we are told the angular is laid off, is perpendicular to *A B*. All this is very nice for stationary practice, but it is certainly out of place in works treating on locomotives. That this is not understood is evident by the appearance of another work which has the method shown by our Fig. 1, and there will probably be more of them before the events of the year pass into history.

Fig. 2 contains only a few more lines than the above, but they simplify the problem, so that the actual reason for on the axle, as will be seen when the line *E F* is drawn through the center of the axle and perpendicular to the center line of motion *A B*.

The line *C D* is square with a line through axle and pin, while the line *E F* is square with the line *A B* as it should be. The effect of the angularity of this line of motion is at once apparent by measurement from the line *C D* to the center of eccentrics; the upper distance is ½ inch longer than the lower. This difference, it is plain, would be greatly increased as the length of the lower rocker arm was increased, or as the length of the eccentric rods was diminished, and it is frequently the case that the center of the lower eccentric is found to be on the line *C D*, or even back of it, for the above reasons.

To find the correct position for the eccentrics, or the angular advance, we have seen that Fig. 1 will not do for the conditions in Fig. 2. There are a few fundamentals connected with the subject, that are just as easy to master as the lines in Fig. 1, and they have the advantage of putting one right for any combinations likely to arise with the eccentric question.

The center line *H* of the upper rocker arm can next be drawn perpendicular to the valve face, and terminate in its arc; after which the center line *I* of the lower rocker arm is drawn perpendicular to the center line of motion *A B*, giving the arm its "offset," as it is called, which is simply making it square with the line *A B*. These lines *H* and *I* represent the position of the rocker arms when the valve stands central over the ports.

The lap may be taken at $\frac{13}{16}$ inch and the lead at $\frac{1}{16}$ inch; and since the valve is in its middle position with rockers, as shown, it follows that, to be open to lead, or $\frac{1}{16}$ inch, the upper rocker pin must be moved back ⅞ inch from the position shown by dotted lines; and since the top and bottom lines are of equal length, as drawn, the upper pin will go back and open the steam port, and lower pin will go forward, each on the respective arcs. From these new positions the full lines *J* and *K* are drawn, showing the valve to be open when the piston is at the beginning of the stroke.

Taking for a radius the distance from the center of the axle to the center of the lower rocker pin when in its middle position, the link arc can be drawn; and with the same radius, with the new position of rocker for a center, arcs cut on the path of the center of eccentrics at M N will give their correct positions. These points will be found parallel to line E F and at an angle with line C D.

The center lines of eccentric rods are drawn from the centers M N to the points of connection O P on the link, to complete the figure, and not because they are needed to exemplify the matter under consideration.

It is now seen how variable is the connection between the angular advance and the position of crank pin, as shown in Fig. 1; and the need of our X-ray to penetrate the opacity of the subject will, no doubt, be conceded by those who have ever had a struggle with it.

O. H. R.

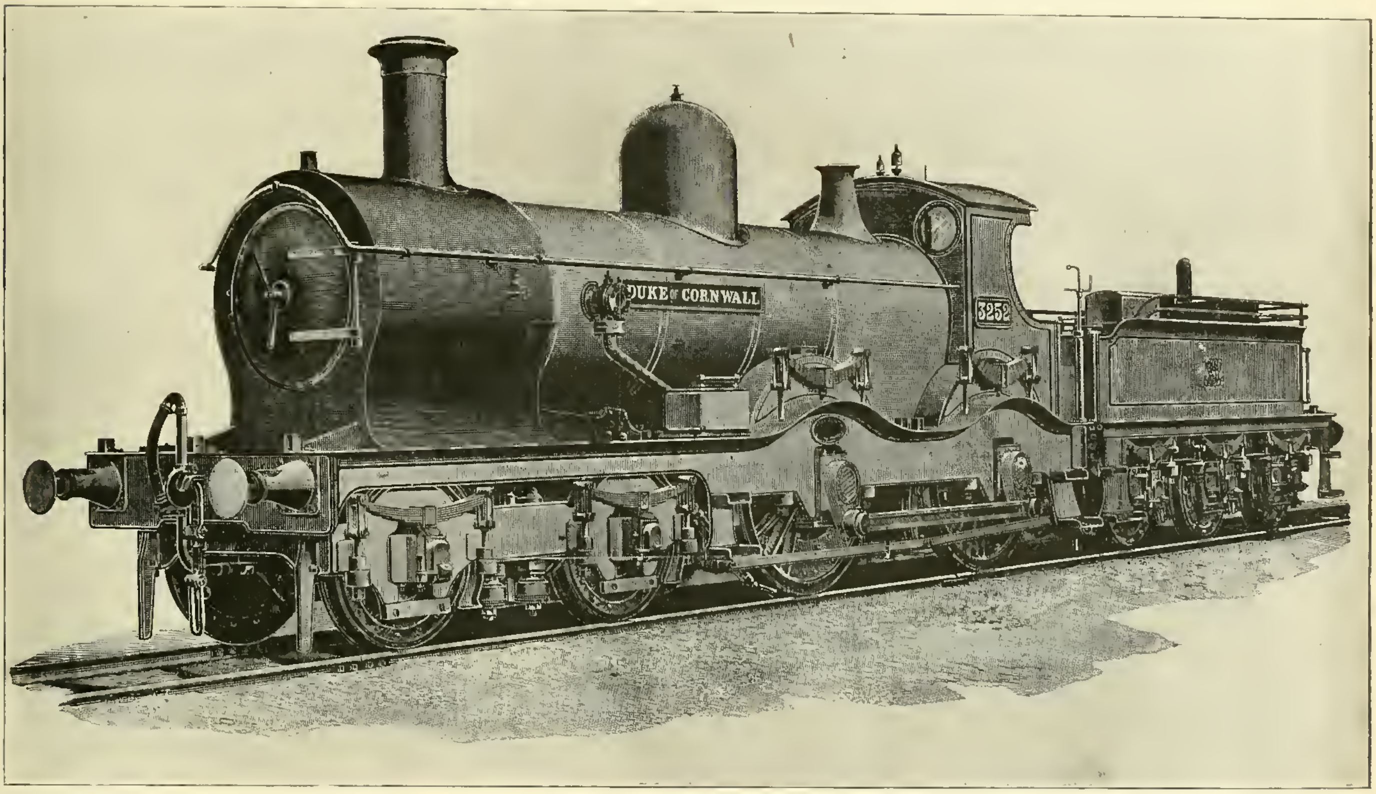
Broken Rail Joints.

Some years ago certain railroad men raised an agitation in favor of laying rails to break joints. We never could see wherein any advantage could result from the rails being laid in that way, but there are a good many disadvantages which present themselves readily enough to railroad men. We do not hear any more agitation in favor of breaking joints, but we occasionally realize the discomfort to travelers that results from the practice having been adopted. If a roadbed is kept in first-class condition, a train will ride comfortably enough with alternated joints; but when the track is permitted to run down and low joints are the rule, the cars sway from side to side in a fashion that is very uncomfortable, to say the least of it.

During a recent journey in the South, the train encountered a piece of track in bad condition, with the joints broken. It broke the temper of every man who attempted to stand in front of the wash basins. The curious spectacle was to be seen of men washing themselves with one hand and holding on by the other. Even with that precaution, an unusual lurch would send them bumping against each other, or against the sides of the toilet room.

Railroads for China.

Adversity often stirs up nations and individuals to efforts formerly thought beyond capacity. The hammering which China received from Japan seems to have stirred the Celestial Empire into sentiments of progress that a thousand years of peace would have failed to excite. The first manifestation of this is the report that the Chinese Government has signed a contract with an Anglo-American syndicate to build a railway from Hankow to Pekin, a distance of 700 miles. This line has been contemplated for some years, and was sanctioned by the emperor in 1889. Chinese public sentiment, however, is strongly adverse to the introduction of modern methods, and every obstacle has been placed in the way of this enterprise. The completion of and operation of a real railway in China—for the pioneer road now running from Tientsing is chiefly a coal carrier and has little but local business—will doubtless work a revolution in sentiment and ultimately result in a very large amount of railway building in the great empire, in which American builders and operators will have no small share.



NEW DESIGN OF LOCOMOTIVE FOR GREAT WESTERN OF ENGLAND.

A correspondent of the "Engineer's Journal," writing about the obstacles to prompt dispatch of business at conventions, dwells to some extent upon the loss of time caused by wrangles over parliamentary rules. This is a nuisance that is felt in nearly all conventions, and ought to be suppressed. Some men who have no information to impart, and yet are ambitious to attain prominence, strive to make themselves conspicuous by dilating on what they think they know about rules of procedure. Rules of that kind have been framed to facilitate the transaction of business, and the men who are constantly raising points of order do not comprehend the spirit of such rules.

One of the most convincing sort of trade catalogues we have seen recently has just been issued by the Cincinnati Milling Machine Co. This concern makes a specialty of one thing—that means excellence.

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Metric System of Measurements Demanded.

For the last thirty years, the advocates of the French system of weights and measures have been laboring unceasingly to make the metric system the only legal one in this country, and there appears reason to believe that they will eventually succeed in their self-imposed mission. A similar band of enthusiasts, in favor of the French system have been working in Great Britain, and they have made so much progress in that conservative land that a committee of the House of Commons have recommended that in two years the metric system of weights and measures shall be rendered compulsory in the British Isles. Now comes a report from Washington that the House Committee on Coinage, Weights and Measures, have recommended that the metric system of weights and measures shall be adopted by the various departments of the Government by July 1, 1898, and by the nation at large January 1, 1901.

It is certain that a reform in the weights and measures, as used in the various States of the Union, is necessary and desirable, but few advocates of the change realize the stupendous nature of the changes which would be involved by mechanical industries in changing from the inch to the meter unit of measurement. The confusion that exists in the measures of capacity in different States is likely to induce the advocates of uniformity to throw their influence on the side of the radical change in our unit of length, which is of the first importance in mechanical operations.

A good case for the need of reform in measures of capacity is made out by the committee, hayseed legislation having bred confusion, like that made a law lately by the Legislature of Vermont, which enacts that in measuring certain commodities one bushel and three-quarters of a peck shall be deemed a bushel.

The barrel of oil or cider in Pennsylvania, Ohio, and many other States, according to legal provision, contains 31½ gallons, but in actual fact it contains 40 or 42 gallons. The gallon of milk in New York contains 231 cubic inches, and in Minnesota it is fixed by law at 282. The standard bushel used by the United States in the Custom Houses, and furnished as standard to the various States, is 3 per cent. smaller than the standard bushel of Great Britain. The bushel of oats varies from 26 pounds in Maryland to 36 pounds in Oregon and Washington. The bushel of barley weighs 32 pounds in Louisiana and 50 in California. The laws of New York and Oregon make 42 pounds of buckwheat a bushel, while those of Minnesota and Nebraska call for 52 pounds, and Kentucky 56 pounds. The bushel of rye weighs 32 pounds in Louisiana, but grows to 56 pounds in Ohio. Potatoes weigh 50 pounds to the bushel in Washington, 56 in Pennsylvania and 60 in Ohio. In Maine, 44 pounds make a bushel of apples, while 57 are required in Wisconsin. A bushel of salt weighs 50 pounds in Virginia and several of the States, but reaches 70 in Massachusetts, and brings down the scale at 80 in Colorado.

That state of affairs, which certainly ought to be remedied at once, presents a good excuse for meddling with the unit of length, in which there is no confusion. When the attempt comes to be made to substitute the meter unit for the inch, the difficulties in the way of carrying out the change will become apparent. Great Britain has a vast foreign trade in machinery and all kinds of hardware, much of it going to countries that have adopted the metric system. Complaints are often heard that making all parts to conform to inch standards is already putting her manufacturers at a disadvantage with Continental competitors. In that event, Britain will endure vast inconvenience to put her people on even terms with rivals, and, consequently, the metric system may be introduced successfully. The case is different in this country. Our foreign trade in machinery articles is so insignificant compared with the home industries, which would find the making of a change in measurement inconvenient, that the consideration of the advantage of the metric system in dealing with foreign nations is likely to receive very little attention.

All our mechanical industries will be greatly affected by the attempt to change our system of measurement, but it seems to us that railroad companies will feel the inconvenience to be the most embarrassing. There is no line of machine work, except arms and ordnance, where so much has been done to establish standard forms and sizes as in railroad rolling stock, and it is very unlikely that the interests involved will agree to have their standards abrogated, or to have the sizes designated by the array of figures required to represent dimensions based on the inch into the fractions of a meter.

The most important line of standard sizes ever established is the United States screw threads. Nothing else is used on railroad rolling stock. To the railroad men who agreed to adopt the system when first proposed, is due much of the credit for putting an end to the confusion of varied sizes of screw threads that prevailed before this reform was effected. It is not to be supposed that they will voluntarily agree to make a radical change on the standard sizes of screw threads merely to comply with a sentiment in favor of universal uniformity. Unless a change were made to have an integral number of threads per decimeter, the number of figures necessary to denominate the sizes would be intolerable. It is impossible to express integral numbers of threads to any part of the meter, without changing the existing pitch of standard screw threads. The existing uniformity has been obtained by so much hard work and persistent effort that those enjoying the advantages of uniformity are not likely to experiment with a return to confusion of sizes.

The enthusiastic advocates of the metric system in this country are mostly college teachers and theorists, who do not realize at what cost a change of measurement would be effected. There is no great objection to the meter as a unit of measurement, except that the parts of our existing system cannot be represented in divisions of the meter without the use of numerous figures. In itself, the meter, which is 39.37 inches long, is not any more convenient than the yard; and the decimeter, the first division or tenth of a meter, 3.937 inches, is not so convenient a unit for shop measurement as an inch is; while the next division, a centimeter, or 0.3937 inch, is too small to make a convenient shop unit. In shop practice it has been found most convenient to use the millimeter as a unit, which is 0.03937 inch, or a little over 1-32 inch. These objections might, however, be tolerated, and the inconvenience endured, if we could take the metric system and apply it to our existing sizes without too much labor. That cannot be done. If ever the metric system comes to be adopted, an entire change of sizes must be made. The parts made to inch measurement must be retained until they are worn out, and new designs introduced that are measureable by even divisions of the meter. It would be quite impracticable to apply the metric measurement to existing gages.

Those who have worked in machine shops using both forms of measurements, say that the binary divisions of the inch lends itself more readily than the decimal divisions for memorizing dimensions. Let us put some of our popular dimensions into metric figures. Take an engine with cylinders 20 x 24 inches, driving wheels 66 inches diameter, boiler 62 inches diameter. By the metric system this is expressed: Cylinders, 508 x 609.6 mm.; driving wheels, 1,676.4 mm. diameter; boiler, 1,574.8 mm. diameter. If our dimensions were arranged according to the metric scale, of course the decimals would be omitted; but still, no man could remember the figures so easily as he can under our system of inches. The mm. as a unit is too small for ordinary mechanical calculations.

The successful operating of a machine shop depends in a great measure on sizes being readily understood and easily remembered. When a mechanic examines a drawing, it is of the greatest importance that the dimensions he is going to put into wood and iron should come to his mind without study or calculation with marking materials. The fewer figures he has to grasp mentally in a measurement, the less chance there will be for mistakes. A common job in a machine shop is to make a bolt 1 7-16 x 6¼ inches, with taper 1-16 inch in 12 inches. A machinist reads that on the drawing, and his familiarity with the 2-foot rule enables him to go on with the job without an instant lost in making calculations. Under the metric scale, the bolt referred to would be described: 36.5125 x 158.75 mm.; taper, 1.5875 in 304.8 mm. If the machinist was as familiar with the millimeter scale as our men are with the foot rule, it is apparent that the increase in figures increases the liability to make a mistake in the measurement. There is not an established dimension which has become standard with us that would not present similar difficulties when the metric system of measurement was applied.

If the enthusiasts for the metric system could look understandingly into a well-equipped tool room, they would receive object lessons that would teach the difficulties and expense to be encountered in making a revolution in our established metrology. They would see an immense variety of taps, dies, reamers, drills, gages and expensive measuring instruments that would have to be abandoned. In the machine shop they could examine screw-cutting lathes that would require new lead screws and screw-cutting gearing, milling machines that would have to be radically changed, and a variety of other tools that would require alterations.

The time may come when sentiment will rise so far above business considerations that a change will be made from the inch to the meter unit. But it is certain that the cost of that luxury will run into many millions of dollars.

Rules to Calculate Train Resistance Need to be Changed.

We have repeatedly referred to glaring errors in engineering text-books, and to the misleading calculations that are based on erroneous formulas. Some of the accepted formulas are so glaringly wrong that the engineers who employ them sometimes make statements which are simply ridiculous. One of the worst examples of an erroneous formula is that of Clark's for train resistance, which is used by nearly all writers who make calculations relating to the power required to move trains at various speeds. The exceptionally fast speed made by the Brooks ten-wheeler pulling a special train on the Lake Shore & Michigan Southern last fall, has been taken advantage of by several writers in English engineering papers to prove, by calculations based on Clark's formula, that the speed attained was away beyond the possible capacity of the locomotive. The calculations were all right—only they were based on false premises. If the Clark formula were correct, there is not a locomotive in America which could keep a train of four cars running at a speed of 70 miles an hour; yet that speed is maintained daily on many railroads. All the text-books we know of, except Kent's, give formulas that represent the train resistance of 70 miles an hour to be about 35 pounds per ton. To keep a train running at 70 miles an hour against that resistance would require tractive power of about 9,000 pounds. Owing to the high piston speed necessary for a train velocity of 70 miles an hour, there are few locomotives that will keep up a cylinder pressure sufficient to develop a traction power of 6,000 pounds. This has been demonstrated often by engineers using the steam engine indicator, and it is proof positive that the ordinarily accepted formula for train resistance is erroneous. This rule makes the initial resistance on starting to be about 6 pounds per ton, increasing with the square of the speed.

American engineers have enjoyed exceptional opportunities for finding out accurate facts concerning the power required to move trains under the varying conditions of railroad operating. Dynamometer cars are employed on several railroads, in charge of engineers who become experts in their business; and the indicator has been employed on American locomotives by numerous investigators, sufficiently competent to read all the lessons of the indicator diagram.

The experience of these investigators indicates that no hard-and-fast rule can be established by which to calculate the resistance of trains. From a great mass of data which the writer has collected on train resistance, from the records of various dynamometer cars, and from indicator diagrams taken on a variety of roads with different kinds of trains, it appears that the train resistance per ton is greatest with empty cars and lowest with heavily loaded freight cars. In tests made on the Chicago, Burlington & Quincy, a train of loaded freight cars weighing 940 tons was run at a speed of 20 miles an hour with an average resistance of 5½ pounds to the ton. A train of empty freight cars weighing 340 tons, run at the same speed, showed an average resistance of about 12 pounds per ton. The resistance of passenger trains is about 7 pounds per ton when running at 20 miles per hour. At 70 miles an hour the total resistance is about 19 or 20 pounds per ton, instead of 35 pounds, as given in the old rules. When the proportionate increase of resistance is followed to 100 miles an hour, it is found to be about 26 pounds per ton.

The proportions of the Brooks locomotive that is under discussion enable the engine to exert over 100 pounds tractive force for every pound of cylinder pressure. A little over 60 pounds mean effective pressure would give the engine the capacity to haul a train of 244 tons (including weight of engine and tender) at the rate of 100 miles an hour. As the boiler pressure was 180 pounds per square inch, and the engine is provided with a valve motion that produces remarkably quick admission and release opening, no engineer capable of making mechanical calculations ought to doubt that the reported speed was genuine.

Another Railroad Using the Brown System.

Two divisions of the Louisville & Nashville have had a modification of the Brown system of discipline without punishment in use for five months, and it is reported to work satisfactorily all round, although some of the men are still suspicious that the change in dealing with them may finally be employed to their disadvantage in some way. We find that this sentiment, based on unworthy suspicion, lingers on other roads where the Brown system of treating men in manly fashion has been introduced; but the discontent is confined to those who are not disposed to behave themselves, or to others under the influence of that species of low-down railroad man.

In some respects the plan adopted by the Louisville & Nashville, and which was worked out by Mr. G. E. Evans, superintendent of transportation, goes farther than the Brown system, for it purposes giving credit to men for good records, which is used to exempt them from punishment when anything happens which, under ordinary circumstances, would lead to suspension or dismissal. For instance, a suspension of 15 days will be canceled by a good record for one year, a suspension of 30 will be canceled by a good record for two years, and so on.

The practical outcome of the adoption of this system has been that, during the five months it has been in use, on one division where there is a total of 234 men employed, one man was discharged and twenty disciplined without suspension. The wages saved to these men was $1,067. On the other division where there are 207 men, eleven cases of discipline without suspension occurred, saving the men in wages a total of $601.

We believe that the saving in wages alone does not begin to represent the benefits likely to result from the introduction of systems of this character, which are based on a desire to do justice between man and man. Such a method is calculated to keep the men in closer touch with their officers, and it is an effectual check upon the impulse punishment so often meted out to railroad men and frequently inflicted without proper investigation. The common plan is to punish every man severely for any fault or mistake, regardless of his previous record. When it becomes necessary to look into the record, the chances are that greater care will be exercised to see who is actually to blame. Any plan of management that promotes care and deliberation in the infliction of punishment cannot fail to be of benefit to railroad men generally.

Baltimore & Ohio in Receivers' Hands.

The most notable event of last month in railroad affairs was the passing of the Baltimore & Ohio into the hands of receivers. It has been known for several years that the finances of this company were in a very precarious condition, brought about principally by the purchase of controlling interest in roads that did not earn the charges incurred. There is also reason for believing that the financial managers, on finding that the increased fixed charges and dividends on stock could not be paid out of earnings, resorted to the ruinous practice of paying unearned dividends, in hopes that increased earnings in following years would justify them in resorting to that means for maintaining the credit of the company. Until the day that the property was put into the hands of the courts, the directors expected to be able to borrow money to pay the interest on the bonds, and failing in that at the last moment they applied for receivers.

Owing to the increasing embarrassment of the company, a policy has been pursued that allowed the whole of the magnificent property to run down, no appropriation having been granted for repairs or maintenance which could possibly be avoided. The result of this has been that rolling stock deteriorated so that the business could not be conducted economically, and the track, bridges, buildings and machinery have fallen into a condition which calls for the immediate expenditure of large sums of money. The receivers are reported to be exerting themselves energetically to raise the money necessary to regenerate the machinery with the least possible delay. Locomotives and cars are to be put at once in good order, and the new rolling stock necessary to do the business properly will be purchased. It is a melancholy sight to see a fine property like the Baltimore & Ohio going into the hands of receivers, but it is better that a radical remedy of that kind should be resorted to than to let the property sink deeper into the mire by unavailing attempts to keep up appearances that were deceptive.

Mr. Paul Reinhard touches a very tender spot when he affirms his belief that accidents caused by rails spreading are the result of negligence on the part of trackmen. The press of this country, in reporting such cases, generally class the cause as "unavoidable," and if the editor has an annual pass he is liable to go farther and say it was an "act of Providence." Even railroad officials, when investigating the cause of accidents, stop suddenly when they run up against the words "rails spread." That settles it, and no further inquiry is made. These good people cannot be expected to know that track is put in proper line at first, and when it begins getting rough the rail spreads only by almost imperceptible degrees, and that in order to allow the wheels to drop between, the rails would have to move about four inches, and this would require from one to two weeks at least. Nor do they know that ties are put in new, and if an accident was caused by their being rotten, that this process has been going on for from four to ten years. In either instance they do not think of blaming the trackman for not seeing these things as he daily inspects his section. If they did, the foreman might have to answer for his negligence before a criminal court.—"Roadmaster and Foreman."

BOOK REVIEWS.

"One Thousand Pointers for Machinists and Apprentice Boys; or, The Best Mechanical Way to Perform Every Important Job on a Locomotive." Illustrated. By Charles McShane (Practical Machinist). Price $1.50. Published by the press of the "Eight Hour Herald," Chicago.

Such is the ambitious title of a work of 135 pages, in the preface of which we are informed of its purpose in the literary world. This is explained by its dedication to the International Association of Machinists, with the hope that it will be found an educator. Methods for doing locomotive work are described in an interestingly clear and concise way, that will make it understood by the shopman. Laying off new work and how to do it—the actual manual part—will be found a useful thing for the young mechanic who is anxious to push himself to the front. There are good things in this little book, and also some bad ones. It tells us: "A single nozzle [meaning an exhaust nozzle] should contain one-tenth the number of square inches in both cylinders." This is a serious error, since it would give for a pair of 19-inch cylinders an area of 56.7 square inches, which is equal to a diameter of 8.5 inches for the nozzle. This cannot be proper pabulum for an apprentice or a full-fledged machinist, when the correct size of such a nozzle should be between 4.5 and 5 inches. Again, it says: "Compound engines are in use on many roads. Some of them have both high and low-pressure cylinders." This can hardly be called information that will help the apprentice or be a guide to the machinist. There are many other objectionable statements that are spared by the reviewer for want of space. The book should be revised so as to eliminate the incorrect portions, and the price cut in two, before success can be predicted for it.

The New York Railroad Club placed itself squarely on record on the large car question at the February meeting, after a short discussion of one of the best and most comprehensive reports on any subject that we have ever read, embodying as it did a review of every phase of it from the standpoint of all departments interested. The following resolution was reported and adopted: "Resolved, that it is the sense of the New York Railroad Club, on the question of large capacity cars for general interchange service, that box and stock cars shall not be built to exceed a capacity of 60,000 pounds, and that this club earnestly recommends to the traffic associations that, in making their rates on light, bulky freight, such rates shall be based on the cubic capacity of the car." It is unnecessary to say that we are gratified at this action of the club and its indorsement of our position in the matter. We will indulge in retrospect merely enough to say that our car record for 1895 was, in the light of the above resolution, not a mistaken one.

During the high winds prevailing in this vicinity recently, two peculiar accidents occurred which never would have been chronicled if a few dollars had been placed where they belong. They were cases of passengers being blown from the car platforms when the trains were moving at speed between stations, and on different roads—a man in one case and a woman in the other, and both badly injured, all for the want of a platform gate, which would have insured a safe passage between the cars of the train. A verdict for fat damages would be the most convincing argument for these roads that a pinch-penny policy don't pay where the safety of passengers is involved.

The New York, New Haven & Hartford road have a parcel rack in their passenger coaches, running continuously from end to end of the car, with compartments long enough and deep enough to hold the chattels of the average passenger, securely and safely. They are an improvement over the smaller affair in use on most railroads.

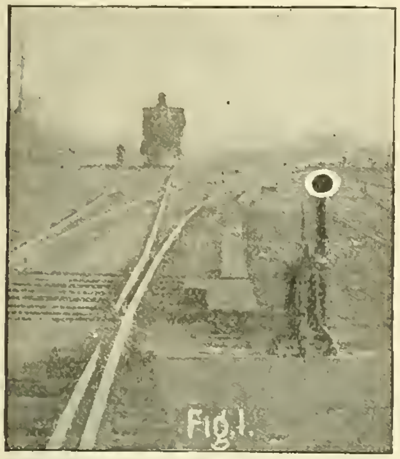
Watson & Stillman, 210 East Forty-third street, New York, have just issued a new catalogue of their hydraulic tools for railroad work, which will be sent to anyone interested.

SWITCH SIGNALS.

By W. H. ELLIOTT, Signal Engineer, C., M. & St. P. R.R.

[FIFTEENTH PAPER.]

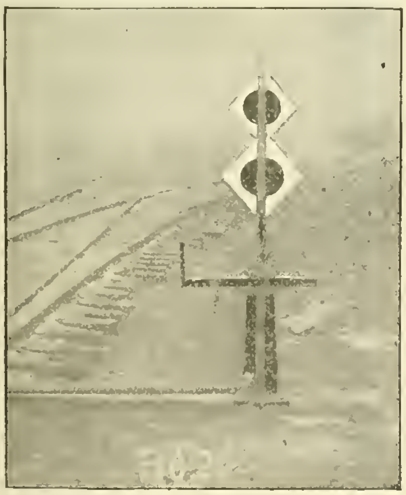
Of the fixed signals, the first to come in use in the early days of railroading were the ones intended to indicate to engineers the position of the switch, a target of simple form placed upon a revolving stand being



SWITCH TARGET USED TO INDICATE DANGER.

the device used, very much as is the common practice of to-day. Naturally, each road adopted a form they thought the best, a proceeding which resulted in almost every road using a different pattern, the clear signal on one road in many instances being used on other roads to indicate danger.

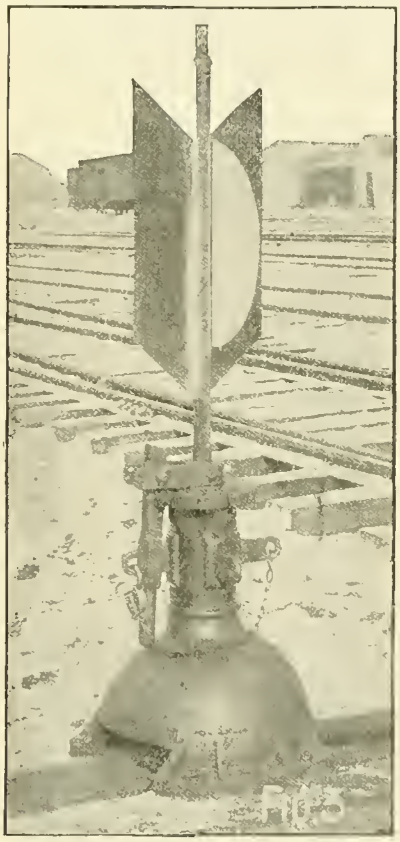
As the switch signals are used solely to indicate the position of the switch, whether it



TARGET USED TO INDICATE SAFETY.

is open or shut, it cannot be said that much confusion would result from their being used in opposite ways on different roads, and no doubt this is the true reason why—up to the present time—there has been no change in the practice, and a standard for all roads seems to be as far off as ever. Practice has demonstrated that the best signal is one of position and not of form or color; but as there is no simple means by which the indication can be given in this way, practice has almost entirely resolved itself into one of form, colors being also made use of, particularly where forms to give two separate indications are used, one for safety and the other for danger.

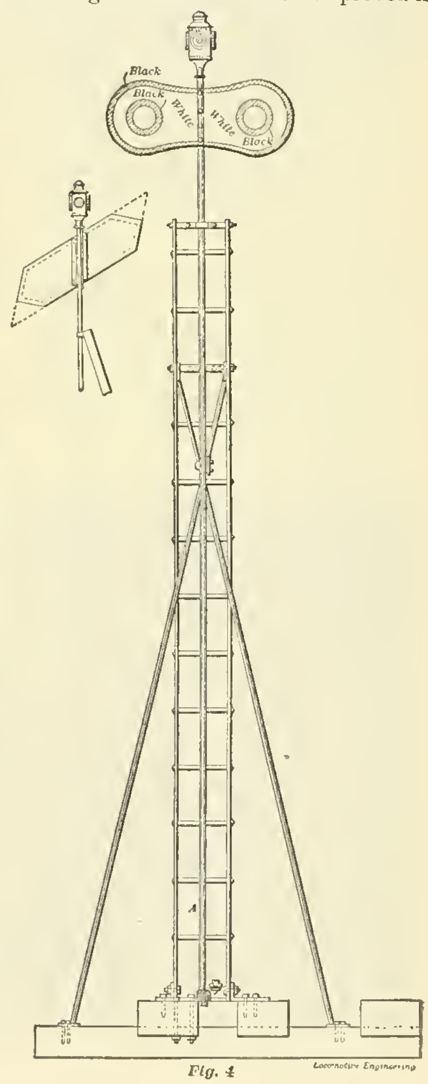
Outside of the form of the signal, of which the best is certainly the most dis-



SWITCH TARGET GIVING INDICATION FOR MAIN LINE OR FOR THE SIDE TRACK.

tinct, there are three different methods in use of indicating by means of a target the position of a switch, the first being when the target is visible and an indication made for the danger; the second where the target is made to show for safety but not for danger, and the third where with two targets on the same shaft, one is used to indicate safety and the other danger. As illustrating this, figures 1, 2 and 3 plainly show the three ways spoken of. Of the three the last is certainly the only one that meets the requirements of one of the first principles of signaling, which is that an indication must be given for safety as well as for danger. As between the other two, the first is by far the better, the presence of a signal being a much more forcible indication and more likely to be noticed than is the absence of one, and as it is much more important to have the danger signal seen and acted upon than it is with the one indicating safety, the first is the one that should be adopted. Again, with the signal showing for safety, one signal will often be obscured by another signal, so that if it should be left at danger, it would be almost impossible for the engineer to notice the fact until quite close to the switch. For this reason, and because of the difficulty met with in obtaining two forms that are distinguishable at any great distance, the plan of using a signal that will give a danger indication only, is belived by many to be the best.

Practice in regard to the usefulness of a switch signal would be much improved if

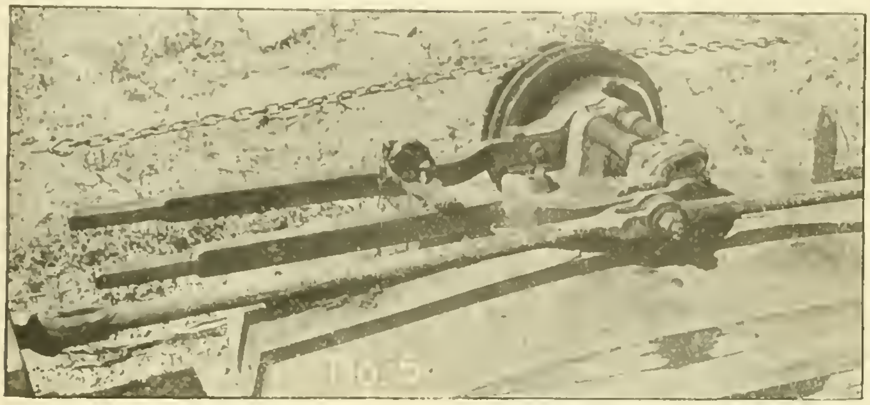


HIGH TARGET STAND GIVING INDICATIONS.

the target was elevated, as is shown in figure 4, the top of the stand being about twelve feet above the top of the rail. As will be noticed, this stand is provided with targets to give the two indications, one a form composed of circular discs joined together, and the other a straight piece of sheet-iron with pointed ends and fastened to the shaft in an inclined position.

The difference between the two forms with this signal, which has been quite extensively introduced, is not distinguishable at so great a distance as one would suppose at first sight, owing to the vertical height of the inclined piece being but little more than that of the circular discs. Should the upper and lower ends of these pieces be left on making the outer edges vertical lines intersecting the two inclined sides, as shown by the dotted lines in the figure, the difference in the form of the two targets would be much more noticeable and be distinguishable at a much greater distance.

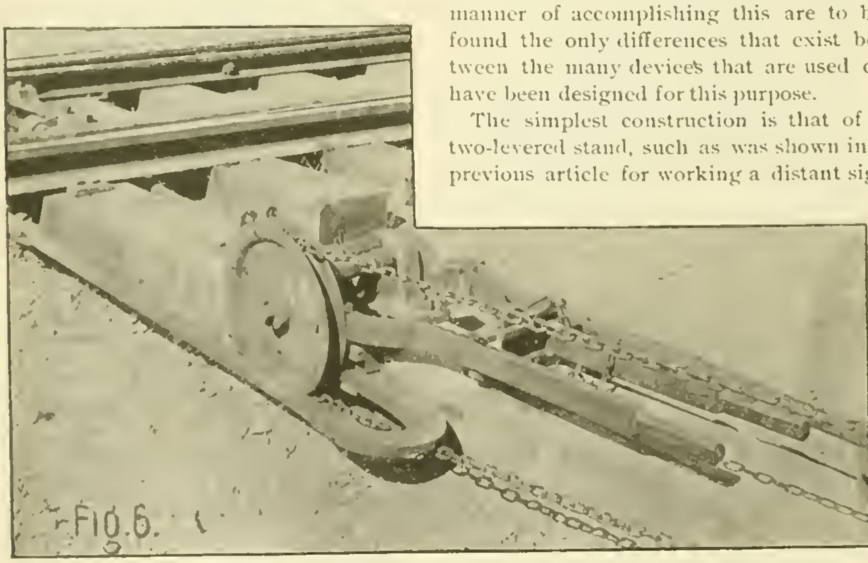
While the target ordinarily used on a switch-stand answers the purpose of a signal fairly well when the track is straight and the target can be seen, there are a number of places on almost every road where it is desirable to have a signal placed at some distance off from the switch, to be worked in connection with the switch to give warning to an approaching train of the position that the switch is in. The conditions to be met are that any signal so used should be of the semaphore pattern, and placed on a high pole as in the case of or a block or interlocking signal, the indication of this form of signal—as has already been pointed out—being more positive and distinguishable at a much greater distance than any other. As the switch is the danger point, and is provided with a signal—a red target in the day time and a red light at night—the signal placed at a distance becomes in reality a distant signal and should be so used, the blade being painted green and the end notched, while at night the light should show green when the signal stands at danger.



U. S. & S. CO. INTERLOCKED SWITCH STAND.

In connecting the signal with the switch, it should be so arranged that the signal would have to be put at danger before any movement of the switch could be made, and that in closing the switch and clearing the signal the switch would have to be completely closed before any movement of the signal could take place—or, in other words, the levers operating the switch and signal should be interlocked. And in the manner of accomplishing this are to be found the only differences that exist between the many devices that are used or have been designed for this purpose.

The simplest construction is that of a two-levered stand, such as was shown in a previous article for working a distant signal in connection with a home block signal, locking bars with a movable dog to work between being attached to each lever, so that the lever working the signal could be pulled over only when the lever working the switch had been reversed.



VIEW SHOWING LOCK ROD.

Although simple, this arrangement is comparatively an expensive one, the levers and locking parts being made of many small pieces carefully fitted, and for this reason has not come into use as much as have some of the less expensive designs.

The design shown in figures 5 and 6 is one made by the Union Switch & Signal Co., the levers being interlocked in a very simple manner. As an additional safeguard, the lever working the signal is locked with the switch by means of a lock-rod (seen in figure 6), so that it is impossible to move the lever to clear the signal unless the switch has been properly closed.

As will be seen, the arrangement consists of two levers, fulcrumed on a base casting, one of the levers being provided with a

GIBBS' INTERLOCKING SWITCH STAND AT "DANGER."

wheel around which the connection to a distant signal is made to pass, and the other with a crank-pin placed at the proper radius, to which the connecting-rod to the switch may be fastened and the switch thrown when the lever is pulled over from one side to the other. By passing the connections to the signal around the wheel in the manner shown, the proper movement of the wires is obtained for working the signal, one wire being pulled in and the other unwound. Both movements of the signal are thus made positive, and the possibility of a wrong indication being given is very much lessened.

The locking of the levers to prevent their both being moved over at the same time, and thus giving a wrong indication while the movement was being made, is accomplished by means of two pins (seen in figure 5), which work at right angles with the levers and fit into holes drilled into the center castings, lugs being provided on each lever, which forces one of the pins into the hole in the other lever, until the lever that is being moved is pulled entirely over. With the switch closed and the signal at safety, the switch-lever is

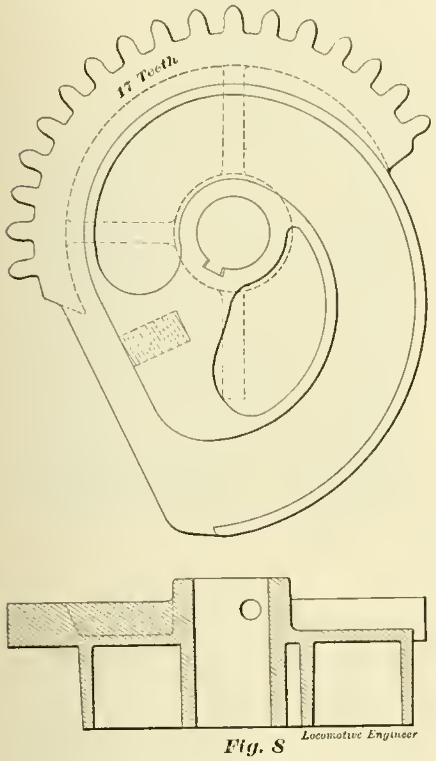


Fig. 8

MOTION PLATE OR CAM OF GIBBS' STAND.

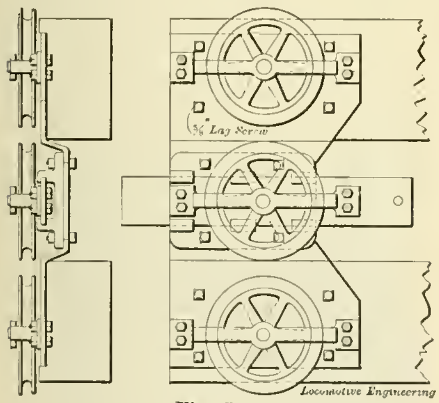


Fig. 9

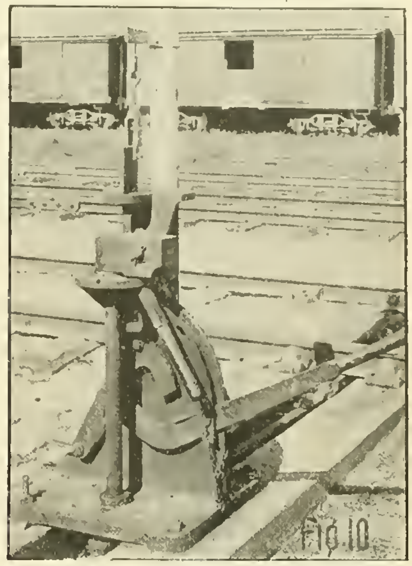
SIGNAL CONTROLLER.

locked until the signal-lever is moved to its extreme position, when the signal will have been changed to danger; with the signal at danger and the switch open, the signal-lever cannot be moved until the switch-lever is pulled over to its extreme position and the switch closed. There is nothing, however, to make the switchman throw the signal-lever back and clear the signal before locking the switch (unless the lock is fastened to the handle), so that it sometimes happens that the signal is left at danger with the switch set for the main line. The arrangement, though, works very well, and has been well designed to overcome the objection that can generally be made to any arrangements using two levers, in that there is always a possibility of the locking or other parts being removed in making repairs to the switch or stand, and by a failure of the section men to properly replace them, the signal might be left at clear with the switch open.

As this has happened in several instances where two-levered arrangements have been used, very bad accidents being the result, it would seem desirable to have an arrangement with which it would not be possible for this to occur. Such a one has been designed and patented by Mr. George Gibbs, Mechanical Engineer of the C., M. & St. P. R'y, and is shown in figure 7, a drawing of the motion-plate being shown in figure 8.

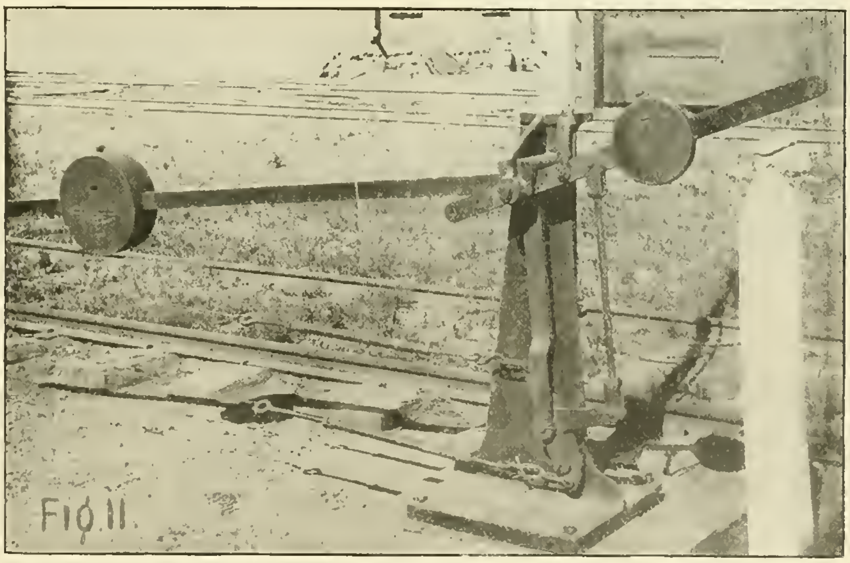
As will be noticed, the body of the stand is cast in one piece, the crank-shaft for moving the switch to which the target is fastened being made to turn in bearings in the center of the casting. In place of a direct connection being made from the crank to the head-rod, the connecting-rod is attached to a sliding-bar working in grooves cast in the bottom of the stand, a pin being provided on the bar which fits in the slot of the motion-plate or cam attached to the lower end of the shaft and moves the bar whenever the cam is turned. This movement provides for the opening and closing of the switch; to work the signal, a gear-wheel having a groove around which a chain may be passed is fastened to the sliding-bar in such a way that when the cam is in a certain position teeth cast on its outer circumference will engage with the teeth of the gear-wheel and turn it, the chain to which the wire to the signal is attached being wound up.

In this way, by turning the shaft, the cam is made to do two things: one to work the sliding-bar to open and close the switch, and the other to turn the wheel pivoted on the bar to wind or unwind the chain and work the signal. To make these two operations take place at different times during the turning of the switch-lever, and thus make the arrangement safe, as the signal should be changed only after the switch is closed or before it has been opened, the teeth are put on that side of the cam which will cause them to engage with the gear-



ALLENTOWN ROLLING MILL CO. INTERLOCKED SWITCH STAND.

wheel only when the slide has been moved to close the switch, the wheel at other times being free and not moved by the movement of the cam. As the signal is weighted to stand at danger, unless held at safety by a pull on the wire, and the first motion of the lever made to open the switch turns the gear-wheel unwinding the chain, the signal is allowed to go to danger before the switch-points have moved, the pin on the slide-bar being brought into contact with the spiral groove of the cam to move the switch only after the chain has been unwound from the wheel. In turning the lever to close the switch and clear the signal, the first move-



COMPENSATING ARRANGEMENT ON DISTANT SIGNAL CONNECTIONS.

ment turns the cam and moves the sliding-bar only, thereby closing the switch, a further movement bringing the gear-wheel back, causing the teeth to engage with those on the cam, turning the wheel and clearing the signal without any further movement of the bar.

Should it be desired to connect up two switches to one signal, so that when either or both switches are opened the signal will stand at danger, a device known as a controller is made use of, which is shown in figure 9. This device accomplishes the purpose for which it was designed, by taking up the slack in the wire, when the switch nearest the signal is closed, and allowing

ELLIOTT'S ELECTRICALLY-LOCKED SWITCH STAND.

the signal to be worked in the usual manner by the stand that is farthest away. The wire from the stand nearest the signal being attached to the slide of the controller, when that switch is opened the middle wheel of the controller is allowed to be drawn in between two other wheels, the wire to the signal being slackened up sufficiently to allow the signal to go to danger. When both switches are closed, the wire is drawn in the same as if only one stand was used and the signal is pulled to clear. In service this stand has given very good results, and but one objection, that of having but one wire to work the signal, has been found with it, dependence being placed upon gravity to make the signal go to danger when the switch was opened. While this would seem to be a very serious objection, owing to the danger of wires or chain freezing up in winter, in practice this has not proved to be the case, if care be used in the installation to secure proper drainage. As there is but one wire the signal will work with a much lighter pull, the extra work of moving the other

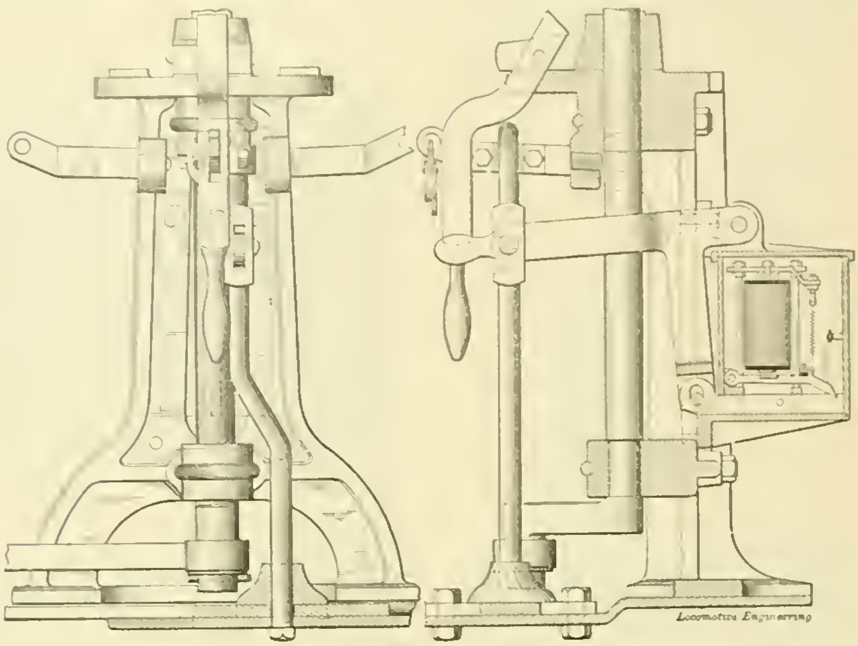


Fig. 13

DETAILS OF ELECTRICALLY-LOCKED SWITCH STAND.

wire being dispensed with and the signal, therefore, being much easier to keep adjusted.

An interlocking switch-stand and signal, which possesses several novel features, is one made by the Allentown Rolling Mill Co., and shown in figures 10 and 11, the signal blades—which are of the usual semaphore pattern—not been shown. As will be seen by reference to figure 10, which is a view of the stand, two levers are used: one to work the distant signal, and the other the home signal and the switch. Two wires are run from the operating lever to the distant signal, the lever being made in the form of a T-crank with the wires attached to the two arms, so that when one is pulled by a movement of the lever the other is slacked up. Working above the top of the T-crank, in grooves cast in the frame of the stand, is a slide to which is attached the cable used to pull the signal to danger, the blade being made of cast-iron, which considerably overbalances the weight of the spectacle arm on the opposite end. The slide when in its normal position, or raised as shown in the figure, fits in a groove cut in the head of the switch-shaft and locks it, preventing the switch from being opened until the slide is pulled down. This is done by raising the switch-lever handle, an arm projecting through the yoke and engaging with a lug on the slide, pulling it down, and with it the signal to the danger position, when the switch can be thrown.

To interlock the T-crank operating the distant with the home signal, the upper arm of the crank is made to work in a plane immediately below the slide, the latter striking on the arm so that it cannot be pulled down unless the crank has been turned to a position causing the distant signal to indicate danger. With the slide down the crank is of course locked, so that the distant signal cannot be cleared until after the slide has been raised, which occurs only when the home signal goes to the safety position after the switch has been closed.

The ingenious arrangement used at the distant signal for automatically compensating the expansion and contraction of the wire, so as to always bring the signal

UNLOCKING SWITCH.

down to the same angle with the vertical, is shown in figure 11. The two lines of wire from the interlocked stand are attached to a loose lever hung on two pins fastened in the opposite arms of a T-crank, the middle arm having attached to it the pipe connection to the signal casting, this signal being of the usual construction and weighted to go to danger when any part becomes disconnected or breaks. Should a wire break, the tension of the other wire would pull the loose lever off from the T-crank and leave it free for the signal to go to danger by gravity.

To take up expansion and contraction of the wire lines, the T-crank, instead of being bolted to a rigid foundation, is fastened to one end of a crank, the other or longer

TURNING SWITCH.

arm being weighted to put a tension on the two levers, and as the weight is very much in excess of any pull required to work the signal, the crank is made to act the same as if fastened to a rigid body instead of to a movable support.

Mechanically this stand is well designed, and the arrangement for compensating the wires is a very good one; but on the whole the arrangement cannot be said to be a very reliable one, owing to the short travel of the wire and to the fact that the normal position of the home signal is at safety. From the short travel and the spring in the wires it is possible to unlock the stand without changing the distant signal to danger should the cranks or wires become in any way fastened, and from the other objection that it is certain that the signal would indicate safety if certain parts should break, or be left disconnected by a malicious or careless workman. In point of fact, there seems to be at the present day no mechanical switch-signal which does not possess some objectionable features; so that if a reliable device is desired that can be made to work with but few failures, and these only on the side of safety, recourse must be had to some form of automatic electric signal. They are expensive, it is true; but is it not better to use such a device if by its action almost perfect protection can be secured? In very dangerous places the matter of expense should not be allowed to enter into the question, as a device that can be relied upon is worth all that it costs.

Experience has demonstrated that the automatic electric signal can be made to work with certainty at any distance from the switch, to show to an approaching train the position the switch is in, and by putting a visible indicator at the switch, a warning can also be given to anyone desiring to use the switch that a train is approaching.

Taken in connection with this subject, an electically-locked switch stand has been recently patented by the writer, by which control of the switch may be put in the hands of an operator at any distance away, enabling him to prevent a train from leaving a siding or branch for the main line, unless it was so desired. In this device, of which a general view is shown in figure 12 and the details in figure 13, an electro-magnet is made to lock a slide controlling a lock-rod or plunger, which passes through a lock-bar attached to the points of the switch, so that unless the magnet is energized the rod cannot be withdrawn and the switch opened. As will be seen, the armature of the magnet is made to drop into a notch cut in the slide controlling the lock-rod, the upper end of the latter being brought under the switch-lever, so that the switch cannot be shut and locked in the usual way without forcing the lock-rod through the lock-bar, and allowing the armature to drop in the notch in the slide and lock the rod until the magnet is again energized.

To work the switch, the two levers are raised together, as shown in figure 14, the upper lever allowing the lock-rod to be raised with it if the slide has been unlocked, withdrawing the lock-rod from the hole in the lock-bar before the switch-lever has cleared the slot in the switch-stand and the spring of the switch has been brought to bear on the lock-bar. Immediately the switch-lever has been raised to a horizontal position, the lock-lever can be dropped and the switch turned in the usual manner, as shown in figure 15.

To enable anyone desiring to use the switch to know when it has been released, without being put to the labor of trying to raise the lock-lever, a small indicator has been provided, which works behind a thick piece of glass put in the side of the box covering the magnet, which will show when the switch has been unlocked, so that anyone finding it locked need only watch the indicator and take it easy.

A circuit-breaker, provided in the box, is made to break the current through the magnet, as soon as the slide has been part way withdrawn, so that the operator can tell exactly when the switch has been opened, and also if it has been closed after the switch has been used, a disc indicator placed in the tower being put in the circuit for this purpose. Where the switch is placed at any very great distance, bells or a telephone can be put in for purposes of communication, the wires for operating the switch being used for this purpose also and the cost of additional wires saved. This switch has now been used for over a year and has given excellent results. If properly installed few or no failures will occur, and these need not cause more than a few minutes delay or the time required to unscrew and take out but one bolt.

Another device that is used in connection with the ordinary switch-stand as a protection for main-line trains, and which has of late been quite extensively introduced, is the one designed by Mr. Pennington, of the "Soo Line," and now known as the Pettibone-Mulliken Derailing Switch. This derailing switch, while in reality an interlocking device, is intended for use at all storage or passing tracks, where the conditions are such that a car might accidentally roll out on the main line and block it; so that in taking up the subject under the head of switch-signals, one is not departing very far from the spirit of the title, even if there is no signal used in connection with the device. As will be seen by reference to figure 16, which is a general plan of the arrangement, connections are made from an ordinary switch-stand to a derailing-switch placed in the side-track at such a distance from the main-line switch that a car being derailed would not foul the main line. To work the derail, a small T-crank and connecting-rod is bolted to the ties at the switch and at the derail, the connecting-rod being attached to the end of the head-rod in each instance. The two arms of the T-crank being connected together by wire, it follows that when the switch is opened and the T-crank turned, the crank at the derail is moved a corresponding amount, the derail being moved at the same time as the switch. By arranging the connections so that when the switch is set for the main line the derail will be open, it will be seen that if the switch is kept closed, as it should be, ample protection is afforded against cars accidentally running out and blocking the main line. This device has one very great recommendation, and that is its cheapness, for the field of its usefulness is large, the need for some de-

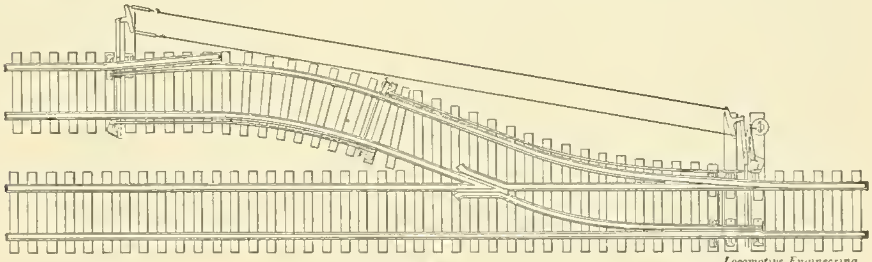


Fig. 16

PETTIBONE-MULLIKEN DERAILING SWITCH.

vice of this kind being made evident on any road almost every day. Beyond its cheapness the construction used has but little to recommend it, and the wonder is, from the large chance of accident due to the lightness of its parts, that no case for which it was responsible has as yet been reported. Judging by what has been found best in all other kinds of track work the parts are all made too light, and while there would appear to be no necessity for making any part stronger than the wire, which is the weakest part, the fact that the device is generally put in and has to be cared for by section men, calls for a construction sufficiently durable to stand the treatment it will receive.

By using wire instead of a more solid connection, there are possibilities of accidents happening from any one of the following causes :

That, if the wire pulling the derail point closed should break, the point would most likely be pulled open by the tension on the other wire, especially if a train was passing at the time.

That a wire which may be broken at any time by trainmen stepping on it, a thing they most certainly will do, is a very weak connection by which to hold a facing point switch closed.

That, having only section men to care for it, the connections are apt to get out of adjustment from expansion and contraction, and in so doing allow the point to open sufficiently to be caught by a sharp flange.

Should the parts be made stronger and pipe used in place of wire, an arrangement safe enough for every purpose would be had and one that would need little or no repairs. The manner of running the pipe and making the connections is also shown in Fig. 16, the pipe being run on carriers screwed to the ties, where it will be out of the way of trainmen working around the switch. To arrange for compensation two cranks are made use of, as shown in the figure, it not being possible to put in the usual "lazy-jack" compensator, on account of the large foundation needed.

To this arrangement the only criticism that can be made is its cost, which is more than double that of the wire connection and if taken in comparison amounts to a great deal when there are many of them to be used. However, this is a matter for each one to decide, whether the additional safety secured by the use of the pipe connection is worth the increased cost. Undoubtedly, the subject is one well worth looking into by those interested.

In closing this the last article of the series, which I hope have proved interesting to the many readers of "Locomotive Engineering," let me acknowledge my indebtedness to Mr. Geo. Gibbs for the very valuable suggestions and able criticisms made by him while these articles were being written. While some may criticise the frankness with which the opinions concerning the different devices have been expressed, I will say they are such as have been formed by me for the greater part from a personal experience with the several devices mentioned, and that in thus publicly expressing my views it has been done with the hope that they may be of some benefit to others situated as I am and aid them in their work.

THE END.

A Pneumatic Belt-Shifter.

Compressed air is on record in another new field of usefulness in machine-tool economy. This time it is our pleasure to note its application to countershafting, for the purpose of shifting a belt from the loose to the tight pulleys, and the reverse.

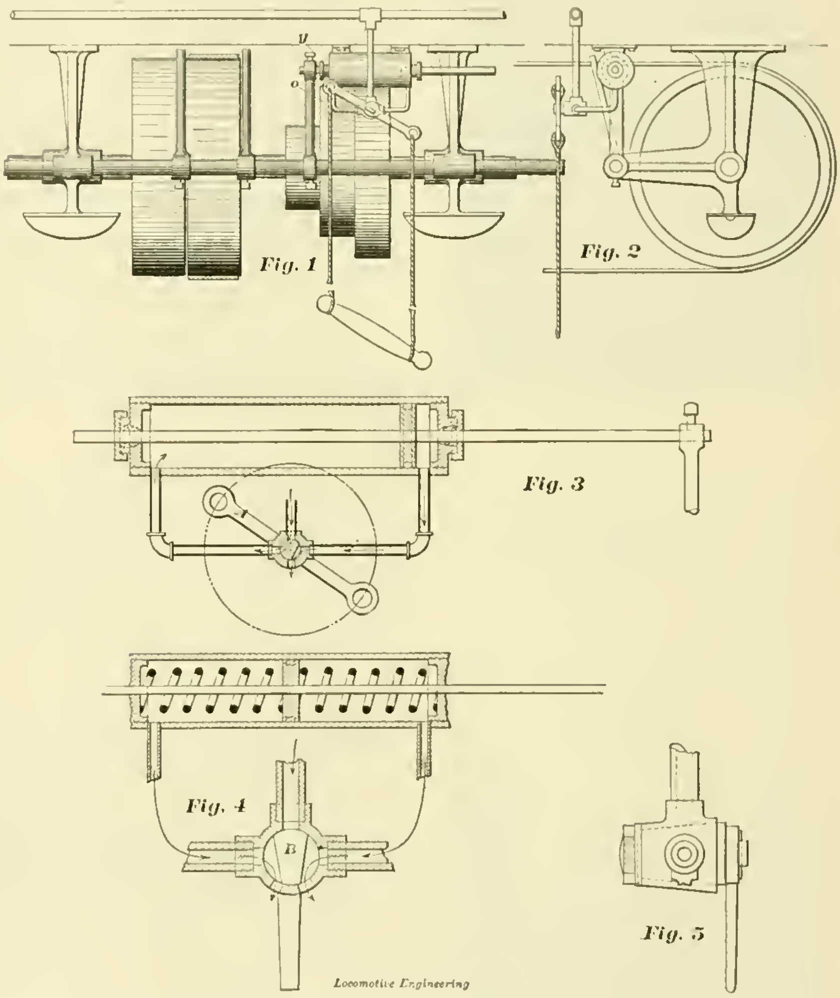


Fig. 1 Fig. 2 Fig. 3 Fig. 4 Fig. 5

Locomotive Engineering

Figs. 1 and 2 give a clear idea of as neat and mechanical a job as can be found in any shop. The device consists simply of a small air cylinder with a piston travel, such as will give the belt the proper throw; the cylinder is piped from each end to a two-way cock, the plug of which has a bar with a looped cord within reach of the operator. Attached to the piston is an arm which extends down to the bar carrying the shifter forks—air does the rest. These views and Fig. 3 explain the whole thing for a belt requiring but one movement.

Tools having a backing belt are provided for by the arrangement shown in Fig. 4, in which the piston, and therefore the belt shifter, are held in a central position by two coiled springs when the belts are on the loose pulleys. The springs are compressed, and their resistance is easily overcome, when air is admitted to the opposite ends of the cylinder, which action will put the belt on either the forward or backing pulleys.

While the march of improvements has been going on in machine-tool construction, and conveniences for the rapid turning-out of work have been schemed out and perfected, the countershaft has apparently been forgotten in the shuffle until recently. It is certainly strange that the old, long, wooden shifter, as crude as a home-made cider press, has not been abandoned before. The forked clutch, that noisy abomination for shifting a belt, will have to walk the plank too, to make room for the newcomer, in shops having a compressed-air system; and if there are any shops without air at this day, it would pay them to put it in at once, if for no other purpose than to utilize this device on their tools.

Mr. H. A. Fergusson, assistant master mechanic, and his foreman, Mr. A. J. Kline, of the Pennsylvania Railway, at the Meadows shops, are responsible for this really good thing, which has been in use now about two years. They have also made a brake to suddenly arrest the motion of a machine tool, and have applied it to a slotter, to stop the tool at any part of its stroke. It is only necessary to pull the air on the shifter, and touch the button on the brake, to stop the machine almost instantly; this is accomplished by an air piston moving against the large end of cone on the machine. The beauty of this kind of a brake is best appreciated by those of us who have burned the palms of our hands trying to make a quick stop on a large machine.

Kinks of this kind are what help the output of a shop, and the best feature of all is, they reduce the element of danger to a lower limit than it had before, by placing in the hands of the operator the means to stop his machine at once in time of imminent danger.

What a "Soulless Corporation" Did for the Public.

At a hearing before a committee of the Senate of New Jersey, to take evidence in favor of a bill giving the directors of the Greenwood Lake Railroad permission to lease their road to the Erie Company, Ex-Mayor Hewitt, of New York, gave evidence which is a striking commentary upon the common cry of "soulless railroad corporations." He said:

"I am the president of the New York and Greenwood Lake Company, and have been for seventeen years. The road was begun in 1870 to form a part of a system to run from New York to the great lakes. In 1873 the railroad company went to the wall, and I was made the receiver.

"The termini in the State of New Jersey were the Montclair Railroad and the New Jersey Midland. As receiver for the Midland I acquired possession of these roads, but seeing that I had plenty to do with the company in New York, I asked the Court to appoint a receiver for the New Jersey roads, and Garret A. Hobart was made receiver. After several years Mr. Hobart conducted the road at an immense loss, and seventeen years ago a new company was formed, and since that time I have been forced to advance over $300,000 out of my own pocket. Then the State of New Jersey came along and taxed us, and collected the taxes regularly. In this way the State has collected $68,000 from me for running a railroad at my own expense. Meanwhile the people have traveled up and down the road at less than it cost me to operate it.

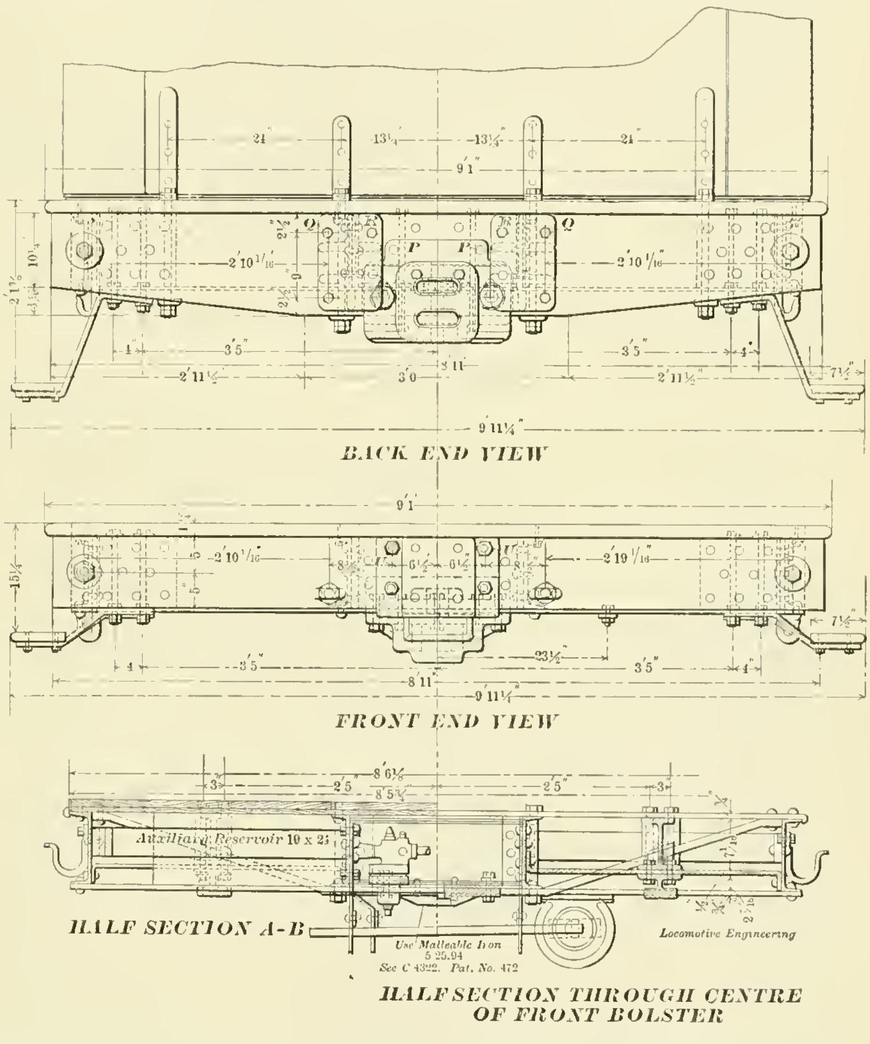
"The reason Mr. Hobart was unable to run the road at a profit was because he had to pay heavily for terminals. When I took it I arranged for this with the Erie Company, and it was given for nothing. It is a high tribute to the generosity of what is popularly known as a 'soulless corporation' that it should take such a kindly position regarding a line that would otherwise have been forced to suspend. The Greenwood Lake Railroad, I can say, in all these years has never paid a cent to its stockholders or officers.

"I thought that I was at the end of my troubles when I got this wreck into working order, when I made its receipts rise from $80,000 to $500,000 a year, and when I arranged to make a contract which would insure to the people of the section of the State through which it passes good service, improvement costing another $500,000 and a chance to develop the resources of the country. I was surprised when I learned that this bill was 'held up.' I was told that, unfortunately, this bill was introduced by the same Senator and at the same time with another bill, and that somebody had a grievance against the railroad company, and that this bill could not pass until that controversy was settled. I never knew until then that New Jersey had degenerated to the vicarious sacrifices in vogue in ancient times."

Steel Tender Frame—Norfolk & Western Railway.

Mr. R. H. Soule, superintendent of motive power of the Norfolk & Western Railway, has a steel tender frame in use on his road that embraces all of the essentials necessary to long life and low cost of maintenance—two factors that seem to be little understood, as would appear from the number of modern frames that are high representatives of the cobbler's art.

Our illustration shows the frame for a 4,000-gallon tender. There are four longitudinal sills made of 10-inch steel channels, 19 feet 3 inches long, all placed with the flanges to the outside; at the front these channels abut against a 1 x 10-inch girder, to which they are secured at the corners by a 1 x 10-inch angle, riveted with eight ¾-inch rivets



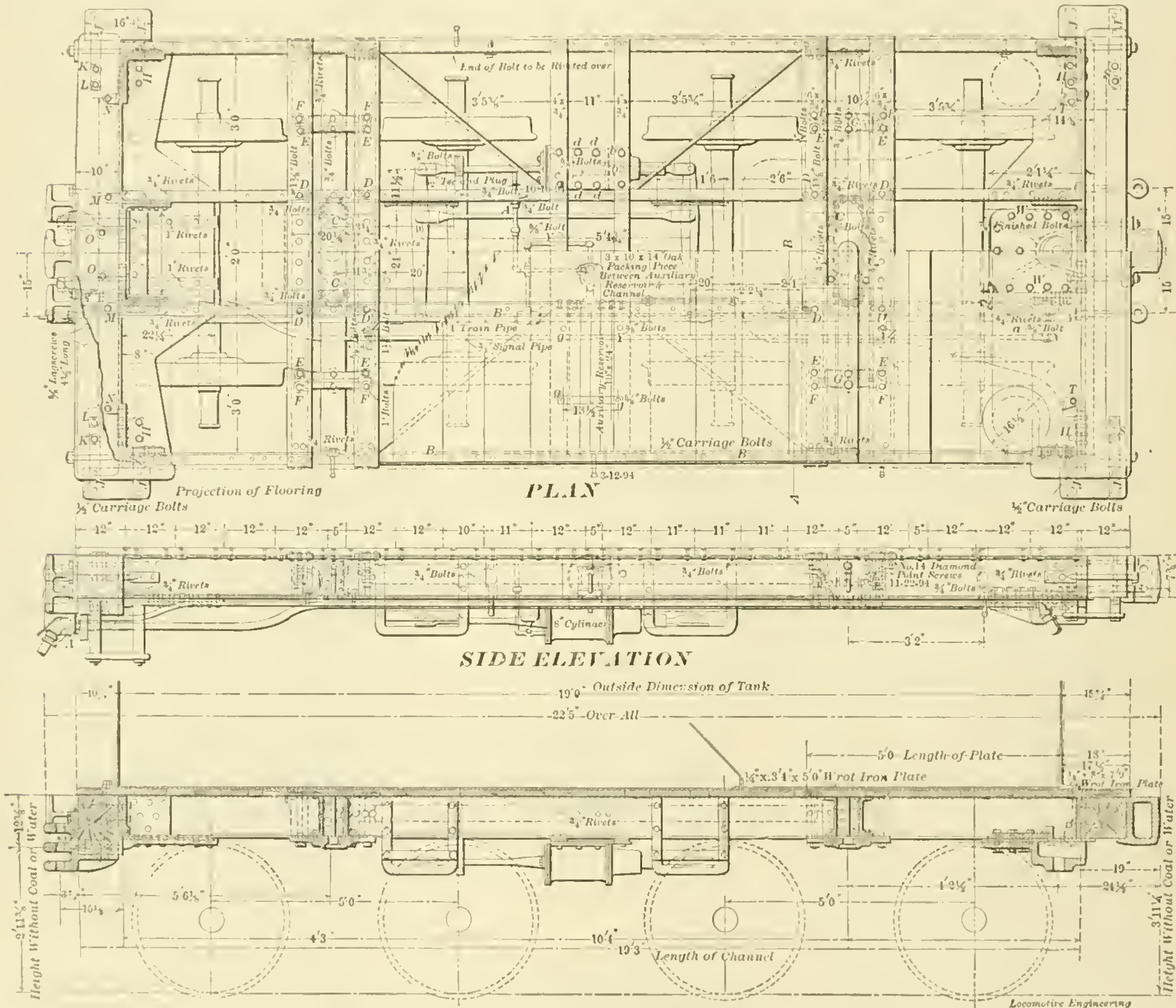
through each leg. The center sills are secured to the 1 x 10-inch girder by a double angle, also riveted with ¾-inch rivets.

At the back end the construction is the same, except that the girder is 1 x 14 inches. The front and rear bumper timbers are bolted to these girders, binding the whole thing firmly into a stiff unyielding framework.

The bolsters are made up of two compression members 1 x 4 inches, placed 16¼ inches from center to center, with the ends against the inner faces of the outside sills and the center passing under the center sills. Immediately above these, resting on the sills, are the two tension members ¾ x 6 inches, to which they are riveted with ¾-inch rivets at the ends, and bolted at the center sills by two 1⅛-inch bolts through each sill and bolster plate.

At the center of the frame, between the bolsters, are four ¾ x 4 inch binders, two on top and two on bottom, placed 15 inches centers and riveted through flanges of sills at each crossing. There are four braces 1 x 4 inches, placed diagonally, with edge up, between the binders.

Bolted to the upper face of the compression members of the bolsters is a ½-



LONGITUDINAL SECTION THROUGH CENTRE

inch plate, fitted between the center sills, affording a bearing for the center plates; all tendency of this plate to buckling is provided for by two channels between the center sills and over the center plates.

The 1¾-inch decking is secured directly to the sills by two carriage bolts through the flanges at each crossing. The tank is evidently designed for water, although the coal space is not as small as it first appeared, being flared out at the front, which increases the capacity somewhat; but the best feature of the flare lies in the added space for the fireman to get a swing at the door—room that is badly needed on many engines with long fireboxes.

It will be noted that the back of the coal space is sloped at an angle of forty-five degrees. This is a decidedly good thing on fast runs, where time for shoveling down coal is at a premium, or hoboes are not traveling, to help out at the critical period.

The frame shown is used alike for passenger and freight service, by changing the arrangement of the coupling and buffing accessories at the rear. For passenger service a vertical plane coupler is applied.

It reads strangely to mention a buffing device in connection with a freight tender; but it is a good thing, and, of course, was adopted on this road. Another improvement prominent in this tender, and rarely seen, is the step at the rear corners, for the convenience of trainmen, making road switching a comparatively safe operation when pitted against the dangerous acrobatic feats performed on brake beams, where no other provision exists to get standing room.

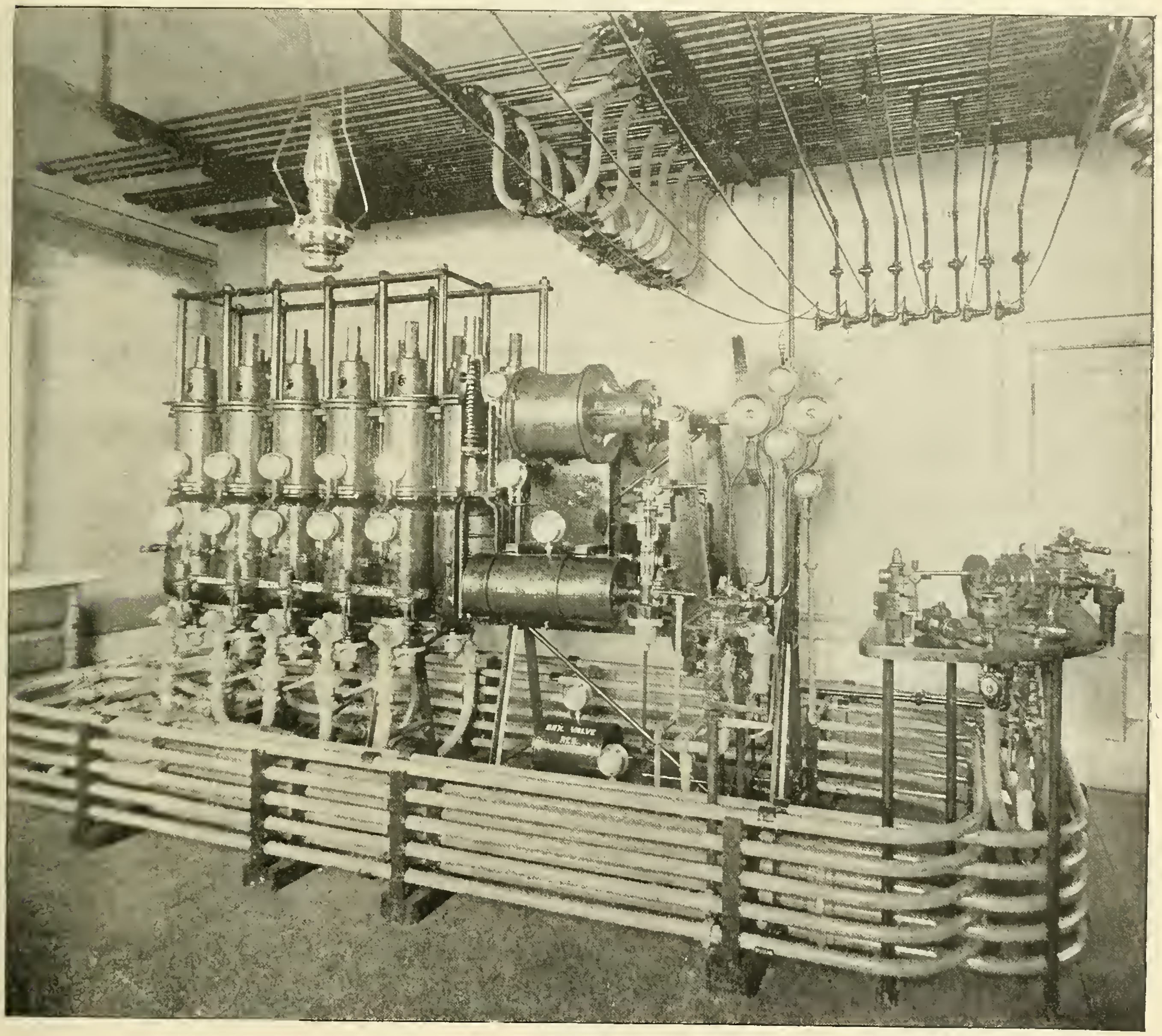
The truck is generally similar to that shown in this issue with the 60,000-pound car—the principal difference lying in the wheels, which are 36 inches diameter, instead of 33 inches; and the axles, which are collared, as shown in the plan of tender. The springs are double elliptic, on the front truck to give an easy motion, and the helical spring is used on the rear truck; this fact makes necessary a shallower bolster on the front truck, on account of the greater height of the elliptic spring, since the arch bars are similar and have the same amount of set in both cases. With the changes noted, the trucks are alike, both having the steel bolster and spring plank, and both of the rigid type.

The mechanical execution of all details is of the highest order—nothing left undone to insure the stability of every part when once put in place; and that means volumes when repairs are to be considered.

A frame of this character will come out of a "racket" distorted, perhaps, but it can be put in shape again for future service, and every motive power man knows that is not an easy thing to do with the old wood affair with its splintered remains.

AIR BRAKE DEPARTMENT

Conducted by F. M. NELLIS.



BOSTON & ALBANY INSTRUCTION ROOM.

The Boston & Albany's New Air-Brake Plant.

The new air-brake schooling plant recently installed by the Boston & Albany at their Springfield shops, as illustrated above, is the best-designed and most complete plant yet brought to our notice. The compactness and simplicity of design, so that the plant may be transplanted in an instruction car at some time in the near future, and the painting of the exterior of the pipes, valves, cylinders and reservoirs in bright representative colors, instead of the orthodox black or Tuscan red, are the distinctive features of the plant.

The plant was designed by E. G. Desoe, general air-brake inspector and instructor of the system, and approved by T. B. Purvis, master mechanic. The color scheme is original with Mr. Desoe, who, in designing the plant, was so forcibly impressed with the advantages to be had from the employment of different colors to designate the several pressures of the air-brake system, that he at once determined to adopt it. Too much cannot be said in praise of the progressiveness of the higher officials in supplying such an efficient means for bettering the air-brake service on their line.

The very important consideration of good ventilation and lighting has been well attended to, as the room selected in which to place the plant is about twenty feet square, eleven feet from floor to ceiling, and has six windows. The furniture consists of desk, chairs to seat about twenty men, wash bowl and vise bench. A large steam-heat radiator furnishes the necessary warmth.

The operative parts of the plant for instruction consist of E-6 and D-8 brake valves, so arranged that they may be worked singly, or in combination to represent "double heading;" two 12-inch driver-brake cylinders with levers attached to a fixed pivot at the lower end, tender brake, ten equipments for freight cars, and a complete air signaling apparatus for seven passenger cars. Arrangements have been made whereby the hose at rear end of tender may be connected to any of the ten cars, and thus change the position of the cars in the train. A conductor's valve and a "back-up hose" are connected to the last car, to illustrate how trains should be handled when backing into stations. Signal and air-brake hose are arranged on the pilot pipes, to instruct brakemen in the proper coupling of hose.

Sectional valves of the entire system are supported by a stand in front of the instructor's station for handy reference. From his position at the brake valve, the instructor can, with the aid of a long pointer, call to their view any part of the apparatus without disturbing the position of the members of his class. Thirty-one gages are used. Every part containing a pressure has a gage. All parts having main-reservoir pressure are painted red; train pipe, blue; equalizing reservoir, black; auxiliary reservoir, brown; brake cylinder, yellow; and signaling apparatus, green. The piping is full car-lengths. The indispensable sectional triple works tandem with the tender-brake triple. The pump and main storage of air pressure are in the engine room, several hundred feet from the schooling plant, thus doing away with a boiler and much noise. The piston travel of the ten cars may be varied by the used of white oak blocks fitting inside of the piston sleeves, and cushioned by special rubbers.

A lever, with several holes so spaced as to change the proportion, is arranged with suitable ropes, pulleys and weights, and is located on the wall back of the train to demonstrate the laws of leverage.

General Superintendent Robeson, who, with his other progressive ideas, takes a lively interest in air-brake matters, has ordered that all employés whose duties bring them in contact with the air brakes shall receive a course of instruction which will enable them to pass a satisfactory examination, when a certificate will be issued to them. Classes of about ten men each will be held every other day, the alternate days being spent by the instructors on the road in actual service. Active interest is already manifested by the men, who are anxious to "get at" the new plant. Mr. Desoe and Assistant Inspector H. S. Walton will give the instructions.

The Convention of Air-Brake Men.

At 9 A. M., April 14th, the Air-Brake Association will assemble in convention in the main hall of the American House, Boston, Mass. This will be the third annual convention of this young association, organized a few years ago, since which time the membership has increased from about a dozen charter members to nearly two hundred actives and associates, representing all sections and classes of air-brake service in the United States.

The honest endeavor and persistent effort of the organization to obtain "a higher efficiency in air-brake service" has enlisted the sympathy and support of many railway officials in its worthy aim.

It is upon the Air-Brake Association that the railways will largely depend in the future for economical maintenance of air brakes, and it is but meet that it should be encouraged in every possible way. A prominent member and ex-president of the Master Car Builders' Association the other day remarked that he believed there was more work needing attention ahead of the air-brake men than before any of the other associations. When the work of reclaiming unused air brakes on freight cars, and the installations of testing plants are considered, the gravity of the situation and the logic of the remark will be appreciated.

That it may receive ample support from railway officials and achieve merited success, is the wish of "Locomotive Engineering."

E. G. Desoe's Colored Pressure Chart.

A most efficient adjunct to air-brake instruction methods, and which is the invention of Mr. E. G. Desoe, general air-brake instructor and inspector of the Boston & Albany Railroad at Springfield, Mass., is shown in our special colored chart in this number.

Besides giving the location and separation of the different pressures in a manner that they may be easily comprehended and remembered, another valuable feature is presented in the proportion lines at the top and upper left-hand corner of the chart, which show the status of the several pressures during the functions of the different brake-valve positions. A little study of the chart will reveal other interesting features than those seen at the first casual glance.

The use of graphics to convey an idea is much superior to dry figures and technical phrases, and the use of this colored chart will no doubt prove mutually advantageous to the instructor and his class. Mr. Desoe is to be complimented upon his useful invention.

Portraits of the Officials of the Air-Brake Association.

The familiar faces of the hustling officers of the Air-Brake Association will be recognized in the group of portraits on another page of this department. They are a wide-awake lot, and look able to direct the affairs of their association in a manner "to obtain a higher efficiency in air-brake service."

Better Position for Locating the Air Gage.

A correspondent deprecates the isolated and useless position to which the air gage is frequently relegated in the cab of a locomotive, and suggests that it be made smaller and be brought down to a better location on the engineer's brake valve. Those who have noted the growing tendency to misplace the gage, will endorse the objections raised as wise and timely.

Personal observations made during the past several months to ascertain to what extent this objectionable practice prevails, has brought out a number of startling facts which substantially support our correspondent's views. The most common practice seems to be to locate the air gage on the fireman's side, from four to six feet from the engineer's seat, and where it is utterly impossible to tell within ten pounds of what pressures the two pointers indicate. Another objection is to roll the gage around so the pipe connections may be made at the side instead of the bottom, and it will disconcert anyone who is accustomed to see the gage set squarely. Still another is to present the side of the gage to the engineer. The most deplorable case, however, was one recently observed where the triple sight-feed lubricator and the cab lamp were interposed between the engineer and air gage. The only glances given the gage by the engineer during the entire trip was when he got down on the footboard. While this was an exceptional case, still there are others equally objectionable on account of the great distance and angle at which the gage is located.

While we are strong in our belief that the gage should be closely watched in order that perfect work may be had, we recognize the inability of the engineer to do so when the gage is badly located, and we would be in favor of extending the bracket to which the brake valve is fastened, so the gage may be fastened directly to it. Arrangements could be made to throw light upon it at night, and we would then have some reason to believe that our recommendations to use the gage in braking would be followed up.

The easiest and best method of maintaining freight brakes is to keep them in constant service Switch all brake cars ahead and obtain the benefits of their service, besides preventing them from drifting into a neglected condition from which, later on, considerable expense will be involved in reclaiming them.

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8. W. C. WALSH, *Ex. Committee*
9. R. H. BLACKALL, *Ex. Committee*

OFFICERS OF "THE ASSOCIATION OF RAILROAD AIR BRAKE MEN.

WHY THE AIR-BRAKE SERVICE IS PRAISED ON SOME ROADS, AND COMPLAINED OF ON OTHERS.

LOOK ON THIS.

An initial reduction of five to seven pounds in service application will set the brakes lightly, and allow the slack of train to bunch gently without shock and without damage to lading and equipment. There will be no fault found here.

After making the initial reduction of five to seven pounds, the careful engineer awaits the crowding ahead sensation which he knows is coming, and will tell him that the slack is bunched; then he knows his train is solid, and the brakes may be applied with any degree of force, and no damage will follow. Should he be obliged to release, he will use the same care again in gathering his slack. He remembers that if the train is to be smoothly handled the slack must first be gently gathered, and in starting the train the slack must be taken out one car at a time. There will be no carrying of chains, and "chaining up" broken draw gear at water tanks and such places with this man. The crew will tell of his skill, which will go far towards making a successful reputation for him.

The emergency application should never be used at water tanks and other such places. The careful man is right in believing less damage is done the train and to his reputation by running by and backing up occasionally than to "steal a little snap" of the emergency. If grade renders it impossible to back up, he will take no chances, but will cut off his engine to take water.

Several feet can usually be gained by using steam while brakes are applied. The careful engineer knows the bad effects of rough applications, and studies to avoid them.

If assistance in stopping is needed by the air brakes, the hand brakes immediately back of the air cars should be set, thus limiting the slack which shall run in and out to the air cars.

Should the train part back of the air-braked cars, the engineer should sound the broke in two signal, and keep the head section clear of the rear section until it is stopped. If the break in two is between air cars, steam should be immediately shut off, and the two sections allowed to come together as soon as possible, thereby decreasing the severity of the shock and the amount of damage done.

With piston travel properly adjusted, and careful handling the air brakes on freight cars will cease to be blamed for causing destruction of property.

The engine and tender brakes should be inspected, and tested to know that they are doing their share of the work. The system of inspection should be reliable and complete.

THEN ON THIS.

A careless application of uncertain amount will generally set the brakes too hard, and will cause the slack to bunch violently. When the caboose brings up, the occupants experience a shock similar to that of a collision.

The careless engineer knows no crowding ahead sensation. He sets the brakes hard, and the crew is made to feel the shock which they compare to running into a stone wall. At first they feel like cutting off the caboose each time the air brakes are used to make a stop, but they finally compromise by setting up the caboose brake to hold slack out of last few cars. So far, so good; but when the air brakes are released, and particularly if steam is immediately used, the slack runs out, one car at a time, until it brings up at a point where it is held stretched in the opposite direction by the caboose brake, and the strain caused may be too great for the draw gear to stand, and a draw bar is either broken or pulled out. The complaint will soon be raised that stock and merchandise is being knocked down, and that the damage done by the brakes more than offsets their usefulness.

The emergency application, and even that little "flash" that is "stolen" by a dash past the service position, is the cause of much damage when train is down to slow speed. The shock is not felt on the engine, but is severe back in the train. Such practices are productive of a large crop of broken draw bars and delays from "chaining up." The shock is always greater at low speeds.

"Kicking off" brakes on a freight train tends to break it in two. A reckless man thinks because he feels no shock on the engine that there is none. He will insist he makes no shock.

If the crew insists upon doing the braking on the rear cars, while the engineer uses the brakes on head cars, the old adage of "Too many cooks, etc.," will be repeated. One salts while the other peppers.

An attempt to keep the head section clear of the rear section, when the part is between air cars, will only succeed momentarily, and will make a wider gap to increase the shock and collision which is sure to follow sooner or later. The damage ofttimes done by following the wrong practice is frequently attributed to burst hose. The wider the gap is made, the greater will be the collision which follows.

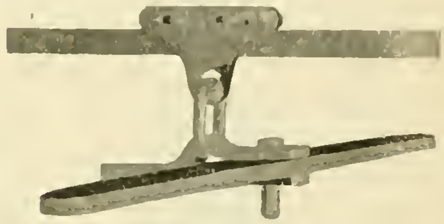
Both good and poor men will do poor work with poor tools. Good brakes must be had if good work is to be expected from the men. An inspection to alone ascertain if all rods, levers shoes, etc., are in place is not sufficient. The pump may make but little pressure, and brakes may leak off shortly after an application.

CORRESPONDENCE.

Carrier for Brake Levers and Rods.

Editors:

To overcome the frictional resistance and disagreeable grinding of the link on carrier irons, as used on Hodge system of car levers, the writer, after a trial of several months, submits cuts of a carrier which gives excellent satisfaction In recommending appliances for railway



cars, simplicity in construction is an important consideration, and is contained in this device.

The cuts show castings from same pattern, riveted or bolted together. The link is inserted by a half turn, and hung on the hooks as shown The sheaves operate in the slots, on edge of a $\frac{5}{8}$ x $1\frac{1}{4}$-inch carrier iron. The centers or "stops" in wheels are $\frac{1}{2}$-inch cold-rolled steel, and side castings 3-16 malleable.

W. H. DURANT,
Ins. A. B. Concord & Mont. R. R.
Concord, N. H.

"Stick to Good Standards, as a Poor One is Worse Than None."

Editors:

In the February number of "Locomotive Engineering" there appeared a design of a tender brake as used by Mr. C. B. Conger. I would like to say that this style of brake was used by our road for a number of years, and was discarded to be superseded by the style of tender brake designed by Mr. James Cullen, superintendent of motive power of the Nashville Chattanooga & St. Louis Railway, a cut of which appeared in your February number.

The following good reasons for discarding that style of tender brake were the inducements which prompted our road to make the change:

1st. All brake-beam levers in our improved system are of the same proportion —namely, $4\frac{1}{2}$ to 1—the total length being the same for all truck levers, thus making them interchangeable.

2d. The cylinder levers are the same length over all for all tenders, the braking power being regulated by the location of the middle hole in these levers.

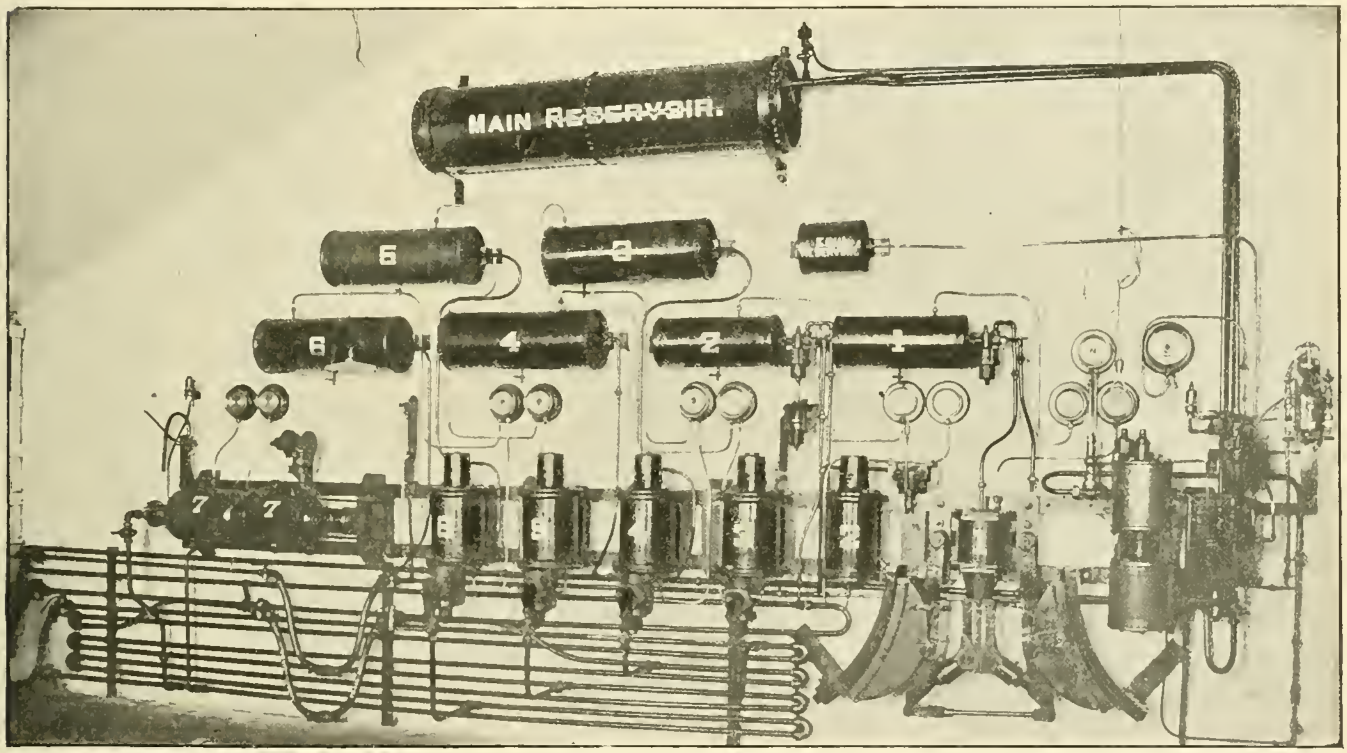
3d. There are a great many tenders which have sloping tanks; these require less braking power on the back truck than on the front truck. In order to vary the braking power on the trucks, it is only necessary to locate the middle hole in the cylinder lever to suit the requirements of each truck. This feature of the design makes it especially desirable for switching engines with sloping tanks where the maximum amount of braking power should be used.

OTTO BEST,
A. B. Ins. N. C. & St. L. R.R.
Nashville, Tenn.

Central Vermont Air-Brake Schooling Plant.

Editors:

A photograph of an air-brake school we have just completed at the shops of the Central Vermont Railroad at this place, is herewith sent you for illustration in "Locomotive Engineering."



The plant consists of a driver brake, tender brake, four passenger cars and one freight car, with the average piping, viz., sixty feet of train pipe for the engine and tender, and at every forty feet a cross-over pipe with its cut-out cock to each passenger and freight brake. Attached to the train pipe is a conductor's valve. On the freight brake is a pressure-retaining valve. Attached to each brake is either a duplex gage or two separate gages, to display the action taken place at any movement of the triple valve, and to show the equalizing pressure at the various piston travels.

To operate the brakes we use the improved engineer's equalizing discharge brake valve, Plate E-6, over which is placed a sectional valve to explain its movements. On the tender brake is a plain triple valve, under which is placed a sectional valve coupled to and working tandem with the former. On the frame near the freight brake is a sectional valve (quick-action) to explain the movements.

Each cylinder is numbered, likewise the auxiliary reservoir, showing at a glance which ones are connected. It is painted on the gage which represents the auxiliary reservoir and likewise the brake cylinder. Added to this equipment is the air signaling apparatus.

You will notice this is only a small plant, but we believe it embodies all the general information necessary to post men in the principles of the automatic air brake.

I might say that we have also added to our school, valve-setting machine, sectional views of injectors and lubricators, which are not shown in our photograph.

WM. DOBSON,
A. B. Insp. & Inst. Cent. V. R. R. Shops.
St. Albans, Vt.

Another Problem from Conger.

Editors:

Some months ago, while illustrating some mistakes in air-brake operation to the class, we used a four-car passenger train for our "instruction plant," and with a B-11 engineer's brake valve (otherwise known as the "small brass brake valve") we were able, by successive reductions of train-pipe pressure and lapping the valve after each reduction, to waste the pressure in the auxiliaries from 70 pounds down to less than 5 pounds and not have any one of the four brakes set. This was done four successive times, of course charging auxiliaries to 70 pounds for each trial. At no time did it take over 8 minutes. On one trial the air was all out of auxiliaries in 4½ minutes.

For the information of those who expect to solve this problem, it is stated that there were gages connected to the quick-action triple on the baggage car which showed train-pipe and auxiliary pressure on a duplex gage. The brake cylinder pressure was shown on another gage. These gages were so placed that they were all plainly visible to the instructor at the brake valve. He could therefore handle the brake valve and watch the exact effect on pressures in car brake equipment.

All the brakes were 10-inch quick-action coach brakes in A1 shape; feed ports clean and proper size; piston travel on full application, 6 to 7 inches; leakage grooves 3¾ inches long; no hand brakes set; no bleed cocks opened, and no leaks of any kind around the equipment to be found. It was one of our passenger trains ready to go out which was being used by the class. On a pleasant day this makes a good air-brake school.

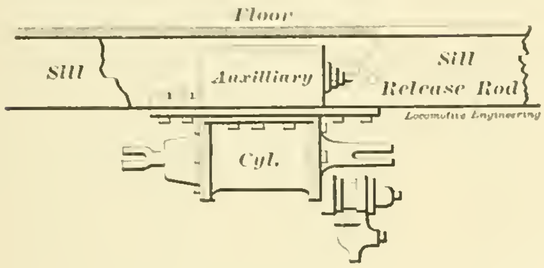
What is the solution of this problem?

C. B. CONGER.
Grand Rapids, Mich.

A Square-Shouldered Air-Brake.

Editors:

While the subject of location of brake cylinders on freight cars is under consideration, I would like to make a suggestion that I believe merits investigation. It is a well-known fact that there are many cars in service already equipped with air brakes, and many more to be equipped, with cross-tie timbers so close together that they will not admit the present design of brake apparatus so it will be convenient to make necessary repairs, etc. In some cases it is practically impossible to remove the back cylinder head without lowering the whole appa-



ratus. My suggestion would be to place the auxiliary reservoir up between the longitudinal sills, with the top up close to floor, and bolt the cylinder directly underneath the auxiliary, and connect triple to brake cylinder as with the passenger-car equipment. The present design of auxiliary could be changed to admit of this. Necessary flanges allowed to bolt to cylinder and to sills by means of a flat bar of iron across the two sills. If necessary, this bar could be let into the sills. The auxiliary and brake cylinder could be cast as a whole, or separate. Auxiliary could be made with square corners, which would give same volume of air and take up less room. The release valve could be tapped into end of auxiliary, and suitable connections made with rod to side of car. Connection could be made between auxiliary and triple by pipe, or some ingenious method could be arranged where pipe would not be necessary. This design would merely take up what room the brake cylinder and triple would occupy. I should think this would be a good arrangement on hopper-bottom cars. There may be objections to this idea that I cannot foresee

J. A. Jesson,
L. & N. R. R.

Louisville, Ky.

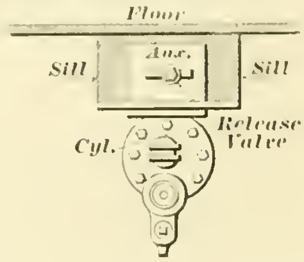
Automatic Draining Device for Main Reservoirs—Better Location for the Air Gage.

Editors:

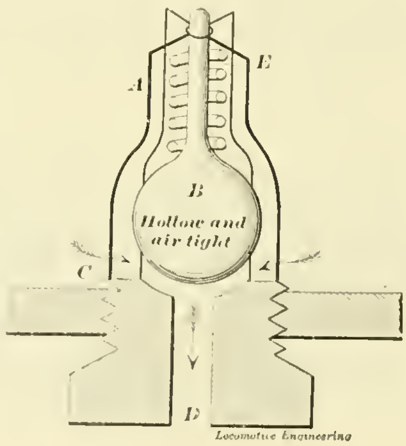
After a careful study of the device for automatically draining main reservoirs, submitted by Mr. de Sanno and illustrated in February number of "Locomotive Engineering," I conclude that it is no very great improvement over the simple drain cock now in use. It consists of numerous parts, and requires more or less attention to keep it in adjustment. Besides, it cannot be operated as quickly or easily as the old-style relief cock, and is liable to get out of order.

However, Mr. de Sanno has accomplished some good in calling the attention of those interested in air-brake work to the necessity for a drain valve that will automatically relieve main reservoirs of the water that accumulates in them.

The principal things to be considered in the construction of air-brake attachments are their simplicity and reliability under all conditions. In the accompanying cut, an idea may be obtained of a simple contrivance that will operate under



all pressures and all conditions of weather and climate. The device consists of a hollow copper or brass ball, arranged to move up and down in a cage. It has a long stem extended from the top through a hole in the top of the cage, to serve as a guide and to prevent the ball from tipping. The ball forms a perfect air-tight joint with its seat. A spring is placed over the ball, and is so adjusted as to permit the water to float the ball and escape when there is no air pressure in the drum. This, to



my mind, is a simple and effective contrivance.

Would like to know which is the best location for the air gage in the cab. I would suggest that it be made smaller, and be attached to the engineer's brake valve. On many locomotives it is placed where it is almost impossible to see it without the aid of a telescope or the newly discovered X-rays.

J. P. Kelly,
New England R. R.

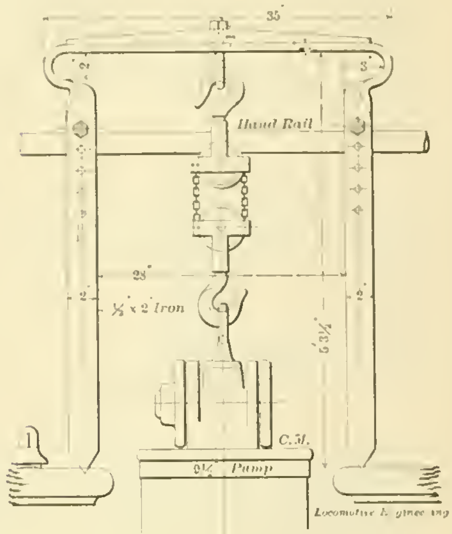
East Hartford, Conn.

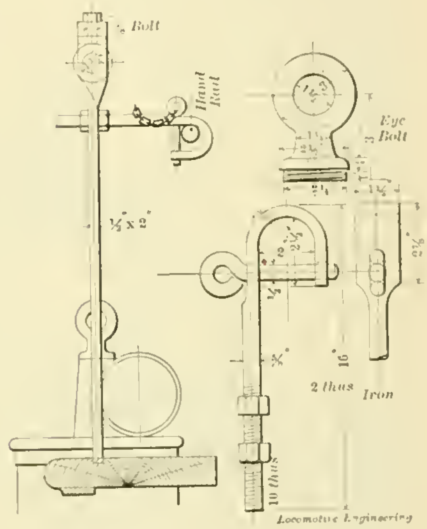
Device for Lifting Air Pumps.

Editors:

In answer to the request in February number of "Locomotive Engineering," requesting a simple way of lifting the 9½-inch pump, I inclose sketch of frame and eye-bolt used at our shops for lifting air pumps on and off engines.

Setting this frame on the running board, securing it to the hand-railing with the





straps which can be adjusted to any height, and screwing the eye-bolt into the reversing cap opening of the head, offers an easy and secure way of handling the 9½-inch or any size air pump.

M. A. Kinney,
A. B. Ins. N. Y., C. & St. L. R. R.

Chicago, Ill.

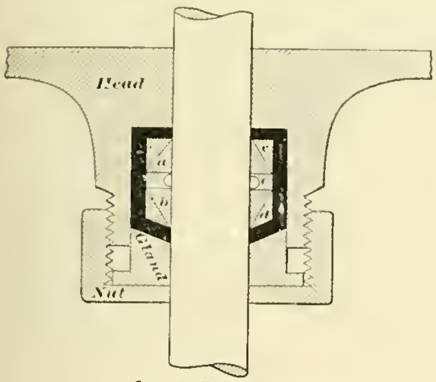
Metallic Packing for Driver-Brake Pistons.

Editors:

The accompanying sketch will illustrate a metallic packing for pull-up driver-brake pistons, which I have been giving a thorough trial for several months, and which has given entire satisfaction.

The packing is made by the Cincinnati Dudley Metallic Packing Co., and is guaranteed for two years. It is less expensive than any other metallic packing that I know of, and is the only packing I have seen that will work to entire satisfaction on a pull-up driver brake.

The conical rings *a* and *b* bear against the rod, and dished rings c and d bear against the rubber which incases the rings. Center ring e is a flat separator which is grooved to collect the lubricant and hold it on the rod. The black line around the packing shown in the sketch is rubber which adjusts the ring to the rod. Tight-



Locomotive Engineering

ening up on the gland nut causes the rings to close on the piston.

It is unnecessary to disconnect the rod to renew this packing. But as the driver brake has no gland it is necessary to disconnect the rod to first apply the packing.

P. P. HALLER,
A. B. Ins. C. & O. Ry.
Covington, Ky.

The Triple Valve's Christening.

Editors:

In the March number of "Locomotive Engineering" "C. W. P." asks why a triple valve is so called, and gives reasons for his idea. No doubt your air-brake editor gave the functions of the triple valve correctly. My reason for calling it a triple valve is because it is a valve casing composed of three valves within, namely, a piston valve, slide valve and a graduating valve.

Chicago, Ill. GEO. D. BOAM.

[The triple valve was given its present name before the graduating valve was introduced, and at a time when the graduating function was performed by the graduating spring.—Eds.]

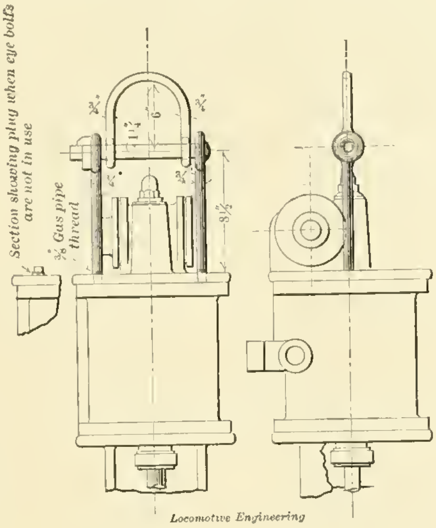
A Pump Lifter.

Editors:

In reply to inquiry made in the January number of your paper, relative to the handling of 9½-inch pumps, I inclose herewith a sketch of a simple device used by the D., L. & W., at Scranton, Pa., and the easy manner with which a hot pump is taken off is every evidence of its extreme value.

It is easily seen by the sketch that the only change necessary is the drilling of two holes through top head of steam cylinder, which are tapped for ⅜ gas pipe plugs, and should be so proportioned as to about balance pumps. Two eye-bolts, 10 inches long, are then screwed in pretty snug, and with the assistance of a clevis and a bolt with key the arrangement is complete. The pump is then raised to position, eye-bolts removed, plugs put in, and the job is finished. In the writer's estimation this is a decided improvement over the rope sling which was formerly used.

This device has been used for a number of years on the old 8-inch pump, and since



Locomotive Engineering

the advent of the 9½-inch it has more than proved its equal to the increased weight.

ALEX. B. BROWN,
D., L. & W. R. R.
Scranton, Pa.

Has the Service Application been Sacrificed?

Editors:

In your March issue appears a contribution of mine with an editorial comment annexed, about which I crave the privilege of a few words.

In presenting some arguments in favor of the use of quick-action brakes on engines and tenders, I spoke of the difference in time of application due to the difference between the sizes of the quick-action and service ports in the triple valve. The comment referred to says: "This is liable to mislead, and is not applicable to the point under discussion," and that "the emergency port is in play but an instant, during which the desired portion of train-pipe pressure is vented to the brake cylinder; then it closes, and the service port finishes the application, with pressure from the auxiliary reservoir." With a drawing of the triple valve before me, I am unable to puzzle out how it is possible that, with the emergency valve held open by reservoir pressure above its piston, it can close before that pressure has equalized with what is below it, which is the same as that in the cylinder. Of course, the train-pipe pressure will cease to enter after it has equalized with that in the cylinder, whether the valve remains open or not; but it is to be noted that before the flow from the train pipe ceases, there is a pressure in the cylinder of about 35, and in some cases even 40 pounds, and surely that is sufficient, especially at low speeds, to produce considerable strain on the drawbars, entering as it does through a port nearly an inch in diameter.

Further along I find the following: "The belief that the graduating springs are being made lighter, in order to shorten the time of emergency application on a 50-car train, is an erroneous one." If that is not the case, the only remaining reason which can be given is that it may possibly give a very slight additional proportion of train-pipe pressure, which extra gain the figures will show to be but a small percentage of the total braking force. In a paper recently presented before the Western Railroad Club, Mr. Waitt questioned whether all the benefits accruing from the introduction of the quick-action brake were not more than offset by the damages resulting from its use. While I do not by any means take such an extreme view of the case as this, I do not believe that, in most of the valves in use, the proper limit of sensitiveness has been overstepped, and without any sufficiently weighty reason.

Proceeding now to another statement which seems to require comment, I quote as follows: "If we were to go backward by replacing the quick-action triples with plain ones, or equivalently stiffen the graduating springs to a degree that would permit the resumption of old-time recklessness and familiarity with the emergency position of the brake valve, we would go back to the M. C. B. brake trials at Burlington in 1887."

If there is any statement in my last article which in any degree, even the remotest, warrants the inference that I have made any such suggestion, I should like to have it pointed out. Neither in terms nor in substance have I ever made any such statement. Plainly and specifically stated, my contention is, that the triple valves, as at present generally made, are more sensitive to emergency actions than the practical conditions of service require, and that, in consequence of this supersensitiveness, injury has been done the service functions of the brake, by making it a matter of great difficulty to make accurate stops without use of the emergency application. To overcome this, I recommend the use of a stiffer graduating spring, and then it follows as a logical inference that the service ports in the engineer's valve could be made considerably larger without danger of getting emergency application when it is not wanted. This does not in any way involve the permission of "recklessness" or "familiarity with the emergency position" of the engineer's valve, but, on the contrary, would tend very largely to check just such destructive practices.

I have ridden on the rear car of a 50-car train equipped with valves having the "standard" graduating spring, during the making of emergency stops, and I have ridden on the same train during the making of emergency stops after the "temporary" graduating springs were put in, and, as far as any one's ordinary perceptions and sensations were concerned, there was practically but very little difference between the various stops made. I have also seen many rack tests made with valves having light springs, and with valves having heavy springs, and there is not a very great difference in the results obtained.

On the other hand, on a single car, a valve with a light spring in it will often make an emergency application when the air is exhausted through a hole only 10-64 of an inch in diameter, while one having a heavy spring will stand a reduction nearly twice as rapid without giving quick action.

It may now be seen that my charge that the service application has been sacrificed to some extent for the sake of an infinitesimal gain in time of emergency applications on long trains is not, as is charged, "entirely speculative" or "without any foundation whatever."

PAUL SYNNESTVEDT.

Chicago, Ill.

[As the emergency port begins at the seat of the non-return check valve, and ends at the entrance of the port to the brake cylinder, it will be closed the moment the check valve seats, regardless of the position of the emergency valve and piston. Tests prove that the port is open but a very small fraction of a second. The advance copy of the report on Piston Travel that will be read before the Air-Brake Men's Convention this month has just been received, and contains valuable indicator cards of brake cylinder pressure which go to prove that our correspondent's figures of the train-pipe pressure that goes to the brake cylinder in an emergency application are considerably too high.

The tension of the graduating springs in the quick-action triple valves, and the size of the service ports in the brake valve, have been determined and decided upon after due deliberation and full consideration of the requirements of service. The fact that a 50-car freight train, running at a speed of 30 miles per hour, has been stopped in half its length, by a continuous service application, and a 5-car passenger train, running at the same speed, was likewise stopped in 335 feet, should, we believe, be sufficient evidence that the service application has not been sacrificed in order that an infinitesimal gain may be added to the already quick emergency feature.—Eds.]

Solution to Kilroy's Problem.

Editors:

I send the following solution of Mr. Kilroy's brake leverage problem in the March number of "Locomotive Engineering:"

Let the tension in tie bar between the two brake levers be x.

Then, since pull at each end must be the same, we have a pressure of x pounds in the two pivots, each 8 inches from the brake shoes.

Pull in rod at top of long brake lever $= \frac{8x}{32} = \frac{x}{4}$; of short brake lever $= \frac{8x}{24} = \frac{x}{3}$.

Taking moments about fulcrum, we have $\frac{x}{3}(10) + \frac{x}{4}(8) = 3{,}000\ (16)$, or $x = 9{,}000$ pounds.

Pressure on brake shoe with long lever $= 9{,}000 + \frac{9000\ (8)}{32} = 11{,}250$ pounds; on the shoe with short lever $= 9{,}000 + \frac{9000\ (8)}{24} = 12{,}000$ pounds.

Tension in pull rod to long lever $= \frac{9000\ (8)}{32} = 2{,}250$ pounds; in pull rod to short lever $= \frac{9000\ (8)}{24} = 3{,}000$ pounds.

H. M. CRANE.

Boston, Mass.

Answer to Thrall's Problem.

Editors:

The feather or dowel had been lost or removed from the brake-valve handle, which allowed the handle to be put on the rotary key, so that when the handle was in release position the rotary valve was in emergency position, thus cutting off all communication between the main reservoir and train line. There was no steam on the engine at the time repairs were made, and the test which should have followed was neglected.

Plattsmouth, Neb. E. B. THRALL.

[R. E. State, of the Big Four Railway, at Bellefontaine, O., and Geo. D. Boam, Chicago, Ill., send correct solutions of this problem.—Eds.]

QUESTIONS AND ANSWERS

On Air-Brake Subjects.

(22) H. L. K., Dayton, O., writes:

In Question No. 2 in January number of "Locomotive Engineering" you say: "Charge the auxiliary reservoir and then cut out the brake at the cock in the cross-over pipe," etc. Please explain how the brake could set after it has been cut out. A.—Although the brake is cut out from the main train pipe, yet train-pipe pressure is had between cut-out cock and triple-valve piston, and any reduction therein would set the brake the same as if the cut-out cock was open and a reduction was made in the main pipe.

(23) J. C., North Bend, B. C., asks:

For what purpose is the short groove in the seat of the D 8 engineer's brake valve situated between port *e* and feed port *f*? Am I right in supposing that it was intended to empty the equalizing reservoir when handle was placed in emergency position, which it does not do? A.—It is placed there to make the dividing line between the full release position and running position as narrow as possible, thereby preventing a lap between these two positions if the handle were carelessly left at an intermediate point between these two positions.

(24) C. H. W., Frankfort, N. Y., asks:

Why is the air cylinder of an air pump lagged? It don't seem to me to be the proper idea. A.—Mainly to preserve the symmetry of the pump, that it may be in keeping with the remainder of the locomotive. A jacketed steam cylinder and a bare air cylinder would be quite unattractive looking. While the principle of jacketing the air cylinder may seem improper from a mechanical standpoint, yet it is believed that no considerable loss is had from so doing, as the pressure the pump works against is moderately low. No doubt the temperature of the air delivered to the main reservoir would be lower if the jacket were removed, but the heating of pumps is believed to be more often due to the wear of the air cylinder and poor fitting packing rings than the heat retained by the use of lagging.

(25) A. L., Grand Rapids, Mich., writes:

Will you kindly give us a decision, through the columns of "Locomotive Engineering," on a question which we have been discussing considerably, and which is as follows: A train consisting of forty loaded and empty cars, equaling 900 tons. On this train there are brakes on ten loaded cars of 340 tons weight. Another train consisting of the same number of cars, and the same tonnage, has brakes on ten empty cars, equaling 140 tons. With the brakes properly adjusted, and all other conditions being equal, which train will make the quicker stop? A.—Theoretically, the first train will have the very slight advantage on account of having the retarding power applied to the greater proportion of the gross tonnage. The advantage mentioned is gained during the application of the brakes on the ten cars, which is almost infinitesimal. A greater variation in distance would probably be had from different stops of the same train, than between these two.

(26) W. W. P., Newark, O., writes:

1. Why is opening, where equalizing reservoir joins D 8 brake valve by pipe at "T" made so small? 2. After service application has been started is it possible to obtain the emergency, and if so, up to what point? 3. Referring to the 8-inch pump, what is the use of the small port extending from near the top of the reversing piston chamber down to the opening through which the reversing piston works through? 4. Will you please give rule to find at what pressure air will equalize when allowed to freely expand from a cylinder of specified size into another cylinder of different capacity? A.—1. To restrict the passage of air into the equalizing reservoir when recharging, thereby assisting to hold down the equalizing piston which has a tendency to rise, owing to the greater freedom with which the air admitted from the main drum will pass to its under side. 2 See answer to Question 36 in December number. 3. To drain the condensation from the top of reversing piston, and also furnish a water-tight packing for the piston rod, which prevents it from wearing rapidly. 4. See answer to "C. F. S." in this issue.

(27) J. A. W., Marshalltown, Ia., writes:

Will you please inform me where the trouble lay in the following two cases, which were overcome without knowing the true cause: 1. What is the cause of an air pump giving short, quick, jerky strokes when the reversing rod is perfectly straight? 2. A pump, after being given a thorough overhauling, and receiving new bushings, valves, rings, etc., refuses to start. Everything seems to work perfectly free and easy. A.—1. Insufficient steam pressure to hold the reversing slide valve to its seat. Condensation and leakage past worn parts will cause it. When the pump is first started, and when the governor is beginning to shut off steam, these jerky strokes are liable to occur with almost any pump after being in service some little time. Opening the pump throttle a little will sometimes stop it. 2. With the scarcity of data furnished it is difficult to say. Would suggest that you examine the port from the main-valve chamber to the reversing slide-valve chamber; also the main-valve stop pin, and the lengths of the other valves, etc., in the steam end of the pump. Possibly some foreign substance prevents full travel of one of the valves.

(28) A. B. C., McGregor, Ia., asks:

Where does the triple valve piston remain after making a 10-pound service reduction, and engineers' valve is placed on lap position? In a train having twelve head cars equipped with quick action triple valves going down a heavy grade, the retaining valves on the six first cars are turned up and retain a pressure of fifteen pounds each after the brakes have been fully applied and then released. After all auxiliary reservoirs have been fully recharged a second application is made. Would the six first cars with retainers turned up be exerting a greater braking power than the second six, and if so, how much more? A.—1. On lap. In other words, the slide valve stands with the graduating port in register with the cylinder port, and the graduating valve is seated; thus closing the passage through the slide valve. All ports are covered. 2. The six head brakes would be exerting greater power than the other six. On the second application, after a five pound reduction, assuming that all cars have their piston travel adjusted at seven inches, a five pound reduction would give approximately on the head and rear cars respectively, 35 and 5 pounds; another five pound reduction would give about 50 and 30; another five pound reduction would give 52 and 50, and the fourth five pound reduction would give about 52 and 50 pounds.

(29) C. F. S., Sioux Falls, S. D., asks:

Will you please give in next issue of "Locomotive Engineering" a rule for finding at what pressures the auxiliary reservoir and train-line pressure will equalize after service and emergency application of the brakes? A.—The Boyle or Marriotte law, which says that the pressure varies inversely as the volume, is about the best rule applicable in this case, but the result obtained from it, as well as from other formulas, does not agree exactly with actual practice, because the changes in temperatures are not considered. For your own use, the following would perhaps be most suitable. Multiply the capacity of the auxiliary reservoir in cubic inches by 85 pounds (70 pounds train-line pressure plus 15 pounds atmospheric pressure), and divide the product by the capacity of the auxiliary reservoir and brake cylinder, and the quotient will be, approximately, the pressure plus 15 pounds atmospheric pressure in the brake cylinder after a full service application. Example: Capacity of freight auxiliary reservoir = 1,625 cubic inches. Capacity of 8-inch brake cylinder at 8-inch stroke $= 8 \times 8 \times .7854 \times 8 = 400$ cubic inches. $1625 \times 85 = 138125 \div 2{,}025 = 68 - 15 = 53$ pounds. No formula for computing the pressures after an emergency application can be given, because of the numerous and conflicting variables involved.

(30) R. P. S., Waycross, Ga., writes:

Please explain why, in handling the D 8 engineer's brake valve, the following takes place: With the handle in running position, we pump pressure of 90 pounds in the main reservoir and 70 pounds in the train line, and governor stops. Placing handle in full release position, the black pointer, which registers train-line pressure, will register same as main-drum pressure. Now, in returning the valve handle to running position, the black hand will fall back to 70 pounds and start air pump. The black pointer falling, shows an escape of pressure in train line. Where does the air escape, and where does it go to? A.—In placing valve handle in full release position the main-reservoir and train-line pressures equalize, as you doubtless know; consequently, both pointers will register alike, and the governor, which is connected to train-line pressure will stop. If the handle be returned to running position immediately after the pointers register alike, the fall of the black pointer will be quite rapid, and shows that it is caused by the auxiliary reservoirs drawing the amount from the train pipe through the triple-valve feed grooves. If the handle remains in full release position some considerable time before it is returned to running position, the fall of the black pointer will be slower, and is due to leaks in the train line, which will probably cause brakes to creep on. Look for leaks in train line, equalizing reservoir to brake valve, pump governor, and all of their connections. The pump will start again when train-line pressure is reduced to the point where it is set for.

(31) J. H. D., St. Paul, Minn., writes:

1. In his cut of tender-brake gear in February number of "Locomotive Engineering," Conger says that the leverage is 4.8 to 1. What does that mean? 2. Assuming that the lever is 24 inches long, with the fulcrum point at 6 inches, all I can make out of it is a pull of 3,750 pounds on the short arm when a force of 1,250 pounds is exerted at the top end of long arm. Where am I wrong? 3. What does he mean by 100 per cent. brake power? A.—It means that the brake-beam levers are so proportioned that the pressure at the brake shoe will be 4.8 times the pull on the top end of his lever. The proportion of a lever is determined by dividing the distance between force and fulcrum by the distance between fulcrum and weight. In this instance the total length of lever is divided by the short end, and the product is 4.8. 2. Your figures are correct, but it must be remembered that the sum of the forces at the two ends gives the pressure at the middle point of the lever. If your 24 x 6-inch lever be used for a brake-beam lever, it will, according to the preceding answer, be a 4 to 1 lever, and will give 1,250 pounds at the top end, 3,750 pounds at the lower end, and 5,000 pounds, the sum of the two ends, at the brake shoe or middle point. The point of the lever to which the brake beam is attached is always figured as weight. 3. He means that the pressure of the cylinder multiplied through the leverage will give a pressure to the brake shoes equal to the weight of the tender resting on the wheels. The percentage of brake power is determined by dividing the pressure delivered to all of the brake beams by the weight of the vehicle. In this case the combined pressures of the four beams is 24,000 pounds, which divided by the weight of the tender, which is also 24,000 pounds, gives 100 per cent. brake power.

The Wisconsin Central Railroad Co. has filed a sensational answer to the foreclosure suits of the Farmers' Loan & Trust Co. in the Northern Pacific case, claiming that all the mortgages on the Northern Pacific property are null and void, and that the bonds issued under them are virtually worthless. The amount of bonds issued under these mortgages is more than $46,000,000. This claim is based upon the fact that in the act of Congress granting the Northern Pacific its charter, the issuance of mortgages by the company was expressly forbidden unless the consent of Congress had been obtained. The company secured consent to issue construction bonds, but the lien created in this way was shortly after satisfied. All of the mortgages issued since that time are claimed to have been issued without the consent of Congress.

A certain prominent and progressive motive-power official, who was recently asked if he intended sending his air-brake inspector to the coming convention of Air-Brake Men in Boston, replied as follows: "I most certainly do. I would as soon think of not attending the M. C. B. and M. M. conventions myself as to allow him to remain away from the Air-Brake Men's convention. Our freight brakes are in good shape, for we switch all air-braked cars ahead and use them. We will have no air brakes to reclaim. I look to my air-brake man to keep up our present good service, and want him to keep up with the times."

In order that all subscribers may have their paper as near the first of the month as possible, "Locomotive Engineering" will go to press about the 20th hereafter, and, in consequence, all air-brake matter must be in by the 15th.

Several contributions sent us for publication this month have been side-tracked on account of not being accompanied by the name of the sender. Anything worth writing is surely worth signing.

A perusal of the parallel, "Why the Air-Brake Service Is Praised on Some Roads and Complained of on Others," may clear the way to "a higher efficiency in air-brake service."

Some Experiments on the Effect of Tube Expanders versus Rollers on Tube Sheets.

Editors:

In the February number of "Locomotive Engineering," I was much interested in the article on the "Distortion of Flue Sheets," and the experiments made by the Pennsylvania Company at their Juniata shops in locating and determining the expansion and movement of flue sheets when fires were kindled in firebox.

This distortion of flue sheets has engaged our attention at the Dubuque shops of the Chicago, Milwaukee & St. Paul Railway, as, no doubt, it has in every other railroad shop in the country, and it has

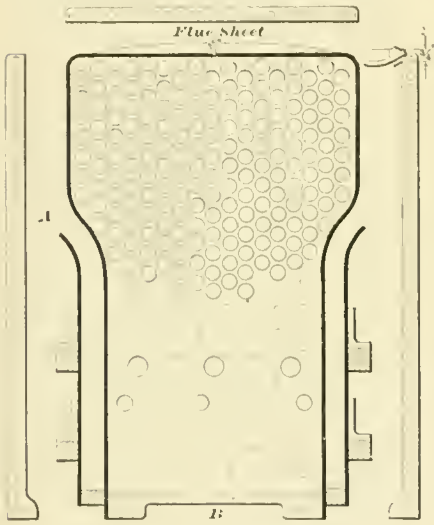


Fig. 2

been the subject of much speculation as to the actual, as well as the theoretical, cause; for the enlarging of the holes in the flue sheets, and especially the great distortion of those holes in the upper portion, and more particularly towards the upper corners, has been variously charged to the continued expansion and contraction, as well as by the use of the flue expanders and flue rollers. Boiler makers differ very much as to the effect produced by either cause.

In June, 1895, two engines were under repairs at these shops; one engine receiving a new flue sheet in firebox, the other a new firebox complete. After the flues in one engine had been set in the usual manner, by the use of a Prosser sectional expander, two flues were removed from the region of the upper corners and the hole in flue sheet calipered. It was then found that the flue holes were $\frac{3}{32}$ inch out of round. Two flues were removed from the flue sheet of the other engine, and the flue holes were found to be $\frac{1}{8}$ inch out of round. This before a fire had been put into the boilers at all. It was then decided to make a careful measurement of the movements of the flue sheet, due to the use of either a Prosser expander or using an ordinary flue roller.

Attached you will please find diagram of the movement of flue sheet of Engine 464. This engine has 175 2¼-inch flues; the firebox entirely new. A center mark was made on flue sheet, and two circles were scribed on flue sheet before flues were expanded. After flues were expanded the same gage was used from the common center, and from this the movement of the flue sheet was located, and the results were somewhat astonishing. The diagram shows more plainly than any words what occurred. It shows that the sheet was expanded between points *A—A* $\frac{5}{16}$ inch; between points *D—D* $\frac{13}{16}$ inch. Flues were expanded with common sectional Prosser expander, and the boiler makers doing the work knew that a record would be taken of the movements of the sheets, and were thus, perhaps, more than ordinarily careful not to expand the

Fig. 3. BEADED FLUE ROLLER USED IN ROLLING FLUES OF ENGINE 780.

flues more than what would be absolutely necessary in order to insure a good job.

A set of flues put into Engine 780; the flues, which were rolled with a common Dudgeon roller, having one of the rolls with a bead (see cut) upon it, so as to expand the flues into the sheet much the same as is done with the use of Prosser expander. The same circles were scribed on the sheet, and the same observation taken of its movement after flues were set as with Engine 464. It was shown that with the use of the roller no perceptible spreading of the flue sheet took place. Boiler makers have maintained that they could enlarge the holes in a flue sheet the same by use of a flue roller as by using an expander. The results show that this is not done. We gave this an ample test by inserting short sections of flues into a discarded flue sheet, the holes of which had been reamed out true; and when the flue was rolled out almost as thin as paper by constant rolling, it was shown that the holes in the flue sheet were not enlarged—also that it is practically impossible to properly expand a flue into a hole by the use of an expander without enlarging the hole in flue sheet.

It might be said that the boiler makers did not use good judgment in driving the tapered pin of the expander; that they drove it harder than necessary. The saying that "What is one man's meat is another man's poison" might hold good here. There is no man can judge the force of the blow that he uses in driving the tapered pin of flue expander. Trials of this show that, whereas one boiler maker expanding a flue into the sheet, the flue will be forced out with a hydraulic pressure of about 3 tons; another man's judgment

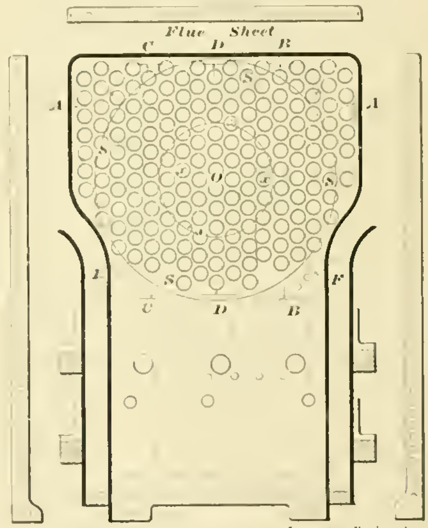


Fig. 1

in expanding another flue will require a force of 7 or 8 tons to remove it. This before the flue has been beaded.

Diagram 2 shows the appearance of the flue sheet taken from the firebox of an old engine. The flue sheet, where riveted to the crown sheet, is pushed upwards ¾ inch, as shown in the sketch. No expansion or contraction will ever produce such an appearance as this. The metal in that sheet had been forced upward by continued repairs, using a flue expander.

Fig. 3 shows the form of beaded roller that was used in setting the flues of Engine 780. It merely takes the place of one of the ordinary flat rollers, so as to produce a bead on inside of flue sheet the same as is done by the Prosser expander.

I am not prepared to argue as to the respective merits of expanding flues or rolling them; each road has its favorite methods. There is, perhaps, enough in this article and the diagrams illustrating to show that it is not altogether contraction and expansion that is the author of many of the evils of fireboxes leaking, but the fault is purely mechanical.

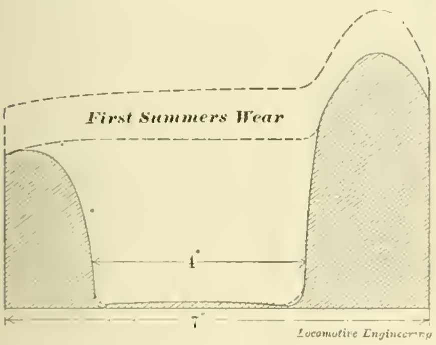
The above experiments were made under the supervision of General Foreman J. C. Miller, who drew the lines on the flue sheets and took all measurements personally.

GEO. H. BROWN.
Dubuque, Ia. Dist. M.M.

Frightful Wear of Tires.

Editors:

In your February number you gave an article on a badly-worn tire and a section of a tire removed from a locomotive belonging to a coal company, which was sent to Altoona for repairs. In 1872 I took charge of a Canadian wooden railway of standard gage, laid with maple rails 4 inches wide on the tread. The tires were 7 inches wide, 3 inches thick, of steel; engine, Rhode Island build; 14 x 24 cylinders; engine employed on constructing the line. The tires required turning after the first summer's work, as shown on the diagram inclosed. At the



close of the second summer's work the tires were completely worn out, as per diagram, and in several places were running on the wheel centers, having nothing to hold the tire together except the flanges on each side. The road was not operated in the winter time, and during the summer it required a very liberal use of sand. A flat four-wheeled car was run ahead of the engine, well supplied with sand and a man on each side to put sand on the rail. The engine only ran about 30,000 miles to wear the tires completely out, when the wheels were sent to the Grand Trunk shops at Montreal to get a new set. I am sorry to say that I neglected to secure a section of the broken tire for exhibition.

JOHN DODSWORTH.
Farnham, P. Que.

First American Contract to Build Locomotives for Russia.

Editors:

In yours of March, pages 255, 256, you state that Ross Winans, the well-known American engineer, obtained the contract to build the railroad rolling stock required for the Russian Railroad. Are you not under a mistake in making this statement? I think you will find that the contract for building the Moscow & St. Petersburg Railroad was given by Major Whistler to Carmichael, Otis & Co., and the building of the rolling stock to Eastwick & Harrison, of Philadelphia, and of Thos. Winans, of Baltimore—thus making the firm of Eastwick, Harrison & Winans. As I was in the employ of Eastwick & Harrison at the time the contract was given, and was offered a position on the staff which they took to Russia, and took the last engine which that firm built in Philadelphia to the Philadelphia & Reading Railway, I feel confident that on further inquiry you will find that my statement is substantially correct. As statements made in your valuable journal will, no doubt, be handed down as authentic, although not perfectly correct, and thus far being misleading, a few words explaining the omission would make the statement correct and maintain your standing as a correct historian.

Farnham, P. Q. JOHN DODSWORTH.

[We gladly publish this correction. The article referred to contained statements which were received in good faith.—Eds.]

A Boy Who Built a Locomotive and the Tools to Make it With.

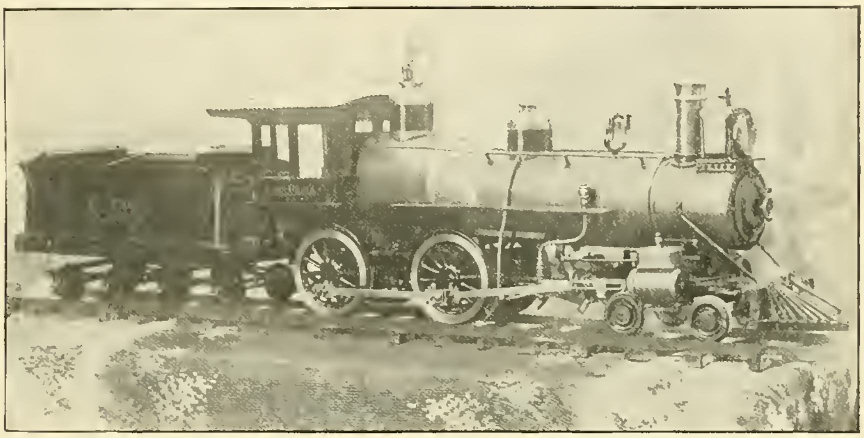
Editors:

In talking about or describing little engines made by young boys, I beg leave to relate the story of Mr. Walter Moyer, of this city. When 16 years old, young Moyer made the locomotive of which I send you a photograph, and which I believe to be the smallest coal-burner in this country. Mr. Moyer's workshop was the back porch in the hotel kept by his father; there he had his foundry, his machine shop and his carpenter shop. He made his own cupola, his own lathe, and the most of his other tools; made his patterns and castings, as well as everything else connected with the engine; and the engine is as complete as any engine ever turned out by the Baldwins or other builders.

Now, young Moyer's father is not a master mechanic, nor his uncle a foreman of a machine shop, where he could go for advice and the use of tools. His own brains have been his tutor during the whole performance. If anyone who is able to do so, would take him in hand and push him along, he would develop into one of this country's brightest master mechanics. Under the head of "Kid Engine Builders," and under the circumstances above related, I claim the world's championship in engine building for young Walter Moyer.

The principal dimensions of this little engine are as follows:

Gage of track, 4½ inches.
Cylinders, ⅞ x 1½ inches.
Steam ports, 1-16 x 1 inch.
Diameter of drivers, 4½ inches.



Diameter of smallest boiler ring, 3¾ inches.
Firebox, 4½ x 2½ inches.
Tubes, 12; ½-inch; 10¾ inches long.
Boiler holds 3 quarts of water.
Tender holds 5 quarts of water.
Weight of engine and tender, ready for the road, 50 pounds.

McPherson, Kan. A. RAMSTROM.

Causes and Cures for Cutting Flanges.

Editors:

I am constrained by knowledge deduced from personal observation to differ materially from the theory advanced by Mr. Smart in the February issue of "Locomotive Engineering," pertaining to the cause of engines cutting the flanges on their driving-wheel tires. The peculiar case of conical wear of the driving-box journal, he cites, is not sufficient criterion to warrant the taking of this instance as a general cause of engines crowding their flanges to the rails. While this peculiar case may have a tendency to produce this effect, it is not indicative of any general principle.

Several cases of cut flanges have come under my notice. By careful and thorough investigation, it has been ascertained that the most prominent causes of these peculiar freaks were due to the engines being out of level on their driving springs. One engine would be cutting a front flange, another cutting the rear flange; this one would be crowding the rail on the right side, that one crowding the rail on the left side. The opposite sides to which these flanges were being cut were found to be low; and by leveling these engines on their driving springs, it would remedy these defects.

When the tread of the tire is excessively worn, it will require additional consideration to get the wheel to travel uniformly on the rails. This may be accomplished by making the sides with cut flanges a trifle lower than the opposite side.

Engines with high cylinder saddle and high centers are more susceptible of throwing their equilibrium outside the line of gravity than engines with low centers. Hence, it will be observed that engines with high centers are the most conspicuous in cutting their flanges.

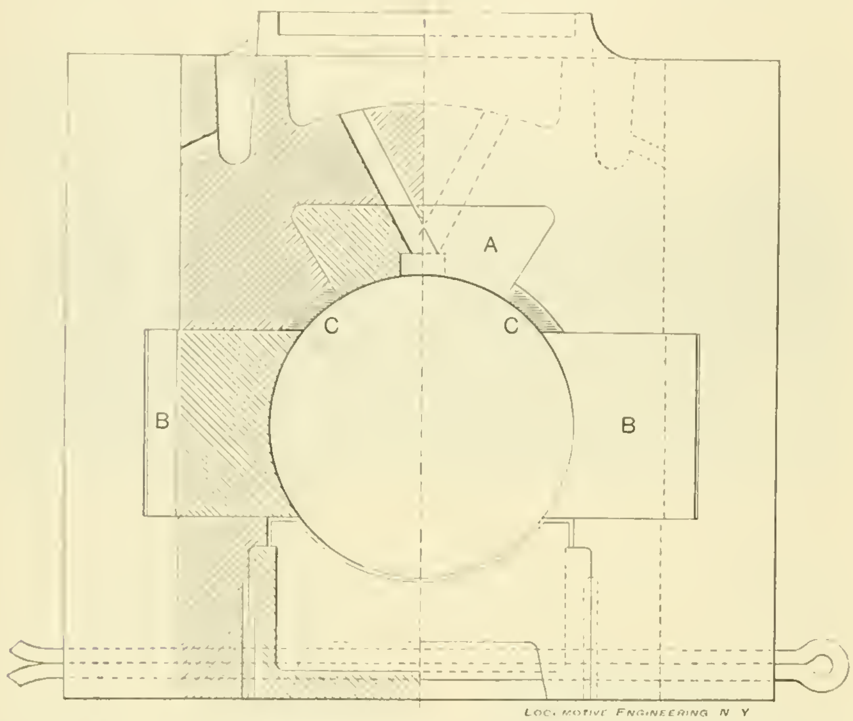
JAMES FRANCIS.
Carbondale, Pa.

Proposed Adjustable Driving Box.

Editors:

Inclosed is a drawing of a driving box which I think will do away with the troubles of loose brasses and pounds to which the driving box is subjected. The cut represents a side view of box, showing the crown brass, which is put in solid, and the two side brasses *B B*, which are adjustable and come through the box and bear against the wedge which adjusts the brasses as the wear comes on them. These brasses have an offset in them, at *B*, where they bear on the wedge to keep them from working out of the side of the box, which is not shown. This shows where the brasses come through the box so the wedge can bear and be adjusted. The flanges may be weak, but the brasses are not supposed to touch them. As the wedge is adjusted, the brass will be moved away from the flange. But, if necessary, the flange can be made heavier to the center line of brass and running out to nothing at each end. As will be seen, the thrust of the forward and back is borne by a solid brass on center line of axle, and these can be kept adjusted to take up wear.

Conroes, Tex. J. W. DEBOLT.



Removing Flues Through the Front Tube Sheet.

Editors:

Noting your comment on the practice of setting flues in locomotive boilers, that copper ferrules are used in the firebox end and none in the front end of boiler in smokebox, and that difficulty is experienced in removing the flues through the small hole of the front flue sheet, and that twisting and hammering is necessary to get the flues out.

Now, is it not a better plan, when flues are to be removed from a boiler, to take out the dry pipe and pass the flues out through the hole in front flue sheet? For this reason: When boiler has run long enough to have flues in such condition that they must be removed on account of scale, should not the inside of the boiler shell be cleaned of the accumulated scale, and not suffer it to remain and thus reduce the amount of space inside the boiler? To this end, I think that the throttle, stand pipe and dry pipe should in all cases be removed so as to admit a man to the interior of boiler, to clean it properly and examine the condition of the seams and shell when the flues are removed. More damage is done to flues a dozen times over in attempting to remove them through their own holes in the front flue sheet, than it would cost to remove the throttle, stand pipe and dry pipe.

GEO. H. BROWN,
Dubuque, Ia. Dist. M.M.

Preventing Trouble with Lubricators.

Editors:

"My lubricator feeds irregularly, or imperfectly," is a complaint that is frequently made by enginemen at terminal stations. Those reports are plainly indicative of strangulation in the small tubes that conduct the oil from the oil cavity to the oil pipes. These are chiefly caused by incrustation, by the lodgement of foreign matter, or by the accumulation of fine particles of sediment in its internal tubes. Incrustation is caused by the ingredients in inferior grades of oil, and, under the circumstances, is unavoidable. In this case, immersing in a vat of strong lye is the most effective remedy.

The accumulation of sediment and foreign matter can, however, be more easily removed. Just before filling your lubricator, open all the valves except the one on the back under the condensing chamber. Then, turn the steam into the lubricator and give the engine simultaneously a little steam, to prevent the steam from the lubricator making its egress through the cylinders, instead of passing down through the feed glasses, past the feed valves, up the tubes in the interior of the lubricator, and escaping through the drain cock.

This method will clear the feed valves and tubes very well. It is essential, to insure the clearing of both tubes, to close the feed valves alternately, observing at the same time that the steam continues to escape freely through the drain cock.

The small orifices in the discharge tubes that conduct the oil from the top of the feed glasses into the oil pipes will occasionally become blocked, but they can be easily opened by disconnecting the oil pipes from the lubricator, and boring those tubes out with a fine steel wire.

It is truly annoying to an engineman, when his mind is freighted with the responsibility incidental to the demands of his hazardous position, to have some imperfection to develop in his machine as he dashes along, unable to give it proper attention; but by subjecting your lubricator to this process of treatment once or twice a week, much vexatious anxiety can be averted and your lubricator will always feed freely.

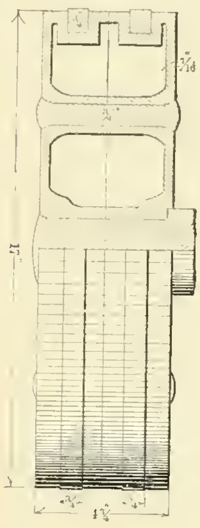
Carbondale, Pa. JAMES FRANCIS.

Metal-working planing machines are in almost all cases the snails of the machine shop. It is a rare thing to find them speeded higher than 15 feet per minute, and we have seen them run at only 9 feet per minute. In our opinion, builders of these tools would vastly improve them if they would arrange them to receive motion from a three-step cone, giving a range of speeds from 16 to 32 feet per minute. Never mind the quick return—sacrifice it if it stands in the way of the proposed improvement.

A Malleable Iron Piston Head.

Editors:

Inclosed please find blueprint of malleable iron piston head that we are now trying on our road. As you will see from the blueprint, these pistons are put up in two sections and riveted together. We have two on trial on Engine No. 9, 17 x 24 inch Baldwin; so far they have been giving good satisfaction. The weight of the piston complete, with 3-inch steel rod and two ¾-inch steam rings, is 175 pounds, as against 265 pounds with cast-iron spider, follower, bull ring and packing rings.



Locomotive Engineering

We ran No. 9 on a heavy freight train for two or three trips, and two trips on through passenger train, Charleston to Augusta, 137 miles. After making these trips we had the pistons removed and weighed, and found that they were still tight and no water had gotten inside.

I would recommend for pistons larger than 17 inches, six hubs for rivets instead of four, as shown in drawing for 17-inch.

Jos. F. Blackwood,
Gen. F'man, S. C. & Ga. Ry.

Charleston, S. C.

Stopping-up of Single versus Double Nozzles.

Editor:

I should like to make one or two remarks from this side of the Atlantic, with regard to your paragraph headed "Position of Exhaust Nozzles," on page 171 of the issue of "Locomotive Engineering" for February.

Where there is incrustation, it is said that "double nozzles can be used with the least obstruction to the escape of steam." It is difficult to see how this can be. The surface of a single large exhaust pipe is considerably less than that of two small ones, and it is the whole of the inner surface that gets coated with incrustation, which after a time must offer a great deal of resistance to the escaping steam. After a pipe has been in service for some time, a vertical section of it presents an outline inside like the teeth of a saw.

Another point I cannot agree with is, that in a single exhaust pipe "the steam from one cylinder shoots over into the other, putting obstructive pressure upon its piston." If it did pop over next door, it would find the folks "not at home," because when the exhaust port of one cylinder is open, the other is closed. In any case, the exhaust is delivered more centrally into the stack with a single pipe, and when it has become foul there is less friction than with two separate ones. This seems also a consideration against the use of annular exhausts, as they must get very choked after a time, though no doubt they save coal when new.

I should think it would be a good thing if exhaust pipes could be arranged on a hinge, so they could be turned down flat and scraped out frequently, as any attempt to clean them in position would send the chips down into the cylinders.

C. E. D. Marshall.

Hassocks, Sussex, Eng.

Boiler Inspection at Reading.

On the Philadelphia & Reading they have in operation a system of boiler inspection which has put an end to accidents to locomotive boilers, that were very common a few years ago. They inspect all staybolts every month, and every three months the dome cap and stand pipe are removed, and the inside of the boiler inspected as closely as circumstances will permit. Every time the flues are removed the inside of the boiler receives a thorough examination. A hydraulic test with hot water is made every three months.

What appears to us the most important feature of the boiler inspections, is the careful method of selecting staybolt inspectors. When a boiler comes into the shops at Reading which is considered a good subject for testing the skill of boiler inspectors, the inspectors are called in, and every man is required to test all the staybolts and report on those he considers broken. The report of every man is compared with that of the general inspector. If anyone displays want of skill he is sent to other work. The general inspector's report is verified by the staybolts when the firebox is removed, and is generally found to be correct.

A writer in "Engineering," discussing the live subject of the metric system, says that the Americans adhere closely to the British weights and measures. As far as we are aware, there is no British measure used in the United States.

The Rand Drill Co. report the sale of six compressors to the A., T. & S. F. Ry. for the different shops along their line. This makes ten railway shops that have been fitted up by the Rand Drill Co. during the month of February.

We now have Mr. Brown's description of his "Discipline Without Suspension" in pamphlet form; price ten cents each, fifteen for one dollar.

The "Signal" articles are completed in this number—they will be issued in book form at once.

PERSONAL.

Mr. De Courcy May has been appointed general manager of the Dickson Manufacturing Co., of Scranton, Pa.

Mr. W. H. Woodin has been elected vice-president of the Jackson & Woodin Manufacturing Co., of Berwick.

Mr. T. E. Cramer has been appointed master mechanic of the Great Northern, with headquarters at Barnesville, Minn.

Mr. Geo. Burns, assistant to the general manager of the Queen & Crescent, has been appointed fuel agent of the Wabash.

Mr. Robert L. Harris has been appointed chief engineer of the South Shore Railway, with headquarters at Yarmouth, Nova Scotia.

Mr. D. M. King, the very able traveling engineer of the Seaboard Air Line, has been chosen an alderman of the city of Raleigh, N. C.

Mr. F. G. Wheeler has been appointed purchasing agent of the Oregon Railway & Navigation Company, with office at Portland, Ore.

Mr. R. Atkinson, who has been acting mechanical superintendent of the Canadian Pacific, has been made mechanical superintendent.

Mr. John K. Cowen, president, and Mr. Oscar G. Murray, first vice-president of the Baltimore & Ohio, have been appointed receivers of that road.

Mr. A. G. Browne has been appointed assistant traffic manager of the Richelieu & Ontario Navigation Co., with headquarters at Montreal, Quebec.

Mr. Joseph Clough has been appointed foreman of the St. Louis, Keokuk & Northwestern at St. Louis, Mo., to succeed Mr. C. E. Lamb, promoted.

Mr. J. A. Gordon, trainmaster of the Cincinnati division Cincinnati, Hamilton & Dayton, has been appointed superintendent of the Wellston division.

Mr. J. N. Wilbur, division master mechanic of the Burlington lines in Missouri at Brookfield, Mo., has been appointed master mechanic at Hannibal, Mo.

Mr. E. L. Brown, heretofore master of trains of the St. Paul & Duluth, has been appointed superintendent of that road, with headquarters at St. Paul, Minn.

Mr. R. B. Turner, division superintendent Cincinnati, Hamilton & Dayton, has been appointed general superintendent, succeeding Mr. Waldo, promoted.

Mr. S. B. Floeter, superintendent of the Wellston division Cincinnati, Hamilton & Dayton, has been transferred to the D. & M. division, with offices at Lima, O.

Mr. Merl Middleton has resigned the position of Western manager for the Safety Car Heating & Lighting Co., to accept a position with the Standard Steel Co., Philadelphia.

Mr. J. B. Michael, the genial master mechanic of the Southern Railway at Knoxville, Tenn., has become tired of hearing his friends asking, "Why don't you get married?"

Mr. T. E. Adams, master mechanic of the Northern division of the Great Northern, has been appointed superintendent of the Dakota division, with headquarters at Grand Forks, N. D.

Mr. Joseph W. Sherwood has been appointed superintendent of the Toledo, St. Louis & Kansas City, with headquarters at Frankfort, Ind. He was formerly superintendent of the Big Four.

Mr. R. Harding, superintendent of the Dakota division of the Great Northern, has been promoted to be general superintendent of the Western district, with headquarters at Spokane, Wash.

Labor Commissioner Lacy, of Raleigh, N. C., who was previously a very popular locomotive engineer, is going into the banking business, and has resigned the position of labor commissioner.

Mr. Joseph Richardson, foreman of locomotive repairs of the Kansas City, St. Joseph & Council Bluffs at Kansas City, Mo., has had his jurisdiction extended over the Hannibal & St. Joseph.

Mr. C. E. Lamb, foreman of the St. Louis, Keokuk & Northwestern at St. Louis, Mo., has been appointed division master mechanic at Brookfield, Mo., to succeed Mr. J. N. Wilbur, transferred.

Mr. J. A. Fickinger, formerly chief engineer of the West Virginia & Pittsburgh, has been appointed general manager of the Monongahela River Railroad, with headquarters at Monongahela, W. Va.

Two mechanical engineers in the service of the Government of Japan are visiting this country inspecting our railroad machinery. It is reported that they may place orders for locomotives and machine tools.

Mr. H. D. Titus, superintendent of the Auburn division of the Lehigh Valley at Auburn, N. Y., has had his jurisdiction extended over the Elmira, Cortland & Northern, which has just been acquired by the Lehigh Valley.

Mr. H. P. Greenough has been appointed superintendent of the Rock Island & Peoria, with headquarters at Rock Island, Ill., in place of Mr. H. B. Sudlow, resigned. He has heretofore been superintendent of telegraph.

Mr. C. G. Waldo has been appointed general manager Cincinnati, Hamilton & Dayton, to succeed Mr. W. M. Greene, resigned. Mr. Waldo has for several years been general superintendent. He was formerly purchasing agent of the same road.

Mr. A. C. Michaelis has been appointed general manager of the Guatemala Railway. He was formerly general freight and passenger agent of the Mexican Central, and held for some years an important position on the International & Great Northern at St. Louis, Mo.

Mr. T. L. Chapman, who was for years superintendent of motive power of the Chesapeake & Ohio, has been appointed assistant to Mr. W. H. Thomas, superintendent of motive power of the Southern Railway. Mr. Chapman will attend to the office work of the mechanical department.

Mr. P. S. Blodgett has been promoted to be general superintendent of the Lake Shore & Michigan Southern, to succeed Mr. W. H. Canniff, general manager. Mr. Blodgett rose on the Lake Shore through the freight department to be superintendent, and from that position went gradually to that which he now occupies.

Mr. W. A. Mills, heretofore assistant to the president of the Columbus, Hocking Valley & Toledo, has been appointed general manager of that road, with headquarters at Toledo, O. Mr. Mills has been assistant to the president for two years, and from September 1, 1881, to February 22, 1893, was general freight agent.

Mr. F. A. Chase, master mechanic of the Kansas City, St. Joseph & Council Bluffs and Hannibal & St. Joseph at St. Joseph, Mo., has been appointed general master mechanic of those roads and the St. Louis, Keokuk & Northwestern and Chicago, Burlington & Kansas City roads, comprising the Missouri lines of the Burlington system, with headquarters at St. Joseph.

Mathew Dodd, one of the best-known engineers in the South, having been for twenty years on the Seaboard Air Line, was shot and killed by a negro tramp whom Dodd had ordered off his engine, on February 20th. Mr. Dodd was a progressive man and has served the Seaboard Air Line as traveling engineer and master mechanic. His murderer was hanged on March 17th.

George Stichter, one of the best-known engineers on the D., L. & W. road, has been promoted to the general foremanship of the Hoboken, N. J., terminal. George has pulled one train, the Dover Express, day in and day out, for twenty-four years, and on the day of his promotion the commuters who have been riding behind him regularly made him a present of a handsome gold watch, a Bible and ten dollars in money. George is now well fixed.

Mr. Wm. H. Canniff, who has been for the past four years general superintendent of the Lake Shore & Michigan Southern, has been promoted to position of general manager. Mr. Canniff entered the service of the company in 1863 as night watchman on what was then an independent road, but is now part of the Lake Shore. Two years afterward he was made station master, and held similar positions of increasing importance till 1879, when he was made track master. From that he rose to be assistant superintendent and general superintendent. He is an excellent railroad man, a good executive officer, and highly popular with all those he comes in contact with.

Mr. Wm. M. Green has been appointed general manager of the Baltimore & Ohio. Mr. Green is the son of a rich railroad manager, and entered railway service, at the age of fifteen, as a clerk on the Columbus & Hocking Valley Railroad. He rose very rapidly to be general manager of the Big Four before that road came under the Vanderbilt control. Of late he has been general manager of the Cincinnati, Hamilton & Dayton. Although most of his experience has been in office work, he has made himself quite familiar with all departments of railroad operating, and is regarded as a particularly able man in his line. He is only thirty-seven years old—a very young man to hold such an important position.

Mr. W. G. Wattson, superintendent of the Hudson River division of the West Shore road, and secretary of the New York Railroad Club, was attacked in his office, on March 7th, by a discharged detective of the road, who shot him twice, once in the shoulder and again in the abdomen, inflicting injuries from which the victim died on the 10th. It is to be hoped that such a dastardly crime will be promptly and severely punished. Mr. Wattson only obeyed instructions in dismissing the man for drunkenness, and stated that he had saved him from discharge before. Men who shoot down employers for discharging them, and girls for refusing to marry them, should be put, along with mad dogs and rattlesnakes, where they can do no more harm. Mr. Wattson was the son of a clergyman, and was born in Maryland forty-two years ago. He began railroad service as a telegraph operator, then was station agent and train dispatcher on roads in Pennsylvania. He went to the West Shore in 1883, and was for several years car accountant before being made superintendent.

Tables showing the speed in feet per minute at which metals can be most economically worked, are a great convenience in the shop, if they do nothing else than stand as a rebuke to the slow-speed and fine-feed man who insists that "we didn't run 'em up so where I served my time." Coarse feed and a speed that is just within the safe side of drawing the temper of the cutting edge of tool, can be given as a general proposition, and a safe one, for all metal-working machine tools.

EQUIPMENT NOTES.

The Mexican Central have ordered ten engines from Rhode Island.

The Seaboard Air Line is about to order fourteen 8 wheel engines.

It is said that the Lehigh Valley are preparing to receive bids for 3,000 cars.

The Central Vermont are said to be in the market for ten or twelve locomotives.

The Delaware, Lackawanna & Western are reported to be in the market for ten locomotives.

It is said that the New York, New Haven & Hartford contemplate ordering forty passenger and freight locomotives.

The Delaware, Lackawanna & Western have placed an order for one thousand cars with the Jackson & Woodin Mfg. Co.

The West Shore are in the market for about 250 cars in small lots, mostly to fill up blank numbers. They will be box and coal cars.

It is said that the Mexico, Cuernavaca & Pacific Co. are about to place orders for the entire rolling-stock equipment and shop machinery for the road.

Negotiations between the General Electric and the Westinghouse Electric Companies have resulted in an arrangement by which both companies will work in harmony.

The Philadelphia & Reading have placed an order for 525 cars with the Union Car Co., and 500 cars with the Lebanon Car Works. All are coal cars except twenty-five refrigerators, which went to the Union Car Co.

The Norfolk & Western have leased from the Railroad Equipment Co., of New York, eight consolidation engines—six of them compound and two simple—built for the Toledo, Ann Arbor & Michigan by the Cooke Locomotive Works.

The Wheeling & Lake Erie have placed an order for twelve locomotives with the Cooke Locomotive Works. Reports were current that the Wheeling & Lake Erie were about to order 1,000 cars, but we understand that the order is not to be given, and that the company intend devoting the money to putting the cars they have in first-class shape.

The Canadian Pacific, says the "Railroad Gazette," has under consideration the building of a large engine for service on heavy grades on Rocky Mountain division, with 20 x 26-inch cylinder and 48-inch driving wheels; also ten heavy switching engines, with cylinders 18 x 24 inches and driving wheels 51 inches diameter. The engines will probably be built in the company's shop.

Baldwin's people have built a second single-driver passenger engine for the Philadelphia & Reading, and the two engines are now employed pulling the fastest trains between Jersey City and Philadelphia. The same builders have just finished two heavy eight-wheel passenger engines for the same road, which will be employed on the fast train service between Philadelphia and Atlantic City.

The Brooks Locomotive Works are building three ten-wheelers for the Ohio River Railroad, two consolidations for the Buffalo & St. Mary's River Railroad, two ten-wheelers and one mastodon with cylinders 21 x 26 for the Adirondacks & St. Lawrence. It is said that Dr. Webb placed the orders for his road on account of the great record made by the Brooks engine when pulling his special train.

The great increase in the volume of business transacted at the Boston city ticket office of the Boston & Maine Railroad has necessitated an enlargement of quarters, and after February 1st the commodious offices at 322 Washington street, at the corner of Milk street and opposite the old South Church, will be occupied as its city ticket office. The location is the one for a long while used by the N. Y. & N. E. R.R., but the renovation which has been going on for the past month has greatly transformed its appearance. The alterations and additions that have been made will now make the office of the Boston & Maine system the largest and most convenient in the city. The appointments are of the latest and most improved order, and are especially designed to facilitate and expedite the prompt transaction of the business demands of the many patrons of the road.

President Ripley, of the Santa Fé system, has done a very popular thing by giving orders that all the reading-rooms along the road shall be reopened. The most unpopular thing that the late Allen Manville did on the Santa Fé was the closing of these rooms, which had been opened for the amusement and edification of the employés. It was done to save a trifling expense, and it raised so much dissatisfaction that we feel certain that the movement cost ten times what the saving amounted to. President Ripley is doing all in his power to cut all unnecessary expenses, but he has been broad-minded enough to see the advantage of giving the men every opportunity to improve their minds and to have amusements which are beneficial. In giving the order he said: "The company owes this to the men. Those who prefer to improve their minds with good books and papers while off duty will now have an opportunity to do so. The men in many Western towns, where the saloon is often the only resting-place, will, I think, appreciate this move and take advantage of it."

More Information Concerning the Use of Graphite on Locomotive Engines.

In many cases a theory is so well founded that practice readily demonstrates all statements made. This seems to be the case with regard to the statements made about Dixon's Pure Flake Graphite. In practice, it has been found that an engineer with a can of this Graphite in his cab, is insured against the annoying delays and against the worriment which so frequently attend the engineer by the development of a hot pin, or the heating of a driving box, or some other difficulty consequent upon a fast run and a heavy train.

It is well known to railway officials that many articles are offered them which seem thoroughly valuable when in the hands of mechanical experts or the inventor's own representatives. With Dixon's Pure Flake Graphite, however, no skilled representative has been sent out by the Dixon Company to apply it, or even to show any engineer how to apply it. The Dixon Company have simply sent out samples to the engineers, and have said to them, "Here is something which we believe will be useful to you. It is a pure Flake Graphite. It is the best solid lubricant known to science. It is not intended to take the place of engine or valve oils, but to be helpful to those oils and to save oil."

The engineer has been recommended to try it in his engine valves, in cylinders, on his eccentrics and pins, and in his driving boxes, and wherever there seems to be undue friction which oil is not sufficient to overcome.

For a thorough and complete test the engineer has been handed two samples. Both equal in quality, both Pure Flake Graphite, but one more finely pulverized than the other for use in the delicate parts, and for use in polishing the pistons of air brakes, etc.

The Dixon Company have probably received a thousand letters during the past year from locomotive engineers all over the country, and there has not been an exception as yet to the good words for Pure Flake Graphite. The following is a fair sample, and shows not only how satisfactory the Graphite proved, but how careful the engineer has been in making his report:

"I can recommend Dixon's Pure Flake Graphite very highly for hot pins, as we are bothered a great deal with them. The division of the L. V. R.R that I run on is up a long heavy grade for 57 miles. It averages 16¾ feet to the mile. Time is fast and trains are heavy. The first use I put the Flake Graphite to was on a consolidated engine, and the pin was hot enough to fry meat. I simply took the cup out of the strap, and poured the Graphite in the strap hole. Then I put the cup back and filled the cup with engine oil and Graphite, and for 30 miles up hill with stock train I pounded the engine as hard as she would stand, and at the top of the hill found the pin cool.

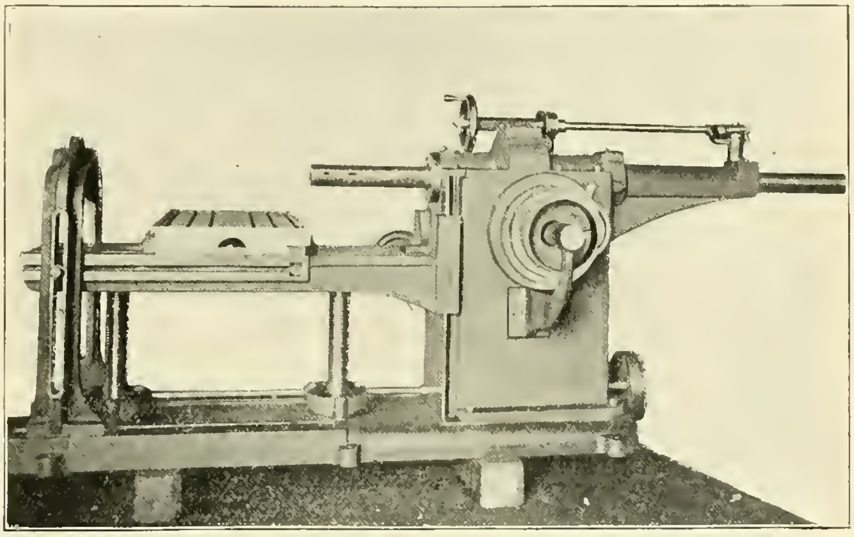
"The second time I used the Flake Graphite, was when I went out with a ten-wheeler. I took an engine that was filed up with bastard-cut file and new brasses, and had never been run to smooth up. The grade all the way from Sayre to Alpine is 29 miles, and we rise 320 feet in that distance. I had 25 large-sized cars of coal in train. The pin ran warm, but not so warm but that I could bear my hand on it. I used the Graphite on it the same as in the first place and went in cool, and coming back with symbol train it did not bother.

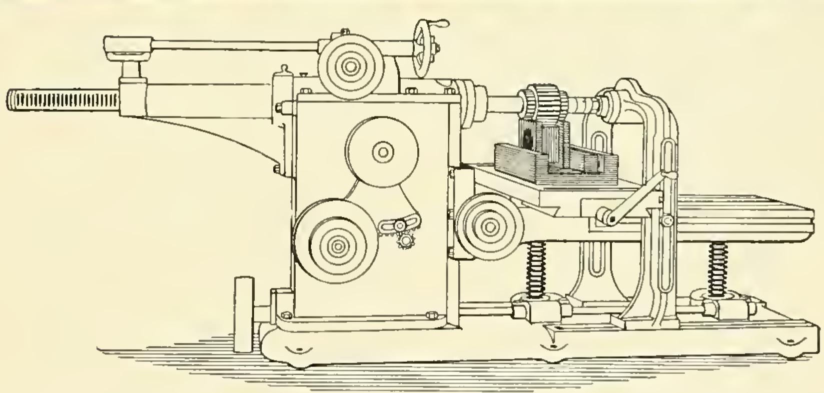
"I have used Dixon's Pure Flake Graphite on valve seats with the best results, and for hot pins it is the best stuff I have used. As I have been running an engine for the past 25 years, I have naturally used nearly everything, and, therefore, am fully competent, I think, to judge of the merits of Dixon's Pure Flake Graphite in comparison with other lubricating materials."

Samples and circulars will be furnished by the Dixon Company, Jersey City, N. J.

Horizontal Boring and Milling Machine.

We illustrate a new combined boring and milling machine, made by the Newton Machine Tool Works, of Philadelphia. There has been a demand in railroad shops especially for a heavy boring machine that could be converted into a milling machine without being complicated or troublesome to change. As a rule, combined machines are very expensive, and some of the important points are sacrificed to produce the combination. As can be seen by the accompanying illustration, this machine can be changed almost instantly from a boring to a milling machine without being at all complicated.





The boring bar of the machine is 4¼ inches in diameter and has an automatic feed of 42 inches. The knee, as shown in illustration, is 6 feet long. The machine will bore to the center of 65 inches over the carriage. While the general outline of the average horizontal boring machine is carried out, the driving and feed mechanism is entirely different. On the sleeve that drives the boring bar is a phosphor-bronze triple-lead worm wheel, and driving this is a hardened steel worm, which has combination thrust collars of phosphor bronze and hardened steel on each end. The driving cone pulleys and back gear are on the side of the worm shaft. By this combination the machine has about double the power of the average horizontal boring machine of the same capacity. The feed pulley on the end of the worm shaft is belted to the cone pulley on the quadrant, and another belt is used on the top cone pulley for feeding the bar. When required to be used as a milling machine, it is only necessary to change the belt on feed cone pulley on the knee and adjust the proper tension with the quadrant.

The Page Woven Wire Fence Co., Adrian, Mich., report a large increase in business over this time a year ago. Some of the first orders received this year were—one of 22 miles from the Maine Central Railway, and another from the Nashville, Chattanooga & St. Louis Railway for car lots. A number of roads are adopting the Page fence as their standard.

The Detroit White Lead Works, Detroit, Mich., suffered a bad loss by fire at their factory on Jones street on February 27th; but as they had a good stock in their warehouse, and at their West Detroit factory, they are in shape to fill orders as before.

E. C. Boyer, of Dayton, O., has issued a new catalogue, in colors, of his lifting jacks—lever and screw. He makes a specialty of jacks for car repair work. Catalogue sent free.

Careless Valve Setting.

Several years ago the Manhattan Elevated Railroad people made a series of experiments with locomotives, using compressed air of high tension. The pressure at the beginning of a round trip was about 600 pounds to the square inch, and the calculation was that there would be a pressure of about 200 pounds in the air tanks when the journey was completed. During the first few trips, the engineer in charge, who was exceedingly well informed on the volume of compressed air necessary to perform certain work, was surprised to discover that the air-tank pressure fell to nearly 120 pounds per square inch. He reviewed his calculations and found nothing wrong, so he applied an indicator to the cylinders of the engine. The diagrams indicated that the valves were not well set, but they were not out sufficiently to cause an irregular exhaust. A careful adjustment was, however, made, and after that there was about 200 pounds pressure in the air tanks at the end of each trip.

Few people would believe that the saving represented in the case mentioned could result from merely adjusting the valves. There is a tendency in some quarters to pay very little attention to valve setting, an approximation to even cut-off being considered sufficient. The engineers who complain when their engines are lame are considered cranks, and their complaints unworthy of notice. On some roads it is rare to hear a freight engine exhausting true, and not a few crack passenger engines sound as if they had lost one exhaust per revolution. There are the best of reasons for believing that a lame engine is wasting steam that might be saved with very little labor in squaring the valves.

A general locomotive foreman of a New England railroad, talking about valve setting during a recent conversation, mentioned an incident of his experience which convinced him that too much care could not be exercised in having the valves of locomotives properly set. "Years ago," he said, "when I first took charge of the division shop, the old engine which I used to run came from the general repair shops after receiving a thorough overhauling. I had run the engine for three years, and knew her to be a free steamer and a fine working engine. When she was sent out after the general repairing, the engineer complained that she would neither steam nor run. I thought it was a case of prejudice, and expected soon to hear no more complaints, but the engineer persisted in saying that the engine was no good; so I went out on the engine and ran her myself during part of a trip. She certainly was a very different engine from what she used to be. She steamed badly, did not run freely and rode hard. I commenced at the smokebox and tried all sorts of adjustments without improvement. The pistons were examined and found all right, and I ascertained that steam was not wasted by too much piston clearance, as I had known to happen before with an engine that got new pistons of reduced thickness.

"There was a young man of the town who was attending a technical school in Boston, and he used to spend a great part of his leisure time about the engine house. He heard the talk about the engine working badly, and wanted to receive permission to apply an indicator to the cylinders. I did not know much about these things and was opposed to it at first, but finally I talked to the master mechanic, and he gave me permission to drill the cylinders and prepare the needed appliances. The student took cards all over the division, and reported that the valves were badly set. That I thought absurd, for I had trammed the valves by the stem marks and they seemed all right, and the engine did not exhaust as if the valves were out. The young fellow spoke, however, so confidently about 'post admission,' 'excessive back pressure,' and other signs of wickedness as revealed by the diagram, that I directed the steam chest covers to be taken off and the valves run over. Then we found that the valves were set about 1/8 inch blind. With a valve travel of 4½ inches and links over 70-inch radius, this made a curious distribution of steam. New valves had been put in with about 3-16 more lap than the old ones had, and by some act of carelessness the valves were set by the old punch marks. When we set the valves properly, the engine worked as well as she ever did."

A current newspaper item says that when M. E. Ingalls became president of the Cheasapeake & Ohio, he decided that the passenger trains should have some distinctive feature that would attract attention. He ordered that all the passenger coaches should be painted orange yellow, with maroon trimmings. The color was popular, and so marked was the appreciation that the fast freight train's cars were also painted an orange hue, and when the stations were rebuilt, remodeled or repainted the orange was used. In time even the switch irons and the signs appeared in that color. It would seem that everything belonging to the road or connected with it had the orange color. The agent at Culloden station had lost a leg and a wooden member was in use. It dawned upon his mind that his leg was not in harmony with the characteristic of the road, and he had the leg painted a gorgeous orange yellow, with the maroon added. All the engines are built as near alike as possible, the size being the only change from the uniformity that prevails on the C. & O.

Standard Gages.

The American Railway Master Mechanics' Association has made several efforts to reform the confusion that existed in wire gages, and they seem to have succeeded at last. In 1882 Mr. R. H. Briggs submitted a report to the association on a standard wire gage, and the discussion that followed showed that the members were very desirous to have one reliable method of measurement. They proposed that the measurement should be in positive parts of an inch, the Brown & Sharpe micrometer gage to be used for measuring. The recommendations were to that effect, but nothing seemed to come of this action.

Mr. Jacob Johann, superintendent of machinery of the Chicago & Alton Railroad, who has always been noted for his progressive tendencies, urged that they adopt a gage similar to what has now been done, but most of the other members seemed to think that measuring by the micrometer would be perfectly sufficient. In connection with the report, Dr. Coleman Sellers, who labored so hard in the interest of uniformity in machine details, wrote: "I think that plates should be rated by their thickness in inches, and the decimal of an inch conforming, as far as possible, to the existing division of the inch, by the binary division; thus, ½ inch, ⅝ inch, ¼-inch plates answer the purpose of the trade and the purpose of calculated strength better than the expression of the thickness of the spaces in a gage, which spaces must be translated into inches.

"Before they can be used in computations, when we get below 1-16 inch, it may be well to have some gage; but even in this case I am inclined to favor the use of the small plate gage, with screw, made by Brown & Sharpe, and the expression of all thickness by the thousandth of an inch. I do not believe in this thing of a gage founded on the French measures, because I hope the craze for that system is on the decrease, and that in America we will never adopt the French system."

The Death-Roll of a Year.

The latest annual report of the Interstate Commerce Commission says:

"During the year ending June 30, 1894, 1,823 railway employés were killed and 23,422 were injured. Compared with the previous year, this shows a decrease of 904 in the number of employés killed and 8,307 in the number of employés injured. One reason for this large decrease in casualty is the reduction, to the extent of 93,394, in the number of employés. No statistics covering the year ending June 30, 1895, have as yet been compiled. It is known, however, that the equipment of cars with handholds and grabirons has been rapidly going on, that the majority of all cars are now so equipped, and that a large number of cars and locomotives have also been fitted with train brakes and automatic couplers during the year. It is believed therefore that the ratio of accidents for the year ending June 30, 1895, will show a still further decrease. For the year ending June 30, 1894, the number of employés for each employé killed was 428, as compared with 320 in the previous year. The number of trainmen employed for one killed was 156, as compared with 115 in the previous year. This a marked improvement, and is believed to be due to the use of better safety equipment.

"The Supreme Court of the United States has held in cases cited that the hazardous character of the business of operating a railroad seems to call for special legislation with respect to railroad corporations, having for its object the protection of their employés as well as the safety of the public, and that it is incumbent upon promoters of works of necessity and utility, where such occupation is attended with danger to life, body or limb, to provide all appliances readily attainable known to science for the prevention of accidents, and that neglect to provide such appliances will be regarded as proof of culpable negligence."

The Nashville, Chattanooga & St. Louis do a very heavy business on what is mostly single track, but they operate the road with extraordinary exemption from serious accidents. They have had only two rear-end collisions in nine years, and one passenger killed in twenty-seven years. These evidences of successful management are due entirely to the admirable system inaugurated by President Thomas. The road is not run under the Brown system, but the officers are unusually generous and fair in the treatment of their men, and all hands seem to feel a personal responsibility in performing their duties faithfully and well.

A new danger to men running locomotives has lately come to notice on Scotch railways. Within a very short time of each other, three engine drivers on Scotch lines have been alarmed by explosions on their locomotives. In each case there was a report in the firebox, followed by the discharge of live coal on the foot-plate to the accompaniment of a disagreeable odor. It seems that the colliers had been careless to a degree in the handling of their supplies of dynamite, and allowed portions of it to get amongst the coal. It must be a rather uncomfortable feeling for men on a locomotive running at high speed to reflect that a few sticks of dynamite may be mixed up with the coal on the tender.

Work on driver and tender brakes that will enable them to "wear out brake shoes" is more to be desired than quick-action triples.

Inspection of Staybolts.

There have been a number of serious explosions of locomotive boilers within the last month, which naturally direct the minds of people interested in the safety of railroad men to the need of constant vigilance to detect the causes which lead to this form of disaster. We do not mean to imply that any of the accidents of recent occurrence might have been prevented by rigid inspection; but we are aware that when a railroad is scarce of motive power, and the engines are in demand to go out again as soon as they reach a terminus, there is a tendency in many quarters to put off the periodical boiler inspection to a time when the engines can be more conveniently spared. The most dangerous parts of a boiler are those secured by staybolts. Breakage of these bolts brings more locomotive boilers to grief than all other causes combined. The most important article in boiler inspection rules should be "Test the staybolts often and carefully." A leading superintendent of motive power, talking to the writer about boiler explosions, said that he had had connection with thirteen exploded boilers, and he could trace the cause of every one to broken staybolts.

There is very great diversity in the times and methods of boiler and staybolt inspection. On some roads the staybolts are inspected every time a boiler is washed out; on others they are inspected every three months; while on not a few roads they are inspected just when the foreman in charge thinks it ought to be done. On some roads, any boiler-maker who can drive a rivet is considered competent to inspect staybolts; on the best managed roads, men who have displayed skill in detecting broken staybolts are appointed inspectors. What is urgently needed are good reliable men for inspectors, and the doing of the work regularly and systematically.

The general offices of the United States Metallic Packing Company have been moved to their works, 427 North Thirteenth street, Philadelphia, Pa., and all communications to this company should be addressed there.

The Q. & C. Co., of Chicago, are now handling the Perfection oil purifier, a device for separating shop oil from the impurities. This device saves much oil that is ordinarily wasted—and thousands of dollars' worth is wasted every month in railroad machine shops.

The Gold storage system of car heating is making rapid progress into use in Great Britain and is very popular.

WHAT YOU WANT TO KNOW.

Questions and Answers.

(27) J. L. G., Azusa, Cal., asks:

What amount of royalty is charged by Wootten firebox or boiler company, or any other such parties, on similar devices? A.—We cannot say, for the figures are inaccessible to us. A letter to the parties controlling these patents will elicit the desired information.

(28) H. T. F., New Kent, Va., asks:

1. Why are some furnaces 32 inches wide and others 42 inches? I refer to shallow fireboxes. A.—There is no good reason for narrowing up a shallow firebox to 32 inches, and many good reasons can be given against such practice. The distance over frames is the governing factor in the design of shallow boxes; and in order to keep the length within reasonable limits, say 10 feet, the width should not be less than 40 inches.

(29) J. N. F., McGraw, Pa., writes:

Please state whether light is blown by the wind in any way, or will it travel in the opposite direction to the wind just as well? A.—Light will travel as well against the wind as with it. The rays sent radiating in straight lines from a luminous body will go in all directions alike, if the body is undisturbed, as in an incandescent lamp, the filament of which is in a vacuum and therefore safe from the action of the wind.

(30) Wm. O., Dayton, O., writes:

I would like to know, through the columns of "Locomotive Engineering," what was, or is, the largest cylinder used on a compound locomotive of to-day, and how much is allowed to extend over the rail. A.—The largest compound cylinder we have a record of is 31 inches diameter and 26 inches stroke, on a 21 x 31 x 26 mogul, built by the Rhode Island Works. We cannot say what the extreme width is on this engine.

(31) J. E. I., Corning, O., writes:

There has been quite a discussion here in regard to valves blowing, and we would like to see it discussed in "Locomotive Engineering." Can an engineman tell which valve is blowing with the Richardson balance valve and single nozzle? If so, how? What I mean is: Can an engineman come into the shop and report the exact valve that is blowing every time? It has been the practice for enginemen to report both valves for examination. A.—This can often be determined by sound when the piston packing rings are tight; but we do not know of any absolutely certain method by which to locate the blow under the conditions you name.

(32) D. A. S., Las Vegas, Mexico, writes:

When an air-pump exhaust pipe is connected to exhaust passages in cylinder saddle, does the steam exhausted from the pump go into the cylinders when engine is running shut off? A.—That is what the effect would be under the conditions you name, but that method of connecting the exhaust pipe from pump to smokebox is one that should not be allowed in practice. The proper way to pipe the exhaust from air pump is to carry the pipe into the smokebox about on a line with the top of exhaust nozzle, to the side of which it should be securely clamped, and the end of pipe turned up under the stack opening.

(33) J. J. C., Clinton, Ill., writes:

In your January issue, under the head of "Notes from the Union Pacific Shops at Omaha," you have given a diagram showing the oval bore of a cylinder, on page 11. Now, as this comes under the subject of front ends, will you kindly inform me what relation exists between size of cylinder and front end, if any? A.—The cylinder with oval bore, referred to, has no connection with the subject of front ends, no more than the sectional elevation of same, just below it on the same page, and the other views of it on page 12. The diagram of the oval shows the construction lines of a cylinder for the sandpapering machine operated by air, the working of which is described on page 10 and illustrated on page 12.

(34) C. H. W., Frankfort, N. Y., asks:

1. Why is a relief valve put on the steam chest of some engines? A.—The function of a relief valve on the steam chest is to admit air to the cylinders when the engine is running with a closed throttle, and thus stop any tendency of admission through the exhaust nozzles, which would occur through the pumping action of the piston when not working steam. 2. Is the relief valve ever put on when the valves are plain, or unbalanced? A.—Yes; the kind of valve it is used with can have no effect on the working of the relief valve; the results obtained are the same with any type of slide valve. 3. Is the relief valve ever left off when balanced valves are used? A.—No; not for that reason alone.

(35) H. R., Oamaru, New Zealand, writes:

As I am a subscriber to your valuable journal, I wish to make a request upon your office. There are a number of opinions as to the merits of the compound engines called the Vauclain, the Brooks and the Richmond. Will you please insert or send special plain and accurate drawings of the three above-named constructions, showing the conveyance of steam from the high-pressure to low-pressure cylinders? A.—We should be glad to extend the favor you ask, but lack of space sufficient to give all the particulars that would render the information of any use to you, will prevent publication of these drawings. This subject is exhaustively treated in Wood's "Compound Locomotives," which can be obtained, post paid, for $3.

(36) W. B. C., Milwaukee, Wis., writes:

We have a dispute here about the deflector plate in extension front of a locomotive. Will you be so kind as to give me your opinion on this, in regard to raising or lowering of the plate, and what effect it will have on the blast? A.—The effect of the deflector plate on the blast is to increase or diminish the flow of the gases through the tubes, as can be readily understood if the deflector is imagined to be removed entirely, in which event there would be no obstruction to the draft. If, on the other hand, the deflector is supposed to extend to the bottom of the smokebox, it is plain that there could be no draft whatever through the tubes. Between these extremes there is a means found that regulates the proper amount of draft through the tubes, and the best position of the plate is one that will clean all the flues and at the same time equalize the "pull" on the fire over the whole grate.

(37) W. H. D., Catskill, N. Y., asks:

Why is the forward-motion eccentric always coupled to the top of link on engines that run on surface roads? A.—The reason for coupling-up, as you state, is that the eccentrics are placed on the axle so as to give the proper movement to the valve, only when the forward-motion eccentric is connected to the top of link. This you can demonstrate for yourself by taking a valve-motion diagram that shows the link in the forward motion, and drawing a line from center of backing eccentric to top of link, and a line also from the center of go-ahead eccentric to bottom of link. You will find the rods are crossed, and in this position the back-up eccentric controls the link and therefore the movement of the valve. Now, by tracing the movement, it will be found that the engine would move in the reverse direction from that intended by the setting of eccentrics, for the reverse lever would be in the forward motion while the valve gear would be in the opposite motion. The top of link is therefore the correct point of connection for the forward-motion eccentric.

(38) R. P., Two Harbors, Minn., writes:

1. I have been firing a consolidation engine with cylinders originally 20 x 24 inches; these cylinders have been bored out until one is 20¼ and the other 20½ inches in diameter. Would not this engine be lame without her valve gear was changed? If so, how would you change it to equalize her? A.—The engine would not be appreciably lame with the small difference in volume of cylinders, which for a cut-off at half-stroke would be 0.04 cubic foot; this would not warrant any change in cut-off to equalize the volume at exhaust. 2. If she was square in the exhaust, would she not be stronger on one side than on the other? A.—Yes, because of a difference of 8 square inches in piston area; and here we have a good reason for equalizing the work done in the cylinders by giving an earlier cut-off to the larger cylinder, or a later one to the smaller cylinder. 3. If the engine was of equal strength, would she not be lame in the exhaust? A.—Yes, because, for reasons given above, it will require practically 0.3 inch difference in the cut-off to equalize the work done; and this will be sufficient to make a distorted exhaust, but not of enough consequence to be considered when weighted against the evils found in the train of a larger cylinder working against a small one.

(39) B. W. R., Chicago, Ill., writes:

A wild train from the South broke in two after passing two reverse curves and around a bluff; flagman was sent back to flag a passenger train which was about due. Flagman went back sufficient distance and stopped passenger train; the passenger train then closed up to rear end of freight train. Flagman was sent back from passenger train to flag a freight which they had passed on a siding a mile or two back. In the meantime, the leading freight train, wishing to back up a few car-lengths to get in on siding, blew three whistles, which were immediately answered by passenger engine, and both trains commenced to back up. The flagman at rear of passenger train took these whistles as a signal for him to come in, which he did; but after passing the first reverse curve, and when nearing the second, he heard the freight train coming. His position was such that he could see neither train, but he immediately started back to flag the freight train; but it came around the curve, close on to him, and passed him and went into rear of passenger train, doing, however, but comparatively little damage. Now the query is: Who was at fault for the freight train getting into the passenger train? The safe way, no doubt, was for flagman to have remained out a sufficient distance until the coming train reached him; but the fact that it is almost the universal custom for flagman to hurry back to his train at the first signal for moving ahead, leaves the query open: Who was to blame? A.—The blame of the accident lay with the man responsible for having one set of signals mean two things. The standard code of train rules gives four long blasts of the whistle for calling in flagman from north or east, and four long and one short blast for calling flagman in from the opposite directions. Had that rule been in use, the accident would not have happened.

(40) W. H. M., Murphysboro, Ill., writes:

Will you kindly inform me how to build a boiler for a small locomotive, the cylinders of which are to be $2\frac{1}{2} \times 3$ inches, and the boiler $7\frac{1}{2}$ inches diameter? The distance between flue sheets is to be $19\frac{1}{2}$ inches, and the firebox $5\frac{1}{2}$ inches wide by $13\frac{1}{2}$ inches long. What I wish to know is, how I can obtain heating surface to supply the two cylinders with steam. A.—This subject of heating surface, and ratio of grate surface to same, is one in which there is a great difference of opinion, but we may closely approach good results by assuming that the total heating surface of boiler in square feet equals the area of one cylinder in square inches multiplied by 6. Numerically expressed, this would read for a 20-inch cylinder: $314.16 \times 6 = 1{,}884.9$ square feet; and this would represent the total heating surface for an engine having cylinders 20 inches in diameter, agreeing closely with engines of that size in service. The area of the heating surface in the tubes can be found by deducting the heating surface of the firebox from the total heating surface required, as found above. Since you have decided upon the grate area, it is only necessary to have a height for the firebox in order to get its heating surface, and this may be taken at $8\frac{1}{2}$ inches for your boiler. The length of flues you have also given, and the diameter to give the surface required can now be calculated. The number of flues, as computed, may be too many to go in the flue sheet and leave the proper amount of space between the flues to give a good circulation to the water; this can be found quicker by laying off the sheet than by calculation for the computed diameter of flue. The union or space between the flues should not be less than $\frac{3}{16}$ inch for this boiler. The height of flue sheet given is for a wagon-top boiler and firebox above the frames.

The Baldwin compound "single" on the Philadelphia & Reading, illustrated in these columns last August, has made such a splendid record in fast passenger service that we understand her double was ordered and built, and is now sharing honors with the "385," which was first put at work.

The Chicago Pneumatic Tool Co., of Chicago, have recently shipped good-sized orders to France, Russia, New Zealand, Australia, Austria and England. It pays to advertise in "Locomotive Engineering."

INDEX TO ADVERTISEMENTS.

Continued on page 353.

INDEX TO ADVERTISERS—Continued.

Buyers' Finding List.

Air Brake Fittings.
Crane Co., Chicago, Ill.
Air Brake Hose.
Boston Belting Co., Boston, Mass.
N. Y. Belting & Packing Co., New York.
Air Brakes.
Westinghouse Air Brake Co., Pittsburg, Pa.
Air Brake Gage.
Utica Steam Gage Co., Utica, N. Y.
Air-Brake Pump Governors.
Foster Engineering Co., Newark, N. J.
Air-Brake Filter.
Von Weisenflue Air-Brake Filter Co., Scranton, Pa.
Air Compressors.
Clayton Air Compressor Works, New York.
Ingersoll-Sergeant Drill Co., N. Y. City.
Norwalk Iron Works Co., South Norwalk, Ct.
Pedrick & Ayer Co., Philadelphia, Pa.
Rand Drill Co., New York.
St. Louis Steam Engine Co., St. Louis, Mo.
Air Drilling Machine.
C. H. Haeseler & Co., Philadelphia, Pa.
Air Hoists.
Pedrick & Ayer Co., Philadelphia, Pa.
Whiting Foundry Equipment Co., Chicago, Ill.
Arch Bars.
Cambria Iron Co., Philadelphia, Pa.
Asbestos.
H. W. Johns Mfg. Co., New York.
Axles.
Cambria Iron Co., Philadelphia, Pa.
Gould Coupler Co., Buffalo, N. Y.
B. M. Jones & Co., Boston, Mass.
Krupp (T. Prosser & Son, New York).
Balanced Slide Valves.
Am. Bal. Slide Valve Co., San Frisco, Cal.
M. C. Hammett, Troy, N. Y.
Bearing Metal.
Ajax Metal Co., Philadelphia, Pa.
Paul S. Reeves, Philadelphia, Pa.
U. S. Metallic Pkg. Co., Philadelphia, Pa.
Bell Ringer.
Trumbull Mfg. Co., Warren, O.
U. S. Metallic Packing Co., Philadelphia, Pa.
Belting.
Boston Belting Co., Boston, Mass.
N. Y. Belting & Packing Co., New York.
Shultz Belting Co., St. Louis, Mo.
Boiler and Firebox Steel.
Shoenberger Steel Co., Pittsburg, Pa.
Boiler Checks—Inside.
Foster Engineering Co., Newark, N. J.
Boilers.
Pittsburg Locomotive Works, Pittsburg, Pa.
Boiler Iron.
Ewald Iron Co., St. Louis, Mo.
Boiler Testers.
Rue Mfg. Co., Philadelphia, Pa.
Boiler Tools.
Richard Dudgeon, New York.
Hilles & Jones Co., Wilmington, Del.
Long & Allstatter Co., Hamilton, O.
Boiler Washers.
Nathan Mfg. Co., New York.
Rue Mfg. Co., Philadelphia, Pa.
Bolt Machinery.
Acme Machinery Co., Cleveland, O.
Bolt Threading Machinery.
Detrick & Harvey Machine Co., Baltimore, Md.
Books.
H. C. Baird & Co., Philadelphia, Pa.
N. W. Henley & Co., New York.
Practical Pub. Co. E. Orange, N. J.
Philadelphia Book Co., Philadelphia, Pa.
Boring and Turning Mills.
Bullard Mch. Tool Co., Bridgeport, Conn.
Brake Adjusters.
Q. & C. Co., Chicago, Ill.
Brake Shoes.
Ramapo Iron Works, Hillburn, N. Y.
Ramapo Wheel & Foundry Co., Ramapo, N. Y.
Brass Castings.
Ajax Metal Co., Inc., Philadelphia, Pa.
Paul S. Reeves, Philadelphia, Pa.
Buffers.
Gould Coupler Co., Buffalo, N. Y.
Bulldozers.
Williams, White & Co., Moline, Ill.
Cab Seats.
Stannard & White, Appleton, Wis.
Cars.
Allison Mfg. Co., Philadelphia, Pa.
Lima Locomotive & Machine Co., Lima, O.
Ramapo Iron Works, Hillburn, N. Y.
Car Couplers.
Gould Coupler Co., Buffalo, N. Y.
McConway & Torley Co., Pittsburg, Pa.
National Malleable Castings Co., Chicago, Ill.
Sams Automatic Coupler Co., Denver, Col.
Shickle, Harrison & Howard Iron Co., St. Louis, Mo.
Smillie Coupler & Mfg. Co., Newark, N. J.
Standard Coupler Co., New York.
Trojan Car Coupler Co., Troy, N. Y.
Car Heating.
William C. Baker, New York.
Gold Car Heating Co., New York.
Safety Car Heating & Ltg. Co., New York.
Car Lighting.
Safety Car Heating & Lighting Co., New York.
Car Paints.
Detroit White Lead Works, Detroit, Mich.

Continued on page 355.

BUYERS' FINDING LIST—*Continued.*

Car Roofing.
P. H. Murphy Mfg. Co., E. St. Louis, Ill.
Standard Paint Co., New York.
Warren Chemical & Mfg. Co., New York.

Car Seats.
Hale & Kilburn Mfg. Co., Philadelphia, Pa.

Car Ventilators.
M. C. Hammett, Troy, N. Y.

Car Wheels.
Boies Steel Wheel Co., Scranton, Pa.
Kalamazoo R. R. Velocipede & Car Co., Kalamazoo, Mich.
Krupp (T. Prosser & Son, New York).
Lima Locomotive & Machine Co., Lima, O.
Ramapo Wheel & Foundry Co., Ramapo, N. Y.
Roberts, Throp & Co., Three Rivers, Mich.
Rood & Brown, Buffalo, N. Y.
Standard Steel Works, Philadelphia, Pa.
Washburn Car Wheel Co., Hartford, Conn.

Cattle Guards.
Q. & C. Co., Chicago, Ill.

Chain Pulley Blocks.
Moore Mfg. & Fdy. Co., Milwaukee, Wis.

Chime Whistles.
Crosby Steam Gage & Valve Co., Boston, Mass.

Clocks.
John J. McGrane, New York.

Coal Handling Machinery.
Link Belt Engineering Co., Philadelphia, Pa.

Coal Chutes.
Williams, White & Co., Moline, Ill.

Correspondence Schools.
Internat'l Corres. Schools Scranton, Pa.
The Scientific Machinist Co., Cleveland, O.

Corundum Wheels.
Sterling Emery Wheel Mfg. Co., Tiffin, O.

Cranes.
Manning, Maxwell & Moore, New York.
Maris Bros., Philadelphia, Pa.
William Sellers & Co., Philadelphia, Pa.
Whiting Foundry Equipment Co., Chicago, Ill.
R. D. Wood & Co., Philadelphia, Pa.

Crank Pin Gages.
M. C. Hammett, Troy, N. Y.

Crank Pins.
Cambria Iron Co., Philadelphia, Pa.
B. M. Jones & Co., Boston, Mass.
Krupp (T. Prosser & Son, New York).

Drills.
Cleveland Twist Drill Co., Cleveland, O.
Standard Tool Co., Cleveland, O.

Drilling Machines
Gould & Eberhardt, Newark, N. J.

Electric Lighting and Power Apparatus.
Westinghouse Elec. & Mfg. Co., Pittsburgh, Pa.

Emery Grinders.
Leland & Faulconer Mfg. Co., Detroit, Mich.

Emery Wheels.
Sterling Emery Wheel Mfg. Co., Tiffin, O.

Enamel.
Detroit White Lead Works, Detroit, Mich.

Engines.
St. Louis Steam Engine Co., St. Louis, Mo.

Engravings.
Bradley & Poates, New York.
Standard Engraving Co., New York.

Exhaust Pipe.
The General Agency Co., New York.

Expanding Mandrel.
Geo. L. Weiss, Cleveland, O.

Files and Rasps.
Nicholson File Co., Providence, R. I.

Filters.
A. Major, New York.

Fire Kindlers.
J. S. Leslie, Paterson, N. J.

Flexible Shaft.
Chicago Flexible Shaft Co., Chicago, Ill.
Stow Mfg. Co., Binghamton, N. Y.
Stow Flexible Shaft Co., Philadelphia, Pa.

Flexible Steam Joint.
Moran Flexible Steam Joint Co., Louisville, Ky.

Flues and Tubes.
Allison Mfg. Co., Philadelphia, Pa.
Tyler Tube & Pipe Co., Washington, Pa.

Forges.
Buffalo Forge Co., Buffalo, N. Y.

Forging Machinery.
Williams, White & Co., Moline, Ill.

Foundry Equipment.
Whiting Foundry Equipment Co., Chicago, Ill.

Frogs and Crossings.
Ramapo Iron Works, Hillburn, N. Y.

Graphite.
Jos. Dixon Crucible Co., Jersey City, N. J.

Hand Cars.
Kalamazoo R. R. Velocipede & Car Co., Kalamazoo, Mich.
Roberts, Throp & Co., Three Rivers, Mich.

Heating System for Shops.
Buffalo Forge Co.
B. F. Sturtevant Co., Boston, Mass.

Hoisting Engines.
Earle C. Bacon, New York.

Hydraulic Tools.
Richard Dudgeon, New York.
Watson & Stillman, New York.
R. D. Wood & Co., Philadelphia, Pa.

Indicators.
Ashcroft Mfg. Co., New York.
Crosby Steam Gage and Valve Co., Boston.

Continued on page 356.

BUYERS' FINDING LIST—*Continued.*

Injectors.
Automatic Injector Co., Cincinnati, O.
Hancock Inspirator Co., Boston, Mass.
Hayden & Derby Mfg. Co., New York.
Nathan Mfg. Co., New York.
Ohio Injector Co., Chicago, Ill.
Rue Mfg. Co., Philadelphia, Pa.
William Sellers & Co., Philadelphia, Pa.

Jacks.
E. C. Boyer, Dayton, O.
Richard Dudgeon, New York.
A. L. Henderer, Wilmington, Del.
A. O. Norton, Boston, Mass.
Watson & Stillman, New York.

Laggings for Locomotives.
Keasbey & Mattison Co., Ambler, Pa.

Locomotives.
Baldwin Locomotive Works, Philadelphia, Pa.
Brooks Locomotive Works, Dunkirk, N. Y.
Cooke Loco. & Machine Co., Paterson, N. J.
Dickson Mfg. Co., Scranton, Pa.
Lima Locomotive & Machine Co., Lima, O.
Pittsburg Locomotive Works, Pittsburg, Pa.
H. K. Porter & Co., Pittsburg, Pa.
R. I. Locomotive Works, Providence, R. I.
Richmond Loco. & Mch. Wks., Richmond, Va.
Rogers Locomotive Works, Paterson, N. J.
Schenectady Loco. Wks., Schenectady, N. Y.

Lubricators
Detroit Lubricator Co., Detroit, Mich.
M. C. Hammett, Troy, N. Y.
Nathan Mfg. Co., New York.

Lubricating Oils
Galena Oil Works, Ltd., Franklin, Pa.
Leonard & Ellis, New York.
Signal Oil Works, Franklin, Pa.

Machine Tools.
Bement, Miles & Co., Philadelphia, Pa.
Bullard Machine Tool Co., Bridgeport, Conn.
Detrick & Harvey Mach. Co., Baltimore, Md.
W. D. Forbes & Co., Hoboken, N. J.
Gould & Eberhardt, Newark, N. J.
Hilles & Jones Co., Wilmington, Del.
Jones & Lamson Machine Co., Springfield, Vt.
Manning, Maxwell & Moore, New York.
National Machinery Co., Tiffin, O.
Newton Machine Tool Wks., Philadelphia, Pa.
Niles Tool Works Co., Hamilton, O.
Geo. Place, New York.
Pratt & Whitney Co., Hartford, Conn.
Prentiss Tool and Supply Co., New York.
William Sellers & Co., Inc., Philadelphia, Pa.

Malleable Iron.
C. E. Rood, Lancaster, N. Y.

Mechanics' Tools
Armstrong Bros. Tool Co., Chicago, Ill.
Keystone Mfg. Co., Buffalo, N. Y.
Chas. A. Strelinger & Co., Detroit, Mich.

Metal Polish.
G. W. Hoffman, Indianapolis, Ind.

Metal Sawing Machines.
Pratt & Whitney Co., Hartford, Conn.
Q. & C. Co., Chicago, Ill.

Milling Machines.
Cincinnati Milling Machine Co., Cincinnati, O.
Pratt & Whiting Co., Hartford, Conn.

Mining Machinery.
Earle C. Bacon, New York.

Molding Machines.
Tabor Mfg. Co., New York City.

Over Clothes.
H. S. Peters, Dover, N. J.

Packing.
Boston Belting Co., Boston, Mass.
Gould Packing Co., East Cambridge, Mass.
H. W. Johns Mfg. Co., New York.
Jenkins Bros., New York.
N. Y. Belting & Packing Co., New York.
U. S. Metallic Packing Co., Philadelphia, Pa.

Paints.
Standard Paint Co., New York.
Detroit White Lead Works, Detroit, Mich.

Patents
John Wedderburn & Co., Washington, D. C.
George P. Whittlesey, Washington, D. C.

Perforated Metal.
Aitchison Perforated Metal Co., Chicago, Ill.
A. J. Beckley & Co., Meriden, Conn.
The Hendrick Mfg. Co., Ltd., Carbondale, Pa.

Photographs.
F. Moore, London, Eng.

Pipe Threading and Cutting Machinery.
Bignall & Keeler Mfg. Co., Edwardsville, Ill.
Armstrong Mfg. Co., Bridgeport, Conn.
D. Saunders' Sons, Yonkers, N. Y.

Pipe Wrench
Sam'l L. Hall's Son, New York.

Piston Rods
Cambria Iron Co., Philadelphia, Pa.
B. M. Jones & Co., Boston, Mass.
Thomas Prosser & Son, New York.

Pneumatic Tools.
Chicago Pneumatic Tool Co., Chicago, Ill.
C. H. Haeseler & Co., Philadelphia, Pa.

Pressed Steel Materials.
Schoen Mfg. Co., Pittsburg, Pa.

Pressure Regulators.
Foster Engineering Co., Newark, N. J.
Newark Regulator Co., Newark, O.

Pump Valves
Boston Belting Co., Boston, Mass.
N. Y. Belting & Packing Co., New York.

Punching and Shearing Machinery.
Hilles & Jones Co., Wilmington, Del.
Long & Allstatter Co., Hamilton, O.
R. D. Wood & Co., Philadelphia, Pa.

Continued on page 357.

BUYERS' FINDING LIST—*Continued.*

Railway Fences.
Page Woven Wire Fence Co., Adrian, Mich.
Railway Gates.
Pneumatic Gate Co., Chicago, Ill.
Standard Ry. Gate Co., Saginaw, Mich.
Retaining Rings
Ramapo Wheel & Foundry Co., Ramapo, N.Y.
Rubber.
Boston Belting Co., Boston, Mass.
N. Y. Belting & Packing Co., New York.
Rust Preventing Compound.
Otto Goetze, New York.
Safety Valves
Ashton Valve Co., Boston, Mass.
Consolidated Valve Co., Bridgeport, Conn.
Crosby Steam Gage & Valve Co., Boston, Mass.
Sanding Apparatus
Henry L. Leach, North Cambridge, Mass.
Sherburne & Co., Boston, Mass.
Shafting
William Sellers & Co., Philadelphia, Pa.
Spark Arrester Plate.
A. J. Beckley & Co., Meriden, Conn.
Hendrick Mfg. Co., Carbondale, Pa.
Springs.
A. French Spring Co., Pittsburg, Pa.
Spring Steel
Thomas Prosser & Son, New York.
Stay-Bolts.
Ewald Iron Co., St. Louis, Mo.
Falls Hollow Stay-Bolt Co., Cuyahoga Falls, O.
B. M. Jones & Co., Boston, Mass.
Steam Gages.
Ashcroft Mfg. Co., New York.
Crosby Steam Gage & Valve Co., Boston.
Utica Steam Gage Co., Utica, N. Y.
Steam Hammers.
Bement, Miles & Co., Philadelphia, Pa.
Steam Hose.
Boston Belting Co., Boston, Mass.
N. Y. Belting & Packing Co., New York.
Steam Pumps.
A. S. Cameron Steam Pump Works, New York.
Steel.
Cambria Iron Co., Philadelphia, Pa.
Ewald Iron Co., St. Louis, Mo.
B. M. Jones & Co., Boston, Mass.
Krupp (T. Prosser & Son, New York).
Latrobe Steel Co., Latrobe, Pa.
Schoen Mfg Co., Pittsburg, Pa.
Shoenberger Steel Co., Pittsburg, Pa.
Steel Tired Wheels.
Boies Steel Wheel Co., Scranton, Pa.
Krupp (T. Prosser & Son, New York).
Ramapo Wheel & Foundry Co., Ramapo, N.Y.
Standard Steel Works, Philadelphia, Pa.
Washburn Car Wheel Co., Hartford, Conn.
Steel Tires.
Latrobe Steel Works, Latrobe, Pa.
Krupp (T. Prosser & Son New York).
Standard Steel Works, Philadelphia, Pa.
Steel Truck Frames.
Fox Solid Pressed Steel Co., Chicago, Ill.
Stocks and Dies.
Armstrong Mfg. Co., Bridgeport, Conn.
Switches.
Ramapo Iron Works, Hillburn, N. Y.
Tie Plates.
Q. & C. Co., Chicago, Ill.
Tires.
Krupp (T. Prosser & Son, New York.)
Latrobe Steel Co., Philadelphia, Pa.
Tool Holders.
Armstrong Bros. Tool Co., Chicago, Ill.
Gould & Eberhardt, Newark, N. J.
Tool Steel
B. M Jones & Co., Boston, Mass.
Tube Expanders.
A. L. Henderer, Wilmington, Del.
Turnbuckles.
Cleveland City Forge & Iron Co., Cleveland, O.
Merrill Bros., Brooklyn, N. Y.
Turret Machines.
Bullard Mch. Tool Co., Bridgeport, Conn.
Jones & Lamson, Springfield, Vt.
Twist Drills.
Cleveland Twist Drill Co., Cleveland, O.
Standard Tool Co., Cleveland, O.
Valves.
Ashton Valve Co., Boston, Mass.
Jenkins Bros., New York.
Ross Valve Co., Troy, N Y.
Valves, Reducing.
Foster Engineering Co., Newark, N. J.
Varnishes.
Detroit White Lead Works, Detroit, Mich.
F. C. Reynolds, New York.
Ventilating Fans.
Buffalo Forge Co.
Vestibules
Gould Coupler Co., Buffalo, N. Y.
Vises.
Bignall & Keeler Mfg. Co., Edwardsville, Ill.
Capital Machine Tool Co., Auburn, N. Y.
Merrill Bros., Brooklyn, N. Y.
Watches.
John J. McGrane, New York.
Welding Compound.
E. G. Newhall & Co., Detroit, Mich.
Wire Fences.
Page Woven Wire Fence Co., Adrian, Mich.
Wood Working Machinery.
J. A. Fay & Co., Cincinnati, O.
Wrought Iron Pipe.
Allison Mfg. Co., Philadelphia, Pa.

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In 2¼ Years.

Is not the Coupler question a very important one, and should it not have your careful study? How much of this money will be wasted by roads which do not get the best?

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THIS is the only single tube "Automatic, or Re-starting," Injector that will start with 25 lbs. of steam and work up to 200 without trouble.

IT is a plain, heavy business machine,—no small priming jets, pipes or valves.

ONLY 24 pieces—less than half the usual number of parts.

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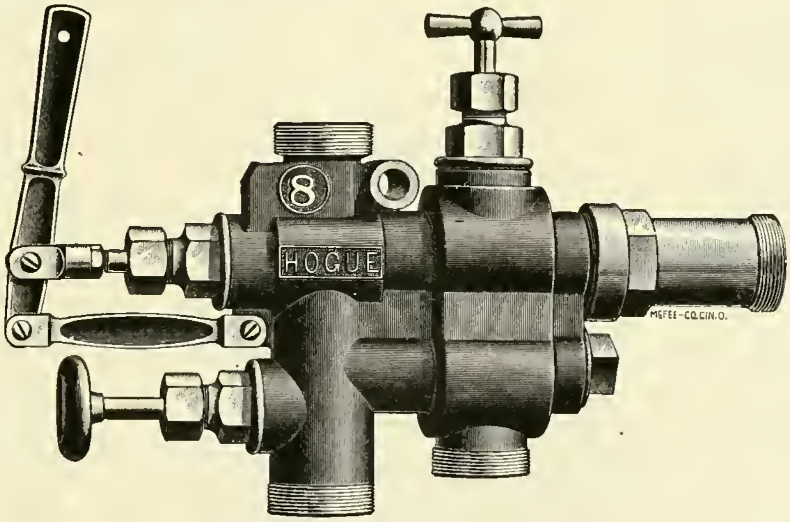

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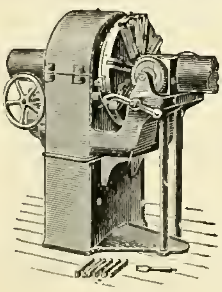
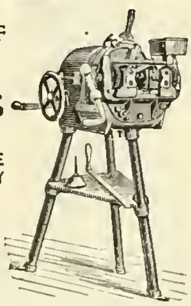


No. 3 Machine.



No. 1 Machine.

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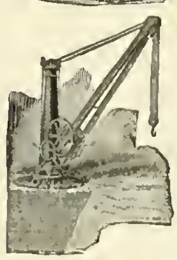

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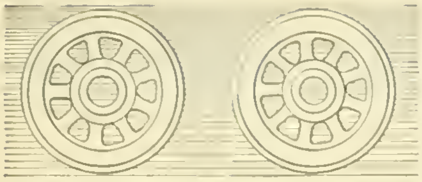

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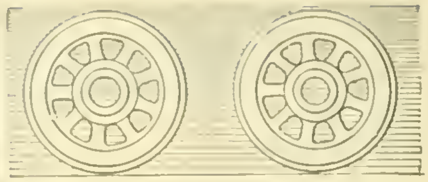

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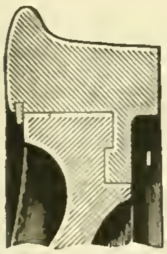

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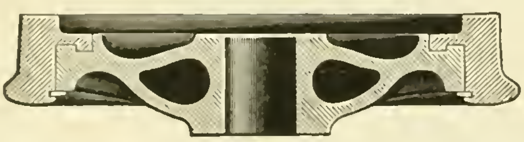

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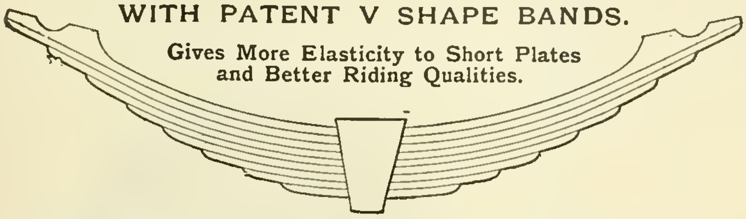

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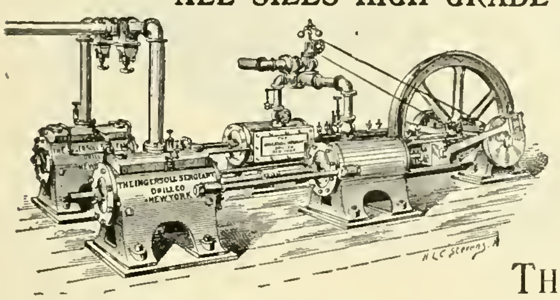

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These cars are the finest that have ever been turned out of the Pullman shops, and are duplicates of the magnificent cars on the New York and Chicago Limited.

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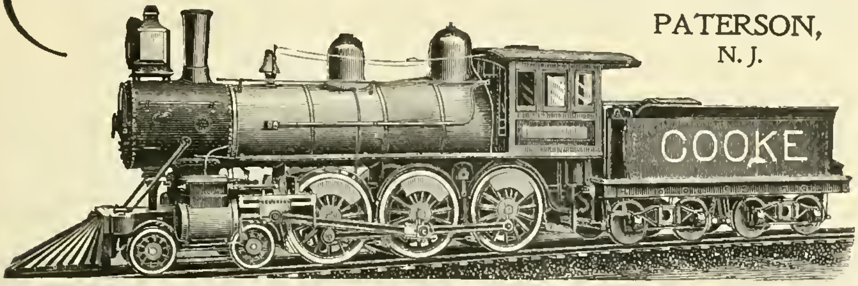

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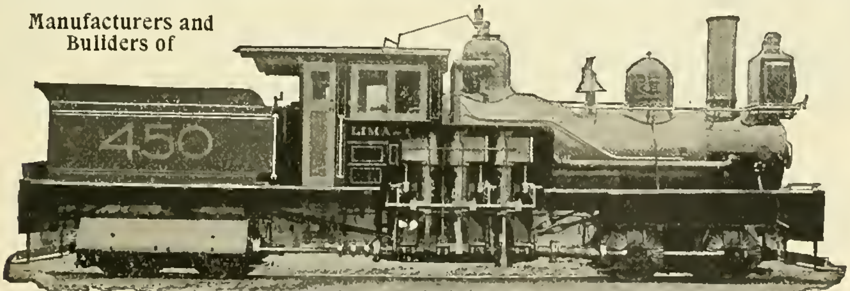

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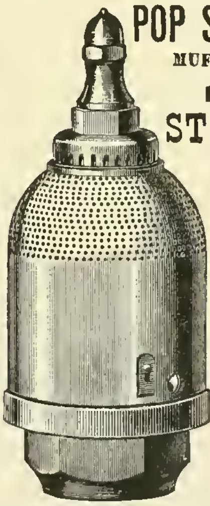

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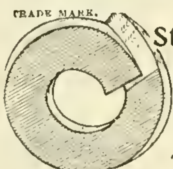

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Steam and Water Packing

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Especially adapted for Locomotives.
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LOCOMOTIVE ENGINEERING
A PRACTICAL JOURNAL of RAILWAY MOTIVE POWER AND ROLLING STOCK.
[Trade-Mark Registered.]
Vol. IX. NEW YORK, MAY, 1896. No. 5.

The "Dunalastair."

The annexed engraving illustrates a new type of locomotive, designed by Mr. John McIntosh, locomotive superintendent of the Caledonian Railway, and built at the company's shops at St. Rollox, Glasgow, Scotland. Mr. McIntosh has sent us a sheet giving leading dimensions, and, writing to us about the engine, says:

"We have just built fifteen engines of this type, and they are now all out of the shops. They are being used for our main-line trains, and working corridor dining expresses between Carlisle and Edinburgh and Glasgow. They have not been built for racing purposes, but merely for overtaking the running of our ordinary heavy express trains; and our experience with them so far has proved that they are very suitable engines for our traffic."

The leading idea of the designer was to produce an engine that would haul the fast heavy passenger trains without double-heading. The dining and "corridor" cars are very heavy vehicles compared to the compartment carriages that are now rapidly falling into disrepute, and powerful engines are required to haul the trains over the steep grades of the Caledonian Railway. The "Dunalastair" has cylinders 18¼ x 26 inches, and two pairs of driving wheels 78 inches diameter on the tread. The working steam pressure is 160 pounds. With a boiler pressure of 160 pounds per square inch, to which the safety valves are set, the engine is capable of developing about 15,000 pounds tractive power in starting. The dimensions of cylinders and driving wheels give 111 pounds of motive power per pound of M. E. P. The total weight on drivers being 69,504 pounds, the ratio of adhesion is 4.6.

To haul fast heavy trains economically, a locomotive must have a boiler capable of supplying all the steam required without excessive forcing. Mr. McIntosh has evidently been properly impressed with the advantages derived from a large boiler, for that of the "Dunalastair" is the largest we remember as being used in Great Britain. The bridges and tunnels are so low that the railway companies in the British Isles cannot use boilers of the size that are in use on several American railroads, but the engine we are describing is not far behind our most successful engines in boiler capacity. The boiler is straight, as usual with British locomotives; and the average diameter is 56⅛ inches, length 10 feet 7 inches between tube sheets. The outside sheets are $\frac{9}{16}$ inch thick. The outside dimensions of the firebox are: Length, 77 inches; breadth, 48½ inches; depth at front, 65 inches; depth at back, 60 inches. The grate area is 20.63 square feet, and the

NEW TYPE FAST EXPRESS LOCOMOTIVE, CALEDONIAN RAILWAY.

heating surface of firebox 138.78 square feet. There are 265 1¾-inch copper tubes in the boiler, providing 1,314.45 square feet of heating surface. The total heating surface is 1,453.23 square feet. The distribution of weight is 35,000 pounds on engine truck, 35,584 pounds on front drivers, and 33,920 pounds on back drivers; a total of 104,504 pounds. The tender has a water capacity of 3,570 English gallons.

When the first of these engines was under construction, there was a great deal of talk to the effect that she was intended for racing with the East Coast route. Mr. McIntosh disclaims that purpose; but all the same, the Caledonian Railway will be particularly well provided with good locomotives should another racing contest arise.

Old Philadelphia & Reading Locomotives.

The annexed engravings illustrate a variety of ancient Philadelphia & Reading locomotives, and embrace in their designs the tentative steps that led up to the modern locomotive. It is well known that the Philadelphia & Reading were pioneers in the development of powerful locomotives, and these pictures show the lines of development.

The engine marked "Catawissa" was a favorite passenger engine of English build. There were a number of these engines. The names were the "Rocket," "Spitfire," "Planet," "Dragon," "Firefly," "Hector," "Engineer" and "Comet." They will be recognized as the "Planet" class, built by the Stephensons. Three of them were rebuilt and a truck put under the front end. These were noted for efficiency in passenger service.

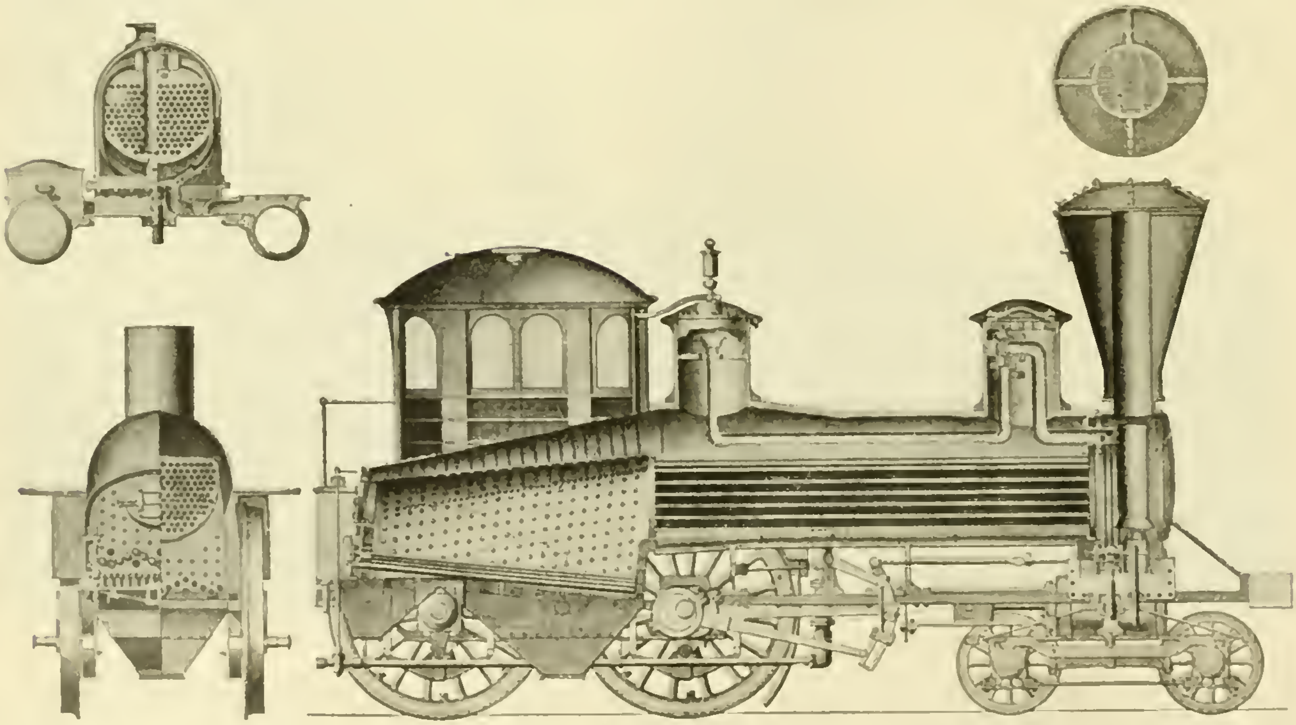
The "Old-Time Baldwins" were pioneer freight locomotives, which were forerunners of the consolidation engine. Seventeen of these engines were built for the road in 1846. Fifteen of the engines had cylinders 15½ x 20 inches, driving wheels 46 inches diameter, the weight being about 40,000 pounds. Two of the engines had cylinders 17¼ x 18 and weighed twenty-five tons. These were the first engines that Mr. Baldwin provided with a cab. They did good work, but were deficient in boiler capacity.

The other three engines represent the services rendered by James Milholland, superintendent of motive power of the Philadelphia & Reading, in improving the locomotive. The ten-wheelers of the same class as the "Dubuque" were built by Norris some time in the '50's, when all other builders except Ross Winans were adhering to inclined cylinders, hay-stack fireboxes and other ancient practices. That engine looks quite modern, has spread truck and firebox above the frames.

The "Hiawatha" and the "Kosciusko" were Milholland's favorite passenger engines, and helped very materially to bring into favor the modern eight-wheeler, from which they do not differ in any essential part.

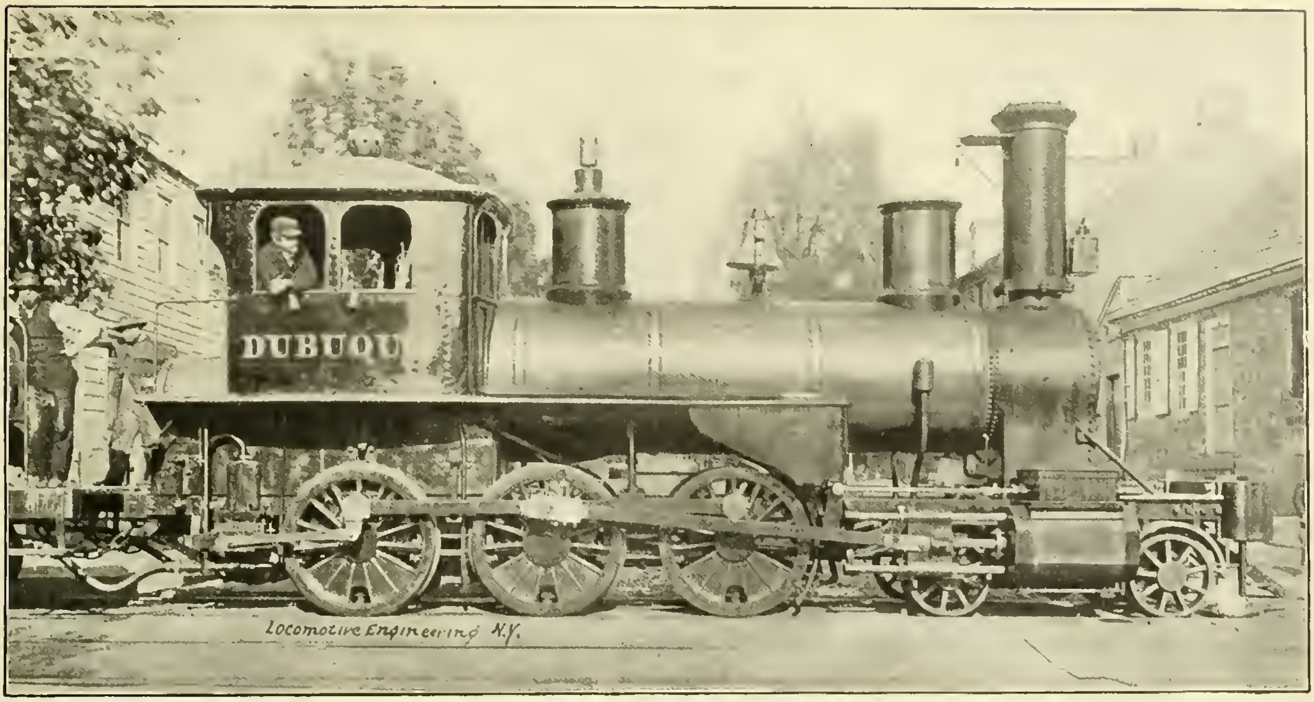
For the photographs from which the engravings were made we are indebted to Mr. L. B. Paxson, superintendent of motive power of the Philadelphia & Reading. Some of the particulars about the engines we received from Mr. E. J. Rousch, road foreman of engines of the Manhattan Elevated Railway.

THE "CATAWISSA."

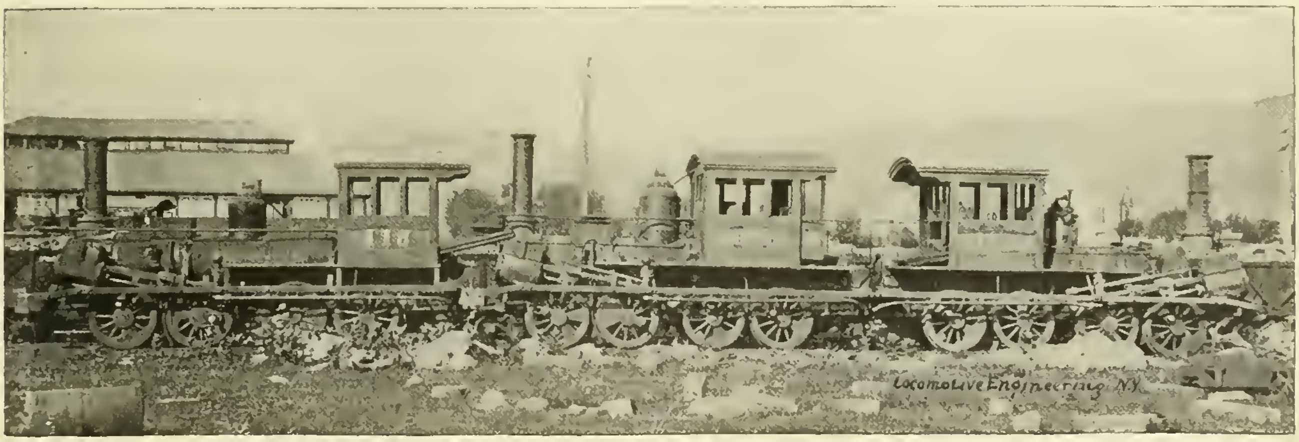


MILHOLLAND'S "HIAWATHA."

A committee of the Traveling Engineers' Association, of which Mr. W. R. Scott is chairman, have sent out a circular, asking questions relating to fuel supply and water supply. The organization is striving to effect reforms and reduce expenses in these two lines, and they desire to get as full information on the questions asked as possible.



MILHOLLAND'S "DUBUQUE."



OLD TIME BALDWINS.

MILHOLLAND'S "KOSCIUSKO."

The "Ne-Ha-Sa-Ne."

The annexed engraving shows an inspection locomotive which the Schenectady Locomotive Works have recently built for Dr. W. S. Webb, president of the St. Lawrence & Adirondack Railway Company.

The engine is designed particularly for track inspection purposes, and has sufficient power to take President Webb's private car, weighing 120,000 pounds, over the grades encountered on his road. The inspection room is nicely finished in mahogany, nicely carpeted, and is furnished with chairs for six passengers. The general features of the engine are the same as the engine "Hudson," designed and built by William Buchanan, superintendent of motive power of the New York Central & Hudson River Railroad, for use on that road, a design which has proved very satisfactory in service.

The principal dimensions of the engine are:

Cylinders, 14 x 22 inches.

Driving wheels, 62 inches diameter.

Boiler, 42 inches diameter at smallest ring.

Working pressure, 180 pounds per square inch.

Heating surface, 783.7 square feet.

Weight in working order, 78,700 pounds.

In removing a cast-iron bushing of a locomotive cylinder recently at the Baldwin Locomotive Works, the excellent quality of the iron was strikingly illustrated. The cylinders were originally about 20 inches in diameter, and for some reason had been bushed to 19 inches by the builders. It was decided to remove the bushing, and it was cut out with a boring bar until a thin shell was left in which the metal was $\frac{1}{32}$ to $\frac{1}{4}$ inch thick, forming a complete cylinder. When the shell was cut open, the metal spread out flat like a piece of sheet iron.

Testing Slide Valves on Purdue University Locomotive.

The committee appointed by the Railway Master Mechanics' Association to investigate the subject of Slide Valves have displayed unusual enterprise. They were required to consider different types of balanced valves, their economy and efficiency over plain unbalanced valves, and what difference in economy and efficiency would result if valves were provided with the Allen port. Mr. G. R. Henderson, chairman of this committee, realized that little information of any value could be secured for a report on that subject by sending out circulars, so he urged the other members of the committee to help in carrying out experiments to ascertain the desired data. Several meetings of the committee were held, and a plan of operations agreed upon. One part of the plan was experiments with different kinds of valves on the Purdue University locomotive, which the trustees of that institution had generously placed at the disposal of the committee, free of charge. Mr. Henderson conducted a series of tests with different valves on that locomotive in the last week of March. He was helped by Mr. L. R. Pomeroy, a member of the committee; Professor Goss, of the University; Mr. F. W. Thomas, engineer of tests of the Norfolk & Western; Mr. C. H. Hammett, of the Richardson Balance Valve Co.; Mr. J. T. Wilson, of the American Balance Slide Valve Co., and the regular staff of university students. The S. P. of "Locomotive Engineering" looked on, and tried to find out something new from watching a locomotive turn its driving wheels at velocity that represented speeds varying from 10 to 60 miles an hour.

A good idea of the appearance of the locomotive and its attachments may be got from an examination of the annexed engraving, reproduced from a photograph sent to us by Professor Goss. When they are making tests with this locomotive, a great variety of instruments are employed to give records likely to be of value. A calorimeter shows the dryness or otherwise of the steam; indicators show the steam distribution in the cylinders and the pressure in the steam chest. Gages are used to indicate the rarefication in the smokebox and ashpan. The heat of the smokebox gases is ascertained by means of a pyrometer. The speed is recorded and the pull on the drawbar is found by a very sensitive dynamometer. Everything that experience suggested and ingenuity could devise to make the testing of a locomotive complete has been applied to this plant.

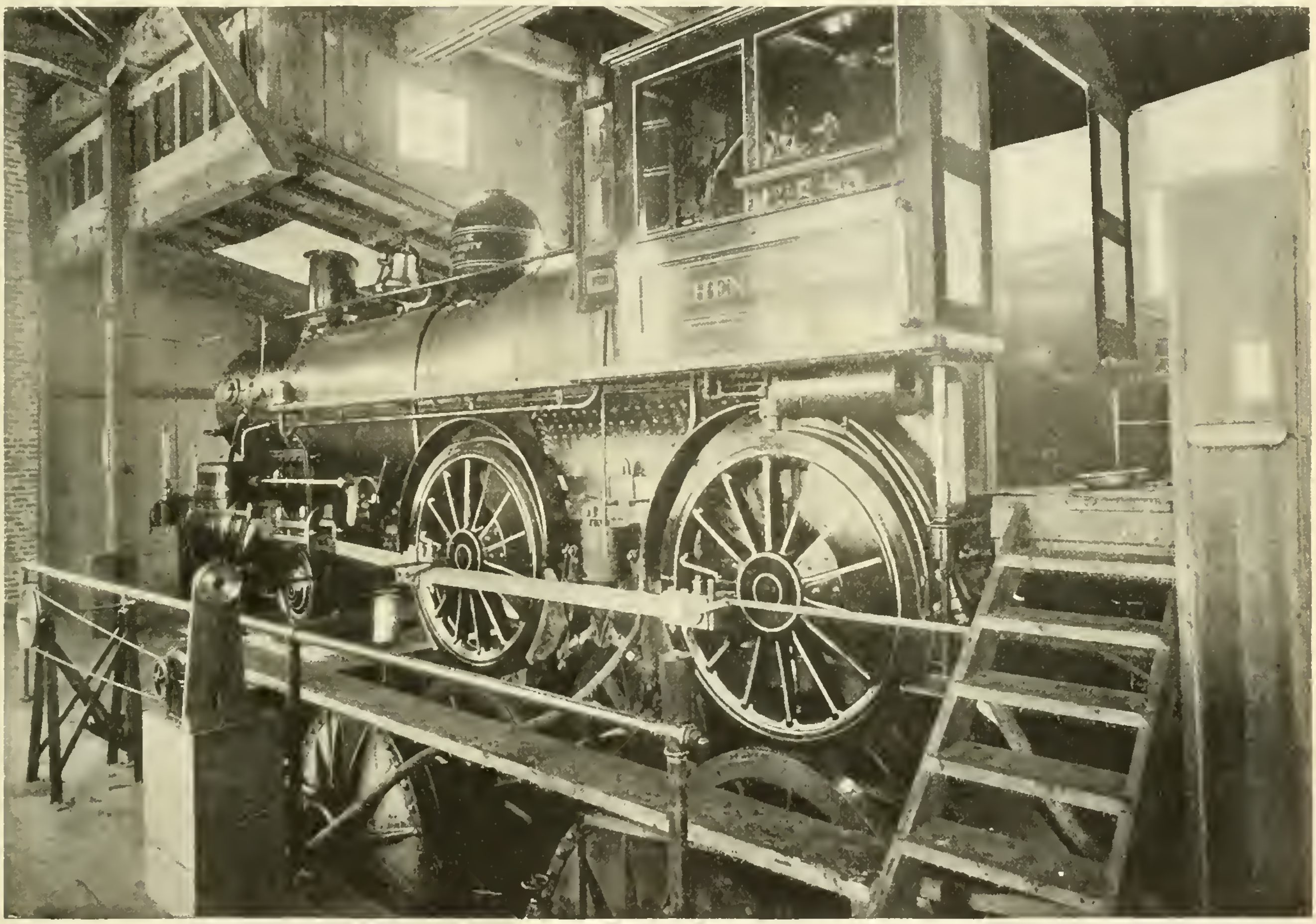
Perfect provision has been made to give the engine any load that may be desired for the test on hand. The rotative force developed is converted into heat and dissipated by means of an ingenious and most efficient water brake, carried on the axles of the supporting wheels. Each test made generally represents as much running as would take a train over an ordinary division. They have made a variety of tests to ascertain the effects of throttling, on the effects of contracting the grate area, on the difference of steam-making due to light and heavy firing, on the effect of different sizes of valves, and on numerous other lines of inquiry which provide accurate information concerning the economical operation of locomotives.

It would be premature for me to attempt to describe in detail the work done by Mr. Henderson and his assistants. The force required to move the valve was measured by a hydraulic dynamometer made by Mr. Philip Wallis in the Lehigh Valley shops at Hazelton, Pa. The dynamometer was attached to the rocker pin and formed part of the valve stem. The block that acted as bush for the rocker pin was connected fore and aft with pistons opposed by water resistance. The water chambers had a pipe connection that led to an indicator. The cards taken from this indicator showed the pressure required to move the valve. The instrument has some defects, but it is certainly the best dynamometer made for the purpose to which it was applied.

The valves experimented with were the Richardson, the American and the unbalanced slide. Tests were made at speeds varying from 10 to 60 miles per hour. The somewhat unusual test was made of running the engine at a rate of 40 miles an hour in full gear. The indicator diagrams taken under that condition indicated very plainly the enormous back pressure which the piston works against when the engine is running at high speed in full gear.

The diagrams taken, showing the power required to move the valves, were remarkably uniform when the conditions were the same. The highest vertical range recorded for balanced valves was about 1¼-inch. With unbalanced valves the power required seemed to be about doubled. Detailed particulars, of course, will be given in the report.

There is something worthy of comment concerning the work done by this committee and that of other investigating committees appointed by the various mechanical associations and clubs. The work is done solely that railroad machinery may be improved, so that the cost of operating railroads will be reduced. The members of the committees do all the work at their own expense, travel to distant places and pay their own hotel bills. When associate members or those not in railroad service, who give help in committee work, travel from their homes they are almost invariably required to pay railroad fares. It will strike the ordinary thinker that business of this kind is decidedly one-sided. Railroad companies ought to bear a little greater share of the burdens carried in their interests.



THE TESTING ENGINE AT PURDUE UNIVERSITY.

Distortion of Flue Sheets.

A very valuable and interesting experiment with boilers was described by Mr. George H. Brown, division master mechanic of the Chicago, Milwaukee & St. Paul, in our April issue, which ought to be carefully read and its teachings heeded by every man in charge of locomotive boilers.

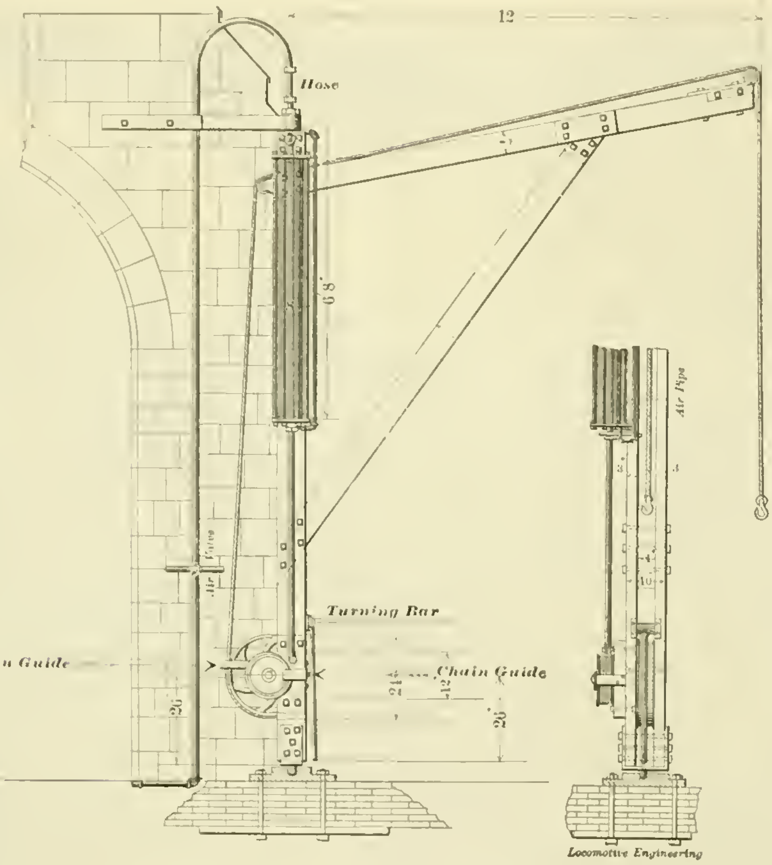
The distortion of flue sheets had been under investigation in the Dubuque shops, where Mr. Brown is in charge. Two engines were undergoing repairs—one receiving a new flue sheet, the other a new firebox. After the flues in one engine had been set in the usual manner by the use of a Prosser sectional expander, two flues were removed from the region of the upper corners and the hole in flue sheet calipered. It was found that the holes were $\frac{3}{32}$ inch out of round. The same thing was done with the other boiler, and the holes in it were found to be ⅛ inch out of round. This was before the boiler had been fired up. It was then determined to make accurate measurements of a firebox entirely new. Accurate measurements taken before and after the flues were set and expanded by a Prosser expander, showed that the sheet was expanded upwards $\frac{3}{16}$ inch and sidewise $\frac{5}{16}$ inch. Experiments of the same kind were then made with another boiler, only a Dudgeon roller was employed to expand the flues. There was no distortion of sheets caused by the roller expander. To amplify this test, they took a discarded flue sheet, reamed the holes true, and rolled pieces of flues in the holes. Some of the pieces were rolled until they were as thin as a piece of paper, and in no case was it found that the hole was distorted by the action of the roller.

When the Dudgeon people read of these experiments, they took a wrought-iron tube 4 inches diameter and $\frac{9}{16}$ inch thick, and fitted a ring ½ inch thick on one end, then applied all the power they could put upon a flue roller. The pressure was so great that it made the metal flow outwards, but it left the holes perfectly true. The piece experimented with is in this office, and can be examined by any visitor.

It appears to us that the obvious lesson of these experiments is—Abandon the sectional flue expander. We have seen fireboxes with the middle of the flue sheet forced up almost an inch above its original level. The fashion has been to attribute that to expansion due to the action of heating and cooling. There is good reason for believing that that theory was wrong, and that the flue expander was the cause of the distortion.

Handy Air Lift.

The annexed illustration shows an air lift used for changing stacks, loading and unloading wheels, etc., at Evanston, Wyo., Union Pacific Railway. This lift was devised by Shop Foreman F. Malone and Gang Boss F. Schmidt, of same place.



The old way of changing stacks was block and tackle, and from three to five men. With this lift one man does the work, and two men for loading and unloading wheels.

Increase of Coal Consumption Due to Wind Resistance.

"Mr. J. H. McConnell, of the Union Pacific, recently gave me some figures which he obtained on this subject, showing the amount of coal necessary to overcome an increased wind velocity.

"A train of nine passenger coaches was hauled a certain distance against a wind blowing at the rate of 10 miles per hour, and the consumption of coal was 7,800 pounds. The same train over the same division, other things being equal, except that the velocity of the wind was 20 miles per hour, required 11,300 pounds of coal. This was not merely an accident, for the same experiment was tried with two different engines, with substantially the same relative results. Here, then, was a consumption of 3,500 pounds of coal, or an increase of nearly 45 per cent., chargeable directly to the increased resistance of the wind at 20 miles an hour over that at 10 miles. It would be interesting to have the figures showing the amount of coal required when there was no wind perceptible, but Mr. McConnell's figures do not go that far. The figures are, however, sufficient to indicate that the matter is one worth considering from another standpoint than its influence on high speeds."—"Railway Age."

Exports of Railroad Material.

During the last fiscal year there were 252 locomotives exported from this country for the use of railroads abroad. Brazil received 138 of these locomotives, Spanish Cuba, 36, and Japan, 23. These were the largest orders for any single country. The value of the locomotives was estimated at $2,379,519.

There were 17,379 car wheels exported, of a total value of $140,010.

There were 2,103 tons of rails sent abroad, the total value being $43,096. Italy received 1,141 tons of these rails.

Armstrong Bros. Tool Co., of Chicago, have moved into their new quarters at 98 West Washington street. They have added bicycles and sundries to their line of tools.

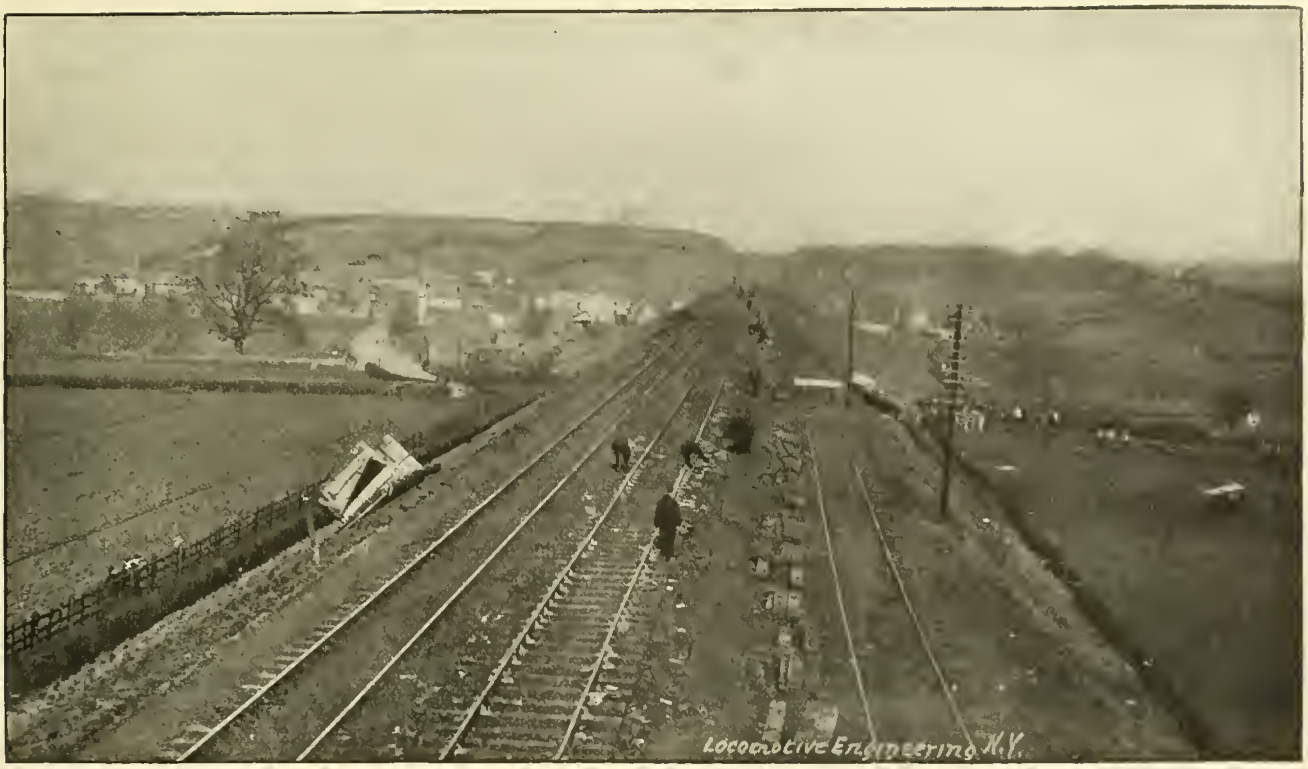
Accident on the Great Northern Railway of England.

On March 7th last, as the up express train on the Great Northern Railway, leaving Leeds at 5:30 P. M. for London, and due at King's Cross terminus at 9:20 P. M., was approaching Little Bytham, about 16 miles north of Peterboro, at a speed of about 70 miles an hour, the two rear cars suddenly left the track, and, after tearing over the permanent way for some 100 yards, struck the brick wall forming the parapet of an underline road bridge and fell into the street below. The first of the cars was badly wrecked, as shown in the accompanying photo, part of the body being smashed to atoms. Two passengers traveling in this car were killed instantaneously. The second car followed the first off the rails and down the bank, and then appears to have attempted to remount the opposite slope. Six passengers were badly injured. The front part of the train, including the dining car, kept to the track and ran some distance before it could be pulled up. Fine rain was falling at the time, rendering the rails slippery; and this, with the down grade of ½ per cent. on which the mishap occurred, considerably hindered the automatic vacuum brakes making a quick stop.

The cause of the accident is attributed to the displacement of the road by the passage of several heavy coal trains immediately after relaying. The engine hauling the train was No. 1003, one of the late Mr. Patrick Stirling's newest 8-footers. The second photo shows the track after the accident, and clearly illustrates the disturbed state of the rails immediately following the derailment.

English papers say that Crawford Marley, who recently died in New Zealand at the age of eighty-three, was the last survivor of those who had a ride on Stephenson's No. 1 engine when the Stockton & Darlington Railway was first opened. He was about thirteen years of age at the time, and, with two other boys, he went to see the "iron horse," which was brought from Newcastle on a dray by eight horses. When the locomotive had been placed on the line, George Stephenson's brother, Joseph, who was in charge of it, asked the lads to run to a farmhouse for some buckets, and the boiler was filled from a spring near at hand. The fire having been lighted and steam raised, the boys, in return for their assistance, were invited to have a ride.

The Bradley Company, Syracuse, N. Y., have published in pamphlet form, the article "The Helve Hammer in a Railroad Shop," which appeared in the February issue of "Locomotive Engineering." Master mechanics and foremen of blacksmith shops will find this pamphlet a useful pocket companion. Send for it.



SCENE OF ACCIDENT ON GREAT NORTHERN OF ENGLAND.

THE COACH AFTER ITS PLUNGE FROM THE BRIDGE.

AN ENGLISH ACCIDENT AT SEVENTY MILES AN HOUR.

A Forgotten Chapter in Railway History.

Under the above caption, the "Mechanical World," from which we copy the engravings, has some interesting data referring to a few of the peculiar devices intended to solve the transportation problem at a very early period in railway history.

Fig. 1 is a combination locomotive and coach for use on branch lines. The "Mechanical World" says: "This combination, which was constructed by Mr. Adams, at Fairfield Works, Bow, England, was called the 'Fairfield,' and was first used on the Tiverton branch on December 23, 1848. Its length was 39 feet. The drivers were 54 inches diameter, and made of solid wrought iron. The middle and trailing wheels were of wood, 42 inches in diameter, and ran independently on their axles as well as their journals, the middle wheels having a lateral motion of 6 inches. The boiler was 36 inches in diameter and 72 inches high, containing 150 tubes; the firebox was 24 inches high and 30 inches in diameter.

"The (one) cylinder was 8 inches in diameter and 12 inches stroke; the connecting rod working a separate crank shaft which communicated with the drivers by side rods, the driving axle being straight, with crank pins on the outside.

"The boiler was placed behind the driving axle; the tank, holding 220 gallons of water, being in front of it, and the coke box was attached to the front part of the carriage, behind the driver. The boiler pressure was 100 pounds.

"The first-class compartment was in the form of a saloon, and accommodated 16 passengers, while the second-class compartment seated 32. The entire weight of the machine was about 10 tons.

"On the experimental trip the 'Fairfield' left Paddington Station at 10:30 A. M. for Swindon, 77 miles away, Mr. Gooch officiating as driver both ways. The machine attained considerable speed, and for a portion of the way reached the rate of 49 miles per hour.

"It was found in practice that the vertical boiler was not a success, so after some nine months' trial it was replaced by a horizontal tubular boiler; then, after further experience, several drawbacks to the efficient working of branch-line traffic by means of the combined engine and carriage were evident, so the engine was disconnected from the carriage and given an extra pair of wheels, and became, in fact, a miniature four-wheel tank locomotive—a style of engine Adams afterwards became noted for building.

"Fig. 2 is a side elevation of the engine and carriage fully equipped for service. Fig. 3 is a corresponding view of two half plans—one showing a complete external view of the machinery, and a horizontal section of the carriage to exhibit the seats; and the other view detailing the framing.

"This engine had outside cylinders, 7 inches in diameter and 12 inches stroke. The accommodation provided by the combined engine and carriage was not sufficient for the traffic, so two additional carriages—one with a guard's compartment—were added; the train thus having accommodation for 150 passengers. This train was worked regularly at 37 miles per hour.

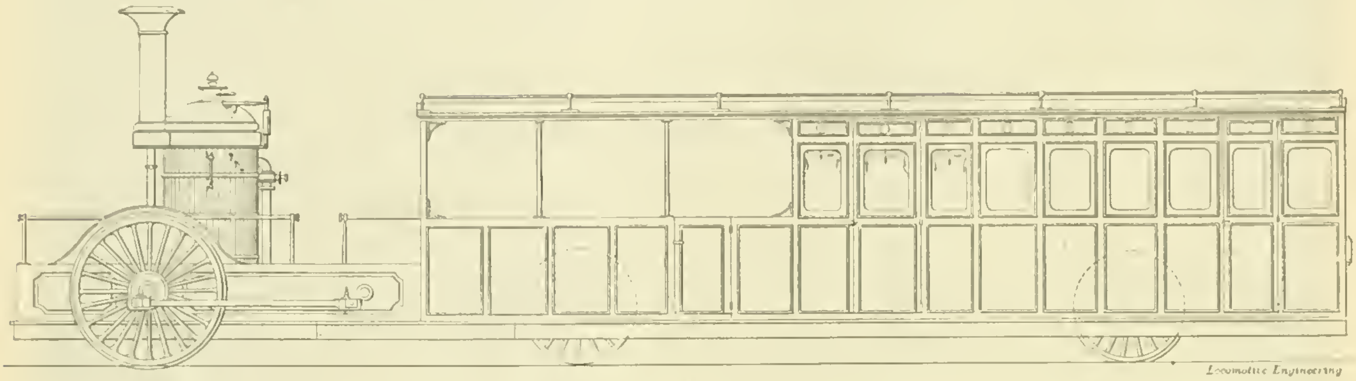


Fig. 1. "FAIRFIELD" ENGINE AND CARRIAGE.

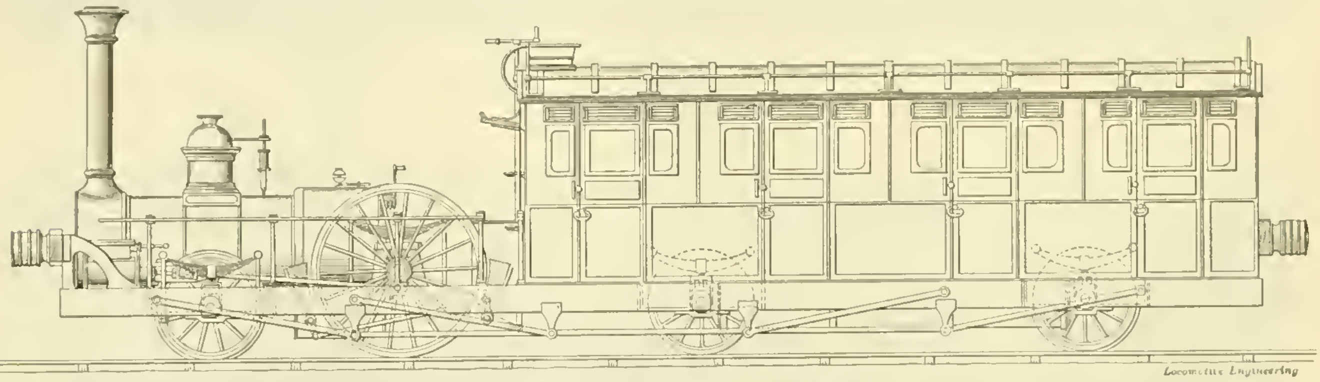


Fig. 2. ADAMS LOCOMOTIVE AND CARRIAGE.

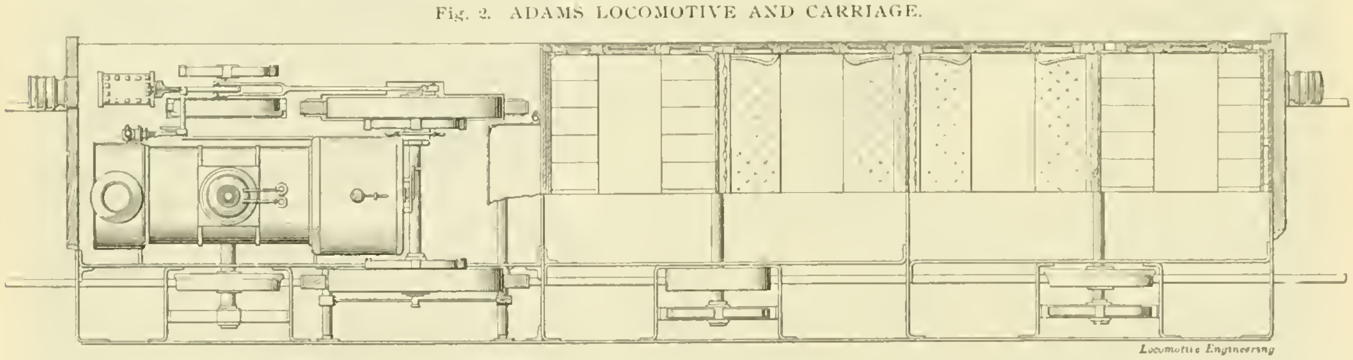


Fig. 3. PLAN.

The combined engine and carriages were built under a patent obtained by Mr. Adams in 1846, some time before Crampton adopted the inside cylinder and intermediate driving shaft."

In the above we are brought to an understanding of some of the trials encountered by the early designers, while engaged in perfecting precedents for the future. It took a nerve to ride 49 miles an hour on a machine like Fig. 1, and they must have had a courage almost sublime to let her turn her "singles" fast enough for that speed.

The Original Extension Front.

The many inquiries we have received, referring to the original designer and inventor of the extension smokebox, led to a searching investigation of the subject, with the view of placing on record all authentic facts connected with the design of a device so popular and so widely used in American practice.

In reply to our letter to Mr. A. M. Waitt, general master car builder of the Lake Shore & Michigan Southern Railway, who is known to have been one of the first in the field of experiment with the extension front and spark arrester, in which efforts tangible results were obtained, that gentleman has kindly given us some lore worthy of preservation, together with the first drawings from which the experiments were made, and we therefore publish both; appending his letter entire, in the following lines:

"Replying to your letter of March 30th, would say that I was chief draftsman of the locomotive department of the Eastern R. R., shortly after Mr. John Thompson resigned the charge of the locomotive department on that road. I served under Mr. Amos Pillsbury, now superintendent of motive power of the Maine Central at Portland.

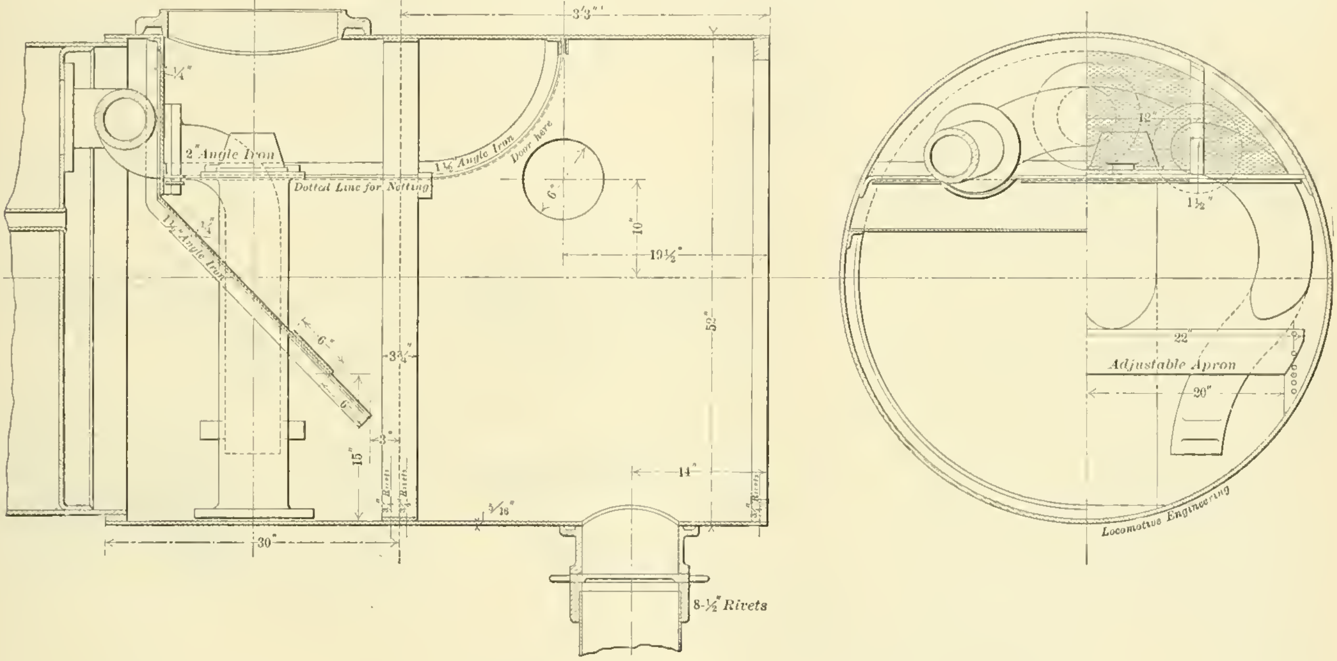
"In 1882 the advisability of applying some device to our locomotives to prevent the issuing of sparks from the smokestack was considered. After thoroughly looking into the subject, I found that there had been experiments made with extended smokeboxes, with both straight and diamond stacks, in different parts of the country; but, as far as I could learn, none of the experiments had given satisfactory results. I spent considerable time and study on the matter, and finally designed a 'spark arrester' in connection with the use of the extended smokebox, straight stack and brick arch in firebox, which design was applied to one of our locomotives and experimented with. I gave personal attention to the working of the device and its proper adjustment, and finally made some modifications which put it into such shape that we adopted the arrangement on all our road engines that went through the shop.

"The device was highly successful as a spark arrester; it also rendered the locomotive unusually economical in coal, and free from smoke. We obtained an adjustment of the diaphragm and smoke arch that also kept the tubes unusually free from blocking up with ashes.

"The success of the device as a spark arrester was shown by the fact that on many night trips between Portland and Boston that I took on engines equipped with the arrangement, there were not sparks enough issued from the stack on the entire trip to fill a small hat. When we arrived at Plymouth, the half-way point, it was always necessary to blow out the large accumulation of cinders in the extension front; the front would be found one-half full of cinders, showing that the device was a veritable spark arrester—not, like many of the ordinary present devices, spark distributors.

"There seems now to be an unwritten principle in connection with the extension front, that all that is desired is to circulate the sparks in the front end until they are broken by contact with the netting and diaphragm, and then throw them out with such force that the ordinary sparks will be extinguished before they alight on the roofs of the cars or on the ground.

"So far as I know, the device designed by me when on the Eastern R. R., in 1882-83, was the first extensively used successful spark arrester devised up to that time. Several companies, among them the Union Pacific and Southern Pacific, had experimented with extension fronts, but abandoned them as being unsuccessful. This abandonment was due, in my opinion, to lack in the proper design of the device.



THE ORIGINAL EXTENSION FRONT.

"In the 'Railway Age' for October 26, 1883, there appeared a communication signed 'Experience,' written from the G. M. M.'s office of the Southern Pacific Ry., in which the arrangement of the extension front was condemned in no uncertain terms. In the issue of November 14, 1883, I replied to that communication over the signature 'Eastern R. R.,' in which I pointed out some of the causes for the lack of success on the Southern Pacific, and indicated the complete success, and the reasons for same, in connection with the device used by the Eastern R. R.

"Some time during the early part of 1883, a paper which I believe was called the 'Journal of Railway Appliances,' published on their front page a cut and description of the extension-front spark arrester that I designed. I have looked over my files, hoping to find that copy of the paper, but it seems to have been mislaid or lost. I send you, however, for your examination, and return after you are through with them, drawings made in January and February, 1883, showing the original design as I made them for the Eastern R. R. engines. One noticeable feature of the design, differing from those now in general use, is the angle of the diaphragm, which did not come down between the exhaust pipes and the tubes, but extended in at an easy angle beyond the exhaust pipes, thereby giving a quite regular and uniform draft through the upper as well as the lower tubes, resulting in keeping the tubes unusually clean.

"If there is any further information that you desire, that I can give you, would be pleased to furnish it; but I think that the above, together with the blueprints and references to the papers named, will give you all the information that I have."

Advantage of Station Platforms.

After the experience gained in loading and unloading passengers quickly in trains serving the World's Fair, the Illinois Central Railroad people determined to abandon, for suburban trains, the practice of having passengers ascend and descend steps. They erected station platforms from which passengers can step upon the platform of the car, with result that the loading and unloading of their suburban passengers has been greatly facilitated. This, of course, is the plan followed in operating all elevated railroads.

In the course of several trips recently made on the suburban trains of the Illinois Central, the writer timed the stoppages at stations and found that they averaged 11 seconds per stop. The underground railways in London carry fewer passengers on a train, and the average stop is about 50 seconds. In a trip made on the Chicago & Northern Pacific, the average length of stops noted was 37 seconds. On the latter road the passengers have to descend steps to a low platform.

When it is important to handle passengers with little delay the raised platform is a great advantage, and the reducing of the time lost in stoppages enables the train to be run to the end of the suburban route more expeditiously. When the competition between electric street railways and surface railways doing suburban traffic is becoming so keen, it would be well for the managers of surface railways to investigate the advantage they could derive from the introduction of raised station platforms. The managers of surface railroads are complaining bitterly about the unfair competition of cheaply-constructed electric street railways; but they display little enterprise in making their own train service so prompt, speedy and comfortable that passengers would be drawn away from the cheap rivals. If all surface suburban passenger trains were operated as well as those on the Illinois Central at Chicago, there would be less reason to complain of revenues being reduced by the unfair competion of electric railways.

The practice followed by all of our railroads, of making passengers ascend and descend four feet from the ground to the platform and back, is a relic of barbarism. It is the practice which was introduced when the level track at a station was considered a good enough level to start from—when a railroad company was not expected to interest itself in the convenience or comfort of passengers. Worse than the discomfort to passengers, in requiring them to climb up steep steps, is the practice of handing baggage from a door over four feet above the ground. The prevailing practice is to drop heavy baggage and express articles that distance to the ground. It is an eloquent testimony to the tyranny which habit and corporate assurance can impose upon a free people, that our suffering citizens have not long ago risen in their might and suppressed the practices that made baggage-smashing a necessary corollary of handling baggage without platforms.

Who Has Tried Graphite in Valve Oil?

General Foreman Geo. Smart, of the B. & M. River R. R. at Edgemont, S. D., states that by the addition of flake graphite to the valve oil for use on their engines they make a saving of 80 to 90 per cent. in oil, and with satisfactory results.

As Horace Greeley used to say, "this is important if true." Not that we doubt Mr. Smart's statement—we believe he does what he says—but the percentage of saving seems to indicate a special and abnormal case. Who has tried flake graphite in valve oil through lubricators, and how much oil can be saved?

A Device for Turning Worn Crank Pins.

Mr. Edwin Priest, division master mechanic of the Boston & Albany R. R., has devised and in operation, an auxiliary to the quartering attachment of a driving wheel lathe, by which to true up worn crank pins while the latter are in the wheels.

Fig. 1 of our illustrations of the device shows the application of it to the work in hand, with all the parts necessary to its operation, and showing their relation to each other. Fig. 2 is an end view, with the pin in section, looking toward the face plate, and Fig. 3 is an enlarged view of the crank pin, quartering spindle and foot slide, with a cut in progress on the pin.

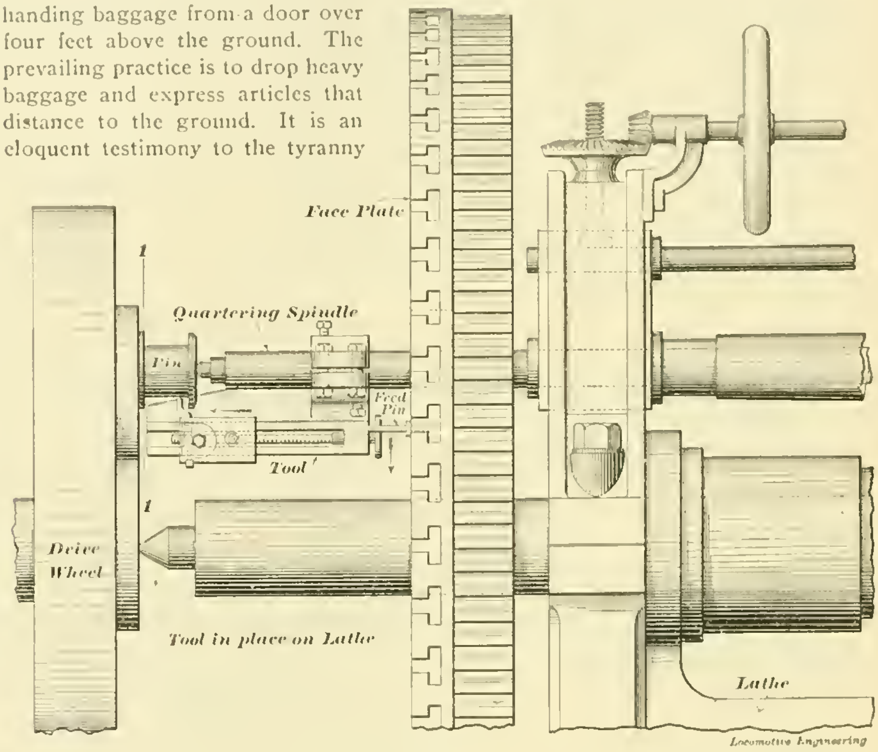


Fig. 1.

The device is simply a casting clamped to, and revolving with the quartering spindle. It is planed dovetail to receive the tool slide which carries a nut and is actuated by a screw turned by means of a star-wheel on the end, making the feed wholly automatic after the cut is started.

Main rod bearings trued up by this device will not have the excuse for a pound, that they could fall back on after the roundhouse doctor had tried to get them into a circular section with the file and other working tools of his profession. This kind of a tool should receive a wider recognition from shop managers, and be classed with the actual necessaries of a plant.

On the last day of March the New York Belting & Packing Co. shipped thirty-three miles of hose from their Passaic, N. J., factory alone.

Knowledge is Becoming Powerful.

In the course of a meeting of railroad mechanical men, Mr. Blank, the superintendent of motive power of a large railroad system, an old man, was asked some questions respecting the operation of certain locomotives, and not being accustomed to speaking in public, he failed to express himself fluently. In the course of the evening's gossip on the hotel porch, we heard a young man possessed of some jaw facility expressing surprise that fossils like the old man ever came to be put in the way of rising to the position of head of the mechanical department. The belief of the group who took part in the conversation was that the promotion had come through some lucky accident, or because of some influence outside of merit. The writer happened to meet an old friend and fellow workman of Mr. Blank's, and remembering the criticism, questions were asked as to how the old gentleman first got his start upward. "It was this way," was the reply: "In the old days, there were no mechanical papers and few books from which a mechanic could learn anything about the scientific principles of the business, and very few men attempted to find that kind of information. But Blank was an exception. He was never satisfied unless he understood the principle underlying all shop operations. When we were working in the shop as journeymen, it burned down one night, and a temporary shop had to be hurried into shape for doing work. The foreman could not calculate the size of pulleys for the speed of tools, and no one else in the place could do it except Blank. He was on that account given charge of that work, and he managed so well that he was soon afterwards made foreman. Although he has not much to say, he knows more about mechanical matters than any man of my acquaintance."

That is a representative case of how many of our silent master mechanics, managers and others have come to be promoted, while others with more to say remained in the ranks. They acquired knowledge concerning the science of their business, and this knowledge was the lever which lifted them into the higher positions. The same forces and influences that raised men of past generations are at work to-day, and the same kind of intellectual capital will bring similar rewards as long as mechanical industries are carried on. It is not enough that a workman should be possessed of the highest manipulative skill. Industry, good sense, quick perception and good habits are almost certain to produce a good workman and a mechanic who is certain to command first-class wages. Men of that class are never found idle in the dullest of times; but it does not by any means follow that they would make capable foremen if promoted. Unless a mechanic acquires some knowledge of what are called scientific methods, he has no right to expect to be put in charge of a shop. He ought at least to be able to do all the calculations required in the management of the place. Knowledge of that kind is not very difficult to acquire, and there are abundant opportunities for workmen to obtain the necessary instruction. If they display no ambition to learn how to calculate the speed of shafting and tools, and have no wish to acquire knowledge of the elements of mechanical physics, they ought to be content to remain ordinary workmen all their days.

It is never safe to call a man a "fossil" because he is not always shouting to make people think he is crammed full of knowledge. Our experience in visiting machine shops is that the ablest men to be met are the most modest in blowing their own trumpets. The self-asserting man pushes ahead among people more ignorant than himself; but the day when the noisy egotist was taken at his own valuation is fast passing away. Under existing conditions, it is well for the ambitious man to study his business.

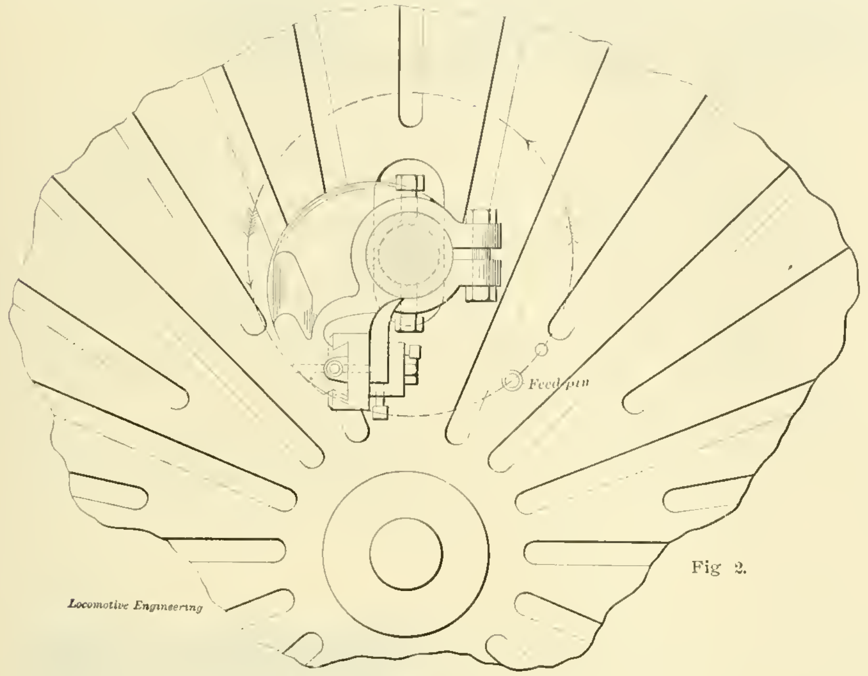


Fig 2.

Section through crank pin at line 1.1

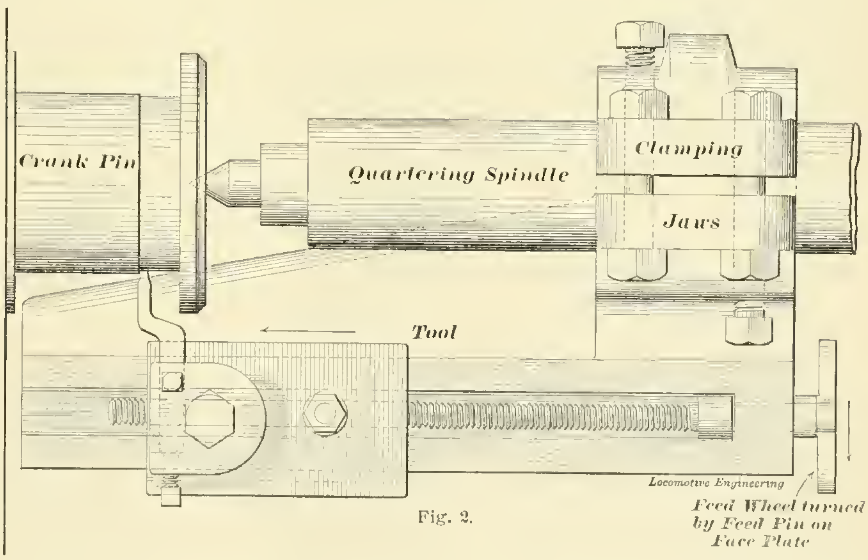


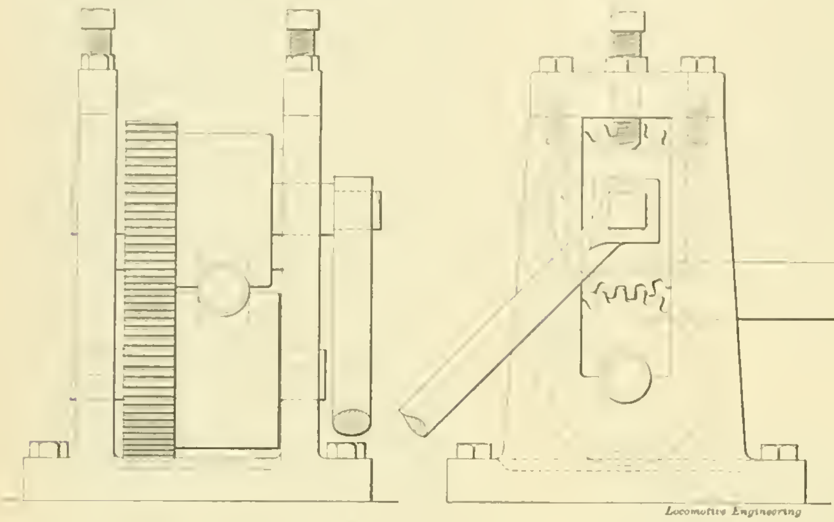
Fig. 2.

A somewhat novel application of air to the doing of mechanical work is to be seen in the shops of the Burlington, Cedar Rapids & Northern, in an apparatus for squeezing the oil out of greasy waste. It consists of an old brake cylinder to the rod of which a piston is attached that fits into a perforated cylinder that holds the waste. The waste is packed into this cylinder and air applied. The pressure squeezes every drop of oil out, and it runs into a pan provided for its reception. Sufficient oil is preserved in this way to use on all the cutting tools that require oil.

Flue-Swaging Machine.

Master Mechanic Willis, of the South Boston shops of the N. Y., N. H. & H., has a machine for swaging flues, which we illustrate as an example of what can be done when untying from old methods which are recognized as standard. It is ingenious, but old in this shop.

A cast-iron frame and two gears having enlarged hubs with a cam-shaped opening between them to receive the hot flue-end, is all there is to it. The flue is passed into the hole, and the cam-opening closes on it, drawing it in as the gears are turned by a wrench on the keyed shaft which passes through the upper gear.



FLUE SWAGING MACHINE.

No templates or forms are required with this tool to determine when to stop swaging, since the proper rotation of the gears gives a constant and correct size to the end of flue. The usefulness of this device would probably be increased if it were made a power-driven tool.

Improvements on an Eastern Road.

The tourist on the New York, New Haven & Hartford road is struck with signs of remarkable activity on the permanent way as the train nears Boston. By the courtesy of Superintendent McAlpine, who kindly chaperoned us over the ground, we found that it was all about a stupendous feat of track-elevating.

For a distance of five miles the right of way is being raised so as to go over streets above grade, and tangents are introduced regardless of expense. In one instance, that of moving out of the way the Sturtevant plant at Jamaica Plain, some engineering difficulties were overcome that reflects credit on those in charge of the improvements. The plant mentioned was moved to make room for the tracks, without missing a turn of the line shafting, or cracking a brick. Stability and permanence seems to be the governing motive in raising these tracks. The massive retaining walls look solid enough to defy time.

Old Engineering Relics.

In the National Museum of Paris, which is called the "Conservatoire des Arts et Metiers," there are many curiosities to be seen which are of great interest to mechanics and engineers. There is to be found what was actually the first vehicle propelled by steam. It was a steam carriage designed by Nicholas Joseph Cugnot, a French army officer, and intended to be employed for military purposes. The machinery part of this engine was all right, but the boiler, shaped like the ordinary tea-kettle, had very small steam-generating capacity.

Near to that curious engine is a water-tube boiler, which ought to be examined with interest by all Americans who visit the place. Those familiar with the history of the steam boat will remember that Robert Fulton built his first steam boat in France, and experimented with it on the Seine. It was launched in 1803, but was not a success, as the speed capacity was under four miles an hour. When the boat was broken up, the boiler was sent to the museum mentioned, and there it can be seen to-day.

Origin of the Word "Engine."

The Latin word "ingenium," which signifies heart, mind, abilities or genius, was originally applied to any mechanical device of an "ingenious" character. In the course of time the word became Anglicised into "engine," and the men who made and operated the engine were called "engineers." How the class now called "civil engineers" came to receive the title of "engineer" is not very clear, unless it was that they were considered ingenious men and got the title that came from the original word.

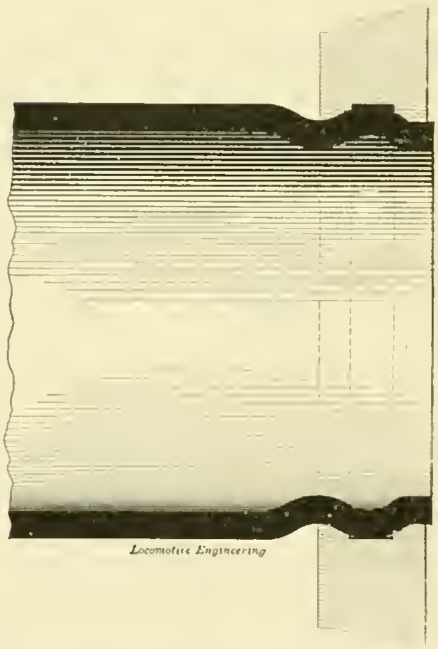
Numerous machines have got names by corruption of the word "engine," as "gin," "jenny," etc.; but of late years the term has been applied almost exclusively to prime movers.

In the early days of railroads the motive power in use was always called a "locomotive engine." Of late years it has been abbreviated to "locomotive." That name originated with one of Stephenson's first engines, which he called "Locomotion," and which was exhibited at the World's Fair in Chicago. Some deviations from the word were common in early days. When the Norris Locomotive Works were built in Philadelphia, the company announced that they were going to build "locomotors."

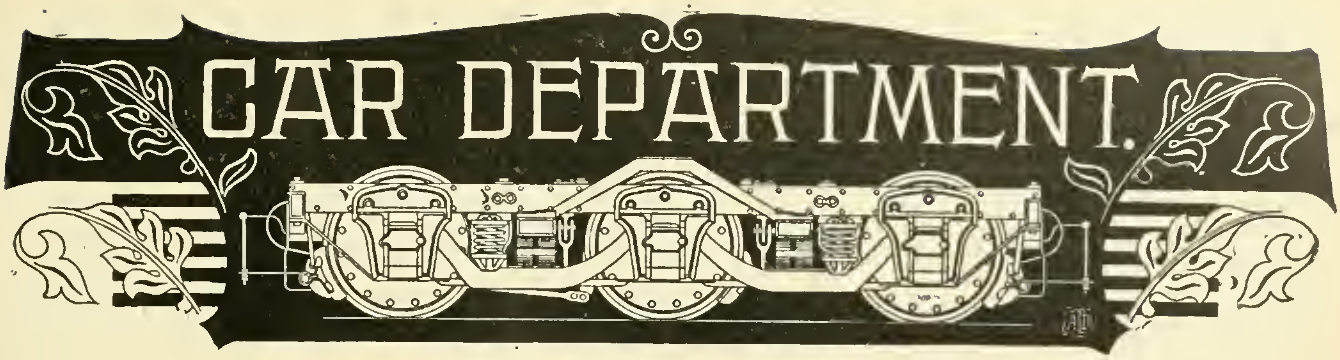
Lowrey's Method of Setting Flues.

Mr. Jno. R. Lowrey, boiler manufacturer, of Omaha, has designed and patented the style of flue-setting shown in our engraving. The flue sheet has the holes bored concave, and, in addition to this, they are bored with an annular groove in the center of the sheet's thickness, into which the flue is set with an expander which has a section similar to the hole in the sheet, after which the ordinary roller expander with beaded rollers is used to finish the job.

The advantages claimed for this method over the old style of setting of bead and copper ferrule is, that the bead is in the sheet, perfectly protected from the action of the fire, and is practically a part of the flue sheet. Each flue with this setting has a bracing effect on the sheets that can be equaled by no other method in use, since the tendency of every flue is to rigidly hold the sheet from moving in or out.



When flues set this way begin to leak (as flues will in time, no matter how set), the roller expander can be relied on to effect a cure, because there is no external bead to burn off and cause a leak, and because, further, it is impossible to reduce the efficiency of that part of the flue which fills the annular groove in the flue sheet. A thorough test has been made of this flue-setting, with results that leave no doubt of its superiority over the old bead-and-ferrule style.



Conducted by ORVILLE H. REYNOLDS, M. E.

Graphics of Truck Arch Bars.

A consideration of the status of much of our freight equipment, with special reference to the multifarious schemes in the design of truck framing, will be certain to be productive of ample food for reflection to anyone possessed of the idea that all car trucks are representative of a practice creditable to the bodies they carry.

The trucks being the foundation on which the whole load is sustained, and the fact that they are obliged to stand a bombardment of shocks without the intervention of suitable means to soften their severity, together with the fact that these shocks are often aggravated by rails unfit to roll on, and by wheels flattened or not round, furnishes the best of reasons for the adoption of a frame on mechanical lines. This need is not more pressing now than at any previous time, notwithstading the increasing weight of cars—for these the pace has been met by increasing the size of material in the arch bars; that's all—the shape of truss generally remaining the same as before, whether right or wrong, in order that the standard may not be departed from.

Champions of the old practice have resorted to almost every means known to them to galvanize into renewed life their weak construction, and in their zeal have not stopped, even, with an inversion of proportions thereof, by giving the parts in tension the dimensions properly belonging to those in compression; the shapes of arches are as numerous as the sea-sands, until for them there is only one avenue now open in untried fields, and that is to put up a frame with the tie-strap on top.

These cut-and-try processes of arriving at results have much to do with bringing the arch-bar or diamond truck framing into disrepute, and helping to the fore an entirely new line of design in solid girder types, which thus far have shown a fairly clean record. But the past of the arch-bar truck of correct design has also demonstrated its fitness for the position of a leader, and it will no doubt remain near the head on account of its reasonable first cost, light weight and low cost of maintenance—three factors that will demand recognition when the time is ripe for the adoption of a standard truck frame for freight cars.

Guesswork and copying some other man's riddles, to the exclusion of original thought, are directly responsible for the failures. An examination of the make-up of a strange production—and perhaps some nearer home—will prove this statement is not a visionary one.

Equalization of stresses in the compression and tension members is a condition hard to find, whereas it should stand as the gage of the designer's ability. By "equalization" is meant that the respective members should have such a section that the upper bar would begin to fail by flexure at the exact instant that the lower bar failed by tension. This might also be hard to find; but a healthy approximation to it has been reached by not losing sight of the fact that the weakened section of the lower bar, due to the holes for the oil-box bolts, must have full consideration, and also bearing in mind that the upper bar is a beam fixed at both ends, and therefore in the best condition possible to resist flexure.

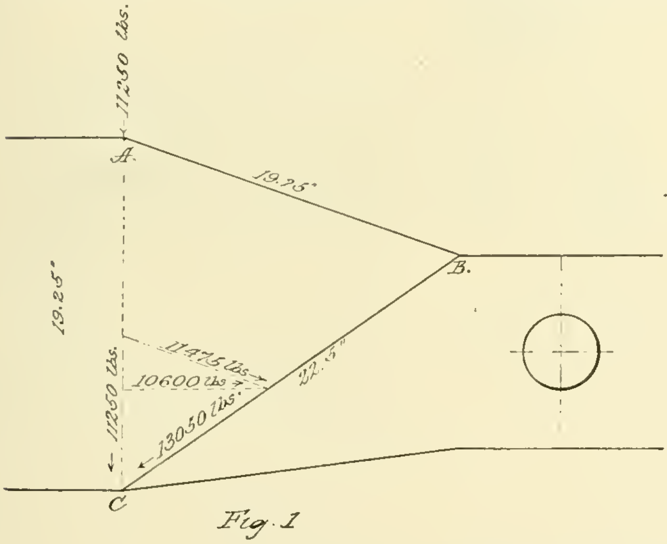


Fig. 1

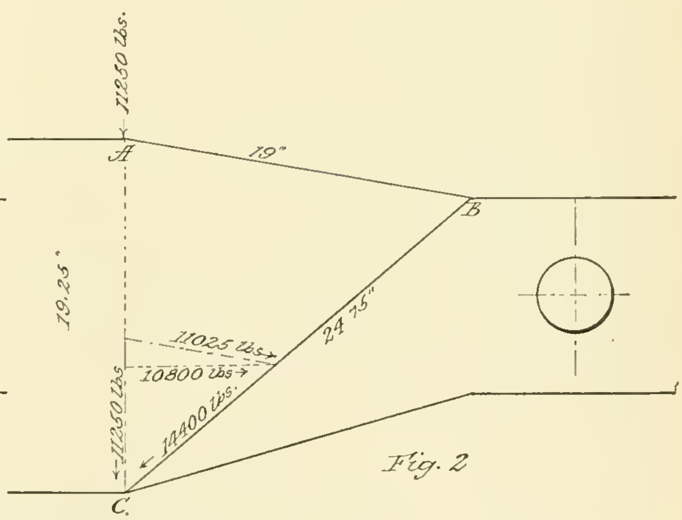


Fig. 2

To show how the shape of the arch affects the stress in its members, we illustrate two designs of one-half of truck frame by center lines only, the space between the bars at the center being the same in both cases, the shape of the arch only being different. The intensity of the stresses is shown by the triangle of forces, drawn on each figure, with the forces in pounds, and their direction.

The load is taken at 60,000 pounds for capacity of car, and 30,000 pounds for that portion of car and trucks carried by the journals; this equals $90{,}000 \div 8 = 11{,}250$ pounds per journal, and is the amount sustained by that portion of the frame shown in both figures. Laying down this load to scale in the direction in which it acts, and drawing the upper line of the triangle parallel to the upper arch bar to an intersection with the lower bar, we have the triangle of forces in which the numerical values are proportional to the length of the sides.

In Fig. 1 we see that there are 11,475 pounds tending to buckle the upper bar, and 13,050 pounds pulling at the lower bar. Fig. 2, which has but one-half the set of Fig. 1, is seen to have 11,025 pounds in compression and 14,400 pounds in tension. The shear on the oil-box bolts is represented by the horizontal components of the triangles; 10,600 pounds and 10,800 pounds in the respective figures.

This object lesson is supplemented by the calculated stresses (in which the agreement is perfect, as it should be) in the following equations, where $L =$ load in pounds:

Compression in Fig. 1 $= L \times A\ B \div A\ C = 11{,}250 \times 19.75 \div 19.25 = 11{,}475$ pounds compression. Tension $= L \times C\ B \div A\ C = 11{,}250 \times 22.5 \div 19.25 = 13{,}050$ pounds.

Compression in Fig. 2 $= L \times A\ B \div A\ C = 11{,}250 \times 19 \div 19.25 = 11{,}025$ pounds. Tension $= L \times C\ B \div A\ C = 11{,}250 \times 24.75 \div 19.25 = 14{,}400$ pounds.

These figures cannot fail to make it plain where strength is needed. When yoked to the graphic process, or taken singly, there is nothing left to conjecture; it only remaining for the designer to properly dispose of the material, and meet the stresses with a factor of safety that will cover all requirements.

The Master Car Builders' Association could work a revolution in this matter of arch-bar trucks, by appointing a committee to put it through a sifting ordeal, with a view to the adoption of the fittest that survived it, as a standard. There is most urgent need of such action at once, to beat down the barriers of personal prejudice that have so long existed to prevent the adoption of such a standard. In our opinion, the results to be obtained by such a committee would be so far-reaching in its benefits to our rolling stock as to stand on an equality with their best efforts in other lines. Their good work with wheels and axles should now be crowned by the same intelligent thought on the truck frame.

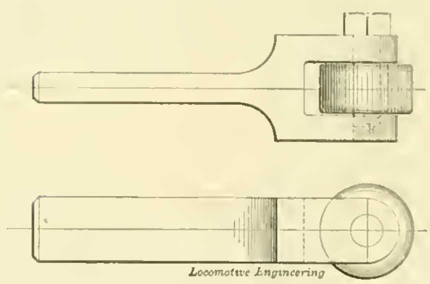
Roller for Car Axle Journals.

We have had occasion in the past to refer to some of the causes of hot boxes; and among them the condition of the journal, as left by the average latheman, always loomed up as the principal disturber.

It is an unwritten law among men wortny of the title of mechanic, that a file should never touch a surface intended for a journal bearing without all other efforts to produce a smooth surface had failed; but the fact must be chronicled that there are some people living yet who rely solely on the file and a liberal application of emery to put a journal into shape for business, when it is notorious that an axle lathe cannot be speeded up for any such purpose. Hot boxes under these conditions are as certain as the tides. The tool is the thing to leave a correct surface; and after that tool, if the material is seamy or hard, the roller, as shown in our illustration, will produce a surface true and smooth, closely approaching that of cold-rolled iron. This tool was designed by Mr. D. H. Teas, foreman at the N. Y., N. H. & H. shops at New Haven, and has finished about 5,000 axles up to date.

The roller is of steel, 3 inches diameter and 1½ inches wide, with a steel bushing, and is secured in the fork by a steel bolt, all hardened. In operation, the journal is finished within 0.01 of an inch with a square-nosed tool, and the collar and dust-guard bearing are merely rough-turned; the roller holder is then put in the tool post, and the journal wiped clean of chips; after which the roller is advanced to the journal and fed across it, leaving the material dense, smooth and true, and the surface practically perfect for a journal bearing.

There are no hot boxes to set against this record of 5,000 axles, which is certainly proof enough that some of the other causes for same are also closely looked after, and that Master Mechanic Leary made no mistake when appointing his foremen.



ROLLER FOR CAR AXLE JOURNALS.

Car Service on the Chesapeake & Ohio Railway.

The National Association of Railway Surgeons have been investigating the sanitary condition of railway cars, and in doing so addressed a letter to Mr. W. S. Morris, superintendent of motive power of the Chesapeake & Ohio, which brought out such a comprehensive reply that we feel it must interest our readers. The following is the letter slightly condensed:

"Our inspection of passenger cars at interchange points embraces necessary common-sense sanitary inspection; in other words, the closets, urinals, etc., are thoroughly inspected and cleaned before leaving terminals, and our standard disinfectant applied to all places exposed to any unhealthy condition. Our disinfectant is practically the same as used by the Pennsylvania Company.

"The only suggestion that I have to offer in regard to heating and ventilating, as well as cleaning of cars, is to discipline thoroughly all of the trainmen and employés connected with this branch of the service, so that they will be alive to any sanitary requirements needed for the healthy condition of the trains.

"The Chesapeake & Ohio Railway Company is far in advance of any other railway company in the United States in the way of heating and lighting its cars. We clean all our coaches and carpets by a pneumatic process every trip the cars make. In the matter of heating, our coaches are heated by hot circulation without the use of stoves, the heat being transmitted from the locomotive, through necessary piping, to a system of drums, etc., placed underneath the car, which raises the temperature of the water of the pipes within the car, thus providing circulation and any temperature desired, from atmospheric to a comfortable condition within the coach.

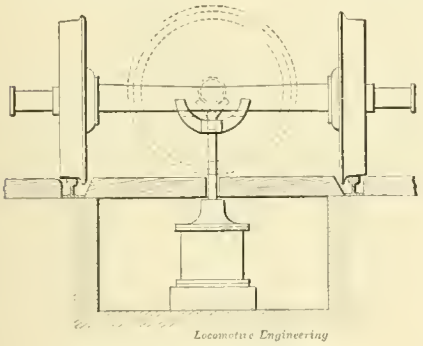
"We claim our light to be absolutely the pioneer in the use of storage electricity. All of the coaches of our through trains are thus lighted, avoiding unnecessary heat and danger from oil lamps; and in connection with this latter would say, that we are successfully operating a system of storage batteries wherein each car is independently lighted and charged for thirty-six hours' continuous lighting by storage batteries. We have in our local trains quite a number of cars lighted by the Pintsch gas system, which avoids the old-time danger of using oil lamps, and is a very satisfactory light. In the summer time there is some heat generated from the light, which our electric lights entirely eliminate. We have numerous tunnels to run through; and being located geographically in a section of the country where the summers are long and midsummer quite hot, we have given all of these matters of sanitary inspection, and the necessary requirements for the comfort and health of passengers, very careful attention; and with our improved methods as described hereinbefore, we have the best-ventilated cars in summer, as well as the most healthful condition existing in all of our trains, from one end of the line to the other that can possibly be brought about at the present time.

"We go as far as to use in our locomotives the New River smokeless coal, and reduce to the lowest minimum the annoyance of smoke and gases."

Observations made during a recent trip among New England roads, tended to show that steel was being largely used in car construction, especially in truck details. Many truck bolsters of pressed steel were found replacing the wooden type, both in repairs and new work. There seems to be a disposition among car men to see what there is in these lighter and stronger designs of truck bolsters. It is certainly a wise move to tear away from these relics of early days, and make some intelligent effort to place the truck construction on a plane of equality with the car body in point of excellence.

Some Fitchburg Kinks.

The Fitchburg Railroad car shops have many useful tools and valuable appliances for doing work, not common to all shops, and new enough to be passed around among those who know a good thing when they see it.



AIR AT CAR WHEEL LATHE.

Among them we find an air hoist at the car-wheel lathe—a place where assistance is needed fully as much as at any point in the shop. Our illustration shows a 10-inch air cylinder in a pit between the rails passing before the lathe; the cylinder is located so as to stand centrally with the lathe centers. When a pair of wheels are required in the lathe, they are simply rolled over the hoist, the air is applied, and the piston raises the wheels to clear. They are then turned to the position shown by dotted lines, which leaves them right to roll into the lathe.

The air is operated at the hoist by means of two small rods running from a two-way cock and passing up through the floor at the side of the cylinder. These rods are merely pressed by the foot—one to apply the air, and the other to release. These auxiliaries are not shown.

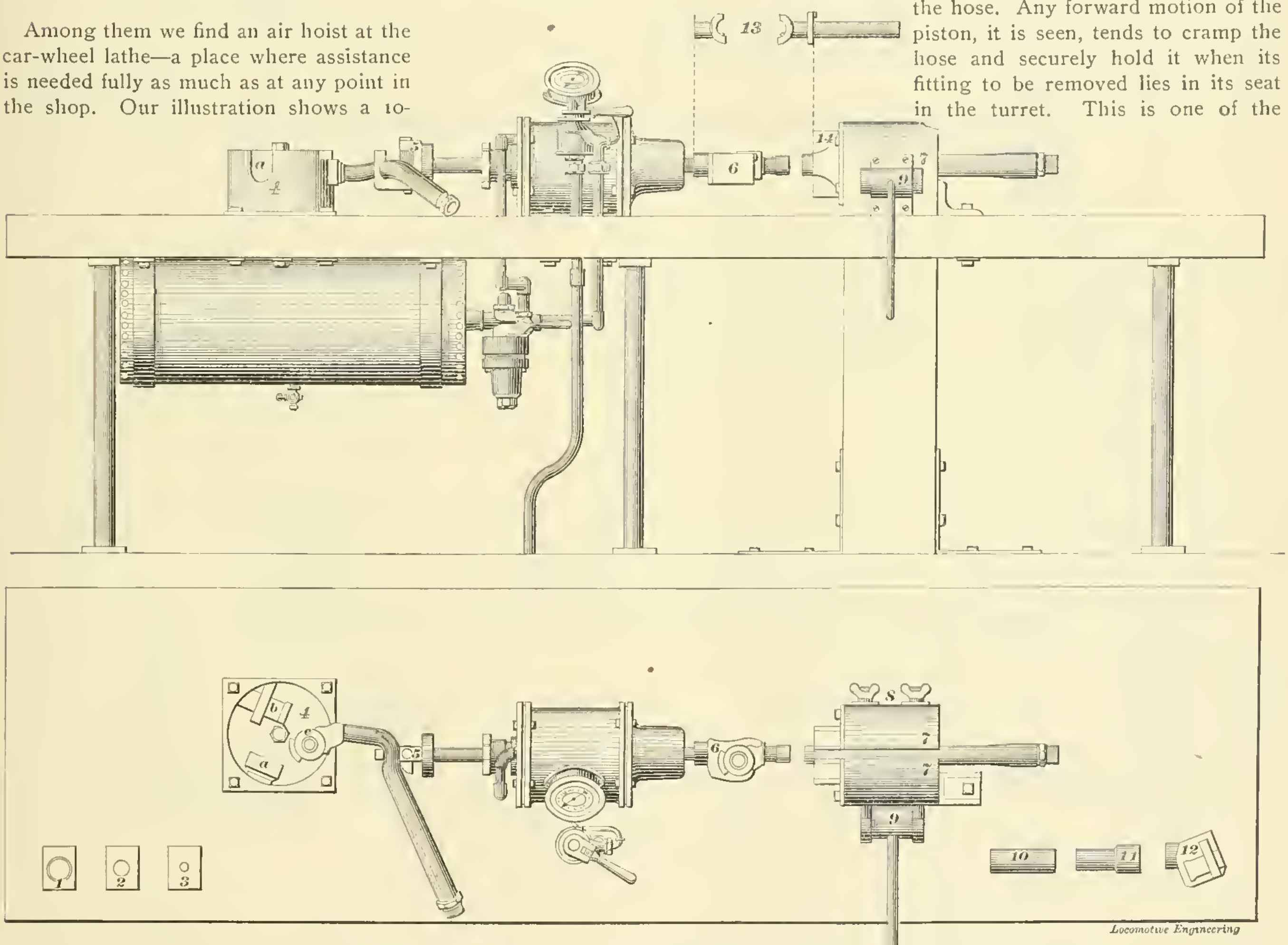
It is only necessary to compare this way of handling wheels in and out of the lathe with the one in general use—where two men are engaged, one of them handling a lever with a block attachment, while the other does the persuasion act—to at once appreciate the fine points of this scheme, with its certainty and ease of action on the forked support.

Machines for applying air-hose fittings are now on file in all well-regulated shops; but a machine that will remove old fittings when defective, or good fittings from old or worn-out hose, is not so much in evidence. We herewith present one that is double-acting in the above sense, in which is seen a very simple affair to do all that it has demonstrated itself capable of.

It has the usual 8-inch cylinder, with a piston rod threaded to receive chucks that will hold the different fittings for hose equipment, these chucks being made so as to bring the fittings in line with the hose when the latter is gripped in the clamp.

The pulling-off part of the device consists of a cast-iron turret lying flat on the table of the machine, in line with the cylinder, and pivoted so as to revolve in a horizontal plane. The top face of this turret is cored to receive the different fittings.

The piston rod extends through the back cylinder head, and has a hook-shaped end in which the hose is laid at right angles to the line of motion, and has a toothed clamp that automatically grips the hose. Any forward motion of the piston, it is seen, tends to cramp the hose and securely hold it when its fitting to be removed lies in its seat in the turret. This is one of the cheapest and best devices of its kind that we have seen.



MACHINE FOR APPLYING AND REMOVING AIR HOSE FITTINGS, FITCHBURG RAILROAD.

1—Holder for 1½-in. straight steam hose nipple.
2— " " 1¼-in. air-brake hose nipple.
3— " " ¾-in. signal hose nipple.
4—Revolving turret.
(a) Pocket for holders 1–2–3.
(b) " " angle steam hose nipple.
(c) " " air brake and signal hose couplings.
5—Cam clutch.
6—Head for holding air brake and signal hose couplings.
7—Vise.
8—Thumb screws adjusting vise to various sizes of hose.
9—Cam for operating vise.
10—Head for holding signal hose nipple.
11— " " air brake and straight steam hose nipples.
12— " " angle steam hose nipple.
13— " adjusting hose clamps.
14—Extension jaw to prevent the hose from crippling.

Distance can hardly be said to "lend enchantment" when a pair of mounted wheels are to be moved over a network of tracks, and pinched around all sorts of obstructions in a crowded shop; and to annihilate some of it, the carriage we illustrate was designed. The engraving tells the story plainly enough.

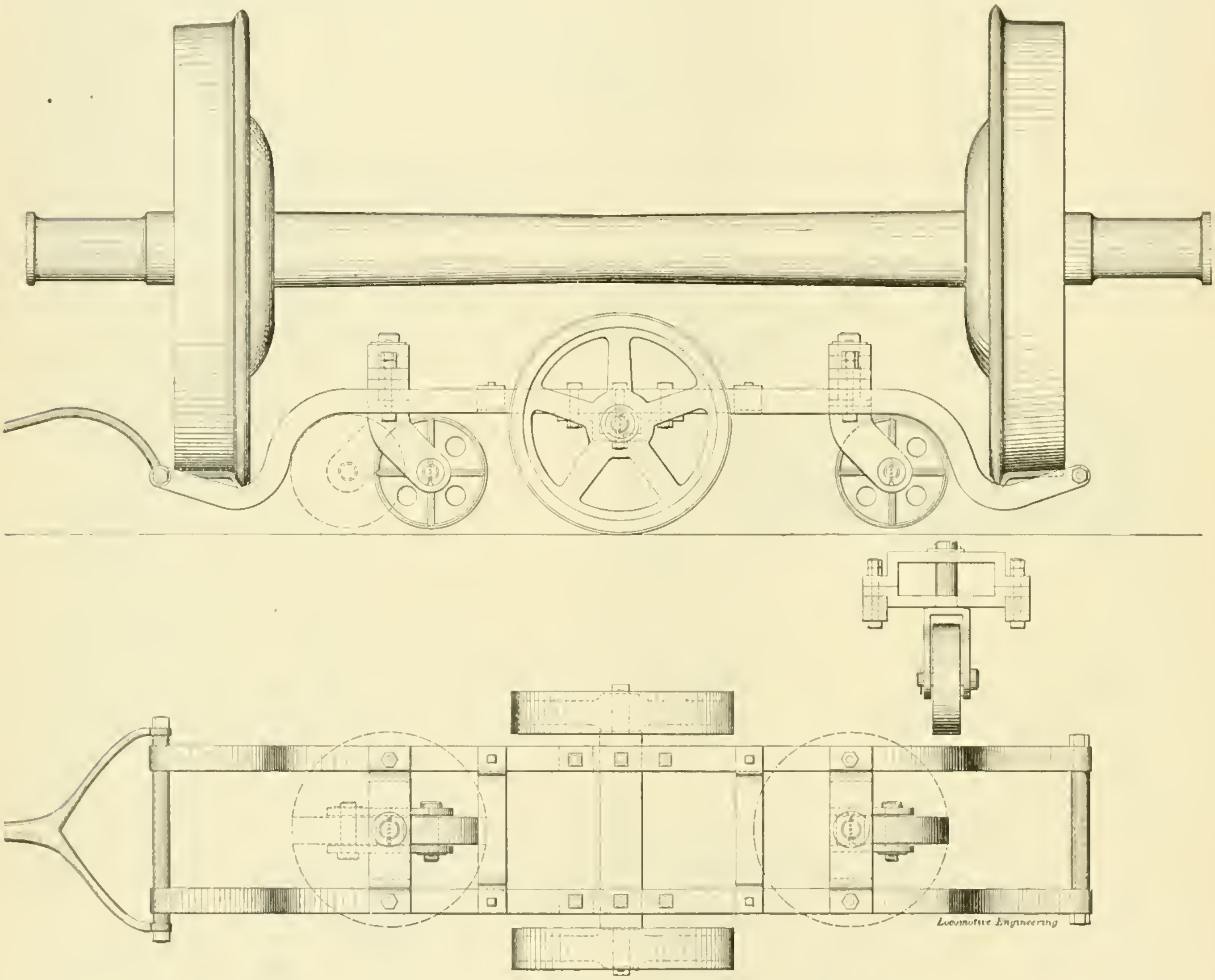
These labor-saving kinks Mr. Eddy, the general foreman, is responsible for, and show that he is ready at all times with a suggestion to help out work on lines calculated to save money. O. H. R.

Some examples of good work in car design and construction of twenty-five years ago are still extant, and are reminders to the younger generation of car builders that they cannot jump into the breach and fill the places being made vacant all too fast by the Grim Reaper until their work can show something to equal these early productions in point of durability combined with lightness. Mr. C. A. Smith, the veteran master car builder of the Union Tank Line, and practically the father of the Master Car Builders' Association (having done more than any other one man to organize and put it on a successful footing), built some passenger cars when he was on the Erie that were marvels at the time—and are yet. These coaches were 70 feet long and weighed 38,000 pounds. That was an enormous length for those days, and coming very near the limit for the present time. They have been in service continuously from the day they were built, except when in for repairs, up to to-day, and no one can predict when the end will come; but when it arrives, it will be the end of the One Hoss Shay. Those cars stand linking the past to the present, as representatives of practice in construction fully equal to that of to-day.

Car-truck frames of the girder type are receiving recognition at this time that must be flattering to the advocates of that style of construction. The master car builder of a prominent road recently made the statement to us that he now had 1,200 cars equipped with pressed-steel trucks, and spoke in glowing terms of their economical performance. Such testimonials as that are likely to make the arch-bar truck weaken in the position it has held so long, as the mainstay of the best builders, and probably has much to do with the installation of a large plant for the manufacture of pressed-steel trucks.

Band saws are no longer filed by hand in well-regulated shops. The filing and setting of the teeth is done automatically on a little machine about 20 inches square, that looks innocent enough when standing still, but is full of business when it gets a saw in its grip.

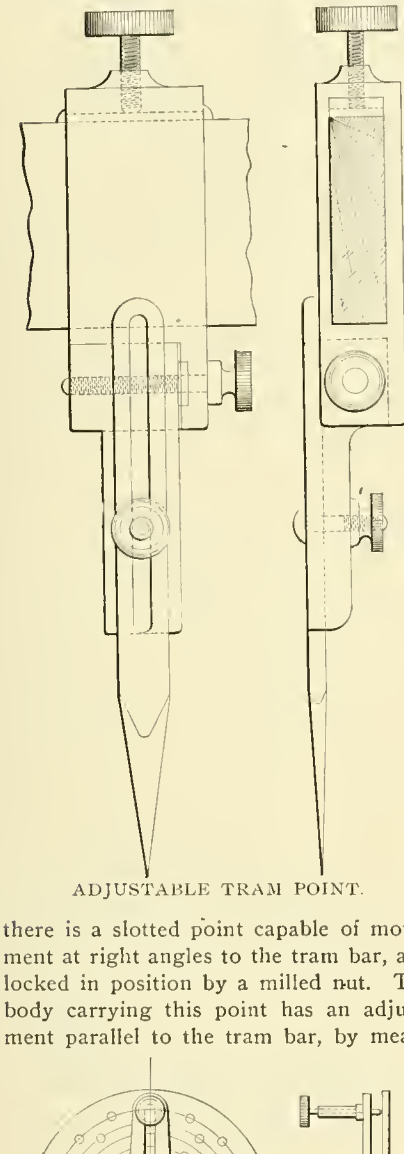
The General Agency Co., New York, which handle the Smith triple-expansion exhaust pipe, have issued rules to be followed in applying the exhaust pipe, some of which might be followed to advantage with all locomotives. In regard to brick arches, for instance, they say: "We recommend the use of a brick arch fully two-thirds the length of fire-box, set six inches from the flue sheet, the center of arch on a line with the center of lower row of flues. The back end of arch should be so set that the area from the top of the back end to the crown sheet shall be 1½ times the area of the flues. Also, the area from the back end of the arch to the back end of firebox shall be the same as the area from the crown sheet to the arch."



CARRIAGE FOR MOUNTED WHEELS, FITCHBURG RAILROAD.

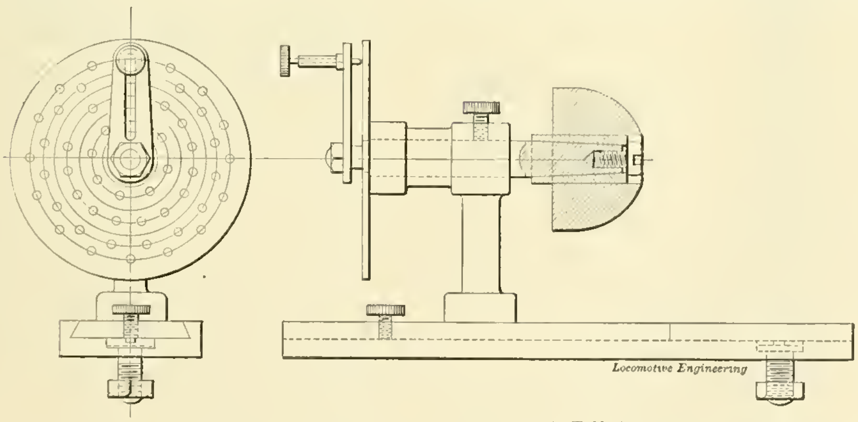
Shop Kinks at Valley Falls.

The convenience of the tram with an extensible and adjustable point is appreciated to the fullest when tramming an engine having more than four drivers. Our illustration shows the best development of this idea that we have seen. As shown,



ADJUSTABLE TRAM POINT.

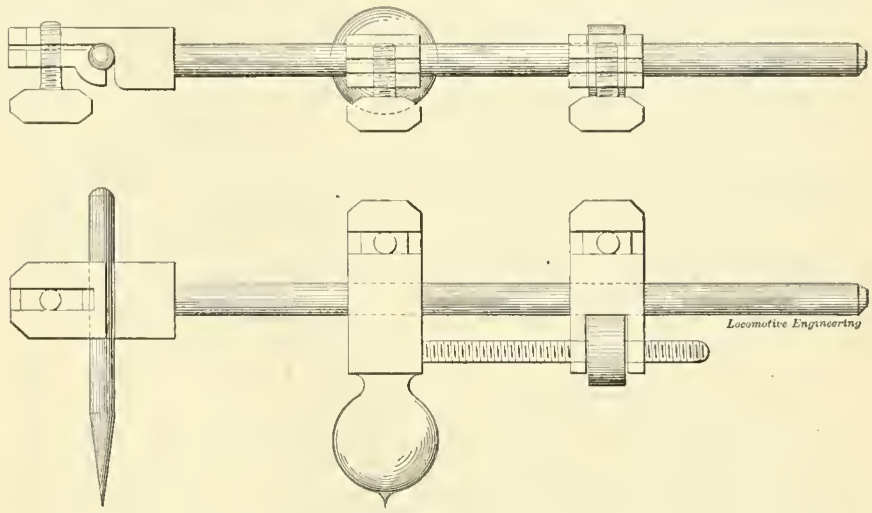
there is a slotted point capable of movement at right angles to the tram bar, and locked in position by a milled nut. The body carrying this point has an adjustment parallel to the tram bar, by means



FOR FLUTING BALL JOINT CUTTERS.

of a screw, and is virtually a micrometer when the collar on the nut is graduated. This last feature is a particularly valuable one, since an adjustment of the tram is possible to any degree of nicety, and any allowance required on the length of rods can be made with absolute certainty.

Contrary to the practice of tramming in most shops, where center points are used for the tram points, we find in these shops that it is the practice to describe circles on the ends of axles and crank pins, and tram from the lines thus made. The tool for making these circles is shown in our picture of the ball divider, which takes its name from the fact that the ball fits in the center, around which the scribing point makes the circle. It will be seen that the little thing is simplicity itself: A ⅜-inch round bar for a body, on which



A CENTER DIVIDER.

slides the ball center and its adjusting screw and nut, both having a clamp screw to hold them in position. One end of the bar has the scribing head with its scriber, which is also firmly held by a clamp.

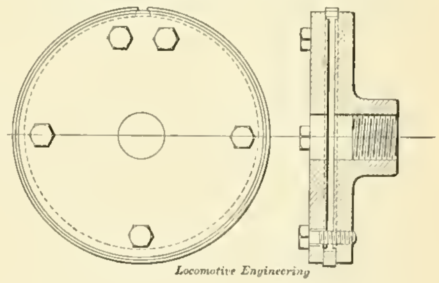
FLUTING OF BALL-JOINT BEARINGS.

The old method of filing teeth on a ball-joint cutter is well known to be a slow and inaccurate way to build the business part of a very useful tool. Our engraving makes it plain that some good head work has been done on the device shown, which is for the purpose of fluting the teeth out of the solid, or forming grooves to receive them when the cutting tool is made with the let-in tooth. It was designed by Mr. Foster, the tool-room foreman, and is not patented.

It is devoid of all complications mechanically, consisting only of a light base, which is secured to the table of the grinding machine and swivels on the bolt shown. This base carries the head on a dovetailed slide, which is held rigidly at any point by the cramping screw passing through it. On the head is mounted a dividing index, which has the outer end of its spindle tapered to receive a split sleeve, on which the work is mounted and secured, by means of a screw forcing the sleeve on the tapered spindle, and thus expanding the former so as to tightly fit the bore of the work, as shown in section.

The sliding head is capable of any radial adjustment within the length of the base, and is therefore fitted to do any radial grinding that may be likely to come up in a railroad shop.

Piston packing-ring practice is so variable in the different shops of the country as to be a matter of comment among those on the inside; and this is all the more strange, because a cast-iron ring of practically the same section is now almost universally used—bringing out the query



CHUCK FOR PISTON RINGS.

as to the diversity of operations to get a common result.

A chuck for turning the cylinder fit on piston rings is herewith shown, which has won the stamp of approval of every mechanic who has seen it. The rig is simply a pair of cast-iron disks bolted together, one of which has a boss threaded to fit the spindle of a lathe. A ring of the so-called "Ramsbottom" type is faced off, but not bored out; and when placed in the chuck, a clamp is put on and the ring is closed the proper amount to have the required tension, the bolts are then set up and the ring is turned exactly to the diameter of the cylinder.

When the ring is released from the

chuck it will, of course, expand, and must be sprung into the cylinder. There are two important advantages to be had in fitting rings this way: First, there is no guesswork as to the fit in the cylinder, as in other methods where the ring is distorted and must wear to a fit; second, the element of tension in the ring—one of the most neglected factors—is a known quantity and always within control.

There is little room for comparison between this purely mechanical sure thing and the go-as-you-please style of a solid ring turned ½ inch larger than the cylinder and afterward cutting and springing it into place.

These kinks are in everyday use in the Valley Falls shops of the New York, New Haven, & Hartford road, where Master Mechanic Butler presides, and where time has not dimmed the luster of a well-earned reputation for advanced tool-room practice won long ago. O. H. R.

Dimensions of Cylinders.

The "Railway Herald," of London, has been publishing weekly a leading article on some important railroad mechanical subject, which has contained a great deal of valuable educational matter for railroad men.

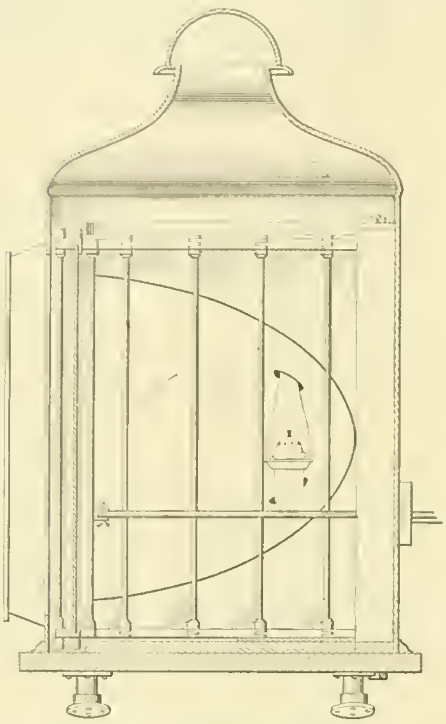
A recent article says: "A point of great importance in the designing of high-speed steam engines is the amount of surface exposed to the cooling influence of the exhaust. It has not been possible, so far, to discover a non-conducting material wherewith to make steam cylinders. The best is to reduce the amount exposed to a minimum. A question well known to those who have studied the differential calculus is: What are the dimensions of the cylinder which present the least external surface for a given volume? There is an infinity of cylinders having the same volume, but among these there is only one in which the external area is least, and in this one cylinder the length is equal to the diameter. Applying this to the case of a steam-engine cylinder, the area in question is represented by the walls of the cylinder barrel, one side of the piston, and the inner face of the opposite cylinder cover. It would seem, therefore, as if to secure the last condensation the stroke should be made equal to the diameter. Locomotives have been built having such cylinder proportions, but probably not on account of this fact. It must not be left out of sight that during the return stroke the whole of the cylinder walls is not exposed to the atmosphere. We have to take into account the compression and readmission periods, and the clearance space; so that for the purpose of reheating as much as possible the walls, previous to the commencement of the stroke in the reverse direction, we must make the stroke somewhat longer than the diameter of the piston."

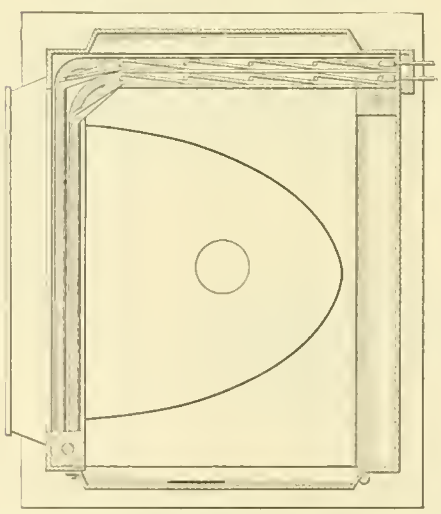
A New Headlight Signal.

Henry J. Davis, of Pueblo, Col., has recently brought out a new thing in headlight signaling.

Instead of using the simple curtain to darken the light when train is in siding to clear, he employs a shade that shows a red headlight when train is on siding, but not in to clear, and a blue headlight when they are in to clear.

In these days of fast time on single-track roads, it would be a great relief to





PLAN.

the man on the flyer to know just how things are fixed at the station he is approaching—if there is a train there now with a clear headlight, he is not sure whether they are in siding, with the rear end hanging out, or on the main line.

Mr. Davis uses shutter slides made up of panels of red and blue glass. These slides are carried in the right side of the headlight case, and are shoved ahead and over the front by rods running back to the cab. These shutter frames are made of metal and hinged, sliding in grooves top and bottom of case, as plainly shown in the engraving. Any further information can be had by addressing the inventor as above.

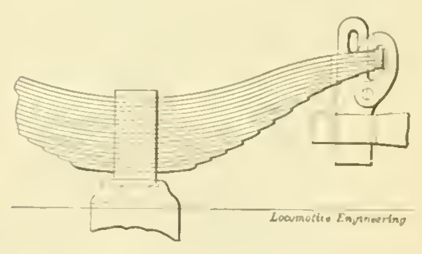
Railroad Through the Sea.

A railroad through the sea is being built in England, and is now almost completed. It runs from Brighton to Rottingdean, a distance of four miles. There are four lines of rails, laid in two pairs, the width of gage between the outer rails being 18 feet. Each pair of rails is supported by concrete blocks mortised to the rock below. The steepest gradient is 1 to 300, and the sharpest curve half-a mile in radius. The rails are laid on the beach so near to low-water mark that they are covered a greater part of the twenty-four hours.

The object of this road is to give the throng of people who resort to Brighton an opportunity to travel on the water without being subject to the annoying motions that cannot be avoided on shipboard. The deck of the car is 23 feet above the rails, and well out of the reach of the waves. The deck will measure 46 x 22 feet, and will carry a saloon 25 x 13 feet. The motive power will come from a trolley wire strung along poles on the shore.—Ex.

Spring-Hanger Strengthener.

The sketch shown illustrates a method of strengthening the spring hanger used on nearly all the locomotives belonging



to the Louisville, New Albany & Chicago Railroad.

The device needs no description. As spring hangers are weakest in the keyhole, and generally break there, the attachment shown is sufficient to divide the strains. It is said to be an effectual preventative of broken hangers.

M. Paul de Hurny, a French naval officer, has invented a process for solidifying petroleum. It is said that common oil has been converted into a solid block as hard as anthracite coal, and that it will burn slowly, giving off intense heat. A ton of this fuel is said to represent thirty times its weight of coal.

Grinding Attachment for a Drill Press.

The Brussels shops of Belgian State Railway have a grinding device in use, which we illustrate by courtesy of Mr. G. R. Henderson, M. E., of the Norfolk & Western Railway, to whom the drawing was furnished by Mr. Barnard, the shop manager.

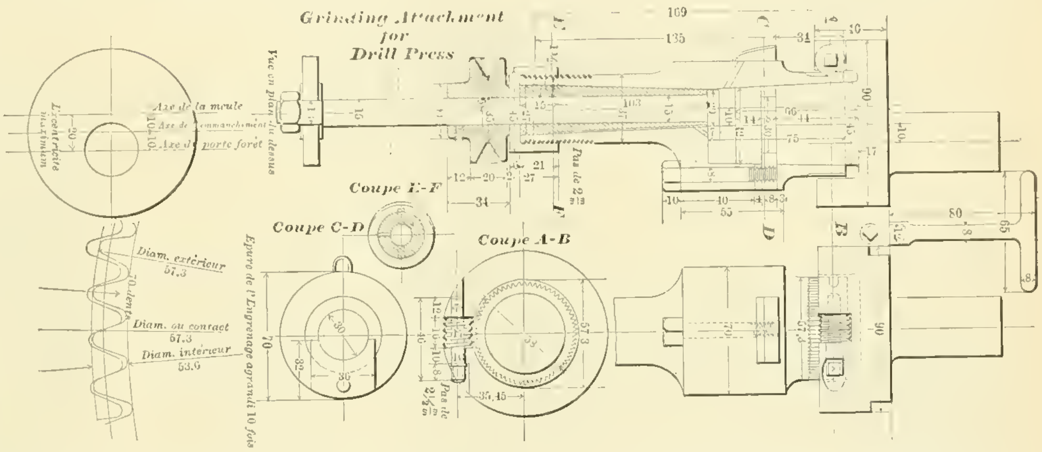
It can be used on any machine having a rotary motion, but was especially designed for application to a drill press. The dimensions are given in metric values, and the descriptive notes are in French; these we leave in their virgin purity, to show the foreign origin of the device, which may appear complicated at first glance and without studying the drawing, which was made for shop use and not for parade. We reproduce it entire.

The construction is such as will drive the grinder from a head fitted to the socket of the drill spindle. This head is made with a conical projection extending down from the under side, and is turned eccentric with the shank that fits the spindle socket; it is shown in section at line *A B*, and in plan marked *coupe A B*. The tapering socket receiving the above projection is a part of the hollow sleeve which carries the grinding spindle, the latter working in a split bushing, and held in position by a collar at the upper end, and at the lower end by the cable sheave which drives the grinder; the emery wheel is shown at the lower end of spindle, secured by a nut. The sleeve carrying this spindle is also made eccentric with the body of which it is a part and the method of fastening is shown in section at line *C D*, and in plan marked *coupe C D*. It consists of a plate sliding through a slot in the sleeve, and engaging in a groove in the tapering projection of under side of body, the plate being tapped to receive a bolt on under side of sleeve. The two parts are thus firmly united longitudinally; but the sleeve is perfectly free to rotate about the body above it, by means of the worm carried in the body, and which engages with the teeth cut on the upper end of the sleeve.

In operation, the head revolves with the drill spindle, and the sleeve, being secured to it, revolves about the axis of the spindle in a path equal to twice its eccentricity, carrying with it the grinder, which, it is seen, has two motions—one about the axis of the prime mover (the drill spindle), and one about its own axis. Motion is transmitted to the grinder by a cable drive on the sheave shown above the grinding wheel.

The device is shown set to its maximum capacity, as will be seen by a reference to the plan view at the bottom of the illustration, where the three center lines are shown in their proper relation to each other for the extreme positions, marked *excentricite maximum*.

When used as an instrument of precision on the interior of a cylinder, the axis of the grinder is made to coincide with that of the drill spindle, or nearly so—depending on the diameter of bore—and any increase of the latter is at once effected by turning the worm screw, for which a wrench or key is provided, as shown. Any movement of the worm tends to separate the axes referred to, and feeds the grinder into the work, on the same principle that a lathe tool is fed into the cut. It is apparent that the device will work with equal facility on the exterior of a job, in which event it would be started from the positions shown in the illustration.



The Roxbury Shops.

The shops of the N. Y., N. H. & H. at the above point bear evidence of old-time days, and the tools are largely of an antiquated type; but Master Mechanic Twombly is not influenced by his surroundings to the extent that he neglects any openings for improving and cheapening the cost of his output. He is a believer in compressed air for handling work about the shops, as is amply evident by the home-made overhead trolley with a small air-lift running lengthwise of the machine shop, another crosswise of the same shop, and still another running from the axle pile to the machine shop, and also one from the wheel platform to the machine shop and roundhouse. These lifts are 8-inch, and, in addition to these, there are 14-inch lifts at each pit, and a small one located over the potash vat, to lower and raise the cage containing the work in process of cleaning.

This system of trolleys has worked a revolution in handling work here, making it unnecessary to truck anything about the shop, and it is immensely popular with the men. There are other shops that have utilized air in a greater diversified field perhaps, but there are few that can approach this in the completeness of its small traveling cranes. Like most railroad shops, this has not attained to the dignity of a full-fledged air compressor, and has to get its pressure from 8-inch pumps, whose air cylinders are bushed to 6 inches diameter, giving a constant working pressure of 100 pounds, which is stored in a reservoir made of an old locomotive boiler.

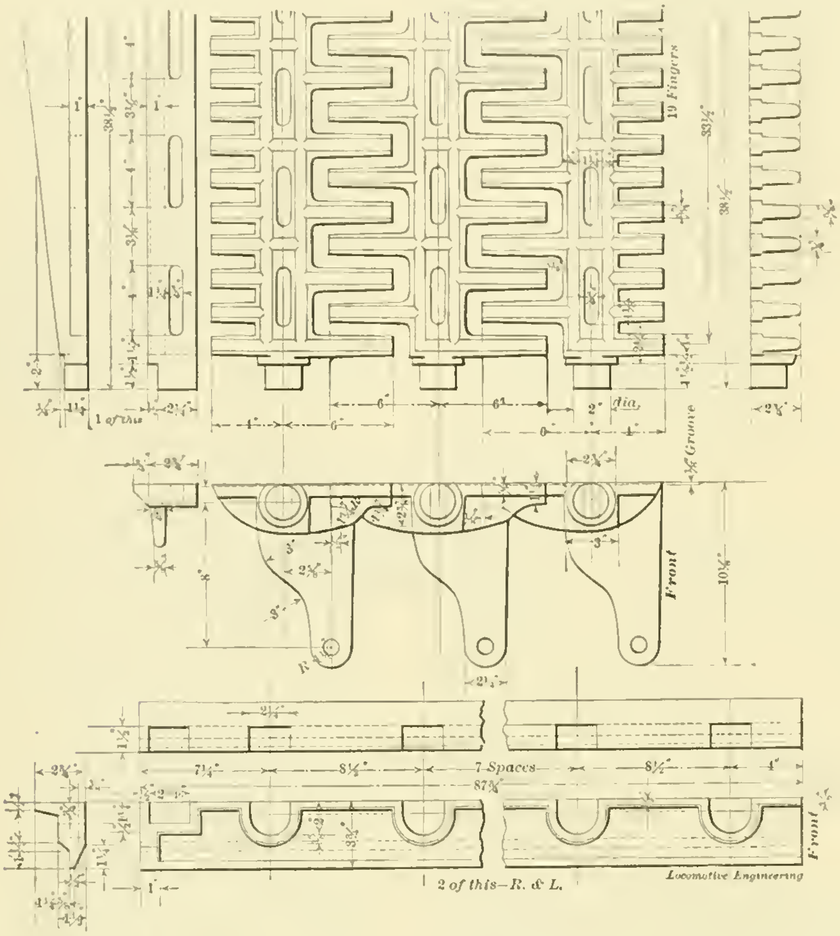
There is a belief among some engineers that an ordinary locomotive will not attain a speed of 100 miles an hour because the steam will not escape fast enough to relieve the piston of back pressure. The Chicago & Northwestern people had a good demonstration that the back pressure as a speed-restraining brake is a fallacy. They were making some experiments on the testing plant illustrated in our March number, when the governor belt accidentally slipped off. The engine at once started to race. The Boyer speed record is graduated up to 100 miles an hour, and the pointer went as far as it could go before steam was shut off. The men in charge thought that the speed was about 150 miles an hour.

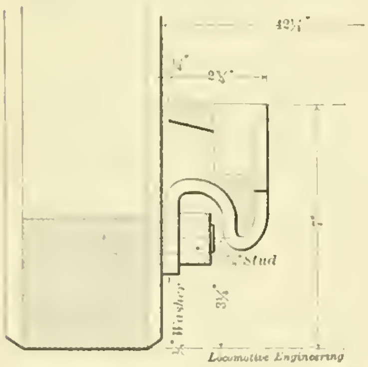
Many years ago, in a railroad repair shop, it was found impossible on a certain occasion to spare the only planer in the shop to plane up the joints of some rocker boxes that were halved together, owing to a rush of planer work. The congestion was relieved by doing the job on a lathe as follows: A little platen or table was made and applied to the lathe carriage, adjustment to height being had by means of four screws, each one of which had a nut above and below the table. The rocker-box halves were bolted to this table, and a milling cutter carried on the lathe centers made as good a job as would have been possible on the planer. This experience is cited as one instance where a man "rose to the occasion" by originality or pure kink gifts, long before the milling machine was as well known as it is at the present time.

No January or April papers now. Commence subscriptions with May.

Locomotive Details—Boston & Maine Railroad.

Our engravings of some locomotive details, showing the standard practice of the Boston & Maine, are given by permission of Mr. Bartlett, superintendent of motive power of that road. The rocking grate and the method of holding the side





ROCKING GRATE, BOSTON & MAINE.

bars are given to show a design that possesses many strong points, among which will be noticed the short fingers on the rockers, only 12 inches over all, as against the average length of 22 inches on many other roads. These short fingers are less liable to breakage on account of the reduced lever arm, and another and greater advantage lies in the increased chopping action on the fire when the grates are rocked—breaking the fire more uniformly over the grate, an item of no small importance with some fuels.

The oil cup for eccentric straps is gotten up with a needle feed, and, in addition to that, has an outside channel cored in the body of the cup by which a warm eccentric can be deluged with oil when the conditions demand it. The engraving of of this is very clear.

Brick arches on this road are applied on common-sense principles, in the relation of their position with reference to the crown sheet, and also their total length. It is an exceptional case to find any established rules laid down for the proportion of brick arches for certain dimensions of fireboxes, or the ratio of opening above the arch to area of all flues. It is, on this ground, refreshing to find one authority on the subject who has courage to give out cold figures to exemplify actual practice.

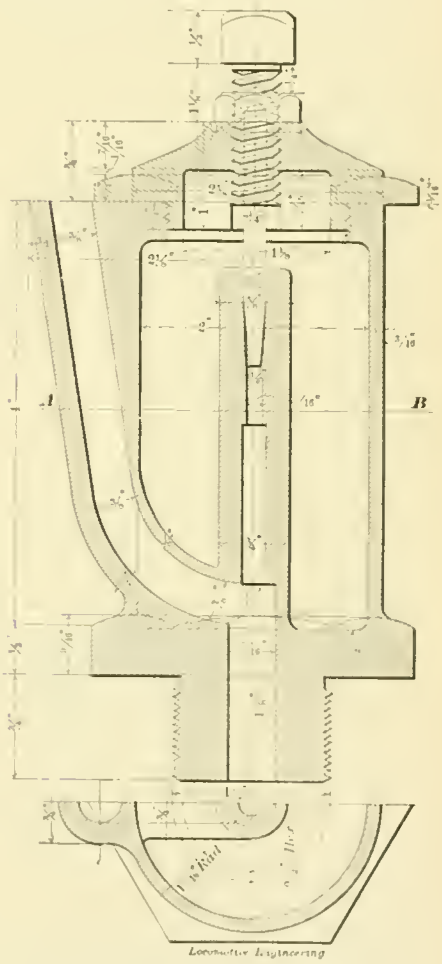
The proportion of area of flues to the openings around arch, at front and back, is made 1½ to 1 in all cases, that having been found to give the most economical performance. The details of construction of the arch in the engraving show it to be in sections 16 inches wide and made in two pieces, the sections being locked at the center by a 1½-inch round bar passing lengthwise of the arch. It is supported at the sides by two 1 x 2-inch wrought-iron lugs, with ⅞ twelve-thread ends, screwed into side sheet under each section of brick. The whole arrangement is good and without one seriously objectionable feature.

The exhaust damper or muffler we show was gotten up to stifle the horrible din made by the exhaust of their heavy engines in the Union Station at Boston. This is accomplished by means of a netting secured to a frame and operated from the cab by a lever which actuates a shaft passing across the smoke arch, back of the exhaust nozzles; the netting being secured to this shaft, is raised completely out of line of the exhaust, or dropped at pleasure.

This device is supposed to have been introduced to enhance the comfort of the "dear public," but the fact that the general offices are located in the building would lead to the belief that some other people's comfort was contemplated. But let that pass—it is a good thing in any event.

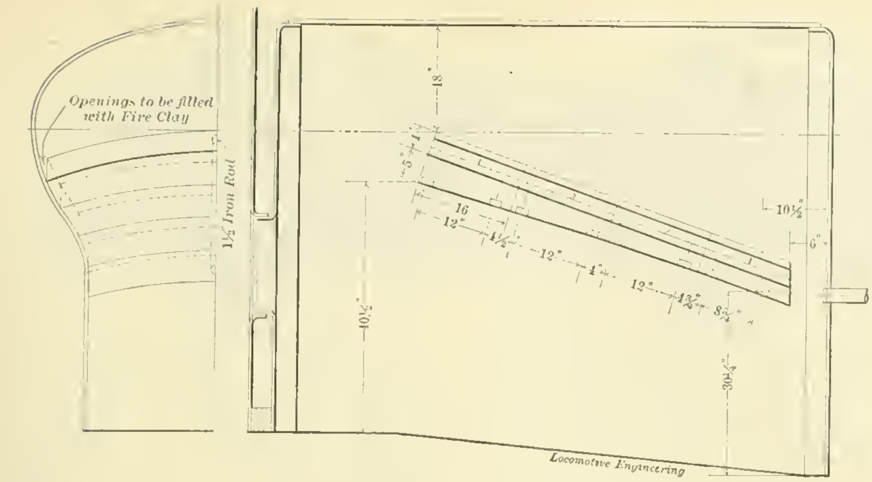
O. H. R.

One of the neatest jobs of cobbling up a break-down in the shop that ever came under our observation, was seen in the



OIL CUP FOR ECCENTRIC STRAP, BOSTON & MAINE.

Fitchburg car shops recently. The punch and shear in the blacksmith shop had a gear, about 48 inches in diameter, which took advantage of a busy season to break in three pieces. It was impossible to hold the work until a new gear could be furnished by the builders of the machine, and Mr. Eddy, the general foreman, came to the front with an original scheme to tide the machine over the push. He bolted two disks of boiler plate to the



BRICK ARCH, BOSTON & MAINE.

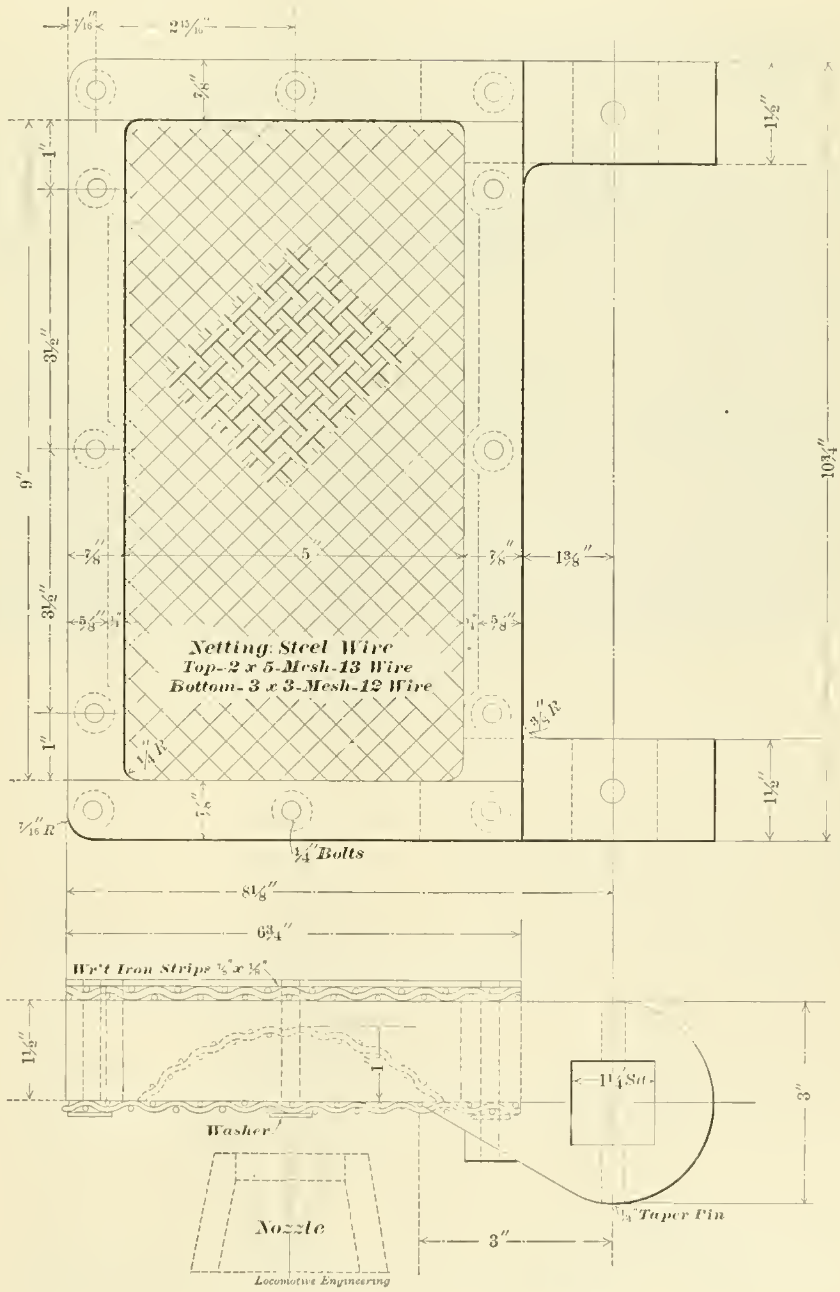
arms of the gear, after placing the broken sections together, as they were in health, and then shrunk a wrought-iron band, 1½ x 1½ inches, over the teeth, in the gear face, and then grooved the pinion to clear the band. That gear has driven the machine every day since, with no signs of dissolution; and when it is remembered that the only precedent on record for a job of that kind is to scrap the gear at once, it looks to us as though another man had "risen to the occasion."

Corridor cars, as they call coaches built on the American plan in England, have generally found favor over there; but on one line, the West Coast, there are grumblings and discontent from the gilded patrons of the roads because the unwelcome third-class travelers intrude on the privacy of the party of the first part. Caste prejudice dies hard; but there is nothing more certain than that what is now regarded by some as an unnecessary innovation, affecting the so-called rights of a certain few, will after the first pang is over be welcomed as a decided improvement over the old practice, notwithstanding that privacy, as they know it, has been sacrificed to comfort and convenience.

The Boston & Maine R. R. is about to build a new plant at Somerville, and abandon the old shops at Charlestown and East Cambridge, the increased business and progressive tendencies of the road demanding more and better facilities for handling their work. New roundhouses do not appear on the new drawings for the reason that the old ones are very conveniently located for housing the engines, and answer the purpose fully as well as though built to-day, but the repair shops are simply obsolete and of no use in keeping up repairs, not to say anything about doing new work. Concord will also have a modern shop, with every device for cheapening the cost of work; electric traveling cranes and motors, and an air plant that will reach all previous efforts in the utilization of air for shop purposes. There is something pathetic in the sacrifice of any old shop that has been the cradle for the power of a growing road, and these will be missed by many grizzly old timers who have formed an attachment for the old rookeries that time will be slow in effacing.

The Pedrick & Ayer Co. have in use in railroad shops 120 of their belted compressors—showing that railroad people are fast recognizing the fact that air-brake pumps are good enough for a makeshift for shop pumps, but not for a regular thing.

Watson & Stillman have 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.



EXHAUST DAMPER, BOSTON & MAINE.

AIR BRAKE DEPARTMENT

Conducted by F. M. NELLIS.

Echoes of the Boston Convention of Air Brake-Men.

Ninety-seven members answered roll call.

Snappy work and harmony characterized all sessions.

The association has a membership of two hundred and forty-two.

The success of the convention exceeded the most sanguine expectations.

One session, beginning at 9 A. M. and ending at 1 P. M., was held each day.

"Dat 'skurzhun t' Plymout' wuz a bute." —*Danny Dugan.*

That an air brake man is a "crank" was demonstrated by the large attendance at all sessions.

The large attendance shows that an increased interest is being taken in air-brake service.

As a rule, the papers were so complete as to preclude lengthy and tedious discussion.

Veteran S. L. Hawks, of the Chicago & Alton Railroad, was present, and gave the youngsters an interesting talk.

The air-brake men seem to have the happy faculty of speaking to the point and sitting down when they are through.

It was noticed that better results were had on roads where the air-brake man is given authority and is held responsible. .

The re-election of President Hutchins, Secretary Kilroy and Treasurer Best was a fitting recognition of faithful and able services rendered.

The Pacific Coast, Canada, Northwest, Southwest and South were well represented. There was an avalanche of members from the Eastern and Middle States.

Railway officials who granted leave of absence and transportation to their air-brake men have made a good investment, and will doubtless receive profitable returns.

The character and amount of air-brake information contained in the several papers read at the convention proves that the air-brake men are great investigators, and that they are well up in the art of seeing.

Professor Swain, of the Boston School of Technology, and engineer of the Massachusetts State Board of Railroad Commissioners, made the opening address and welcomed the convention to Boston.

The members could successfully trace the air through the winding passages of the valves of the air-brake system, but they were complete failures in attempting to master the crooked streets of Boston.

President Hutchins proved himself to be a presiding officer of extraordinary ability. His rulings showed a close acquaintance with all air-brake subjects, and that he was equal to the requirements and responsibilities of his office.

"Locomotive Engineering's" colored air-brake chart, and group of portraits of the Air-Brake Association officers, were the most appropriate and highly appreciated of the numerous souvenirs distributed to the members at the convention.

"False piston travel" is a newly-coined expression direct from the Air-Brake Men's Boston Convention, and is employed to describe the momentarily increased piston travel resulting from a car jolting over crossings, frogs, low joints, etc.

"Lost piston travel" is another brand-new term originated at the Boston Convention, and "is produced by deflection in rigging, lost motion in pedestals, boxes, brasses, truck transoms, center bearings and brake connections, and live levers striking in release on truck frames."

What better evidence is needed that the Air-Brake Association is on the right track, and is accomplishing good, than the complimentary and encouraging words of such eminently practical railroad men as F. D. Adams and J. W. Marden— both veteran master car builders.

Nashville, Tenn., was selected as the place for holding next year's convention.

The Air-Brake as a Life Prolonger.

Professor Swain, in making his opening address to the Air-Brake Men, states: "From the figures in the last report of the Interstate Commerce Commission, it appears that one passenger was killed for every forty-four million passenger miles run, *i. e.*, that the chances are that a traveler will not be killed on a railroad until he has traveled forty-four million miles. In other words, if a child were born traveling in a railway car, and were to spend its life traveling in the same car at a speed of fifty miles an hour, it would live to be one hundred years old before it would be killed by a railroad accident."

A Graphic Illustration.

The report of the Committee on Water-Raising System on Sleeping Cars says: "A passenger arising from his berth in a sleeping car in the morning will use about a gallon and a half of water in washing. To fill the space vacated by the water with air pressure at 20 pounds will require 817 cubic inches of air at atmospheric pressure, and 2.6 strokes of an eight-inch pump must be made to compress it. At 70 pounds, almost 2,000 cubic inches of free air will be required, and 6.4 strokes must be made to compress it."

A Great Waste of Pressure.

In substance the paper on Piston Travel read at the Air Brake Men's Boston convention says that in making 175 stops, a thirty-car freight train, with piston travel adjusted at nine inches, will use 8,736,000 cubic inches of free air more than if the adjustment be made at five inches. To compress this volume to seventy pounds would require an eight-inch pump to run at full speed with 140 pounds steam pressure for three and three-quarter hours. A nine-and-a-half inch pump would do the same work in about two hours.

Automatic draining valves for main reservoirs that will be an improvement over the present drain plug must be simply constructed, positive in action, and able to successfully combat the interfering influences of sediment, gummy oil and ice. Service trials frequently kill devices which look well on paper. Designers cannot give too much attention to the practical side of the question.

Fred Hain, Buffalo, N. Y.; D. L. Bachman, Perth Amboy, N. J.; C. W. Harton, Richmond, Va., and M. C. Glenn, sent correct solution to "Thrall's Problem" a few days too late for insertion in the April number.

C. F. Sundberg, Sioux Falls, S. D.; Leroy M. Carlton, Eagle Grove, Ia., and R. Escol State, Bellefontaine, O., have sent correct solutions to "Conger's Problem" in April number.

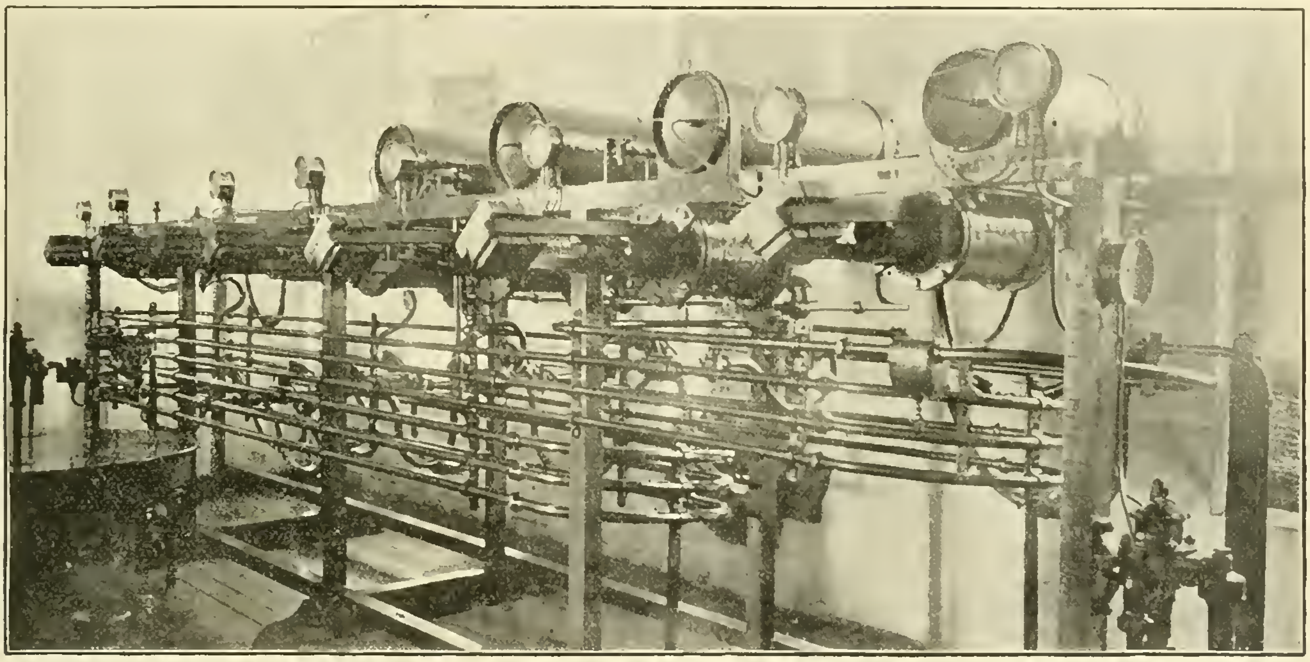
CORRESPONDENCE.

Central of Georgia Railroad Air-Brake Instruction Plant.

Editors:

I am sending you, under separate cover, a photograph of an air-brake instruction room now in operation on the Central of Georgia Railroad at Macon, Ga.

The room is 16 x 32 feet; the rack is 3 x 6 x 25 feet, with full equipment for engine and tender (less driving brakes), three passenger cars and three freight cars, signal, and full length of pipe for each car. We use a 9½-inch pump, which is located in the engine room about six hundred feet away, and is connected to a reservoir containing about 95,700 cubic inches. This air is conveyed from there, through a 1½-inch pipe, to reservoir in room, containing 17,400 cubic inches, which is located in right-hand corner of room. Reducing valve is connected direct to reservoir, and signal pipe is run on back of rack.



All turns in the piping are made with easy bends, there being only eight right angle fittings used on the rack. We use seven duplex gages, they being connected to auxiliary reservoirs and brake cylinders; the gage on the end of rack to the left is connected to signal pipe. The brake cylinders are fitted with stirrups ½ x 2 inches, with three 2-inch blocks in each, so that the piston travel may be lengthened or shortened and the effect shown.

We have D-5 brake valve, quick-action triple, governor, signal valve and reducing valve cut in section, so that all ports may be seen, and are mounted on a table which is shown in part near the center of the room. The frame is made of 3 x 3-inch timber, and is braced with three 1-inch rods through the wall.

Macon, Ga. W. W. ELFE.

A Record Breaker.

Editors:

The first of April, 1894, I overhauled an 8-inch Westinghouse air pump, and on the 12th of the month it was placed in service on C. & O. Engine No. 23. In May, 1895, Engine 23 came into the shop for general repairs. The pump was taken off and tested, and was found to be in good shape supplying plenty of air. The general foreman, seeing the able manner in which pump performed its work, requested it to be replaced on the engine to see how long a pump would last; also to test the general benefit of metallic piston-rod packing with which this pump was equipped. The engine remained in the repair shop for three weeks before it was again assigned for duty.

On March 12, 1896, the engine again returned to the repair shop for general overhauling. Again the pump was placed on the test stand and found to be very slow in accumulating pressure, so it was dismantled and prepared for a hot lye bath.

The following is the condition which the pump was found to be in, after a year and eleven months' yard service of twenty-four hours per day, minus the three weeks in the repair shop and the time laid up for boiler-washing—in other words, three years and ten months' service of eleven hours per day, which would allow ample time for boiler-washing and repairs. During this period the pump was supplied with five discharge valves, four receiving valves, reversing valve, bushing and stem, aggregating a cost of about seven dollars. This proves that metallic packing is a great saving for air pumps. The piston rod was only worn the two hundredth part of an inch in diameter, and was perfectly straight.

The steam cylinder was worn the one hundredth part of an inch, bell shape, being smaller in the center of the cylinder and one sixty-fourth of an inch elongated.

The air cylinder was worn the one hundredth part of an inch, bell shape, being smaller in the center of the cylinder, but perfectly round and as smooth as glass. The steam rings had an opening of one-eighth of an inch, while the air rings were completely worn out. I used an oil cup on the piston-rod packing, which was as tight as the day it was put into service.

P. P. HALLER,
A. B. Insp., C. & O. Ry.

Covington, Ky.

Solution of Conger's Problem.

Editors:

The brake was set at first application with a light reduction of train-pipe pressure. Although we doubted it at first, yet the gages showed that some of the auxiliary air passed through the feed port before the triple piston moved.

The brake piston did not move far enough to cover the leakage grooves, and all the air that came out of the auxiliary into brake cylinder was wasted. Another reduction was made, with the same result, bringing valve to lap. After a few times experimenting, it was an easy matter to drain every auxiliary reservoir of air so low that no movement of brake piston was produced less than 5 pounds. This could be done in five or six minutes. When this low pressure was reached, the brake valve was placed on full emergency, and all the air in reservoir flowed out through leakage groove.

This same experiment was tried with an equalizing discharge valve D-8, and in nearly every case some of the pistons would go by the leakage groove—an additional good point for the D-8 over the B-11. When piston travel was increased to 9 inches, the pistons covered the grooves on first application with more certainty than with a 5 to 6-inch piston travel.

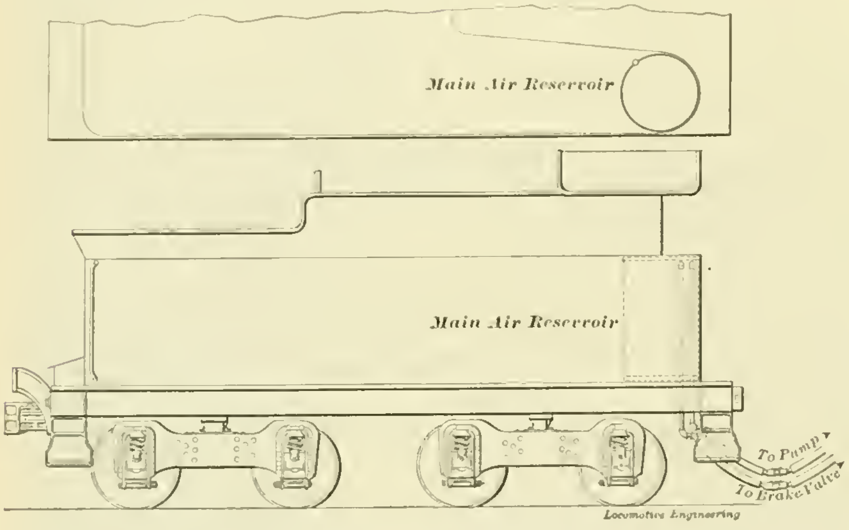
Now the question arises—If this can be done purposely as an object lesson, is it not likely to be done carelessly or ignorantly when trying to make a station stop, and that too, without releasing brake between successive reduction?

A light reduction at first application that does not insure all the leakage grooves being covered, generally leaves some of the brakes not set at all, as the reductions afterward are necessarily light; and when it is seen that the train is going to run by, bang! goes the brake valve into emergency.

I think the reason some careless fellows never have this trouble is because they get the emergency action at the first crack—that covers the leakage grooves—sure pop.

C. B. Conger.

Grand Rapids, Mich.



Location for the Main Reservoir.

Editors:

Herewith I forward you a print showing location for main air reservoir on tender. I would like to have your opinion as to whether this would be a good place to put a main reservoir.

I have seen reservoirs placed in almost every conceivable place on engine or tender, and, in my experience, they were always in the way of repairs and required altogether too much lifting up and down.

Westtown, Pa. Geo. E. Rhoads.

Main Drum Release Valves.

Editors:

The air drum relief valve illustrated by me in February number of "Locomotive Engineering" is not an automatic-acting valve, from the fact that its operation is governed by the engineer cutting out the governor. It should not operate under less than two or three pounds in excess of what the governor is set for. I fail to see any complication about it. The valve is adjusted in the air-brake repair room.

Will the water run out by gravity with Mr. Kelley's valve?

W. de Sanno,
Pan Handle Shops.

Indianapolis, Ind.

Graphite for Air Gages.

Editors:

I believe it is bad practice to oil any of the moving parts in repairing steam gages. I have found that powdered graphite sprinkled over the hairspring and other moving parts produces very good results.

W. de Sanno,
Pan Pandle Shops.

Indianapolis, Ind.

Being Busy, He Took an Examination by Mail.

It is not an unusual thing for an air-brake instructor to receive a letter containing questions and answers purporting to be honestly prepared by some employé who, on account of sickness or business matters, is unable to personally appear, and asks that he be given a rating based on the replies to the questions submitted. The following, which was clipped from a New Hampshire newspaper, is self-explanatory, and concludes with a humorous letter, which, if true, eclipses all previous efforts, and also savors of an honesty not contained in the above-mentioned proxy:

The present general inspection of all the employés of the Boston & Maine for color blindness has its humorous aspect, and among the odd experiences of the examination, none was more amusing than that told by one of the boys as having followed the issuing of an order for the section hands to appear before the examiner. A day or two after this order had been sent out a messenger boy came hurrying in with a small package neatly tied up and addressed to the eye inspector. The latter opened it, and was surprised to find a glass eye wrapped up in tissue paper, and also an old-fashioned watch. The contents of the package proved a puzzle to the inspector till he unfolded a hastily scribbled note, which, on being deciphered, was found to read as follows:

———, N. H., Nov. 1.

"Oy inspector:

"Dear Sur:—The day before yesterday at nune I got word to come down and have my ise looked after for colur blindnes, as ye cal it. I had 46 ties and 10 rales to put down beyond the sand cut, and as jerry Sullivan and Dominick Colly were laid up since the wake that wuz holded over the dead corpse of Daniel Doherty, my hands were tu short to spare me. 'Twas lucky that the right oy that wuz furst in me head was put out with the blow of a pik and me glas oy that is a perfect figur of the oy that was not put out is sent to you together with my watch for examination. I culd spare the glass oy better than the oy in me hed, an' if she is cullor blind oyl get me one that ain't. Youres truly,

Anthony Driscoll.

Air-Brake Cylinder Indicator Cards.

Cards No. 1 to No. 5, inclusive, are from coach No. 54, with light brake rigging and plain wooden beams.

Card No. 3 shows increased piston travel by jarring coach after brakes were applied.

Cards No. 4 and No. 5 were taken without changing the slack, showing increase of travel, while running, beyond that of standing test.

Cards No. 6 to No. 10, inclusive, are from coach No. 54, with same brake rigging as previous cards, with new wooden beams trussed.

Cards No. 9 and No. 10 are to be compared for piston travel, standing and running.

Cards No. 11 to No. 15, inclusive, are from coach No. 54, with M. C. B. standard brake rigging and trussed metallic brake beams.

Card No. 14 shows increased piston travel by jarring coach after brakes were applied.

Cards No. 12 and No. 15 are to be compared for piston travel, standing and running.

The loop in No. 16 was caused by brake being held on to stop, resulting in a short backward movement of brake piston.

The smoothness of release line No. 17 is due to the brakes having been released at speed.

The zigzag portion of application line No. 19 results from the suddenly arrested motion of brake gear when shoes strike the wheels. It is most noticeable in standing applications.

In all cards it will be seen that the release line does not join the base until the brake is entirely off. This is caused by the cylinder and brake-beam release springs.

Nos. 20 and 21 show the effect of shortened travel in service and emergency applications made while standing.

Diagrams 1 to 4, inclusive, are intended to show the difference between a standing application and others made running with the same adjustment. The broken line is a reproduction of a representative standing card, and the full one is a resultant of many running applications; the terminal pressure, or that where brake was held for an interval between graduations, and the corresponding piston travel being indicated by a dot.

No. 1 represents the light rigging tested in first series, before referred to. No. 2 is the same rigging with beams trussed, or second series. Nos. 3 and 4 represent the M. C. B. standard brake gear and strong metallic beams used in the third series of tests, No. 3 being with a longer travel than No. 4.

In No. 1 a single point will be noticed very close to the terminal pressure of the standing card. This was the result of a rapid service application at slow speed, the train coming to rest before the usual amount of lost travel obtained running was had.

WEIGHT OF BEAMS.

Plain wooden beams.....	99 pounds.
Trussed wooden beams..	129 "
Trussed metallic beams..	82 "

Card No. 16 was taken with light brake rigging and plain wooden beams, coach on rear of train, three plain triple valves in front.

Card No. 17 was taken with light brake rigging and trussed wooden beams, coach on rear of train, three plain triple valves in front.

Card No. 18 was taken with M. C. B. standard brake rigging and trussed metallic beams, coach on rear of train, five plain triple valves in front.

Card No. 19 was taken with M. C. B. standard brake rigging, trussed metallic beams; application was made with the test valve in the yard, on coach only.

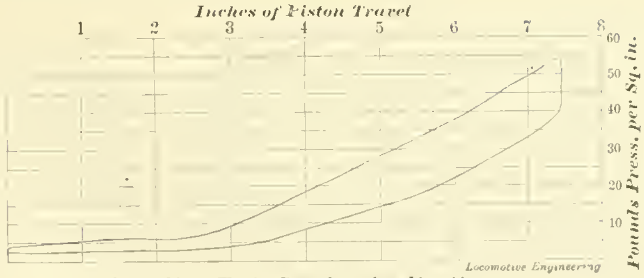
Cards No. 20 and No. 21 were taken with light brake rigging and trussed wooden beams; applications were made with valve in the yard; travel was shortened with hand brake.

Methods of Compressing Air for Testing Air Brakes.

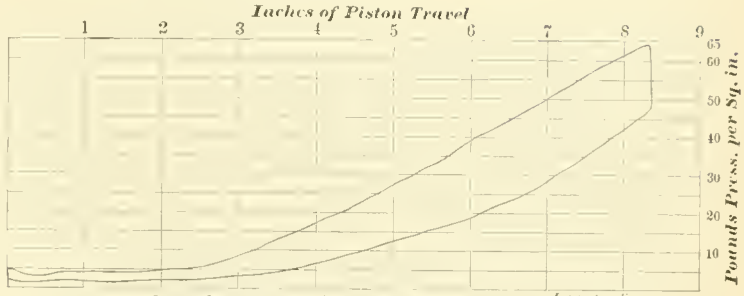
At the Central Railroad Club a report was read on Air-Brake Testing and Inpecting Plants, from which we condense the following points:

"The local conditions on each railroad will determine the necessity for equipping each division terminal and interchange point with air plants to meet requirements of testing cars.

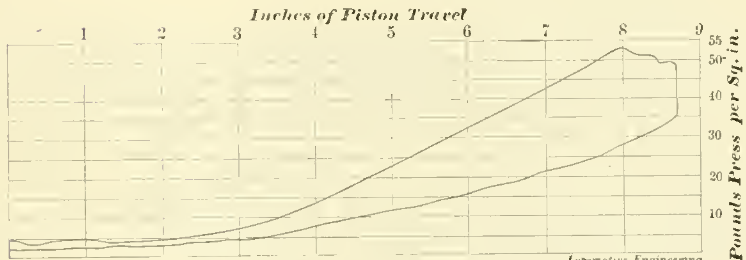
"In relation to the character of the plants necessary to provide for the proper inspec-



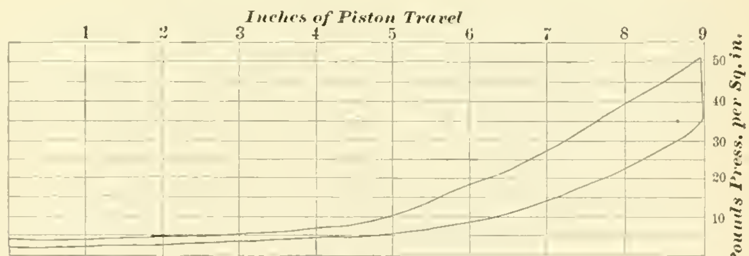
Standing Test—Service Application
No. 1



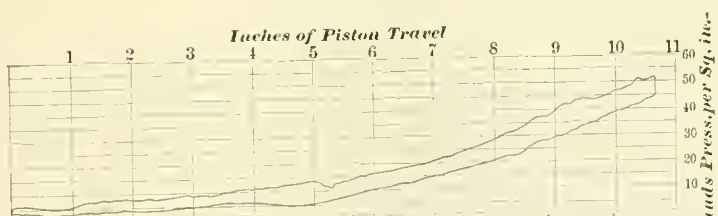
Standing Test—Service Application
No. 2



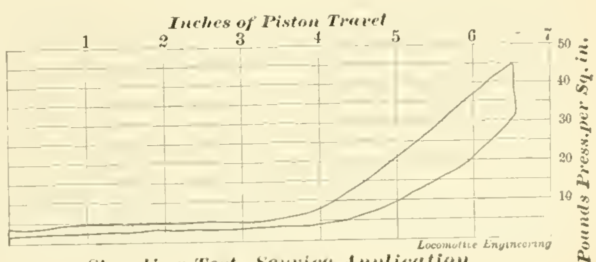
Standing Test—Service Application
No. 3



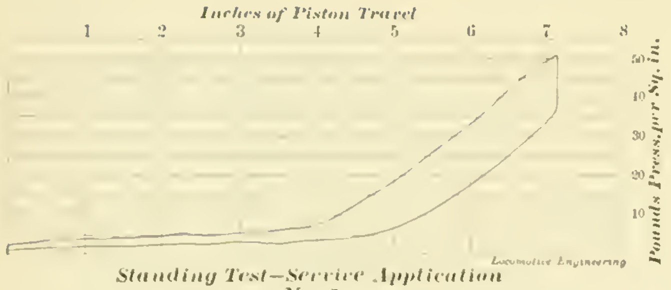
Standing Test—Service Application
No. 4



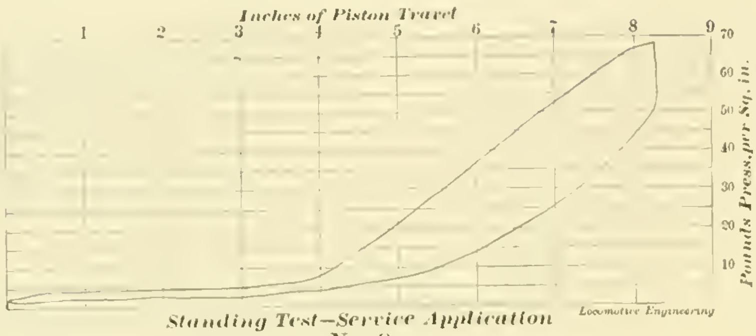
Running Test—Service Application
No. 5



Standing Test—Service Application
No. 6



Standing Test—Service Application
No. 7



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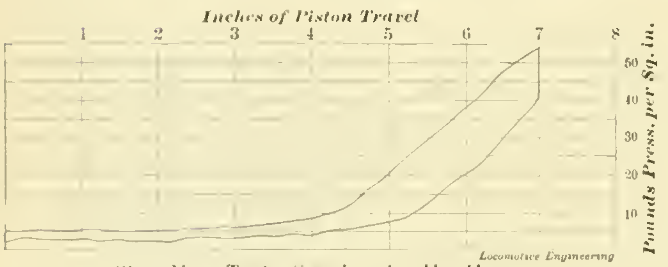

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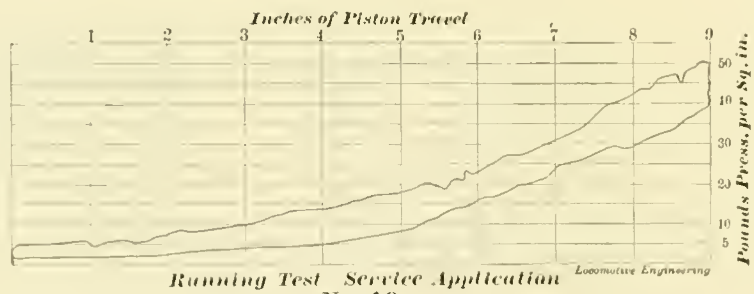

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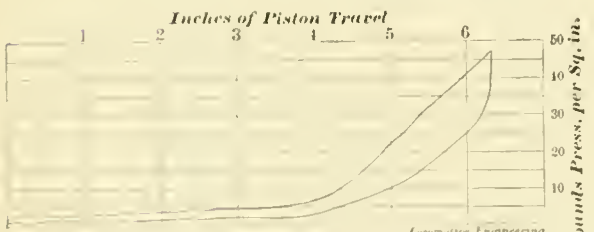

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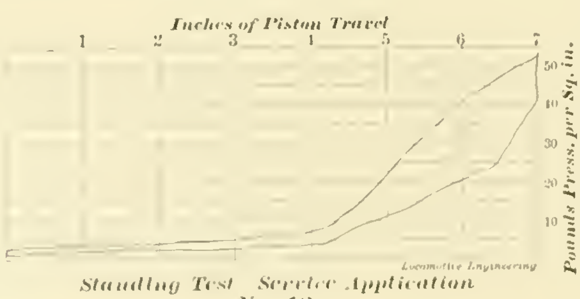


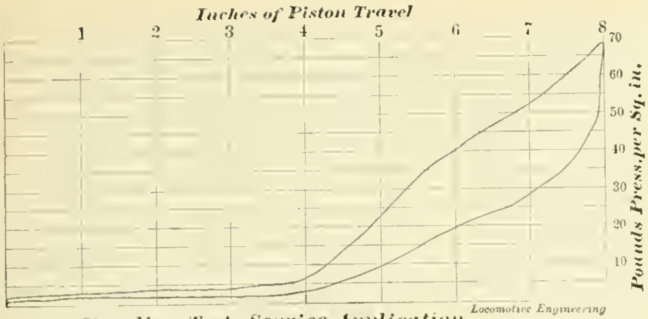
Standing Test Service Application
No. 12

tion and test of cars at the points above referred to, experience has thus far developed that two 8-inch air-brake pumps are of adequate capacity to supply 15,000 lineal feet of 1¼-inch pipe. At a point having an interchange of 600 cars per day, this amount of piping has been sufficient without any additional storage reservoirs. This fact is especially mentioned, as it may be of interest in connection with the question of reservoir storage capacity required for testing plants in addition to the pipe-line storage. It has also developed that plants with less number of feet of pipe require additional reservoir storage to compensate for the decrease storage in pipe line. At one point of this kind with 3,000 feet of piping, three reservoirs of the size in use on locomotives have been found satisfactory, air being supplied with one 8-inch pump.

"We would recommend in all air-brake plants that an excess pressure of from 20 to 30 pounds be carried to provide for the decrease in pressure from frequent testing, and to insure that test corresponds with a regular train service test.

"At points where steam is not available from shops or other boiler plants, different methods have been employed—one being to provide a small boiler of 12-horse power to generate steam for running air pump, costing approximately $165. Another plan now in use on a prominent line, which has been adopted on account of its slight expense, is the locating of a large storage reservoir, made of a locomotive boiler, at a convenient point for yard or road engines, which, when not otherwise engaged, are connected to reservoir supplying it with the necessary amount of air for testing a very limited number of cars, that would otherwise cause delay to train if not tested until road engine was coupled to train. The idea has been suggested that an efficient and economical arrangement would be to use wind-mills for operating a pump of economical design for this purpose—the air motor costing approximately, with a 60-foot steel tower and a 12-foot steel wheel complete, $125. A special air pump, now manufactured and used in connection with such an air motor for other purposes, having from 8 to 12-inch stroke with from 4 to 6-inch diameter of piston, can be obtained for $35, making a total of $160. An air motor and compressor of this description, under ordinary conditions, is capable of delivering 120 cubic feet of air per hour at 90 pounds pressure per square inch, being sufficient for testing from 300 to 400 cars per day.

"The special features that recommend this arrangement for furnishing compressed air are the exceedingly low cost of installation, slight expense in operation and maintenance, no fuel or regular attendant being required; for these reasons careful consideration should be given this device."



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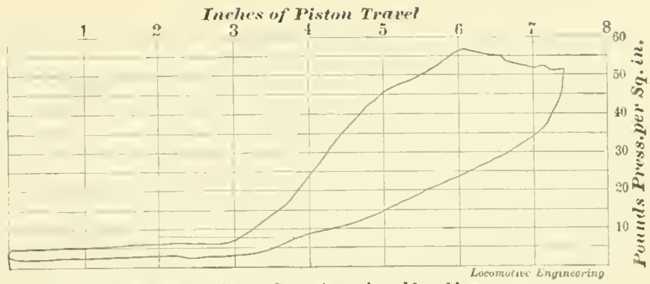


Standing Test—Service Application
No. 14

Cost of Lubricating Brake Cylinders.

The following figures, taken from the Air-Brake Men's report on "Economical Lubrication of Brake Cylinders," are interesting and instructive:

COST OF OILING AND CLEANING.

"The time required for oiling and cleaning a 10-inch passenger cylinder and an 8-inch freight cylinder put up in the usual manner, has been found by actual trials, conducted by one member of your committee, to be as follows:

One 10-inch passenger cylinder, ¾ hour labor	$0 12
Oil	0 00½
Total	$0 12½
One 8-inch freight cylinder, ½ hour labor	$0 08
Oil	0 00½
Total	$0 08½

"To show the financial importance of this question, we have computed the cost of keeping a freight car cylinder lubricated according to the Master Car Builders' rule, and also when they are oiled and cleaned once in six months and once in twelve months, with no oiling between cleanings:

"(1) M. C. B. Rule. Cleaned once every year, oiled every three months:

One oiling and cleaning	$0 09
Three oilings (at 1½ cents each)	0 04½
Total per year per car	$0 13½
Cost per year per 1,000 cars	$135 00

"(2) Cleaned and oiled every six months:

Two oilings and cleanings, at 9 cents	$0 18
Total per car per year	0 18
Cost per year per 1,000 cars	$180 00

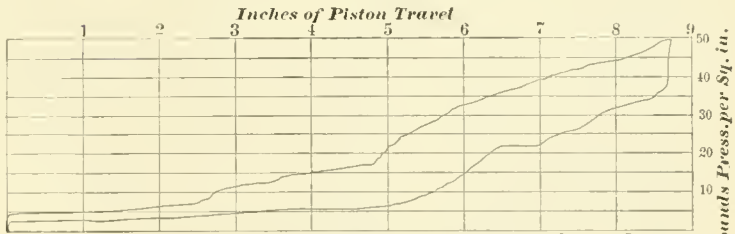
"(3) Cleaned and oiled every twelve months:

One oiling and cleaning	$0 09
Total per car per year	0 09
Cost per year per 1,000 cars	$90 00

"If from these figures we determine the total annual cost of lubricating and cleaning the 300,000 cars now equipped with brakes, and the 1,000,000 cars that will ultimately be so equipped, the results are as follows:

PERIODS OF OILING AND CLEANING.

	No. 1.	No. 2.	No. 3.
300,000 cars	$40,500	$54,000	$27,000
1,000,000 cars	135,000	180,000	90,000



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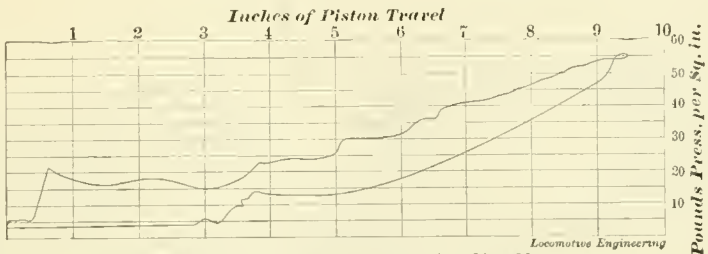

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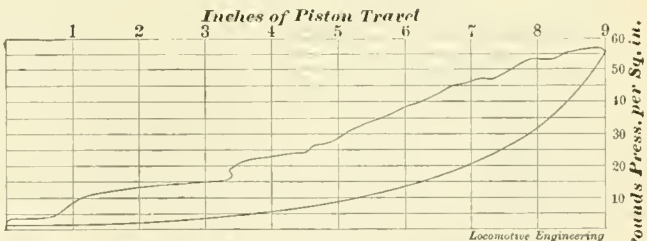

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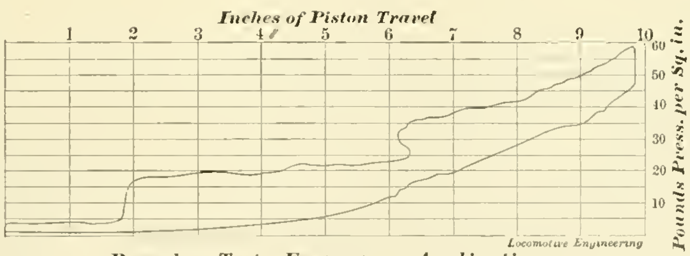

Running Test Emergency Application
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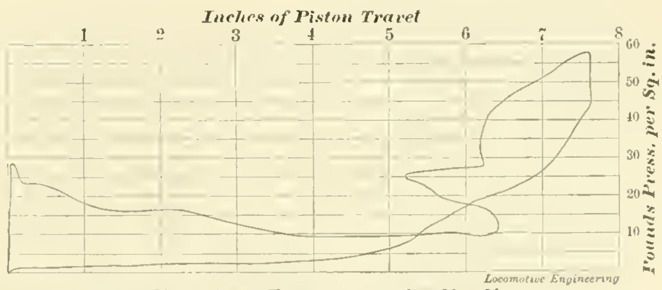


Standing Test—Emergency Application
No. 19

"From these figures it will be evident that while the cost of the work, according to either of the three methods, for the present equipment, or the total of future equipment, is not an extravagantly large item, the adoption of a shorter period between cleanings than actually necessary is going to cost railroads quite a sum.

"After duly weighing all the information in our possesion, we have come to the conclusion that a freight cylinder on a car in average service, if thoroughly cleaned and lubricated with a heavy-bodied oil or a suitable grease, can be allowed to run one year without further attention."

QUESTIONS AND ANSWERS

On Air-Brake Subjects.

(32) R. Q., Chicago, Ill., writes:

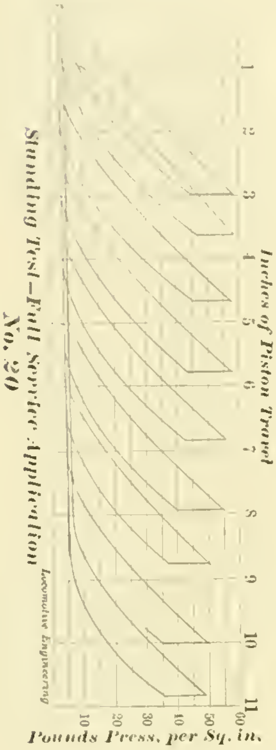
In your educational colored air-brake chart, presented with the April number, is shown the governor connected with the main reservoir. Is that not a mistake, or is that the way the connection is made with an engineer's valve with the feed valve attachment? We have no such valves here yet, and I may be wrong. A.—The attachment is proper. All engines having brake valves with feed-valve attachments should have the pump governor connected to the main reservoir.

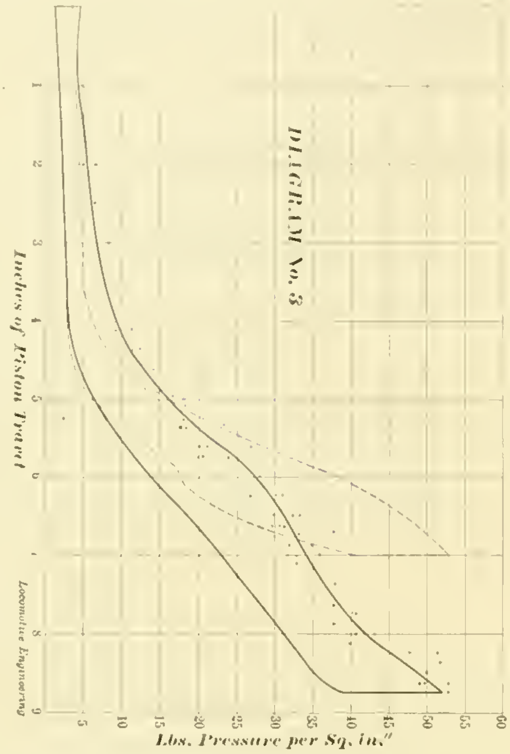
(33) H. O. L., South Easton, Pa., writes:

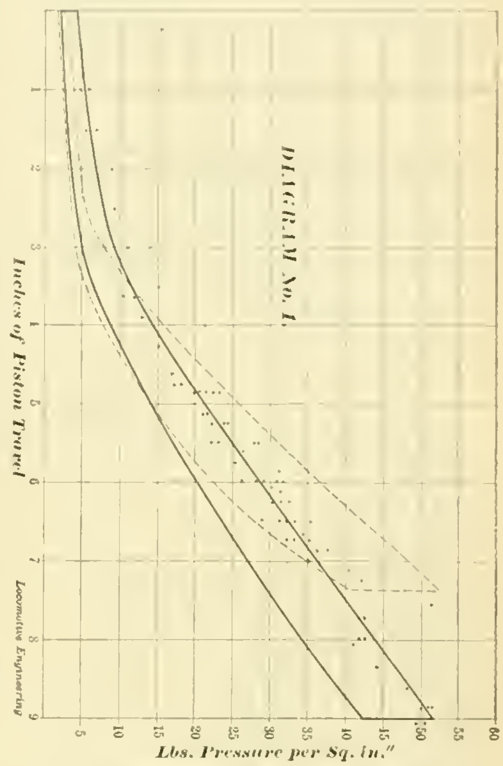
Brake cylinders have leakage grooves to prevent brakes from creeping on when there are small leaks in the train pipe. Driving brakes, however, have no leakage grooves, and experience has taught me that a small leak in the train pipe will allow them to creep on. Why do not driver-brake cylinders have leakage grooves in them? A.—With the cam type of driver brake, the piston travel is frequently adjusted at so short a travel that the piston would not pass beyond the groove. There is no reason why a very short groove should not be used in the cam-brake type of cylinder, and a longer one be used in the outside-equalized form.

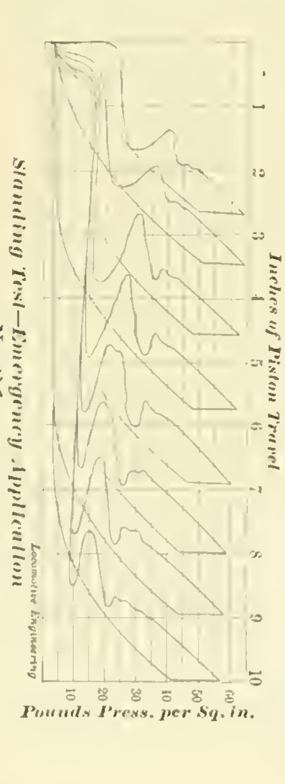
(34) J. V. R. S., Quincy, Ill., writes:

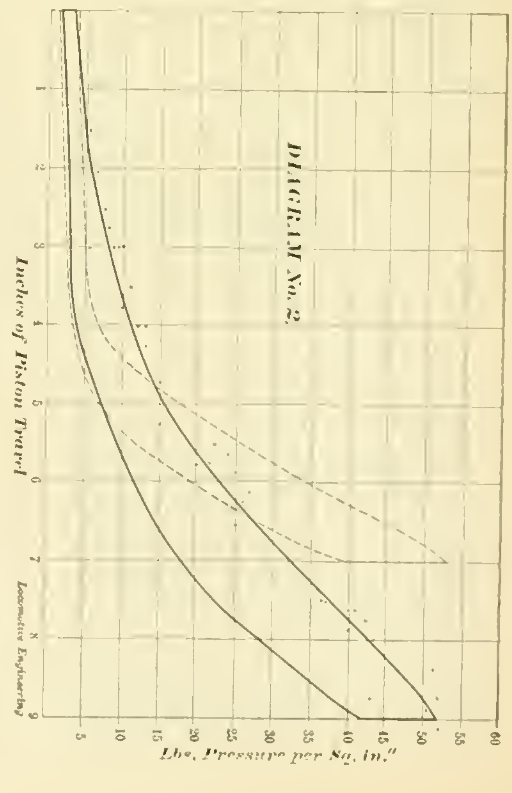
What is the use of the thread in the elbow in train-pipe discharge under engi-











neer's brake valve? A.—When the equalizing discharge brake valve was first introduced, much objection was raised, by engineers not accustomed to its use, to the annoyance caused by the sound of escaping pressure in the cab. Accordingly, threads were cut in the angle fitting, in which a pipe could be screwed to convey the objectionable sound outside. Later developments proved that the sound should be heard, as it was a reliable warning of the action of equalizing piston, and told the length of train and whether angle cocks had become closed, and the pipe was therefore abandoned. To the engineer posted in air brakes the sound is a welcome one. Many air-brake men are cutting out the threads, thus preventing the use of the pipe.

(35) J. P. D., East St. Louis, Ill., writes: I was under the impression that if all the different sizes of brake cylinders and their respective auxiliary reservoirs of the W. A. B. Co. were coupled to a train pipe, and a service application was made, the pressure to the square inch would be the same in each brake cylinder, and they would equalize at the same pressure; but in trying a standard freight reservoir and cylinder and a 10-inch cylinder and 12 x 33-inch auxiliary reservoir together, I found that the passenger equalized at a higher pressure with both pistons traveling the same stroke. A.—The several cylinders and their auxiliary reservoirs are so designed as to give the same pressure per square inch at uniform piston travel, and the same pressures should be had. Piping, however, enters into the problem. Condition of triple valves and test gages may greatly influence results obtained. It is a good plan to change gages about in making tests.

There appears to be an impression among many persons that they do not violate any law when they pull the bell rope and stop a passenger train. James Kelly, of New York, knows now that stopping a train is a serious matter. He is doing a four months' term in jail for having wantonly stopped a train on the New York, New Haven & Hartford.

Compound Switching Locomotive.

The accompanying photograph and specification illustrate and describe a six-wheel connected compound switching locomotive, designed by Mr. Wm. Buchanan, superintendent of motive power and rolling stock of the New York Central, for use in making-up passenger trains in the Grand Central Station, New York, and built by the Schenectady Locomotive Works.

The end in view in designing this engine was to dispense with the objectionable sound of the exhaust. This is accomplished by use of the two-cylinder compounding device, the exhaust reservoir in front of cylinders, and the annular variable exhaust in smokebox, so that the engine in the heaviest service is practically noiseless.

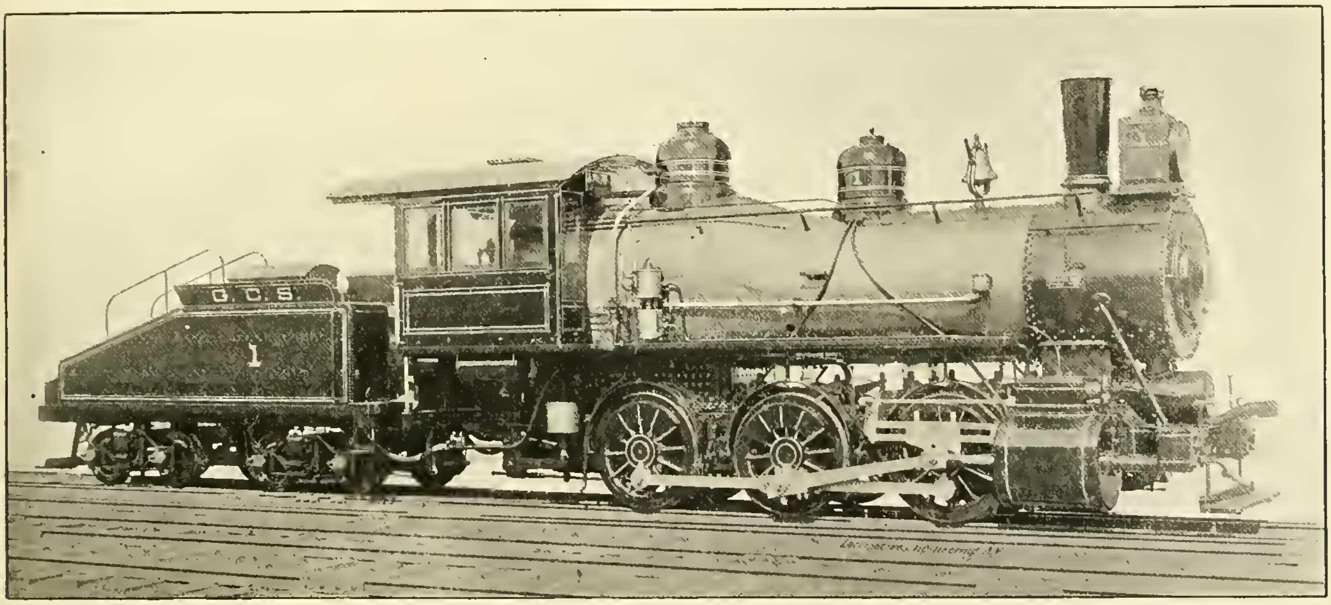
As stated, the engine is of the two-cylinder compound type, the high-pressure cylinder being 19 x 24 inches, and the low-pressure cylinder 29 x 24 inches. The intercepting valve is of the Schenectady Locomotive Works improved type. The exhaust of the low-pressure cylinder passes through a large pipe to the reservoir in front of smokebox, and thence through into the variable exhaust in smokebox. The exhaust reservoir is provided with perforated plates through which the steam passes.

The exhaust from the air pump is also muffled by passing through the exhaust reservoir.

The engine weighs 125,000 pounds in working order, and has been fitted out with every approved appliance for promoting durability and convenience in operating. The boiler, made of carbon steel $\frac{9}{16}$ inch thick, is 60 inches diameter at front and provides 1,709.5 square feet of heating surface. The horizontal seams have butt joints, sextuple-riveted, with welt strip inside and out. The circumferential seams are double-riveted. The working pressure of the boiler is 180 pounds per square inch.

The extreme valve travel is 5½ inches; low-pressure steam port is 20 x 1½; high pressure, 18 x 1½. Richardson balanced valves are employed, and United States metallic packing for rods. The driving-wheel centers are steeled cast iron, and the driving boxes are of the same material. The boiler is fed by Monitor injectors. The safety valves are Consolidated muffled and Ashton blow-back. A variable exhaust is used with a range from 5 to 8 inches diameter. The boiler is covered with magnesia sectional lagging. The Westinghouse-American combined brakes are applied to all the drivers.

The engine steams very freely, is very quick in its action, and fills a long-felt need of a noiseless switching locomotive for work in city yards.



COMPOUND SWITCHER—GRAND CENTRAL STATION.

The Pedrick & Ayer Co., of 1001 Hamilton street, Philadelphia, Pa., have just issued a plain, neat catalog of all the tools they make. This catalog is unique in that it tells the size, capacity, weight and price of all tools. As they make a specialty of tools for railway repair shops this book should be in the hands of all foremen, master mechanics and superintendents of motive power. Ask for it.

The F. S. Pease Oil Co., of Buffalo, N. Y., the well-known manufacturers and dealers in railroad oils, have occupied their present store since 1848, when the business was founded.

The State legislature of New York has passed a law making the transportation of bicycles by railroad companies part of a passenger's baggage not subject to charge.

LOCOMOTIVE ENGINEERING
A PRACTICAL JOURNAL of RAILWAY MOTIVE POWER AND ROLLING STOCK.

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NO BACK NUMBERS BEYOND THE CURRENT YEAR.

Notice.

We were entirely out of copies for April on the 15th of the month. The air-brake instruction chart caused them to sell like hot cakes. We cannot supply papers, but we still have charts, put up in tubes for framing, at 25 cents each.

SINCLAIR & HILL.

Be Firemen First, Engineers Afterwards.

The increasing responsibilities thrown upon the locomotive engineer by the never-ending additions to train mechanism, are making most railroad companies strict in examining firemen concerning their knowledge of engine and train mechanism before permitting them to take charge of a locomotive. Conditions are very much changed from the days when a fireman was considered fit for promotion, when his turn came, if he knew how to "keep her hot" and could read the time-card. When a man had merely to wait and do his daily work to inherit a change from the scoop to the throttle lever, it was quite natural that there should be very little ambition displayed to study into the mysteries of triple valves, valve motion, combustion and other subjects which a good engineer ought to be familiar with. In those days it was only the exceptionally ambitious and inquisitive man who would make himself familiar with the details of train mechanism, and the scientific principles of his business.

It is really for the good of enginemen that firemen should understand that an examination has to be passed before they will be permitted to run a locomotive; but the spirit of emulation, resulting from the new conditions, has drawbacks that are troublesome when not properly controlled. The education sentiment infects many young firemen so strongly that they are filled with ambition to become engineers before they learn to perform the work of a good fireman. Men moved in this direction ought to remember that their principal recommendation for promotion is the fact they have given satisfaction as firemen, and done the work in a way to commend them for more important duties. When a man is slovenly and neglectful of the work that falls to him in one position, it is natural that those who control the promotion of men should infer that inferiority in one position would be followed by the same faults in a higher line of work.

The first thing a young fireman ought to devote his mind to is, how to fire so that steam may be kept up. This requires both skill and careful attention, and a young man may make a few trips before he succeeds in doing this important part of his work to the satisfaction of the engineer. Persevering attention will soon make him master of this part of the work; but he should always bear in mind that firing is the most important of his duties, and that unusual skill in doing the work will soon give him a much higher reputation than anything he can tell about valve motion. In connection with manipulative skill with the scoop, with the ability to tell what part of the fire is thinnest and how to scatter the coal to even it up, he should study the methods of firing that makes steam most easily with the kind of coal used and for the work to be done. When the pointer of the steam gage begins to go back, the inexperienced fireman will be inclined to begin throwing in more coal, to shake the grates, or to use the rake or poker. Before anything is done, he should glance at the fire and judge by its looks what is wanted. This can be most successfully done by turning the scoop upside down and holding it inside the door, pointing downwards. This induces a current of air upon the surface of the fire, and enables the eye to take in the condition of the whole burning mass of fuel. There may be white, glaring spots, indicating holes in the fire, which must be covered forthwith; there may be dark portions, due to heavy firing on spots, and they should be broken up by rake or poker—tools, however, that must be used with good judgment or harm will be done. The fire may be even and not too deep, and yet have a dull appearance on the surface; this would indicate that the admission of air was too restricted, and that the grates needed shaking. The fireman should be on the watch to see that the tendency of the draft is to burn the fire evenly all over the grate surface. If the action of the exhaust has a tendency to cut the fire at the front or back, the engineer should be told about it, for the draft appliances need to be adjusted.

There is one thing, however, on which a zealous fireman needs to put restraint upon himself, and that is, to keep up a high pressure of steam only when it is needed. The fireman who keeps the safety valves screaming every time steam is shut off, wastes fuel and makes a nuisance with the unnecessary noise.

The secondary duties which a good fireman performs, exercise an important influence on his standing as a good or inferior fireman. He ought to keep a clean cab and do his work systematically, having a place for everything and everything in its place. The popular fireman reaches the engine in good season before starting time, and sees that the fire is in good order, the ashpan clean, that the tank is full of water, the sandbox loaded, the oil cans filled, and that the fire tools are there and in good order. If he does that regularly, keeps his part of the engine clean, and does the firing properly, he is in a good way for promotion. After he has acquired these habits and they come natural, he may safely devote his mind to the study of engine and train mechanism.

Does High Steam Pressure Increase the Danger of Boiler Explosions?

In one of our correspondence pages a railroad man of mature experience discusses the question of the increase of danger likely to arise a few years hence, from the greatly increased boiler pressure which is now coming into general use. The point is made that the danger from this source is not immediate when boilers are new and calculated to sustain the added pressure safely, but that it will be decidedly manifest after boilers get old and deteriorated. Maintaining locomotive boilers safe is of so much importance to railroad men and railroad companies, that we have no apology to make for again discussing a subject which is old to these columns.

Nearly all engineers will agree that there is more danger of a boiler explosion with a boiler carrying 200 pounds of steam pressure per square inch, than there is to one carrying half that pressure; but circumstances may render the lightly-pressed boiler the more dangerous of the two. We think that facts have proved that the explosions of locomotive boilers, in proportion to the number of locomotives in use, have been less frequent during the period when 140 pounds per square inch was the common pressure, than they were during the period when 100 pounds per square inch was considered the proper pressure to carry. The immunity from accident of boilers carrying the higher pressure has no doubt been due in a great measure to the use of better material, to improvement in safety valves, and to the building of better-designed boilers; but we believe that much more potent, as promoting safety, have been the improved methods of inspection, and the spread of the knowledge that systematic inspection of boilers is an imperative duty if explosions are to be prevented.

When steam boilers were first used for

supplying steam to engines, the pressure was a few pounds above the atmosphere. The first practical use of a steam boiler being employed for commercial purposes was in 1543, when Blasco de Garcy, a Spanish sea captain, used steam in the propulsion of a ship of 200 tons burden, and pushed it along at a speed of three miles an hour. The most serious objection raised to this form of ship propulsion was, "that a steam boiler was necessary, which was liable to explode." From that day to this, every movement towards making the heat from the combustion of coal, by generation of steam, more efficient for doing work, has called for increase of steam pressure, and every move towards higher pressures has been opposed on the grounds that the danger from explosions would be increased.

All through the history of the steam boiler, from the caldron period to the present day, when the strength to withstand a pressure of 200 pounds is a matter of no guesswork, but of careful calculation, every upward move has been made by engineers who had discovered means of calculating the strength of parts necessary to resist the tension advocated. Nearly all the opposition to high pressures has come from persons who believed that steam in tension contained some mysterious agent, that was liable to fly loose without warning, and tear iron sheets to atoms, spreading disaster around. The fear of boiler explosions is, to a great extent, an inheritance from the times when steam and the supernatural were very closely mixed up.

Ever since caldrons for cooking were invented, the cooks in charge have resorted to crude methods for holding in the savory fumes, which have resulted in explosions—which made ignorant persons believe that evil spirits sometimes took possession of the chief family cooking utensil and tore it to pieces—with disastrous results. One of our earliest recollections was watching a Scotch housewife at Yule-time display native ingenuity in preventing the savory contents of the pot that was cooking the family dinner, from wasting themselves on the atmosphere of the household. She packed the edges of the lid with several folds of linen cloth, and placed several stones upon the top of the lid to hold it down. In spite of the weight, the lid would be jerked up occasionally, to the chagrin of the chief engineer. Only for her ignorance she would have been called reckless. Ordinary people were a long time in discovering that the vapor from boiling water could not be bottled up without danger of an explosion.

The first intelligent test of the potency of confined steam was made by the Marquis of Worcester, in 1643. In describing the experiment he said: "I have taken a piece of whole cannon, whereof the end was burst, and filled it three-quarters full of water, stopping and screwing up the open end, as also the touch-hole, and making a constant fire under it—within twenty-four hours it burst and made a great crack."

The "great crack" of Worcester's cannon, and the bursting of cooking caldrons, have been followed by explosions that have blotted out many a valuable life; but a high steam tension is not a necessary condition for a destructive boiler explosion. Some of the worst explosions of early steam engineering days happened to boilers carrying less than 20 pounds pressure per square inch.

We do not believe that the records of boiler explosions, for all the time since steam was applied to industrial purposes, give any reason to suppose that the continued raising of boiler pressure will result in increasing the number of accidents. The mechanical science which enables an engineer to calculate the exact margin of strength required to make a boiler safe, when a pressure of 200 pounds or more is carried, will enable the same intellectual forces to provide the means of keeping that boiler safe until its time for scrapping arrives. Well-managed railroad companies that avail themselves of the advantages of high-pressure steam, will provide the means necessary to keep the boilers safe; badly-managed roads will try to enjoy the advantages of high steam pressure, and will meet with disaster when the boilers become deteriorated, just as they have bad luck with boilers of lesser steam tension. What will happen under bad management is no argument against the introduction of an improvement. The air brake is inefficient under the treatment it receives from certain railroad companies; but that is no argument against the value and efficiency of the air brake.

We are aware of nothing in the engineering world where the logical working of cause and effect is so apparent as in accidents to locomotive boilers. The best-managed railroad may have a boiler explosion at rare intervals from causes that the best of management will sometimes fail to detect: but if explosions are common on a road, it is proof positive that there exists gross carelessness in the inspection of the boilers. A well-known railroad had some years ago an epidemic of boiler explosions, and the causes were invariably attributed to carelessness on the part of the engineer, who was not generally left to defend himself. A new management came in, and a rigid system of boiler inspection was instituted, and regularly enforced, with the result that boiler explosions have ceased on that system.

One would naturally conclude from the talk heard among railroad mechanical officers at club and association meetings, that every railroad in the country had in force rigid rules of boiler inspection which are as strictly adhered to as the rules against passing a meeting-point without orders. During a recent journey the writer stumbled accidentally upon two railroads that have no system of boiler inspection in operation, and one of the roads has over one hundred locomotives. We are afraid that, with all the talk about boiler inspection, many roads do not display very much effort to keep the boilers in safe condition. The educational crusade in favor of systematic boiler inspection, that has been going on for the last few years, has relaxed, and it ought to be vigorously revived.

Every mechanic should send ten cents in stamps to the "American Machinist," 256 Broadway, for their special number describing the great gun lathe at Watervliet Arsenal. This lathe is 138 feet long, weighs 560,000 pounds—about as much as five heavy eight-wheelers—the head-stock alone is heavier than a consolidation locomotive. It turns, bores and rifles sixteen-inch bore guns fifty feet long. There are twenty-five pages of description of the lathe and its work. "What the Great Lathe Does, and How It Does It," by Anthony Victorin, the consulting and mechanical engineer of the Ordnance Department, is part of the article, accompanied by fifteen handsome half-tones of the work. Inset of the lathe, for framing, goes with the paper. This is the best thing the old, reliable "American Machinist" has ever done.

In this country many railroad companies think that they are imposed upon by newspaper publishers that ask for transportation in return for advertising favors. The railroad managers who feel that way ought to have a little experience with French journalists. "Newspaperdom" recently published an article on "Paris Newspaper Subsidies" which intimated that in four years the Paris newspapers alone received $83,541 from railway companies in the form of subsidies and subscriptions. No railroad or scientific paper was mentioned among those receiving financial support from the railway companies.

A new molding sand for the production of thick castings, free from blowholes, has recently been introduced by Messrs. Kuhlmann Bros., of Grüne, near Iserlohn, Westphalia. The molding sand is first burnt hard, then finely ground, and afterwards mixed with sal-ammoniac dissolved in water. It is claimed that in a casting made in sand prepared as above, when the metal comes in contact with it, a layer of steam and hydrochlorate of ammonia is formed between the metal and the sand, thus preventing the metal from running through the sand, and allowing of the production of a clean casting.

PERSONAL.

Mr. A. Dolbeer has left the Sterlingworth Supply Co. to return to railroad life.

Mr. William J. Vance has resigned as master mechanic of the Cleveland, Akron & Columbus at Mount Vernon, O.

Mr. Alfred Atwood has been appointed locomotive superintendent of the Mexican Railway, with headquarters at Apizaco, Mex.

Mr. W. S. Cooke has been appointed superintendent of the St. Louis, Chicago & St. Paul, with headquarters at Springfield, Ill.

Mr. H. M. Burgan has been appointed purchasing agent of the Western Maryland Railroad, with headquarters at Baltimore, Md.

Mr. N. E. Matthews has been appointed purchasing agent of the Ohio Southern, with headquarters at Springfield, O., in place of Mr. C. H. Roser.

Mr. M. F. Bonzano, assistant manager of the South Jersey, has been appointed general superintendent of that road, with headquarters at Philadelphia, Pa.,

Mr. Chas. H. Burnett has been appointed purchasing agent of the St. Lawrence & Adirondack Railway, with office at 51 East Forty-first street, New York.

It is reported that Mr. Edward S. Washburn, vice-president of the Kansas City, Fort Scott & Memphis, will be chosen president of that road, to succeed George H. Nettleton, deceased.

Mr. C. F. Parker, general manager of the St. Louis, Alton & Terre Haute, which has just been leased to the Illinois Central, has been appointed general agent of the latter road at St. Louis.

Mr. John T. Clark, formerly foreman of the Lake Erie & Western shops at Muncie, Ind., has been appointed master mechanic of the Northern Ohio, with headquarters at Delphos, O.

Mr. J. A. Murray has been appointed coal and coke agent of the Baltimore & Ohio, in charge of the coal and coke traffic east and west of the Ohio River, with headquarters at Baltimore, Md.

It is reported that Mr. D. H. McLaren, who recently resigned as general superintendent of the Montana Central, will accept a position with the Cincinnati, Hamilton & Dayton at Cincinnati, O.

Mr. R. J. Willson, of the Cincinnati, Jackson & Mackinaw Railway at Marshall, Mich., has been promoted to be general foreman, to take charge of the new shops belonging to the company at Van Wert, O.

Mr. F. B. McKercher, who has been for some time superintendent of the car service of the Mexican Central Railway, has been appointed assistant general manager of the road, with headquarters at the city of Mexico.

Mr. D. M. Philbin has been appointed general superintendent of the Duluth & Winnipeg, with office at Duluth, Minn., taking effect April 6th. He was formerly superintendent of the Duluth, South Shore & Atlantic.

Mr. W. R. McKeen, Jr., has been appointed general foreman of the locomotive department of the Vandalia Line, with headquarters at Terre Haute, in addition to his duties as general foreman of the car department.

Mr. B. F. Marshall, heretofore master mechanic of the Northern Ohio, has been appointed master mechanic of the Cleveland, Akron & Columbus, with headquarters at Mount Vernon, O., to succeed Mr. W. J. Vance, resigned.

It must be rather unhealthly, occupying position of division superintendent on the Missouri, Kansas & Texas Railway, for we notice that two of the superintendents have been granted leave of absence on account of ill-health.

Mr. I. W. Fowler, general superintendent of the St. Louis, Chicago & St. Paul Railroad, has resigned. He has been doing very hard work for years, and intends taking a short vacation before entering upon other work.

Mr. Page Cherry, who has been in charge of the heater and refrigerator service on the Baltimore & Ohio, has been appointed superintendent of the refrigerator-car department of that road, with headquarters at Chicago.

Mr. F. C. Payne, heretofore superintendent of the Danbury division of the New York, New Haven & Hartford, has been appointed superintendent of the Air Line division of the same road, with headquarters at New Haven, Conn.

Mr. Morris Clapp has resigned his position as engine dispatcher of the C. R. R. of N. J. at Jersey City, and gone back to running. Mr. Norman E. Sproul, formerly master mechanic of the same road at Phillipsburg, takes his place.

Mr. Ed. Scallen, who has been locomotive and car foreman at Butte, Mont., of the Montana Central Railway the last three years, has resigned and is looking for a position. His address is 1211 East Twenty-first street, Minneapolis, Minn.

Mr. Joseph B. Stewart has been appointed superintendent of the Hudson River Division of the West Shore Railroad, superintendent of the Wallkill Valley Railroad, and superintendent of the New Jersey Junction Railroad, in place of William G. Wattson, deceased.

Mr. S. T. Wellman, the well-known metallurgical engineer, has associated himself with Messrs. J. W. Seaver and C. H. Wellman to form the Wellman & Seaver Engineering Co., with offices at Cleveland, O. They intend making a speciality in the construction of steel plants and furnaces.

Mr. George P. Wilson, so well known to the railroad trade for his connection with the metallic packing companies, has accepted a position with the Keasbey & Mattison Co., Ambler, Pa. Mr. Wilson was with this firm before, and has met with great success in introducing their admirable covering.

Mr. E. S. Janes, chief clerk to the general manager of the Boston & Albany, and Secretary of the New England Railroad Club, has been made chief clerk of the rolling stock department at Springfield. Mr. Janes will be at home there, as he held the same position for ten years under Mr. Underhill.

Mr. Wm. Mahl, assistant to the president of the Southern Pacific Company, has been elected controller of the company, to succeed Mr. G. L. Lansing, deceased. Mr. Mahl has held a confidential position with the company for many years, and was consulted by the president concerning all mechanical matters.

It is our melancholy duty to chronicle the death of Mr. Will J. Bieber, general foreman of the Cheaspeake & Ohio shops at Huntingdon, W. Va. His remains were taken to Jackson, Mich., for interment, where his casket was more than covered by the floral offerings of his old shop-mates on the Michigan Central.

Mr. Edward M. Raynor, a veteran locomotive engineer and master mechanic, died at Syracuse, N. Y., last month. He was an engineer on the New York Central, where he rose to be engine dispatcher. While in the former position he helped to organize the Brotherhood of Locomotive Engineers. For several years he was master mechanic of the Charleston, Sumter & Northern.

Our correspondent in Lima, O., writes us that Mr. F. O. Miller has been appointed traveling engineer of the Cincinnati, Hamilton & Dayton. Mr. Miller was a delegate from Division 95 of the Brotherhood of Locomotive Engineers to the St. Paul Convention. He also represented several other divisions there, and for some time served as chief to Division 95. He is a hustler, and has the best wishes of all.

Mr. R. H. L'Hommedieu, who has been assistant general superintendent of the Michigan Central since September, 1890, has been appointed general superintendent of that road, with office at Detroit, Mich., to succeed Mr. Robert Miller, transferred. Mr. L'Hommedieu has been with the Michigan Central since 1873, and was superintendent of the Western division from 1879 to 1890. He is a brother-in-law of President Ledyard.

Those likely to require the services of a first-class stenographer, to take meetings where mechanical subjects are under discussion, will be interested in learning that Mr. R. W. Ryan has changed his headquarters to the Mills Building, New York. Mr. Ryan has reported the leading engineering and mechanical conventions in this country for years, and is acknowledged to be exceptionally correct in doing that difficult kind of work.

Major Edward Leslie, of the Rotary Snow Plow Co., died very suddenly at Paterson, N. J., and a report was circulated through press dispatches that he had poisoned himself. The body was taken to Ontario for interment in the place of his nativity, and his relatives wished to have a post-mortem examination made to ascertain the cause of death. This was done by eminent physicians, and they found that death was due to disease of the brain.

The numerous friends of Mr. W. S. Morris, superintendent of motive power of the Chesapeake & Ohio, will be grieved to hear that his wife died on March 11th. Mrs. Morris died very suddenly of heart failure, while her husband was away from home, which made the loss all the more painful. Mrs. Morris made many friends when attending the conventions, who will all learn with sorrow the mournful news of her death in the early prime of womanhood.

Mr. F. A. Husted has been transferred from the Northern division of the Cincinnati, Hamilton & Dayton to the Southern division. The change is considered a good promotion, as the duties, responsibilities and emoluments are greater in the new position. Mr. Husted has been very popular with all hands on the Northern division, and on the occasion of his leaving, the employés of the road gave him a surprise party and presented him with some handsome ornamental presents.

Mr. Robert Miller, for nearly six years general superintendent of the Michigan Central, has been appointed superintendent of motive power and equipment of that road, with headquarters at Detroit, Mich. Mr. Miller has been with the Michigan Central since 1876, and was successively master car builder and assistant general superintendent before he was appointed general superintendent, September 6, 1890. He was with the Chicago, Burlington & Quincy from 1859 to June, 1876.

Mr. Henry Wood, heretofore manager of the Choctaw, Oklahoma & Gulf, has been appointed general manager of that road, with headquarters at South McAlester, I. T., in place of Mr. Francis I. Gowan, who has been president and general manager, and who will continue as president. Mr. Wood announces the appointment of F. A. Moliter as engineer of maintenance of way, with headquarters at Shawnee, Okla., and J. W. Evans as trainmaster in charge of the transportation department, with headquarters at South McAlester.

Mr. W. L. Darling, principal assistant engineer of the Northern Pacific at St. Paul, Minn., has been appointed chief engineer of that road, with headquarters at St. Paul, in place of Mr. E. H. McHenry, who is now receiver. Mr. Darling has been connected with the Northern Pacific since January, 1889, and has been principal assistant engineer since March, 1891. He was formerly assistant engineer of the St. Paul, Minneapolis & Manitoba, and from 1879 to December, 1887, was connected with the engineering departments of various other roads.

Mr. C. M. Higginson has been appointed assistant to the superintendent of the Atchison, Topeka & Santa Fé Railway. He will have immediate supervision of all coal properties in which this company is interested, and will perform such other duties as may be assigned to him by the president. Mr. Higginson has been connected with the Chicago, Burlington & Quincy for many years. He was for years chief clerk of the mechanical department at Aurora, and later held a confidential position with the general manager. He has devoted a great deal of attention to questions relating to combustion and fuel.

Mr. Thos. B. Purves, Jr., has been appointed superintendent of rolling stock of the Boston & Albany Railroad in charge of both locomotive and car departments, with headquarters at Springfield, Mass. The circular of appointment notifies all concerned to send reports to Mr. Purves. Mr. William Taft, for the past two years acting superintendent of motive power, is made superintendent of motive power, with office in Boston. This is the only case we have ever heard of where a road has two such officers. The promotion of Mr. Purves is the deserved recognition of a capable mechanic who has done his work intelligently and well, from the scoop up through all the minor offices in the department.

Mr. Thomas H. Watson, the senior member of Watson & Stillman, New York, makers of hydraulic machinery, died last month. He was born in Scotland sixty years ago, and was brought to this country when quite young. He learned the machinist trade in New York City, and before he attained his majority was foreman for Dudgeon & Lyon, makers of hydraulic machinery. A few years afterwards he rose to be superintendent of the works. Then, with others, he established a company to engage in the line of business he was best acquainted with. In 1883 the company was dissolved, and became the firm of Watson & Stillman. They were very successful in business. Mr. Watson has been ailing for several years, but he attended to business till within two weeks of his death.

A circular issued by Mr. Garstang, superintendent of motive power of the Cleveland, Cincinnati, Chicago & St. Louis, intimates that Mr. W. J. Hartman has been appointed instructor of train, air and steam appliances of the Cleveland, Cincinnati, Chicago & St. Louis, with headquarters at Indianapolis, Ind. All orders and instructions issued by him to master mechanics, enginemen and trainmen, in regard to the proper method of application and handling these devices, must be duly respected. He will report to and receive instructions from the superintendent of motive power, and perform such other duties as may be assigned to him from time to time. Mr. Hartman was for years with the Westinghouse Air-Brake Company, and is very thoroughly informed concerning air-brake mechanism. He has lately been with the Seaboard Air Line, and was highly successful in instructing the men concerning all kinds of railroad machinery.

Mr. Harvey Middleton has been appointed general superintendent of motive power of the Baltimore & Ohio Railroad in place of Mr. G. B. Hazlehurst, resigned. Mr. Middleton is one of the best-known and most popular railroad mechanical men in the country. Mr. Middleton has filled several difficult positions, and succeeded in the unusual achievement of holding the position of superintendent of construction of the Pullman Car Works for five years. Mr. Middleton is one of a host of men now holding good positions on railroads who received the first part of their mechanical training in the Philadelphia & Erie shops at Renovo, Pa. He worked there in the varied capacities of machinist, fireman and draftsman, and rose to be assistant master mechanic. Mr. Howard Fry was then superintendent of motive power. In 1880 he was made master mechanic of the Louisville & Nashville, by Mr. Reuben Wells, and two years later left to be superintendent of machinery of the St. Paul, Minneapolis & Manitoba, now the Great Northern. Subsequently he was superintendent of motive power of the Louisville & Nashville, and then of the Atchison, Topeka & Santa Fé. He will have jurisdiction over the car department as well as of the motive power department of the Baltimore & Ohio.

One of the most genial and warm-hearted friends we ever made was Mr. Charles E. Smart, long general master mechanic of the Michigan Central Railroad. We have frequently rambled about the shops at Jackson, Mich., in company with Mr. Smart, and it seemed that every boy and workman in the place looked upon the head of the department as their personal friend. His big heart was always moving him to plan something new for the benefit of those under him, and his benevolent labors were fully appreciated. It then goes without saying that the news that, after a brief illness, Mr. Smart died on March 29th, sent sadness and mourning to many hearts. Mr. Smart was a native of Rochester, N. Y., where he was born in 1840. His parents were evidently, like many others in those days, searching for a prosperous location, and about 1856 they drifted West to Niles, Mich., where Charles entered a machine shop and began to learn the machinist trade. Within the following five years he had experience as machinist apprentice and fireman. Then he went South for about a year, but returned when the war tumult was getting hot. After that he was in Cuba for some time, and after a brief stay there returned to acquire more experience on American railroads. He rambled about considerably, as most mechanics do who are ambitious to know how their work is done in different sections. His final anchor was cast when he settled in Saginaw, Mich., as locomotive engineer with a consort in tow. Two years later he was appointed master mechanic, where he remained till 1883, when, at the recommendation of Mr. Robert Miller, general superintendent of the road, he was appointed general master mechanic, and moved to the mechanical headquarters at Jackson, Mich., where he had been gaining friends and reputation ever since. For a man of his ability we have never met another equally endowed who made so many friends and so few enemies.

EQUIPMENT NOTES.

The Lehigh Valley have placed an order for 1,000 freight cars.

The Seaboard Air Line have ordered some Campbell-House combination cars.

The Baltimore & Southern are reported to be in the market for locomotives and cars.

The Baltimore & Ohio are preparing to place orders for a large number of cars and locomotives.

The Pittsburgh Locomotive Works have received orders from the Seaboard Air Line for twelve engines, and from the Vandalia Lines for twenty-four moguls.

Convention Bores.

We are afraid that our friend M. N. Forney is cultivating the caustic leanings of his brilliant mind to the dwarfing of good-natured sentiment. In a three-thousand word article which he published lately in his long-named paper, on the Master Mechanics' Convention, the greater part of the discourse is directed to "bores." He scarifies the bores who prepare tedious reports, the bores who have too much to say in discussing these reports, and the bores who cut discussion short by a motion to close. He proposes that the following notice should be printed and posted where it is likely to be read by all the members present:

"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."

Female Stone-Breakers.

From a paper read at the New England Railroad Club, giving an account of a visit to Jamaica, we clip the following item:

"All the stone used for ballasting purposes is soft rock, and it is all broken up into small pieces by native black women. They sit along the line, upon heaps of broken stone, sheltered from the powerful sun's rays by rude shelters of palm leaves, and, day after day, pound away at the soft stone with hammers, breaking it into small fragments. They are paid so much a barrel for the work, and earn from nine pence to one shilling a day, eighteen cents to twenty-four cents. All this ballasting material is distributed along the roadbed by these women, who carry it in small round baskets and trays, each holding from twenty-five to fifty pounds. Not only this, but every mile of railroad in Jamaica was constructed in this manner; and not only is this stone ballast all carried on their heads by these women, but every particle of the material for embankments, and all the gravel and filling material—and at Annatto Bay I saw long lines of black, barefooted and bareheaded women carrying sand from the seashore to the line of the road, a quarter of a mile away. These women seem perfectly happy, and are always talking and laughing. But they will do a wonderful amount of work in a day, and the reason for employing them is because it is cheaper for the same amount of work done than by any other way."

When Scotchmen Were No Mechanics.

There is an impression in many countries that Scotland is the best breeding land of mechanics in the world, and the number of Scotchmen who are in responsible positions, directing mechanical operations, indicates that this belief is well founded. Yet the training which has produced this excellence in mechanics has all been given in one century. James Watt, himself a Scotchman, never had any respect for the mechanical instincts of his own countrymen, and it is certain that he never would have hired Murdock, who turned out to be the most valuable man that Boulton & Watt ever employed. Boulton, the business man, hired Murdock because when the young man called to ask for employment he had a hat made of wood, which he had made in a lathe of his own invention—the first lathe designed to turn an ellipse.

Watt told Sir Walter Scott, that though many of them sought employment at his works he could never get them to become first-class workmen. They had an insuperable aversion to toiling persistently in one way, and that prevented them from becoming first-class mechanics. He followed the rule of not employing Scotchmen. His views may have been correct, for his countrymen then had very little training in close, exact work; but, on the other hand, Watt was a chronic dyspeptic, full of spleen and prejudice, and he may have done his countrymen injustice, for they were not different from other nationalities so far as inheritance of mechanical training was concerned.

Readers of old scientific books often meet with the expression "Nature abhors a vacuum," and the idea has been employed by poets and writers of general literature in various forms of illustration. Until comparatively recent times philosophers believed that it was impossible to create a vacuum, and Galileo was the first to suspect that the horror attributed to Nature was imaginary, or that it was confined to limits of no wide range. The first practical support of his idea was obtained when they applied a pump to a very deep well in Florence and found that the water would rise only 32 feet, leaving the upper part of the pipe empty. This led to the discovery that in raising water there was a close relation between the atmospheric pressure and the distance water could be raised by a pump creating a vacuum.

Thirty-eight out of fifty freight conductors on the Fall Brook Railway received a premium last year of \$60 each, on account of their services having been entirely satisfactory. The premiums form part of the Brown system of discipline without punishment. Most of those who failed to get the premium made mistakes with the disposition of cars. There were no collisions or accidents due to carelessness on the part of conductors.

The management of the Fall Brook Railway report to their directors that about 2,000 freight cars will require to be equipped with air brakes within the next two years, in order to comply with the law.

Bloodhounds and Train Robbers.

"During the days of slavery, dogs were used throughout the South to run down fugitive slaves; but for many years after the war man-hunting with hounds was almost unheard of. Now and again it was tried; but lack of training in the dogs, and perhaps want of patience in their owners, brought about so many failures that the practice was almost forgotten.

"Ten years ago, when two desperate men held up a train on the Atlantic & Pacific, in the Southwest, and secured many thousands of dollars in booty, a ranchman in Arizona offered to trace the highwaymen if a sufficient force for their capture was furnished him and a reward for his trouble offered. These preliminaries being settled, he appeared on the scene, twenty-four hours after the crime had been committed, with a couple of not very dangerous looking dogs and a rifle. He was ragged in costume, and apparently ragged mentally, but, as the result proved, knew what he was about. 'Keep your eye on them dogs and your hands on your weepons—there's going to be more or less fun,' was all he had to say to his associates in starting. Three days later, after a weary chase of many miles over one of the roughest trails in the world, the dogs came up with and cornered the highwaymen. The latter killed both of the dogs; but before they could escape, the pursuing posse was upon them and they surrendered. They afterwards confessed their guilt, and told where the booty was hidden. Nearly $50,000 was recovered. The amount of money involved, and the satisfactory work of the bloodhounds, revived the old practice of trailing men with dogs, and there are now hundreds of the useful animals in the possession of the peace officers of the West. They are carefully bred and trained for the police duties."—"Express Gazette."

A New Valve Gear.

A patent has been obtained by Mr. M. N. Forney on a combination which the Patent Office describes as "A fluid-pressure cylinder, a piston and rod working therein, a connecting rod coupling the piston rod to a crank, a main valve having supply ports adapted to communicate with ports in the cylinder, mechanism for reciprocating said main valve, an independent cut-off valve controlling the supply ports of the main valve, a link capable of angular adjustment in pivotal bearings, by ordinary means, a block sliding on said link, and a lever connected to said block and to the cut-off valve, and deriving its motion from the connecting rod, and thus imparting a movement coincident to that of the piston to the cut-off valve, and one transversely to that of the piston to the block, whereby the movement of the cut-off valve is advanced or delayed in relation to that of the piston and main valve by the angular position of the link."

The description means that Mr. Forney has put out good money paying the Patent Office fees on a combination of piston valve and cut-off, operated by a radial motion, which has a very close relationship to Joy's motion. We wish Mr. Forney much good luck out of his invention; but if he proposes to give a stock company the opportunity to boom the latest thing in valve gear, we must respectfully intimate that all our money is tied up.

The English press has always a great deal to say about the persons who were in any manner directly or indirectly connected with the first runs made by Stephenson's "Rocket." Of course, people interested in the development of inland transportation naturally like to hear about the persons who took part in the experiments that led up to a successful locomotive. Americans have not displayed much interest in the historical part of machine development, or we would read more about the men who were present when Cooper's "Tom Thumb" demonstrated on the Baltimore & Ohio that the native mechanics could be depended upon to design and build successful locomotives. We wonder if there is any person alive who saw Horatio Allen make his memorable trip on the "Stourbridge Lion?" The rebuilt "De Witt Clinton" attracted great attention at the World's Fair. We think that David Matthew, who helped to build the original engine and ran it on the first trip, is still alive. Reminiscences of the trip would make interesting reading.

The Buffalo Forge Co. inform us that they sell a great many mechanical draft plants by mail, with complete plans for erection, not only in this country, but elsewhere. Their installation is not attended with any complications which an ordinary engineer cannot overcome. This you will readily appreciate by noting the following copy of letter from the Oakland Gas, Light & Heat Co., Oakland, Cal.: "Replying to your inquiry of the 7th inst., we take pleasure in saying, that the forced draft apparatus sold this company by your house is working satisfactorily in every respect. It has been in constant use for over one year, and has not cost one dollar for repairs or attention."

The Puget Sound, Mount Tacoma & Eastern Railway Co. has been incorporated at Tacoma, with a capital stock of $2,000,000, principally subscribed by Eastern capitalists. The new road will follow what is known as "Hart's Logging Railway" for ten miles in the direction of Mount Tacoma, forty miles distant from the city, the first object being a scenic railway to that place. From Mount Tacoma the road will run Eastward, and will probably connect with the Chicago, Burlington & Quincy.

Bob Burdette, the humorist, tells a story of a girl who was walking alongside of a creek, and seeing a bird on a tree, took up a stone to throw at the bird and hit a fish in the creek behind her. An incident of a similar kind happened on the Fall Brook Railway, and is related in the annual report of the road. Jack McDonald and a companion were put off a train because they were drunk. They resented that treatment, and the companion took a rock and threw it at the conductor. It missed the conductor, but found McDonald and nearly broke his skull.

The speed of a railway train in miles per hour can be found by counting the number of rails over which a car wheel passes in 20.4 seconds, because 20.4 seconds bears the same ratio to an hour that 30 feet, the length of a rail, bears to a mile. The fish plates or the thumps may be counted. Thus, supposing that 39 thumps are made by a wheel in 20.4 seconds, the train is then running at the rate of 39 miles an hour.

The American Society of Mechanical Engineers will hold their semi-annual meeting at St. Louis from May 19th to 22d. Their headquarters will be at the Southern Hotel. A variety of good practical papers on engineering subjects will be read and discussed.

The Manufacturers' Advertising Bureau, of which Mr. Benj. R. Western is proprietor, has changed quarters from 111 to 126 Liberty street, New York, the increase of business requiring more office accommodation.

Our railmakers are competing successfully in foreign markets with the railmakers of Europe. They sell the rails that go to foreign countries for about 25 per cent. less than they charge home customers.

The Dunkirk Engineering Co., Dunkirk, N. Y., which recently went into the hands of a receiver, will probably be reorganized on a sound business basis by Mr. Newton and his associates.

D. Van Nostrand Co., of 23 Murray street, this city, have issued a new catalog of electrical books, which is very complete.

The Q. & C. Co. have moved their New York offices to the twentieth floor of 100 Broadway.

The Atchison, Topeka & Santa Fé are about to build new repair shops at Argentine, Kan.

PRACTICAL LETTERS FROM PRACTICAL MEN

Mileage of Pennsylvania Railroad Locomotives.

Editors:

In answering your letter in reference to mileage of Class P, Engine 2106, I will say that the tires were not turned while making this mileage. This engine was in continuous service, and when engine was shopped the tires were worn $\frac{7}{16}$ inch, and the rail wore $\frac{9}{32}$ inch. Ross steel brake shoes were used. There were no frogs broken by this engine, or any reports from supervisors that engine was injuring frogs or crossings. We double crew our passenger engines wherever we can, and get all the extra mileage possible. This engine on a regular run makes 292 miles per week day, and from 242 to 292 miles per day on Sundays. During this time we had water floods, ice gorges and some wrecks that engine would not run through, but transfer and return, making short mileage.

In December, 1893, this engine ran off track going into Williamsport yard, by switch rod breaking, causing some damage to engine, requiring nine days to repair same. In December, 1895, engine was shopped two days on account of putting patch on crack in boiler. In January, 1896, engine was taken off through run and put on short run, and no other repairs made on engine except running repairs.

Hoping this will give the desired information, I remain, yours truly,

Sunbury, Pa. L. J. GUYON,
Road Foreman of Engineers.

[We have secured this information as an answer to several correspondents, who wrote asking for more details about the mileage made by these locomotives.—Eds.]

Cutting of Flanges.

Editors:

Having read Mr. J. Francis' comment on observations advanced by me some months ago, will say that Mr. Francis, in the first place, says he "materially differs;" then he coincides with me by saying it may have a "tendency." The remarks I made were that the form of journals and coning and size of wheels had a deal to do with it. Mine is by no means a solitary case, but facts gathered by careful observation with regard to the spring theory and engines being out of level. That was a primary cause, or, I may say, is with the American standard engine, which every apprentice knows; but the causes I have mentioned are conducive to the same results, and more so now with consolidated and ten-wheelers whose points of suspension are not exactly the same.

I have crowded the frame right up to the saddle, and lowered the opposite side both in a quadrilateral direction and from right to left, and, to help it, have thrown the wheels as much as practicable—and the same flanges cut. We are not running eight-wheelers with three points of suspension; neither are we using the old strap on rods. I concur with what Mr. Francis says; but let him watch the points I have mentioned in my previous letter, and let us know in six months from now.

Of course, in the standard eight-wheeler, there only being three points of support, it is far more easy to overcome inaccuracies or faulty workmanship, because the weight is so easily transferred from one point to the other; but when you come to the other classes, it is far different. Every round house foreman in the country has used the medicine which Mr. Francis mentions—I, for one of them, and found it very useful and just what the doctor ordered for the standard; but I am afraid he would have to take more heroic measures with the other classes of engines, as a rule.

What we want is the many defects that are conducive to flange-cutting, and after that the cure. Mother's molasses and brimstone was a good spring medicine, but the science of medicine has advanced. Since those days we have found hundreds of medicines, and suffered from many ailments that then we knew not of.

GEO. SMART.

Edgewood, S. D.

High Pressures and Boiler Explosions.

Editors:

I read of a boiler explosion the other day. I don't like to hear of them. I know more about them than I wish I did, and it brings up a thought that has often been on my mind—what is going to be the result of the extreme high pressures that are carried at the present day?

We remember when the maximum pressure was 120 pounds, and when those boilers got old and weak they sometimes exploded. Now the locomotive of the present carries from 175 to 190 pounds pressure. Of course, the boiler is constructed as strong proportionately as the boiler of thirty years ago; but is there not a much wider field for deterioration? Every practical mechanic knows that when a boiler is new he has but little trouble. If there are weak points in this new boiler they are likely to expose themselves and be remedied. It is when the boiler becomes generally weakened by age that it lets go, and, with no sustaining strength behind, this causes the general explosion.

The point I want to bring out is—Is not this line of weakness, so much feared by master mechanics, going to be much increased by starting from a higher point, or from 190 pounds instead of 130 pounds? In other words, What is going to be the result fifteen years from now?

I well understand that most explosions are due to other causes than over-pressure; but is this not a matter that has got to be or should be acknowledged? It may be that news is much more general, or it may be because there are many more locomotives than there were some years ago; but it seems that we read of more explosions than we did then. All this is taking place in face of a rigid inspection that is almost universally used, which was unheard of thirty years ago, and in the face of superior material, every piece of which is tested in the most approved way. The construction also has improved in many ways, particularly in relief of steam.

Still when I stand upon an engine and see the steam gage at 190 pounds, I wonder how old the boiler is. Suppose Engine 999, after ten years, has been rebuilt several times, has a new firebox, new flues, new braces, and all that; what about the condition of other sheets? Is the natural weakening of the sheet from age, expansion, contraction and other causes incident to any locomotive, going to be in excess of the older engines, that were constructed with lighter sheets?

Johnstown, Pa. A. DOLBEER.

A Sample of Old-Time Railroad Discipline.

Editors:

Railroading at the present time is not what it used to be when trains were few and time was slow. Now the business is carried on with military precision, while in the old days infractions of the rules, under favorable circumstances, were not looked upon as culpable, as the following incident will illustrate:

Among the old-time freight conductors on the B. & M., in Iowa, was Joe McD——. The road at that time was in its infancy, though its well-kept track made reasonably fast speed no departure from safety. Mac, on general principles, was a pretty good sort of a fellow, but a great stickler for literally translating all the rules of the time-card, and the 15-miles-an-hour ordinance he never willingly permitted to be departed from during daylight; though at night, when nearly all the telegraph offices were closed, he would steal time with all the reckless abandon of the most hardened time thief on the division.

One day the writer, with the "Camanche," No. 61, started out with train No. 15, Mac occupying the post of honor in the caboose. This train was slow, having some seven hours card-time to make the last sixty miles, from Chariton to Creston, and due at the latter point at 11 P. M. Lunch counters had not yet been established along the road, and it was either live twenty-four hours on the contents of a boarding-house lunch bucket or stop at Lucas at 5 P. M. and get a warm meal at the hotel. On this day we were somewhat late in leaving Chariton, and when we did get started had thirty-two minutes to make the eight miles to Lucas at the time-card limit of speed. I swung the sixteen loads of coal over the top of White Breast grade, three miles from Chariton, at a good canter; then by Mac's order the brakemen dragged the train down the hill at such slow pace that when we reached Lucas we were exactly on time. I stepped from the engine as it passed the station, and started up the street for supper, when I noticed Mac frantically gesticulating from the caboose to go ahead. About that time, divining my mission, he ordered the train brought to a stop. Some twenty-five minutes' delay was occasioned by my absence, and when I reached the depot I observed Mac in the telegraph office, and learned that he had wired the superintendent the cause of our delay. I went to the engine, pulled out, and at a twelve-mile jog had ample time to make our meeting point at Osceola and take the siding.

When I returned to Ottumwa I found a letter awaiting me, requesting my presence at the superintendent's office at 4 P. M. Superintendent B——, by the way, had come up from the ranks, and, as will be seen later, realized that other things, such as eating, were as indispensable in railroading as a strict conformity to time-card ethics.

I went to his office at the appointed hour, and, upon entering, found Mac sitting there; and as I passed the time of day with the superintendent, Mac gave me a look of compassion, as much as to say, "I pity you, old boy!" Directly Mr. B—— turned in his chair and said: "Now, K——, suppose you were going West on No. 15; you leave Chariton twenty minutes late; have just time enough to make Lucas on time; have two hours to make Osceola (eighteen miles) for No. 10; are pretty hungry, and aware that you can get nothing to eat till the next day. What would you do?" "Why, sir," said I, "I would stop at Lucas and eat, and take the chances of making Osceola for No. 10; and if the occasion required, would give her a little more throttle and an extra notch up Woodburn Hill than would be necessary to make the fifteen miles an hour allowed in the time-card." The superintendent bowed his head in a sort of reminiscent way; then turned to Mac and, repeating the question, said: "What would you do?" Mac replied: "I would go right along from Lucas, for I wouldn't have any right to stop there when it was time to leave." "Would you go without your supper rather than infringe the rule, if you still had plenty of time to make the meeting-point without exceeding the proper speed?" "Yes, sir, I would," said Mac, decidedly. "Well," remarked Mr. B——, "McD——, you are a fool—a dod-blasted fool! Any man who would go hungry when he has a chance to get a warm meal—even if he has to steal time to catch up again—is a dod-blasted fool!" Then he again turned to me: "K——," he said, "you can go now; and hereafter, when you have McD—— for a conductor, you stop and eat; McD—— can go on afoot, and you can pick him up when you overtake him."

Chicago, Ill. S. J. Kidder.

What Is the Most Practical Pressure to Use with Air Hoists?

Editors:

I wrote an article on Air Hoists some time ago in which I made several claims. Fortunately, before sending it there came to my hands the first number of a little paper that is published in New York, devoted exclusively to compressed air. This publication explodes one claim that I made. Then I had nerve enough to claim that I was among the first that made use of this power for purposes outside the familiar and common use of stopping cars; but the article referred to tells me that it has been in use in building, among other things, the Hoosac Tunnel. Now, this being so, while I am getting old, I cannot claim priority to this. In fact, when I made my claim I overlooked the rock drill. At the same time, I feel that a great impetus has been given to this force within the last fifteen years, when we notice in "Locomotive Engineering" no less than six firms that are manufacturing air compressors. At the same time, I hate to see all my little thunder going to waste, or covered up in ante-claims. A man who has not done much to move the world along, hates like poison to see some of his pets turned down; so I will plunge again, and if anybody wants to sit on me they have the privilege.

Now, I will be modest; but fifteen years ago, at least, I was standing in the brass foundry of the Renovo shops. They were taking a pot, with several hundred pounds of metal in it, from the pit. It was done by hand; and when the foreman who had helped, came back to where I was standing, and removed the sponge from his face, he made some remark that was not strictly pious. In return I said that I could get up something that would do the work for him. I might have forgotten it, but Tom did not, and the result was that I had to make my word good; and so I got a pipe cast the right length, with flanges on it, bored it out and had a piston put in—similar to the air piston then used under passenger cars. I had a crane put up, and hung this cylinder on. It connected with an air pump a few feet away. I made a small 3-way cock and started it up. It was a success at once. We were voted a leather medal by the men interested. Circumstances were such that I did not have much opportunity to push the matter. In fact, I did not give it much attention, but incidentally heard that it had gone into use in several Western shops—no doubt in an improved form; but there is no doubt that they originated from the hoist put in the Renovo foundry.

My next personal experience with an air hoist was last year, in the Boies Wheel Works, of Scranton, Pa. I speak of this because there came up an element which I feel should be guarded against. In that shop we had a water hoist with a very heavy pressure. This had the weakness of all water hoists—a tendency to freeze in winter. After we had put in air, we concluded to introduce it into the water hoist. We only had an area of 12 square inches in the piston, and 75 pounds pressure, and we wanted to lift from 800 to 1,000 pounds. You will see that we were practically using the maximum power of the lift. In case of any defect—and there were several—we had annoyance. First, the hoist leaked. We put in new packing, and this developed a rough spot in the cylinder, which caused grief. Then it developed, or brought to our notice, another element, that you do not notice if you have an abundance of power; and that is the elastic quality of air. We could raise this hoist until it reached the rough spot in the cylinder, when it would stop and hang until the air accumulated. Then it would shoot by with a vengeance. If it had had a greater area or a heavier pressure, it could have been controlled.

This brings us back to the question which I had in view when I began this letter and that is—What is the most practical pressure to use upon air hoists? Now, I don't mean for special work, which may have peculiarities not suitable for ordinary work. But in the ordinary locomotive and car shop it is the question of what is practical, and we must bear in mind that with a lift you must always have a point to lift from that has the sustaining strength of the lift. For an ordinary machine there is not much work that requires an excess of 1,000 lbs. Driving axles are less than that. Car wheels, car axles, boiler fronts, tires, etc.—there are very few parts that need over a ton. So, without going more into details, I will assume that you have as a maximum load for your hoist one ton. A greater load than this will in most cases require reconstruction of your framework of shop, to get a point to hoist from.

Not long ago I was in a shop where they were endeavoring to put up an air compressor that would have a capacity of 150 pounds to the inch. It seems to me this is all wrong for the lifting of a ton. If you have a lift 8 inches diameter, you have about 50 inches in area; and with 60 pounds pressure only, you have 3,000 pounds lift. This gives you a margin for leaks and things that you are liable to meet with. But, says someone, why not go back to the pump, and instead of using 75 pounds pressure use 150 pounds? Yes; if you do you will simply reduce the size of your lifting cylinder—not its weight very much, for if it has to carry a heavier pressure it must be made stronger and heavier. If you use 150 pounds pressure you must use a water jacket, or your pump will get very hot, and probably will with even this precaution. Then all fittings must be made to correspond.

How many of us have watched the testing of a boiler. There is no trouble until the pressure rises above 100 pounds, then to 125 you still feel easy, but when it begins to reach 150 and 175 you get restless. In other words, the control of air at 75 pounds is simple, at 150 pounds is hard.

Next, we assume that most of you have got some pipe, and probably an extra air drum, that you intend to use. Well, if you are going to 150 pounds pressure, don't use the average pipe and air drum that are lying around your yard. They are not built that way. Perhaps your pipe has been through fire or water, or something happened to it. It looks all right, but don't insist upon its carrying a load of 150 pounds. The average pipeman who is traveling will "sit" on me right here, but the advice I give you is worth taking.

I happened to be in the shops of the Fall Brook Railroad at Corning, N. Y., and while I don't admire the general construction of these shops, they have got some features there that are worth examining. They are using air, taking their power from the main shaft with a pulley that is secured to the shaft by a clutch. This clutch is operated by air pressure. When it reaches a certain amount, the clutch is thrown off; when below, the clutch is thrown in, and it begins to operate the pump. My visit there was short, and I failed to get the matter fully into my head; but it struck me that they had attained useful simplicity in air pumping. I should advise anyone thinking of arranging an air pump to examine Mr. Foster's shop at Corning.

Johnstown, Pa. A. DOLBEER.

Portable Milling Machine for Locomotive Frame Jaws.

Our illustration of a milling machine for use on frame jaws shows a tool that has been badly needed in every shop in the land. It is the invention of Messrs. Buchanan and Davisson of Urbana, Ill., who, seeing the field for such a tool, proceeded to devise something to cover it.

It is simple in construction, consisting of a frame which carries a spiral-fluted milling cutter, a worm and worm wheel, and gears for the operation of those parts. The machine is secured to the engine frame by suitable clamps, one machine on each side of engine, and both driven by air, steam, endless rope or crank, as desired.

The countershaft furnished should make

180 revolutions per minute; this will give a feed of one inch per minute, which certainly eclipses the record of the best man that ever pushed a file on that kind of a job.

This machine has been in use in the C., C., C. & St. L. shops for one year, with flattering results. It needs no recommendation—the illustration tells the story plainly enough to all who have had the job to do with a file and face plate.

The Ashton Valve Co., Boston, have issued a new illustrated catalogue of standard size, showing the principal steam-boiler appliances made by the company. The catalogue is got out in first-class style. Any one interested in steam-boiler attachments will find the catalogue a useful reference.

We learn from the Pratt & Whitney Co., of Hartford, Conn., that the orders for the standard wire gage—made standard by the Master Mechanics' Association—are coming in very steadily, and the prospects are good for the general adoption of the gage.

Stealing a Blacksmith.

BY SAM SHORT.

I am fond of the men who guide the interests of railroads in the Southwest, for they are always so sincerely glad to receive a call from a drummer who has been rubbing against the outside world. I had been there before, and I approached Crossing, the headquarters of the Prairie Southwestern, with the consciousness that I was going to enjoy a most entertaining visit with my old friend Glide, who is general master mechanic. We had the right to be friends, for we had both dodged foremen, gang bosses, and the whole representatives of authority, in the same shop, when we were too young to be fired for small delinquencies. We had both abused the hard hitters among engineers who paid no attention to the comfort of firemen, and our antipathies were a unit for the traveling engineers and others who insisted on clean jackets, shining, bright work and other abominations that make a fireman prematurely tired. Silas Glide had a hand in inducing my sweetheart to jilt me in favor of himself, but after a brief season, when my heart was volcanic, I settled down to the belief that he was a real benefactor, even in that.

I always had an uncomfortable feeling that Silas helped to make the trouble worse between me and the G. M., when I was master mechanic and he was backshop foreman, but that may have been because he took my place. When General Manager Wartmouth called for his resignation eighteen months later, it seemed that the sting of my resentment was healed. So we are now good friends.

When I got to Silas' office, they told me that he was in the shops, and I went out to chase him down. After a protracted hunt, I found him in the blacksmith shop. He tried to receive me cordially, but it was a dismal failure, and his welcome was mixed with side expressions that savored of profanity. All the time he had a faraway expression in his eyes, which I had seen before when his mind was elsewhere, and I inquired if Bessie's tenth was free from infant distempers, thinking that was the origin of his solicitude.

"The youngsters are all right," he grunted; "What is wrong is that blanked blanked Smith, who came and stole my foreman blacksmith."

"Reversing the case of Lochinvar, a damsel in bloomers came and carried him off on a tandem bicycle, I suppose?"

"No such nonsense or luck. Another master mechanic came round and induced Tom to emigrate on the offer of twenty dollars a month more pay! But this is no place to talk about it," he continued, "let us go to the office."

The office did not offer many attractions, but we talked business, and then went and looked round the other shops, which did not present many novelties.

When the whistle blew, I went home with Mr. Glide, as a matter of course. The reception was tumultuous—a whole flock of youngsters clinging over their father to secure preference for their experiences and adventures of the day. As we reached the porch Bessie appeared, and tried, with small effect, to restore order from the chaos of reception. Managing children was not the forte of this gazelle-eyed brunette. After she finished making ample apologies for her slovenly appearance, and for the untidy condition of the rooms, we were ushered into the dining room, and there the social part of the evening commenced. There was much household talk, about the smartness of this and that juvenile member of the family, and there were a good many reminiscence of "Auld Lang Syne" that were told over again, and seemed as fresh as when new.

When Bessie and the children finally disappeared, Silas brought out his best box of cigars, and then I knew that he was ready to unbosom himself about his shop troubles.

After slight prompting, he began: "You remember, when we were both on the N. & Y., before General Manager Warmouth fired you, that the Railroad branch of the Young Men's Christian Association got up educational night classes for the benefit of the men, and how much trouble you had getting the boys to take an interest in what was intended for their benefit."

"Yes." (Although I did not say so, I remembered how Silas sneered at the thing, and nearly spread the belief that I was advocating the classes for a selfish purpose. It was going to give me a tighter hold on the boys.)

"Well, among those who attended those classes regularly was big Tom Long, helper to the tool dresser. Do you remember Tom?"

"Yes." I remembered giving Tom private lessons in reading and writing, because he was ambitious, and had asked me where he could get lessons.

"That same Tom," continued Silas, "attended the classes till they were given up for want of interest. That was the year after you left. Tom learned to do some drawing and a great many things blacksmiths seldom take any interest in. He subscribed for mechanical papers, read books about blacksmithing, and learned a great deal about the working of steel and iron. When Phil Brown, the tool dresser, fell sick, the foreman put Tom on the fire, and he did the work better than Brown. Then the foreman gave him a regular fire, and Tom was a full-fledged blacksmith. Of course, he had me to thank for letting him go right ahead.

"Tom's head was turned by the good treatment he received. One day he up and told the foreman that he had learned all the blacksmithing that shop could give him, and he was going where he could learn something. So he went away. He must have had a hard time getting another job, for someone told me months afterwards that he was working in a sewing machine shop in Chicago. Funny place that for a blacksmith who wanted to learn something.

"I did not hear anything of Tom for several years, till one day, after I had come to Crossing, in walks Tom, as big and confident-looking as ever, and struck me for a job. I said, 'I heard you have been learning to make sewing machines; do you think that would help you in welding a locomotive frame?'

"'I don't know that it would,' replied Tom; 'but I have learned lots of things that would help me to cut the cost of work in a railroad blacksmith shop, if I only had the chance.' Then he proceeded to tell what he would do when he struck a job as foreman.

"The old man is always roasting me about the cost of repair work, and he had joked me, with a knife point in his fun, that I did not need a scrap heap as I kept the blacksmith shop for that purpose. Now, Tom talked with so much confidence of what he could do that he made me half believe him, although there is nothing I hate like conceited men who are going to change things. But I have always noticed that men with a high estimate of their own ability convince many other people to their way of thinking.

"I told Tom to come back in a day or two, and I would see if I could get a fire for him. Two days later, when he called, I had made up my mind to put him on as assistant to Hodges, the foreman blacksmith. Tom started in to clean the scrap out of the floor of the blacksmith shop, and to select it. Three days after he had begun, and I was getting pleased with the the improved look of the shop, Hodges came and said that there was no room for two foremen in one shop, that the new man must go or he would quit. I should not have hesitated about holding to my old foreman; but as bad luck would have it, the Old Man had gone through the shop that very day, and congratulated me on the improved appearance of the blacksmith shop. Then I told him that I had put on one of the boys I raised on the N. & Y., as assistant foreman, and he was a hustler.

"Hodges was bluffing, and gave in when he saw that I would not discharge Tom; but the two could not get along together, and within the month I had to send Hodges adrift.

"Tom cleaned up the shop first, and got all material arranged where men could find it. He next overhauled all the forges, changed the draft arrangements with decided improvement, washed the windows that had become nearly blind with dirt, and had hammers, bolt headers and all the tools in the place put in first-class order.

"Things looked so much better in the shop that I was more than satisfied. That was before the panic, and business was rushing on the road, with the result that the shops were kept busy. The Old Man insisted on our making all sorts of things in the shops, even links and pins. One day that I went into the blacksmith shop, I found an odd-looking contrivance connected with the steam hammer by which a pair of men were scarfing, bending and welding links. On the bolt header was an apparatus which was turning out coupling pins finished.

"I asked Tom where he learned how to make these things, and he answered, 'In the sewing-machine factory.' He said that there were lots of ingenious formers used in the sewing-machine factory which he would make large enough to finish railroad fittings. And he was as good as his word. I was able to show a year after he took hold that for a great deal of the work we had reduced the cost one-half. Besides that we had less trouble from broken frames and other heavy castings than we ever had before.

"Everything went lovely till about two months ago, when that dude, Smith, who has our old job on the N. & Y., stopped over at Crossing, and, of course, came and looked over the shops.

"'That's a good foreman blacksmith you have,' he remarked to me; 'I think I shall steal him from you.'

"I thought he was joking and did not trouble myself. But sure enough, two weeks later, Tom came to me and said that he had got an offer of a job with $20 a month more money. He added that he was not working for his health, but he would just as well remain at Crossing if I would raise him the $20.

"That made me mad, and I pointed out that I had been the making of him, and by my favor he was receiving $90 a month. I did not fail to remind him that I had raised him from a helper to a blacksmith fire, and then I had made him foreman when he did not have a dollar to his name. His conduct was black ingratitude. 'I have made a man of you, and you are ready to desert me for a paltry $20 a month.'

"He did not take my talk pleasantly. In fact, he called me a stupid old fossil, and worse names. Said he would not work any longer for me. So we parted.

"Old Hodges had been hanging round the town ever since Long took his place, and I thought the best thing I could do was to put him back on his old job. Well, do you know, he let the shop fall back into its old condition in about a month, and went to doing the work in the old way. We are slack now, but have some cars building. The shops are working forty-eight hours a week, and in that time the blacksmith shop had no difficulty in doing all the work called for. Now the foreman of the car shop is complaining that he can't get his blacksmith work, and Hodges wants to hire more men. That's what's worrying me," groaned Silas, "and half the time I am acting foreman of the blacksmith shop."

"Do you have any idea of how much

letting Long go has cost the road over the saving of $20 a month?" I asked.

Silas squirmed a little at that question and said, "I can't tell exactly, but Mr. Burr, who is chief clerk and storekeeper, says that the change is costing the company $20 a day. It can't be so bad as that; but I am looking after things myself, and may have to let Hodges go again. The Old Man was in the blacksmith shop yesterday and went away looking very black. I am afraid Burr will say something about the increased cost of the work. If it should reach the ears of the Old Man, he would do some tall growling."

Next day I called on Mr. Dawson, the Old Man, who was an old acquaintance, having been train dispatcher when I was M. M. of the N. & Y. I had not been in his office long when he asked if I wished to return to railroading. "No, I had no ambition," was my answer. "Do you know of anyone needing a master mechanic?" I asked, thinking of several friends who are out in the cold.

"Yes," he said, "I want a master mechanic myself, and want him badly. I can't stand Glide any longer. The way he runs his department is bringing me into trouble."

I urged him to be a little patient with our old friend, and when I came away he promised to give him another chance. Since I came home I received a letter from Dawson asking me to send in the names of master mechanics I considered would handle his machinery department satisfactorily.

Welding Safe Ends of Tubes.

Those familiar with the most improved method of safe-welding boiler tubes are probably aware that the Manhattan Elevated Railroad practice butt-welding exclusively, and that Mr. R. B. Reading, general foreman,, is a warm advocate of the practice. There was a report on Safe-Welding of Boiler Tubes submitted to the Central Railroad Club lately, and a stand was taken in favor of scarf-welding of safe ends. The discussion was to have taken place at last meeting, but it was postponed till May at the request of Mr. Reading, who was unable to attend the last meeting. He expects to go to Buffalo in May, armed with incontestable evidence in favor of butt-welding. Butt-welding is not followed in many shops, but most of those who have tried it insist very firmly that a better weld is made than by the other process. A scarf entails a thin point which gets burned in the process of heating—it burns before the thick part gets up to a welding heat. When the weld is done, the burned material leaves a weak circle which often results in fracture.

The Central Railway Club did a sensible and considerate thing in putting off the discussion to enable Mr. Reading to be heard. He will submit information of value.

Wear of Tires Affected by Form of Rail Head.

There have been at various times animated discussions among railroad engineers concerning the form of rail head to put the metal in the best shape for producing the maximum of strength and wearing qualities. Among the most intelligent students and investigators of this important subject, Prof. P. H. Dudley, inspecting engineer of the Vanderbilt lines, takes a prominent place, and there is good reason for believing that he has designed a form of rail as nearly perfect as can be produced. In a highly valuable paper which he prepared on the wear of tires on passenger engines on the New York Central Railroad, Professor Dudley shows that, while the load on drivers has greatly increased of late years, and the speed of trains accelerated, the wear of tire per 1,000 miles run has decreased. The cause of this unexpected result is undoubtedly the introduction of the broad-head rail designed by Professor Dudley.

The first improved rail he designed was 80 pounds to the yard, radius of top 12 inches, and corner radius 5-16 inch. A rail of 100 pounds weight per yard, designed later, has a top radius of 14 inches and corner radius 5-16 inch. The wear of tires running on these rails is very interesting when compared with the wear of the tires of lighter engines running on a 65-pound rail with narrow, deep head. The most salient parts of the paper read:

"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 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 13,360 pounds, ran an average of 19,400 miles for a loss of 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 11-16 inches wide. Its use was yearly extended; and by 1889, locomotives on the Hudson division made nearly one-half of 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 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

Graphite Paint for Railway Uses.

At the meetings of the Civil Engineers and of Superintendents of Bridges, the question, "What is the best, most durable and most economical paint for iron construction work, bridges, etc.?" or some similar question, is always discussed.

The rivalry between iron and lead paints is of long standing. It is conceded that lead paints set too quickly and run too readily when applied to vertical surfaces. There is no question of the poisonous nature of lead paints, and the iron paint makers claim that lead paints destroy the oil.

On the other hand, the lead paint makers claim that oxide of iron paints are in themselves rust producers, and scale and blister more readily than lead paints, and are very short lived.

Both factions seem to agree that PROBABLY graphite or carbon paints may be the coming paint for protecting iron and all metal work, as well as wood work, from the sudden changes of the weather, from the effects of acid fumes and the various other destructive agents. They claim, however, that graphite paint has not been fully tested, and that is the reason some statement should be made concerning graphite paint.

About thirty years ago the Joseph Dixon Crucible Company, of Jersey City, N. J., began the manufacture of Dixon's Silica-Graphite Paint, using a flake graphite and finely pulverized silica, both produced at the Company's mines at Ticonderoga, N. Y. The union of silica and graphite in proper proportions makes an ideal pigment, the silica acting as a filler and affording the necessary hardness, and the flake graphite, lapping flake over flake fish-scale fashion, ensuring flexibility and toughness, and withstanding successfully the expansion and contraction of heat and cold.

Both silica and graphite are known as inert materials, and both are impervious to the destructive effects of heat and cold, acid fumes, etc. Both are non-poisonous, and neither will destroy or affect the oil in any way.

It is a matter of record, that roofs and iron work properly painted with Dixon's Silica-Graphite Paint have not required repainting in ten, fifteen, and even twenty years. It is to-day largely used by railroads and other corporations, and as its use is regularly continued it is evident that it is found satisfactory in every respect.

Dixon's Silica-Graphite Paint is more easily spread than any other paint. It covers pound for pound three times more surface than the lead paints, and twice the surface of mineral paints. It is strictly a pure linseed oil, kettle boiled paint, and those who have used it for the past twenty-five years claim for it the greatest durability and economy.

Dixon's Silica-Graphite Paint is the only flake graphite paint made, and it is the only graphite paint with an established record and reputation. The testimonials published in some of the earlier circulars of the Company have been used by other makers of so-called graphite paint to give color to their statements.

As graphite has very strange coloring power, it is impossible to make graphite paint in light colors. It can be successfully made in black, slate, olive green and dark red color. For further information address Joseph Dixon Crucible Company.

loss of 1-16 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 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. Wm. 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; and below will be found the entire list, except for Engine No. 903. When the Class "I" engine was designed in 1889, 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—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 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 1-16 inch loss in thickness of the tire. The mileage of 19,400 miles per loss of 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 23,166 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."

An Early Advocate of Railroads.

The following curious memorial made to the House of Representatives at Washington, in 1819, has been discovered by Mr. W. H. French, file clerk:

"The memorial of Benjamin Dearborn, of Boston, respectfully represents: That he has devised in theory a mode of propelling wheel carriages in a manner probably unknown in any country; and has perfectly satisfied his own mind of the practicability of conveying mails and passengers with such celerity as has never before been accomplished, and in complete security from Robberies on the highway.

"For obtaining these results he relies on carriages propelled by steam on level railroads; and contemplates that they be furnished with accommodations for passengers to take their meals and their rest during the passage, as in a packet; that they be sufficiently high for persons to walk in them without stooping, and so capacious as to accommodate Twenty, Thirty, or more Passengers and their Baggage.

"The inequalities of the earth's surface will require levels of various elevations in the railroads; and your memorialist has devised means which he believes will be completely effectual for lifting the carriage by the inherent power of its machinery from one level to another, as also for the passage of carriages by each other on the same road; and he feels confident that whenever such an establishment shall be advanced to its most improved state, the carriage will move with a rapidity at least equal to a mile in three minutes.

"Protection from the attack of assailants will be insured, not only by the celerity of the movement, but by weapons of defense belonging to the carriage and always kept ready in it, to be wielded by the number of passengers constantly traveling in this spacious vehicle, where they would have liberty to stand erect, and to exercise their arms in their own defense.

"The practicability of moving steam carriages on the common road was long since advocated in a publication by that ingenious and useful citizen, Oliver Evans; your memorialist therefore does not assume the merit of originating the idea of a steam carriage, but only of modifying the system in such a manner as to produce the results here stated, which could not be effected on a common road."

"How to Save Money in Railroad Blacksmith Shops" is the title of a pamphlet by Orville H. Reynolds, M. E., associate editor of "Locomotive Engineering," published by Sinclair & Hill, publishers of "Locomotive Engineering," 256 Broadway, New York; price 25 cents. The pamphlet has forty illustrations, and gives very plain and comprehensive descriptions of work done in blacksmith shops by the aid of dies and formers operated under bulldozers and helve hammers. The operations described reduce the cost of blacksmith-shop work in figures varying from 25 to 90 per cent. It would abundantly pay railroad companies to put this pamphlet in the hands of every blacksmith they employ.

The Standard Paint Co. have removed their offices to 81-83 John street, New York.

The First Sleeping Cars.

Various railroad companies claim to have been the first to give to the public the comfort and convenience of sleeping cars, but we think that what is now the Philadelphia, Wilmington & Baltimore is clearly entitled to the credit for that enterprise. Anyone who has access to a library containing old files of the "Baltimore Chronicle" will find in the issue of October 31, 1838, the following article:

"The cars intended for night traveling between this city and Philadelphia, and which afford berths for 24 persons in each, have been placed on the road, and will be used for the first time to-night. . . . .

"Night traveling on a railroad is, by the introduction of these cars, made as comfortable as that by day, and is relieved of all irksomeness. The enterprise which conceived and constructed the railroad between this city and Philadelphia cannot be too highly extolled, and the anxiety evinced by the officers who now have it under control, in watching over the comfort of the passengers, and the great expense incurred for that object, are worthy of praise and deserve to receive the approbation of the public. A ride to Philadelphia now, even in the depth of winter, may be made without inconvenience, discomfort or suffering from the weather. You can get into the cars, where there is a pleasant fire, and in six hours you are landed in Philadelphia. If you travel in the night, you go to rest in a pleasant berth, sleep as soundly as in your own bed at home, and on awakening next morning find yourself at the end of your journey. Nothing now seems to be wanting to make railroad traveling perfect and complete in every convenience, except the introduction of dining cars, and these we are sure will soon be introduced."

Considering that the above was written within ten years after the first locomotive turned a wheel in this country, it indicates that both the railroads and travelers soon learned about how travel could be made luxurious. The time for the sleeping car had not yet arrived; and after a brief experience which showed that the supply had been provided before the demand arose, the sleeping cars were taken off.

Mr. Jos. Lythgoe, manager of the Rhode Island Locomotive Works, has in his tool-room a business-like little tool for truing and removing stock from small jobs, that would be a good thing to place right out in the shop and give men access to it at all times. There are many times in the course of a day's work when somebody wants to remove from a sixty-fourth to a sixteenth of an inch of material from a small job; this is just too little to plane, mill or shape, and just too much to file; in such a case the little machine referred to would be a source of revenue anywhere. It is simply a pair of steel disks, 18 or 20 inches in diameter and 3/8 inch thick, the flat sides of which are covered with any grade of emery cloth found most suitable for the work. These wheels are mounted and run similarly to emery wheels, which they are, in fact, with the difference that they are always true and cannot be gouged.

The Chicago & West Michigan Railway is the last to adopt the Brown System of Discipline Without Suspension. Mr. J. K. V. Agnew, general superintendent, has issued a circular giving particulars of how the system will be worked. It is different in several respects from the Brown System. A certain number of marks will be entered against the record of an employé for violations of rules or carelessness, instead of suspension of fine, as formerly imposed; for repetition of any offense, double the number of marks will be entered. For every twelve consecutive months of service free from demerit marks, or free from necessity for imposing a reprimand, ten marks will be deducted from any that may have been previously entered against an employé's record. When sixty marks are entered against the record of any employé, his services will be dispensed with. Dishonesty, intemperance, disloyalty, insubordination, incivility, willful negligence, incompetency or disobedience of the company's rules will be considered sufficient cause for immediate dismissal.

Jenkins Brothers, New York, write us: "We are, as you probably are aware, the originators of Unvulcanized joint packing, and, in accordance with our views to always manufacture a high grade of goods, we have been experimenting for some time in order to obtain a packing that would fulfill all requirements. We think we have done so with what we call our new 'Jenkins '96,' and from the reports furnished us by prominent engineers and steam-fitters who have given this new 'Jenkins '96' a trial as well as ourselves, we feel proud to know that not a fault can be found with it. While we have not changed the good qualities of our old 'Jenkins' packing, we have added to its efficiency. The improvement consists in manufacturing a packing suitable for any and all pressures of steam—that will not rot, burn, blow or squeeze out under any conditions; and, furthermore, we have obtained a result which we believe no other packing manufacturers have yet obtained—that is, a packing that has all the above advantages and will last for years in a joint. In fact, it will last as long as the metal itself, and can be broken and used again and again. We are very well aware that this is a broad statement to make; nevertheless, we stake our reputation upon it."

Agitation Favoring the Metric System.

The American Metrological Society, whose headquarters are in Columbia University, New York, is displaying extraordinary activity agitating in favor of a bill before Congress to make the metric system of weights and measures obligatory in this country at an early date. We have received a circular letter signed by the president and secretary of the society, urging us to sign a petition in favor of the Hurley Bill, which makes the metric system of weights and measures the only legal basis of weighing and measuring after January 1, 1901. Strangely enough, the measure exempts the surveys of public lands.

The advocates of the new system of metrology are so enthusiastic in favor of the French system that they have no patience with those who intimate that the change would entail vast inconvenience and expense upon industrial interests. Then why exempt the measurement of land? An acre could be expressed in metric measure more intelligibly than 2⅞ threads to the inch, and the men dealing with screw-thread computations have certainly less time for the numerous calculations they would be required to make than the land-measurer. It is the old story of catering to the rustic member and putting new burdens upon mechanical interests. The schoolmen, who have originated and worked up the agitation in favor of the French system, care nothing about what interests may suffer by the change so long as they can ride their hobby. Should the law be passed and attempts made to enforce it, the mechanical interests will soon be heard from in a way that the advocates of the "reform" little expected.

A sweeping measure, calling for an entire change in our weights and measures, is impracticable. Our system of length measurement is practically uniform, but the measures of capacity and weight are confused. A true statesman would try to reform the measurements that are in confusion, and leave those that are uniform alone. But we cannot expect broad-minded measures to emanate from the one-sided, ignorant cranks who expect to obtain glory and prominence from advocating radical changes that entail industrial revolution.

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 Pittsburgh capitalists, whose plant will be located in Pittsburgh. Ample capital has been provided, and the concern has 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, and the work will be pushed as rapidly as possible, and the new concern expects to be turning out the Fox pressed-steel truck about October 1st next. The plans are very elaborate, and 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 x 62 feet will be located the machine shop, blacksmith shop, pump house, boiler house, electric light plant, and a small building to 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 plant, 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, and by the perfect working of the truck, thus avoiding all unnecessary friction to all parts of the train.

The Boston Belting Co. have published a catalogue illustrating and describing their fire hose and attachments. It contains a great deal of useful information about fire hose, nozzles, couplings, and other apparatus employed in putting out fires.

A Railroad Journey in Jamaica.

In a paper read before the New England Railroad Club, Mr. C. W. Willis gives the following account of a trip over a railroad:

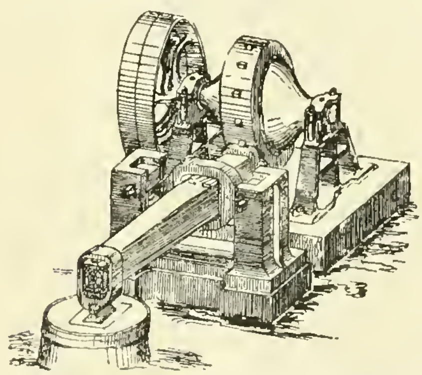
"The little station stands in the midst of a grove of cocoanut palms. It is a light, airy structure, with a wide portico at one end. The station officials, ticket agent and telegraph operator are all black, and all extremely courteous—an indication that Jamaica railways have attained one condition which thus far has been but a dream and a flight of imagination with regard to American railways, too altogether improbable to be realized either in this or the next century.

"The little train stood on the track a short distance away, ready to back down for the passengers. The cars were small and very light, and the wheels all had spokes like carriage wheels; the cars were old and showed the ravages of the climate, and were almost devoid of paint, both inside and out. They are divided into compartments, and there are first and second class carriages. For the benefit of any who may in the future travel in Jamaica, I will explain that the difference between first and second class is largely a choice of 'niggers.' In the first-class coach the passengers will probably wear shoes, and there are very thin cushions on the seats; while in the second-class, the passengers are barefoot and there are no cushions. But the difference is slight, so save your money and ride second-class. The cars are entered at the side, and the seats, two in each compartment, face each other, so if the compartment is full a part of the passengers must certainly ride backward.

"The tiny, English-built engine, though the road is standard gage, stood blowing off steam furiously, and the black engineer and fireman lounged lazily in the cab—for, owing to the torrid climate, the engines are provided with cabs. Soon the engine was coupled to the cars and the train backed down to the station. Then the shrill whistle began to blow, and it blew steadily for about two minutes. I was told that it is customary to blow the whistle for two minutes, fifteen minutes before it is time for the train to start, though it seemed to me to be just the other way. There is no bell on the engine. Soon we were seated in our compartment, as good luck would have it being the sole occupants—myself and wife—and the starting-time arrived. The black conductor blew a small whistle, the engineer answered with a shrill blast, and away we rattled over this curious West Indian road, winding across the plain of St. Thomas in ye Vale, between the green hills, over high viaducts, past groves of palms and fields of cane, banana and plantain plantations and mangrove swamps, every now and then seeing a great black bee-hive-like structure, fully as large as a bushel basket, perched high in some great tree, the home of the tree or nest building ants. We stopped at frequent stations, about which congregated people of all sizes, colors and conditions of life, some of them in astonishingly abbreviated costumes; and at one of these stations, the last before we entered the first of the many tunnels, we heard the sound of feet on the roof of the car, and were somewhat amused to see a lighted lamp lowered down through a hole in the roof—reminding the passengers to make ready for the tunnel. Away again we sped, half of the time going at a tremendous speed by the force of gravity alone, until we saw the blue Caribbean spread out before us, soon reaching the city of Kingston."

Some Odd Helve Hammers.

Our illustration was taken from a catalog issued by Martini & Ise, of Haspe, Germany, and shows the kind of helve hammers still in use there.



One good American hammer like the Bradley, would dance all around a quartet of these antediluvians.

Why Coal-Mine Water Corrodes Iron.

The railroad companies which have to use feed water that is mixed with the water pumped out of the coal mines, learn from expensive experience that the water frequently contains corrosive agents which exert disastrous influences on boiler sheets. To an ordinary man with a little knowledge of chemistry, it appears strange that the mild acid elements present in coal should develop such strong corrosive agents; yet we have repeatedly found water in mines that would show a decided acid reaction in simple tests.

Speaking to Dr. Dudley, the expert chemist of the Pennsylvania Railroad at Altoona, on the subject, he informed us that sulphur was often found in coal in the form of organic sulphides combined with carbon. Under favorable circumstances, this sulphide will combine with oxygen and form sulphuric acid. Owing to this change worked out in Nature's laboratory, the water in coal mines is frequently found heavily charged with free sulphuric acid. This is most likely to happen where there is scarcity of carbonates that would combine with sulphuric acid to make sulphates.

WHAT YOU WANT TO KNOW.

Questions and Answers.

(41) E. W., Chanute, Kan., writes:

The eccentrics on a locomotive have a 5-inch throw. We take off one eccentric and turn it off, reducing the diameter 1 inch, but do not change the throw. Can the engine's valves be squared in full stroke or cut-off; and if they can, please state how and why? A.—The valves can be squared just the same after the reduction of diameter of the eccentric as before, for the reason that such reduction has not altered the throw; and the valve travel and angular advance will therefore remain as they were before the eccentric was turned.

(42) H. B. Z., Algiera, La., writes:

Please advise, in your Question and Answer column, information as follows: Give diagram or construction lines to be used in drawing a gear wheel; if you cannot give diagram, any information on this subject will be thankfully received. A.—Our space is too limited to go into this question understandingly, and we therefore refer you to George B. Grant's "Odontics, or the Theory and Practice of the Teeth of Gears," published at Lexington, Mass., a work that will tell you all about all kinds of gears and the theory of their construction.

(43) J. A. N., Northampton, Mass., writes:

Please tell me which side of driving-box brasses wears the most, and why, on an eight-wheeled passenger engine, forward or back. A.—It has been found by the investigators of brass wear, that the forward side of a brass almost invariably shows more wear than the rear side. The reason for this is found in the pressure on the piston always forcing the axle forward against the brass, this effect being the same whether the crank pin is above the axle or below it. The back boxes always show more wear than the forward ones, and this is said to be explained by the fact that the former get more of the dust than the latter when running.

(44) J. W., Waterloo, Ia., writes:

1. Who was the inventor of the extension front ends? A.—Mr. John Thompson, master mechanic of the Eastern Railway, now a part of the Boston & Maine system, was the inventor of this device, about 1880. 2. Of what benefit are they? A.—They retain cinders and sparks by means of the deflectors and netting, that would otherwise go out of the stack. 3. What is the use of the diaphragm; how does the raising or lowering of it affect the fire? A.—The diaphragm is used to regulate and equalize the draft through the flues and grate; raising it gives a freer draft, and lowering it has the opposite effect. 4. If an engine pulls hard on her fire and fire-hole door, does the diaphragm require raising or lowering? A.—When an engine "pulls hard on her fire and fire-hole door," and the diaphragm gives results in accordance with Answer 3, it is time to enlarge the exhaust nozzles.

(45) T. H. W., Schenectady, N. Y., writes:

1. Please explain the following problem: At a locomotive works where I am employed, an engine which had run about two months was returned for repairs, when it was found that the cylinders were worn on top nearly ¼ inch. The piston was of the built-up pattern of spider, rings and follower. A.—We cannot give an intelligent answer to questions of this character, for the reason that too much data is wanting; it is necessary to know all the points of construction before passing on the cause of this trouble. One case of the kind within our knowledge was cured by extending the piston through front cylinder head. 2. What composition expands when cooling? A.—Antimony expands by cooling. When alloyed with 80 parts by weight of lead, to 20 of antimony, it forms an excellent anti-friction metal with absolutely no shrinkage—the latter metal hardening the alloy.

(46) J. W., Toccoa, Ga., writes:

Will you kindly give me, through "Locomotive Engineering," the amount of power necessary to be applied to a brake wheel 14 inches in diameter, to break or twist off a brake staff $1\frac{1}{8}$ inch diameter, having a ⅜-inch hole through staff, at the point where the break occurred. Also give me the rule for finding same. A.—The force necessary to twist off the brake shaft of your dimensions may be found by the following formula for torsional strength of a solid round bar: $W R = 0.196\ D^3 S$, and $W = (0.196 \times D^3 \times S) \div R$; in which W = force applied at the periphery of wheel, R = radius at which force is applied—or distance from the center of brake shaft to periphery of wheel—D = diameter of brake shaft in inches, and S = ultimate shearing strength of wrought iron in pounds per square inch. The $1\frac{1}{8}$-inch shaft having a ⅜-inch hole through it, is only equal to a shaft $\frac{15}{16}$-inch in diameter, or 0.9375 inch. Substituting the known values for the symbols, we have: $(0.196 \times 0.9375^3 \times 40{,}000) \div 7 = 6{,}459 \div 7 = 923$ pounds pull at the brake wheel to twist off the shaft. There are two uncertain elements here, namely, the possible strength of a man at the wheel and that of the iron in the brake shaft. If the resistance of latter is taken at 20,000 pounds, instead of 40,000, the force necessary to overcome it will be only one-half that found, or 461 pounds. This would be equal to 230 pounds on each side of wheel, and a force that could be exerted by a strong man.

(47) N. D., Wilkesbarre, Pa., writes:

Will you please tell me what is meant by a triple-expansion engine? I often see it mentioned in your paper. A.—The number of expansions of steam in all engines is practically equal to initial pressure divided by terminal pressure; this means, for a high-pressure engine, that if we divide the absolute pressure of the incoming steam by the absolute pressure of the steam at exhaust, we have the number of times the steam has been expanded. For example, we may take a locomotive with boiler pressure at 135 pounds; this will give, by adding 15 pounds for atmospheric pressure, an absolute pressure of 150 pounds. Then, if the terminal pressure is equal to 15 pounds above atmosphere, the absolute terminal pressure would be, by adding 15 pounds to reach vacuum, 30 pounds absolute. Then, by the formula above, we would have $150 \div 30 = 5$ expansions, which means that the engine has cut off at $\frac{1}{5}$ stroke; and this is a higher rate of expansion than can be economically carried out in one cylinder. If now we have the same initial pressure as before, and expand the steam down to a terminal pressure equal to 10 pounds absolute, we would have $150 \div 10 = 15$ expansions, or three times more than we found in the first case and to keep the expansion within a reasonable limit, it would therefore require three cylinders in which the expansions would average five to each cylinder—or, in other words, the steam would be expanded through three cylinders. This is effected by exhausting the steam from a high-pressure cylinder into a second, and from there into a third cylinder. The engine then becomes a triple-expansion engine. If one more cylinder were used, the engine would be called a quadruple-expansion.

(48) J. V. R. S., Quincy, Ill., writes:

1. All our engines have extension fronts and smoke very much at the door when shut off; what causes it? A.—The reason for this we cannot give without seeing the engine; but it is plain that there is not draft enough, whatever the cause for it. 2. I put a large nozzle in the engine, 3¾-inch, and had to raise the draft sheet to get steam; now she fills up the front end in twenty miles; have no arch; how can I prevent it? A.—We cannot say without more knowledge of the situation. 3. My neighbor said to me that he could take ¼ inch off an eccentric and not change her valve travel. I said, "How will you make up for the ¼ inch taken off the eccentrics." He said he would lengthen the eccentric rods. Now, I said that would be all right to open the back port, but would not open the front port the same. Am I right, or is he? A.—Reducing the diameter of an eccentric cannot alter the movement of a valve, so long as the throw remains unaltered. The only change that is made necessary is that of lengthening the rods. The old rods gave a correct opening front and back, and it don't require any abstruse reasoning to see that new rods would perform a like service. 4. Can you give me a receipt to plate a head-light reflector? A.—We are not in possession of such a receipt. Any liquid plating would be useless—it should be electro-plated. 5. My head-light smokes; I put a new wick in. In cleaning the burner, saw that the air duct was all right in casing at top and bottom; still it smokes. A.—Some of the air passages are evidently choked. Thoroughly clean the whole thing. 6. I have an engine that has a double nozzle, measuring 16 inches from top of nozzles or breeches to top of arch; don't you think they are too short? Have no lifting pipe in arch. A.—We cannot say what the height should be, since you do not give diameter of cylinders or stack.

(49) E. L. G., Minneapolis, Minn., writes:

Will you please state, through your columns, where the most strain comes on main crank pin—when engine is running at high rate of speed, when working steam, or when steam has been shut off? I have put these questions to quite a number of "old-timers," and the answers have been about equally divided. I would like to have your opinion. A.—To answer these questions it will be necessary to assume a type of locomotive, the boiler pressure, and also the speed; for the first we will take an 18 x 24 eight-wheel engine with 62-inch drivers, for the second 150 pounds boiler pressure, and for the third a speed of 60 miles per hour. With this boiler pressure and speed the initial pressure will be a variable quantity, depending on the valve motion, but it may be taken at 110 pounds. To simplify a very complex subject, the obliquity of the main rod will be neglected, and the thrust will be supposed to act in the direction of the piston's axis—that is, the stress will be taken as a maximum when the crank pin is passing the centers. The intensity of this stress is found by multiplying the area of piston by the initial pressure, and we then have $18 \times 18 \times 0.7854 \times 110 = 254.47 \times 110 = 27{,}991$ pounds on the piston when the valve opens for admission. When running at the same speed with the throttle closed, the centrifugal force of the reciprocating parts is to be considered as the disturbing factor. We will assume the reciprocating parts to weigh 700 pounds, and that this weight is equally divided between the front and back wheels; this will give 350 pounds to each pin for reciprocating weight alone. The centrifugal force due to this weight, at a speed of 60 miles an hour, can now be found by multiplying together the weight in pounds, the square of the number of revolutions per minute, the radius of the crank in feet, and the constant number 0.00034; the number of revolutions per minute, at 60 miles an hour, equals 325. Arranging these values in accordance with the written formula, we have $350 \times 325 \times 325 \times 1 \times 0.00034 = 350 \times 105{,}625 \times 1 \times 0.00034 = 12{,}569$ pounds centrifugal force on the pin. From these figures we see that the stresses are greater when the engine is working steam.

We are informed by the Ashcroft Manufacturing Company that they have purchased of Jarvis B. Edson, 87 Liberty street, the Edson recording and alarm gage, and that hereafter they will be the sole manufacturers of this gage. They say: "With our unrivaled facilities for manufacturing, and the long experience which we have had in the manufacture of all kinds of delicate instruments for measuring pressures, we are well equipped to continue the manufacture of the Edson recording gage, which is the recognized standard recording gage all over the world."

The General Agency Co., New York, have sent out two cards of a convenient size for the pocket which will be useful to enginemen. One has tables giving the miles per hour the train is going when the driving wheels of eleven different diameters are making certain revolutions. With a knowledge of the size of drivers, a man can get the exact speed by counting the revolutions. Inversely, it gives the number of revolutions when the speed in miles per hour is known. Any of our readers can have the card by applying to the General Agency Co.

The Pennsylvania Railroad Company has just ordered from the Norwalk Iron Works Company, of South Norwalk, Conn., one 10 x 12-inch air compressor for use in its Wellsville, O., shops. This company has ordered five similar machines since December, 1895, and has at the present time twenty Norwalk compound air compressors in use upon its lines.

Watson & Stillman have received an order for the building of fifteen draw-benches for bicycle-tube manufacture, each of them with a stroke of 18 feet.

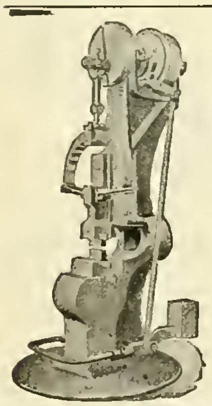
The Boston Belting Co. have moved to new and larger quarters at 100-102 Reade street, New York.

INDEX TO ADVERTISEMENTS.

The Burlington, Cedar Rapids & Northern Railway have lately made some important additions to their outfit of shop tools. We learn from Mr. Bushnell that within the last few months they have put in one driving-wheel press, one air compressor in machine shop, one dimension planer, one universal wood worker, and gainer in car shop, one large steam driven punch and shears, and one Bradley hammer in the blacksmith shop. They have done for years a great volume of work with very indefinite facilities, and this will enable them to make a much better showing on the cost of repairs.

The United States polish, handled by Mr. George W. Hoffman, Indianapolis, Ind., is becoming very popular with those who have to polish headlights and other bright work. The business has increased so much that offices have been opened at 1 Park row, New York, 111 E. Madison street, Chicago, and 503 Montgomery avenue, San Francisco, Cal. Those who are anxious to make the best polish with the least expenditure of muscle should send for a sample of this polish.

The Gold Car-Heating Co. are preparing for what now appears like a lively trade in their electric heaters for next season. Their heaters are exquisite in design, making with the nickel-plating a combination that is beautiful indeed. An inspection of their numerous styles for offices, street cars and residences will tell how well prepared they are to handle this trade. This company controls all American rights of the Flexible metallic tubing, which is used to replace rubber hose for steam, water or air. This tubing is carried in sizes from 1/4 inch to 3 inches, inclusive; it is said to be safe at high pressures, and is so flexible as to assume any shape desired.



Buyers' Finding List.

Air Brake Fittings.
Crane Co., Chicago, Ill.
Air Brake Hose.
Boston Belting Co., Boston, Mass.
N. Y. Belting & Packing Co., New York.
Air Brakes.
Westinghouse Air Brake Co., Pittsburg, Pa.
Air Brake Gage.
Utica Steam Gage Co., Utica, N. Y.
Air-Brake Pump Governors.
Foster Engineering Co., Newark, N. J.
Air-Brake Filter.
Von Weisenflue Air-Brake Filter Co., Scranton, Pa.
Air Compressors.
Clayton Air Compressor Works, New York.
Ingersoll-Sergeant Drill Co., N. Y. City.
Norwalk Iron Works Co., South Norwalk, Ct.
Pedrick & Ayer Co., Philadelphia, Pa.
Rand Drill Co., New York.
St. Louis Steam Engine Co., St. Louis, Mo.
Air Drilling Machine.
C. H. Haeseler & Co., Philadelphia, Pa.
Air Hoists.
Pedrick & Ayer Co., Philadelphia, Pa.
Whiting Foundry Equipment Co., Chicago, Ill.
Arch Bars.
Cambria Iron Co., Philadelphia, Pa.
Asbestos.
H. W. Johns Mfg. Co., New York.
Axles.
Cambria Iron Co., Philadelphia, Pa.
Gould Coupler Co., Buffalo, N. Y.
B. M. Jones & Co., Boston, Mass.
Krupp (T. Prosser & Son, New York).
Balanced Slide Valves.
Am. Bal. Slide Valve Co., San Frisco, Cal.
M. C. Hammett, Troy, N. Y.
Bearing Metal.
Ajax Metal Co., Philadelphia, Pa.
Paul S. Reeves, Philadelphia, Pa.
U. S. Metallic Pkg. Co., Philadelphia, Pa.
Bell Ringer.
Trumbull Mfg. Co., Warren, O.
U. S. Metallic Packing Co., Philadelphia, Pa.
Belting.
Boston Belting Co., Boston, Mass.
N. Y. Belting & Packing Co., New York.
Shultz Belting Co., St. Louis, Mo.
Boiler and Firebox Steel.
Shoenberger Steel Co., Pittsburg, Pa.
Boiler Checks—Inside.
Foster Engineering Co., Newark, N. J.
Boilers.
Pittsburg Locomotive Works, Pittsburg, Pa.
Boiler Iron.
Ewald Iron Co., St. Louis, Mo.
Boiler Testers.
Rue Mfg. Co., Philadelphia, Pa.
Boiler Tools.
Richard Dudgeon, New York.
Hilles & Jones Co., Wilmington, Del.
Long & Allstatter Co., Hamilton, O.
Boiler Washers.
Nathan Mfg. Co., New York.
Rue Mfg. Co., Philadelphia, Pa.
Bolt Machinery.
Acme Machinery Co., Cleveland, O.
Bolt Threading Machinery.
Detrick & Harvey Machine Co., Baltimore, Md.
Books.
H. C. Baird & Co., Philadelphia, Pa.
N. W. Henley & Co., New York.
Open Court Pub. Co., Chicago, Ill.
Practical Pub. Co. E. Orange, N. J.
Philadelphia Book Co., Philadelphia, Pa.
Boring and Turning Mills.
Bullard Mch. Tool Co., Bridgeport, Conn.
Brake Adjusters.
Q. & C. Co., Chicago, Ill.
Brake Shoes.
Ramapo Iron Works, Hillburn, N. Y.
Ramapo Wheel & Foundry Co., Ramapo, N. Y.
Brass Castings.
Ajax Metal Co., Inc., Philadelphia, Pa.
Paul S. Reeves, Philadelphia, Pa.
Buffers.
Gould Coupler Co., Buffalo, N. Y.
Bulldozers.
Williams, White & Co., Moline, Ill.
Cab Seats
Stannard & White, Appleton, Wis.
Cars.
Allison Mfg. Co., Philadelphia, Pa.
Lima Locomotive & Machine Co., Lima, O.
Ramapo Iron Works, Hillburn, N. Y.
Car Couplers.
Gould Coupler Co., Buffalo, N. Y.
McConway & Torley Co., Pittsburg, Pa.
National Malleable Castings Co., Chicago, Ill.
Sams Automatic Coupler Co., Denver, Col.
Shickle, Harrison & Howard Iron Co., St. Louis, Mo.
Smillie Coupler & Mfg. Co., Newark, N. J.
Standard Coupler Co., New York.
Trojan Car Coupler Co., Troy, N. Y.
Car Heating.
William C. Baker, New York.
Gold Car Heating Co., New York.
Safety Car Heating & Ltg. Co., New York.
Car Lighting.
Safety Car Heating & Lighting Co., New York.

Continued on page 428.

BUYERS' FINDING LIST—*Continued.*

Car Paints.
Detroit White Lead Works, Detroit, Mich.
Car Roofing.
P. H. Murphy Mfg. Co., E. St. Louis, Ill.
Standard Paint Co., New York.
Warren Chemical & Mfg. Co., New York.
Car Seats.
Hale & Kilburn Mfg. Co., Philadelphia, Pa.
Car Ventilators.
M. C. Hammett, Troy, N. Y.
Car Wheels.
Boies Steel Wheel Co., Scranton, Pa.
Krupp (T. Prosser & Son, New York).
Lima Locomotive & Machine Co., Lima, O.
Ramapo Wheel & Foundry Co., Ramapo, N.Y.
Roberts, Throp & Co., Three Rivers, Mich.
Rood & Brown, Buffalo, N. Y.
Standard Steel Works, Philadelphia, Pa.
Washburn Car Wheel Co., Hartford, Conn.
Cattle Guards.
Q. & C. Co., Chicago, Ill.
Chain Pulley Blocks.
Moore Mfg. & Fdy. Co., Milwaukee, Wis.
Chime Whistles.
Crosby Steam Gage & Valve Co., Boston, Mass.
Clocks.
John J. McGrane, New York.
Coal Handling Machinery.
Link Belt Engineering Co., Philadelphia, Pa.
Coal Chutes.
Williams, White & Co., Moline, Ill.
Correspondence Schools.
Internat'l Corres. Schools Scranton, Pa.
The Scientific Machinist Co., Cleveland, O.
Corundum Wheels.
Sterling Emery Wheel Mfg. Co., Tiffin, O.
Cranes.
Manning, Maxwell & Moore, New York.
Maris Bros., Philadelphia, Pa.
William Sellers & Co., Philadelphia, Pa.
Whiting Foundry Equipment Co., Chicago, Ill.
R. D. Wood & Co , Philadelphia, Pa.
Crank Pin Gages.
M. C. Hammett, Troy, N. Y.
Crank Pins.
Cambria Iron Co., Philadelphia, Pa.
B. M. Jones & Co., Boston, Mass.
Krupp (T. Prosser & Son, New York).
Drills.
Cleveland Twist Drill Co., Cleveland, O.
Standard Tool Co., Cleveland, O.
Drilling Machines.
J. T. Connelly, Milton, Pa.
Gould & Eberhardt, Newark, N. J.
Electric Lighting and Power Apparatus.
Westinghouse Elec. & Mfg. Co., Pittsburgh, Pa.
Emery Grinders.
Leland & Faulconer Mfg. Co., Detroit, Mich.
Emery Wheels.
Sterling Emery Wheel Mfg. Co., Tiffin, O.
Enamel.
Detroit White Lead Works, Detroit, Mich.
Engines.
St. Louis Steam Engine Co., St. Louis, Mo.
Engravings.
Bradley & Poates, New York.
Standard Engraving Co , New York.
Exhaust Pipe.
The General Agency Co., New York.
Expanding Mandrel.
Geo. L. Weiss, Cleveland, O.
Files and Rasps.
Nicholson File Co., Providence, R. I.
Filters.
A. Major, New York.
Fire Kindlers.
J. S. Leslie, Paterson, N. J.
Flexible Shaft.
Stow Mfg. Co., Binghamton, N. Y.
Stow Flexible Shaft Co., Philadelphia, Pa.
Flexible Steam Joint.
Moran Flexible Steam Joint Co., Louisville, Ky.
Flues and Tubes.
Allison Mfg. Co., Philadelphia, Pa.
Tyler Tube & Pipe Co., Washington, Pa.
Forges.
Buffalo Forge Co., Buffalo, N. Y.
Forging Machinery.
Williams, White & Co., Moline, Ill.
Foundry Equipment.
Whiting Foundry Equipment Co., Chicago, Ill.
Frogs and Crossings.
Ramapo Iron Works, Hillburn, N. Y.
Graphite.
Jos. Dixon Crucible Co., Jersey City, N. J.
Hand Cars.
Roberts, Throp & Co., Three Rivers, Mich.
Heating System for Shops.
Buffalo Forge Co.
B. F. Sturtevant Co., Boston, Mass.
Hoisting Engines.
Earle C. Bacon, New York.
Hydraulic Tools.
Richard Dudgeon, New York.
Watson & Stillman, New York.
R. D. Wood & Co., Philadelphia, Pa.
Indicators.
Crosby Steam Gage and Valve Co., Boston.

Continued on page 429.

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MANUFACTURERS OF
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LOCOMOTIVE BOILER TUBES.
WROUGHT IRON PIPE OF SUPERIOR QUALITY.

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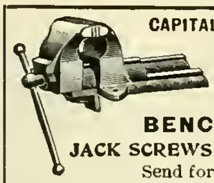

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Auburn, N. Y., U. S. A.,
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BENCH SCREWS,
JACK SCREWS and BICYCLE PUMPS.
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Pat. March 12, 1895.
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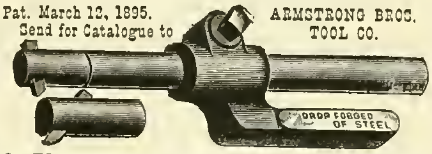
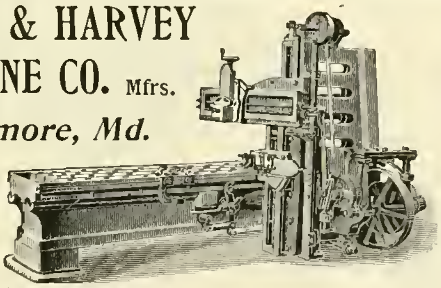


80 EDGEWOOD AVENUE. CHICAGO.

DETRICK & HARVEY MACHINE CO. Mfrs.
Baltimore, Md.



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FAST AND ELEGANT TRAINS.

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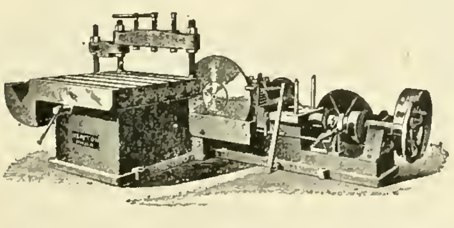

Built in 38 sizes.
450 Machines in operation.

COLD SAW CUTTING-OFF MACHINES.

BUYERS' FINDING LIST—*Continued.*

Injectors.
Automatic Injector Co., Cincinnati, O.
Hancock Inspirator Co., Boston, Mass.
Hayden & Derby Mfg. Co., New York.
Nathan Mfg. Co., New York.
Ohio Injector Co., Chicago, Ill.
Rue Mfg. Co., Philadelphia, Pa.
William Sellers & Co., Philadelphia, Pa.

Jacks.
E. C. Boyer, Dayton, O.
Richard Dudgeon, New York.
A. L. Henderer, Wilmington, Del.
A. O. Norton, Boston, Mass.
Watson & Stillman, New York.

Laggings for Locomotives.
Keasbey & Mattison Co, Ambler, Pa.

Locomotives.
Baldwin Locomotive Works, Philadelphia, Pa.
Brooks Locomotive Works, Dunkirk, N. Y.
Cooke Loco. & Machine Co., Paterson, N. J.
Dickson Mfg. Co., Scranton, Pa.
Lima Locomotive & Machine Co., Lima, O.
Pittsburg Locomotive Works, Pittsburg, Pa.
H. K. Porter & Co., Pittsburg, Pa.
R. I. Locomotive Works, Providence, R. I.
Richmond Loco. & Mch. Wks., Richmond, Va.
Rogers Locomotive Works, Paterson, N. J.
Schenectady Loco. Wks., Schenectady, N.Y.

Lubricators
Detroit Lubricator Co., Detroit, Mich.
M. C. Hammett, Troy, N. Y.
Nathan Mfg. Co., New York.

Lubricating Oils.
Galena Oil Works, Ltd., Franklin, Pa.
Leonard & Ellis, New York.
Signal Oil Works, Franklin, Pa.

Machine Tools
Bement, Miles & Co., Philadelphia, Pa.
Bullard Machine Tool Co., Bridgeport, Conn.
Detrick & Harvey Mach. Co., Baltimore, Md.
W. D. Forbes & Co., Hoboken, N. J.
Gould & Eberhardt, Newark, N. J.
Hilles & Jones Co., Wilmington, Del.
Jones & Lamson Machine Co., Springfield, Vt.
Manning, Maxwell & Moore, New York.
National Machinery Co., Tiffin, O.
Newton Machine Tool Wks., Philadelphia, Pa.
Niles Tool Works Co., Hamilton, O.
Geo. Place, New York.
Pratt & Whitney Co., Hartford, Conn.
Prentiss Tool and Supply Co., New York.
William Sellers & Co., Inc., Philadelphia, Pa.

Malleable Iron.
C. E. Rood, Lancaster, N. Y.

Mechanics' Tools.
Armstrong Bros. Tool Co., Chicago, Ill.
Keystone Mfg. Co., Buffalo, N. Y.
Chas. A. Strelinger & Co., Detroit, Mich.

Metal Polish.
G. W. Hoffman, Indianapolis, Ind.

Metal Sawing Machines.
Pratt & Whitney Co., Hartford, Conn.
Q. & C. Co., Chicago, Ill.

Milling Machines.
Cincinnati Milling Machine Co., Cincinnati, O.
Pratt & Whiting Co., Hartford, Conn.

Mining Machinery.
Earle C. Bacon, New York.

Molding Machines.
Tabor Mfg. Co., New York City.

Over Clothes.
H. S. Peters, Dover, N. J.

Packing.
Boston Belting Co., Boston, Mass.
Gould Packing Co., East Cambridge, Mass.
H. W. Johns Mfg. Co., New York.
Jenkins Bros., New York.
N. Y. Belting & Packing Co., New York.
U. S. Metallic Packing Co., Philadelphia, Pa.

Paints.
Standard Paint Co., New York.
Detroit White Lead Works, Detroit, Mich.

Patents.
John Wedderburn & Co., Washington, D. C.
George P. Whittlesey, Washington, D. C.

Perforated Metal.
Aitchison Perforated Metal Co., Chicago, Ill.
A. J. Beckley & Co., Meriden, Conn.
The Hendrick Mfg. Co., Ltd., Carbondale, Pa.

Photographs.
F. Moore, London, Eng.

Pipe Threading and Cutting Machinery.
Bignall & Keeler Mfg. Co., Edwardsville, Ill.
Armstrong Mfg. Co., Bridgeport, Conn.
D. Saunders' Sons, Yonkers, N. Y.

Piston Rods.
Cambria Iron Co., Philadelphia, Pa.
B. M. Jones & Co., Boston, Mass.
Thomas Prosser & Son, New York.

Pneumatic Tools.
Chicago Pneumatic Tool Co., Chicago, Ill.
C. H. Haeseler & Co., Philadelphia, Pa.

Pressed Steel Materials.
Schoen Mfg. Co., Pittsburg, Pa.

Pressure Regulators.
Foster Engineering Co., Newark, N. J.
Newark Regulator Co., Newark, O.

Pump Valves.
Boston Belting Co., Boston, Mass.
N. Y. Belting & Packing Co., New York.

Punching and Shearing Machinery.
Hilles & Jones Co., Wilmington, Del.
Long & Allstatter Co., Hamilton, O.
Williams, White & Co., Moline, Ill.
R. D. Wood & Co., Philadelphia, Pa.

Continued on page 430.

BUYERS' FINDING LIST—*Continued.*

Railway Fences.
Page Woven Wire Fence Co., Adrian, Mich.
Railway Gates.
Pneumatic Gate Co., Chicago, Ill.
Standard Ry. Gate Co., Saginaw, Mich.
Retaining Rings.
Ramapo Wheel & Foundry Co., Ramapo, N.Y
Rubber.
Boston Belting Co., Boston, Mass.
N. Y. Belting & Packing Co., New York.
Rust Preventing Compound.
Otto Goetze, New York.
Safety Valves
Ashton Valve Co., Boston, Mass.
Consolidated Valve Co., Bridgeport, Conn.
Crosby Steam Gage & Valve Co., Boston, Mass.
Sanding Apparatus
Henry L. Leach, North Cambridge, Mass.
Sherburne & Co., Boston, Mass.
Shafting.
William Sellers & Co., Philadelphia, Pa.
Spark Arrester Plate.
A. J. Beckley & Co., Meriden, Conn.
Hendrick Mfg. Co., Carbondale, Pa.
Springs.
A. French Spring Co., Pittsburg, Pa.
Spring Steel
Thomas Prosser & Son, New York.
Stay-Bolts.
Ewald Iron Co., St. Louis, Mo.
Falls Hollow Stay-Bolt Co., Cuyahoga Falls, O
B. M. Jones & Co., Boston, Mass.
Steam Gages.
Crosby Steam Gage & Valve Co., Boston.
Utica Steam Gage Co., Utica, N. Y.
Steam Hammers
Bement, Miles & Co., Philadelphia, Pa.
Steam Hose.
Boston Belting Co., Boston, Mass.
N. Y. Belting & Packing Co., New York.
Steam Pumps.
A. S Cameron Steam Pump Works, New York
Steel.
Cambria Iron Co, Philadelphia, Pa.
Ewald Iron Co., St. Louis, Mo.
B. M. Jones & Co., Boston, Mass.
Krupp (T. Prosser & Son, New York).
Latrobe Steel Co., Latrobe, Pa.
Schoen Mfg Co., Pittsburg, Pa.
Shoenberger Steel Co., Pittsburg, Pa.
Steel Tired Wheels.
Boies Steel Wheel Co., Scranton, Pa.
Krupp (T. Prosser & Son, New York).
Ramapo Wheel & Foundry Co., Ramapo, N.Y
Standard Steel Works, Philadelphia, Pa.
Washburn Car Wheel Co., Hartford, Conn.
Steel Tires.
Latrobe Steel Works, Latrobe, Pa.
Krupp (T. Prosser & Son New York).
Standard Steel Works, Philadelphia, Pa.
Steel Truck Frames.
Fox Solid Pressed Steel Co., Chicago, Ill.
Stocks and Dies.
Armstrong Mfg. Co., Bridgeport, Conn.
Switches.
Ramapo Iron Works, Hillburn, N. Y.
Tie Plates.
Q. & C. Co., Chicago, Ill.
Tires.
Krupp (T. Prosser & Son, New York).
Latrobe Steel Co., Philadelphia, Pa.
Tool Holders.
Armstrong Bros. Tool Co., Chicago, Ill.
Gould & Eberhardt, Newark, N. J.
Tool Steel
B. M. Jones & Co., Boston, Mass.
Tube Expanders.
A. L. Henderer, Wilmington, Del.
Turnbuckles.
Cleveland City Forge & Iron Co., Cleveland, O
Merrill Bros., Brooklyn, N. Y.
Turret Machines.
Bullard Mch. Tool Co., Bridgeport, Conn.
Jones & Lamson, Springfield, Vt.
Twist Drills.
Cleveland Twist Drill Co., Cleveland, O.
Standard Tool Co., Cleveland, O.
Valves.
Ashton Valve Co., Boston, Mass.
Jenkins Bros., New York.
Ross Valve Co., Troy, N. Y.
Valves, Reducing.
Foster Engineering Co., Newark, N. J.
Varnishes.
Detroit White Lead Works, Detroit, Mich.
F. C. Reynolds, New York.
Ventilating Fans.
Buffalo Forge Co.
Vestibules
Gould Coupler Co., Buffalo, N. Y.
Vises.
Bignall & Keeler Mfg. Co., Edwardsville, Ill.
Capital Machine Tool Co., Auburn, N. Y.
Merrill Bros., Brooklyn, N. Y.
Watches.
John J. McGrane, New York.
Wire Fences.
Page Woven Wire Fence Co., Adrian, Mich.
Wood Working Machinery.
The Egan Co., Cincinnati, O.
Wrought Iron Pipe.
Allison Mfg. Co., Philadelphia Pa.

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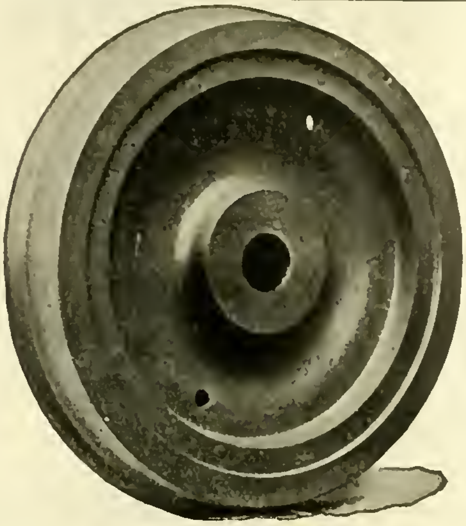

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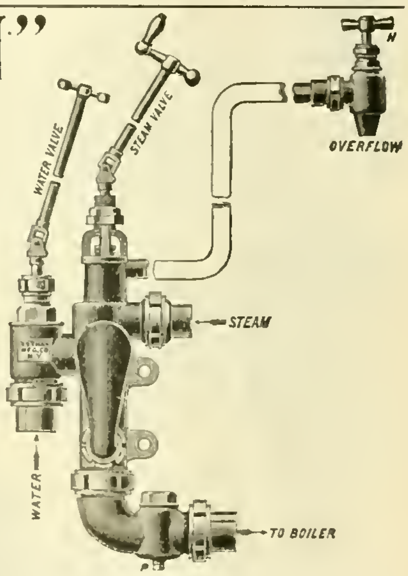

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For Locomotive Cylinders and Air Brakes.

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FOR HARD COAL AND COKE.

THESE FORGES will heat irons fast enough to keep a hammer-man busy, and have features that make them the best on earth.

Patent Arch Top
That Cannot Sag.

Rocking Grate
Insures a Clean Fire.

Dumping Ash Pan,
Air Box Always Free.

7 SIZES. SEND FOR PRINTED MATTER.

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The only line from or to New England running **through Sleeping Cars** over the **New York Central & Hudson River, Lake Shore & Michigan Southern, Michigan Central and "Big Four" R. R'ds.**

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NORTHWEST AND SOUTHWEST.

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For information, maps, time-tables and reservation of berths apply to

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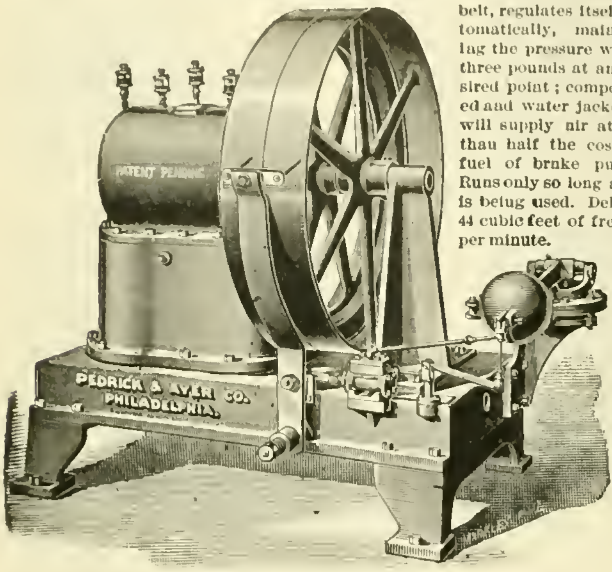
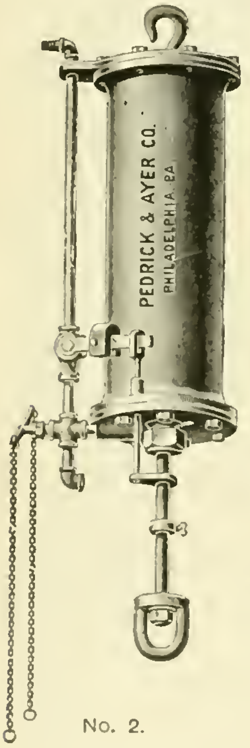
COMPOUND AUTOMATIC AIR COMPRESSOR.—Driven by a belt, regulates itself automatically, maintaining the pressure within three pounds at any desired point; compounded and water jacketed; will supply air at less than half the cost for fuel of brake pumps. Runs only so long as air is being used. Delivers 44 cubic feet of free air per minute.



Requires no attention but oiling, and but little of that. Case Dust-Proof.



No. 2.

OUR NO. 2 LIFT is for delicate and exact work; it can be made to lift or lower any amount at will, and has an automatic stop that will keep the load at the desired height under any conditions, and leave the operator free to use both hands in adjusting work. Ideal as a lift over machine tools.

ALL KINDS OF SPECIAL TOOLS FOR RAILWAY REPAIR SHOPS.

Take Your Vacation in Maine.

THE lover of outdoor life is always delighted with the coming of spring, for its warm glowing days open to him a series of pastimes in which he may indulge, reaping therefrom the many pleasures and vicissitudes which are, to his mind, only the necessary perquisites demanded to relieve the drudgeries and routines of everyday life.

The ice which has covered the lakes and brooklets for months past is fast disappearing, and then comes a period of delight for the fisherman, which in Maine consists of trolling some one of the famous streams of Northern or Eastern New England for trout, perch or other fish which abounds its waters in great numbers.

The Rangeley's, Moosehead, Winnipesaukee, Memphremagog, or, in fact, any of the lakes in this region which offer exceptional opportunities for fishing, are made easily accessible by the Boston & Maine Railroad, for its train service to these points is frequent, and reduced-rate round-trip tickets are obtainable.

Time-tables and a descriptive pamphlet, entitled "Fishing and Hunting," will be sent for a two-cent stamp, upon application to the

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BOSTON & MAINE R.R.

Eclipses Them All—Thirty-five and a Half Hours, Chicago to Jacksonville, Fla.

The Monon Route, with its customary enterprise, has put on a new fast train that makes the run between Chicago and Jacksonville in 35½ hours.

The train is composed of elegant Pullman Perfected Safety Vestibuled, Open and Compartment Sleepers, including Drawing-room and Buffet Sleepers, as well as comfortable day coaches, with Monon Celebrated High-back Seats.

This train leaves Chicago daily at 8:32 P. M., arriving at Cincinnati next morning, 7:30; Chattanooga, 5:50 P. M.; Atlanta, 10:40 P. M.; reaching Jacksonville at 8:20 the second morning, in ample time to make connection with all lines for points in Central and Southern Florida.

This is the fastest time ever made by any line between Chicago and Florida.

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Genl. Pass. Agt., Chicago.

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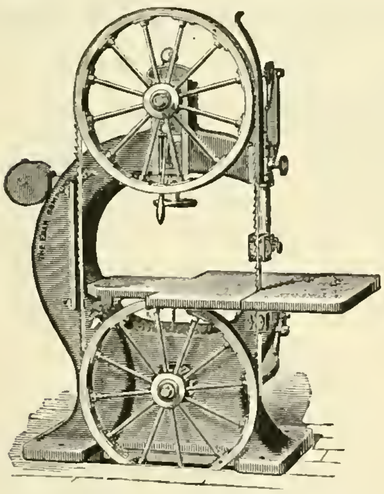

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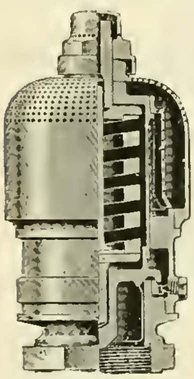

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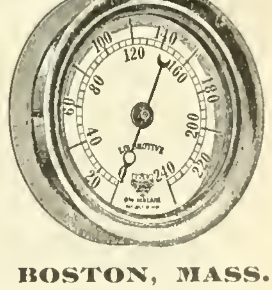

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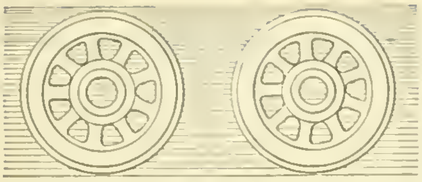

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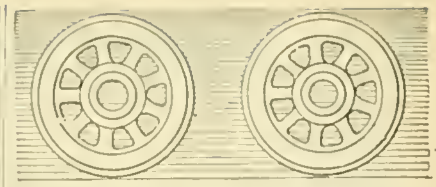

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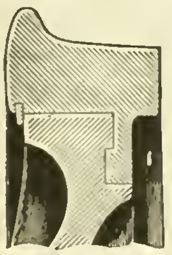

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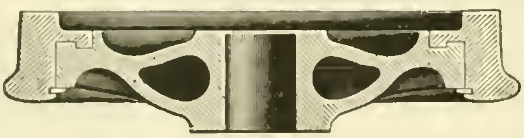

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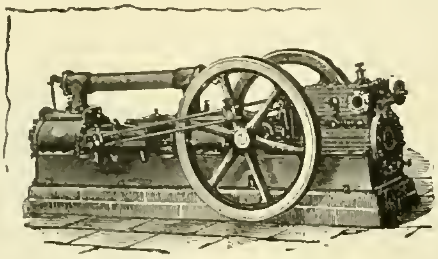

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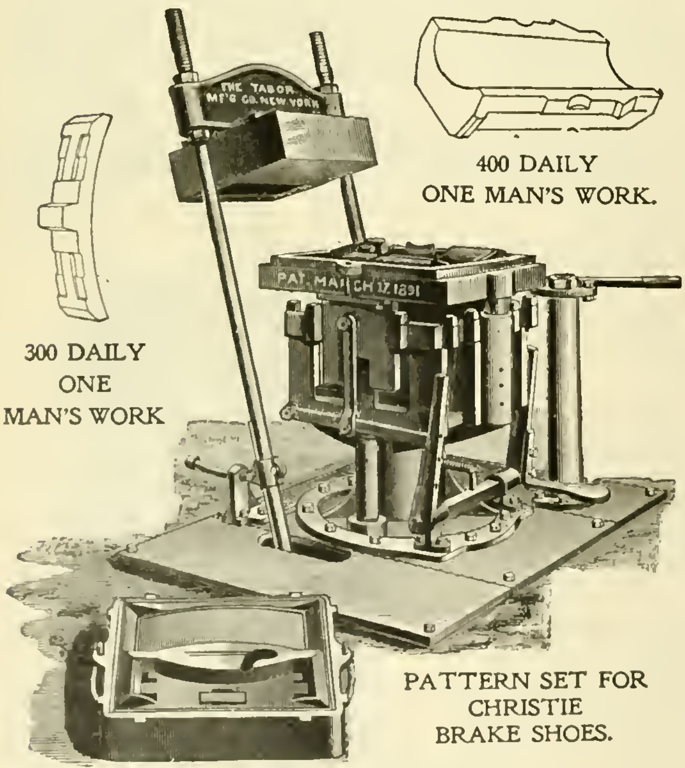

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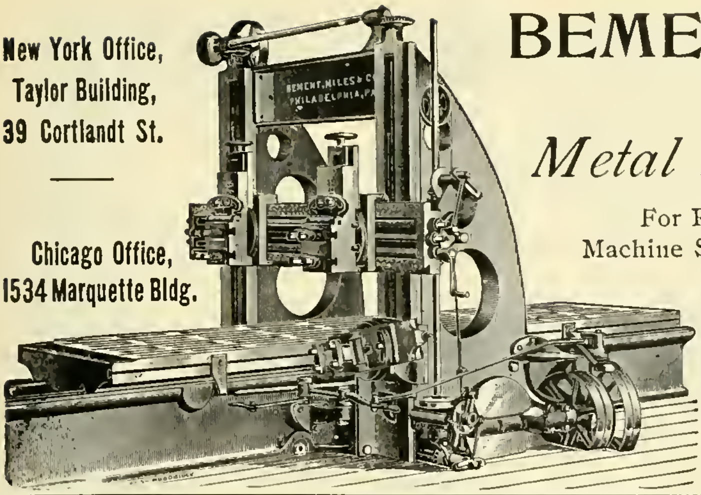

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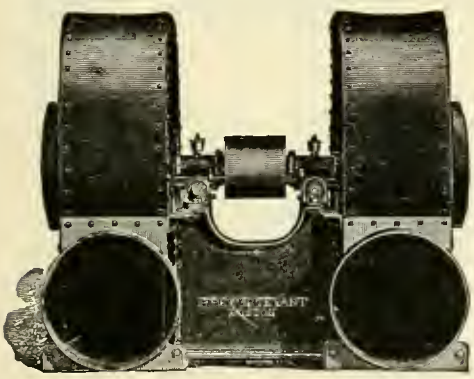

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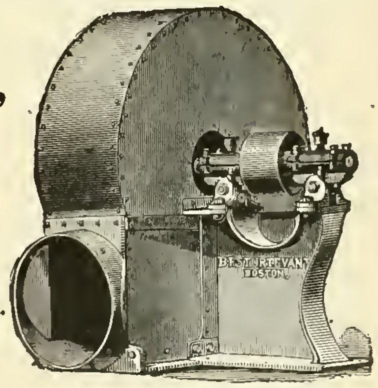

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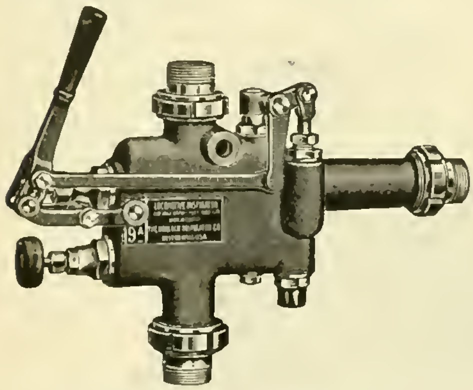

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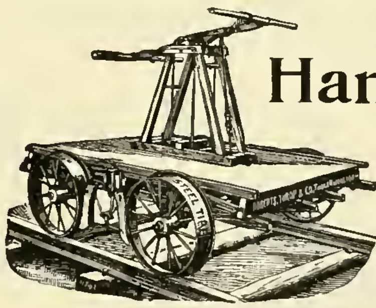

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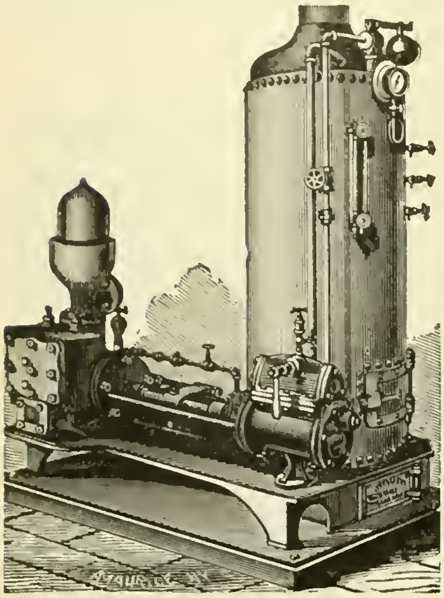

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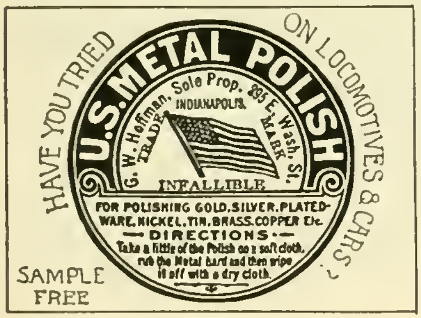

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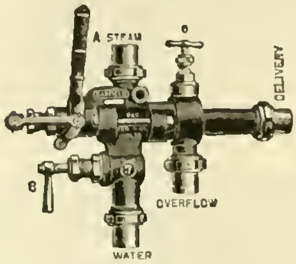

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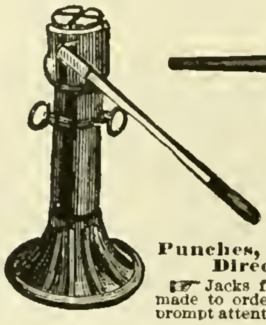

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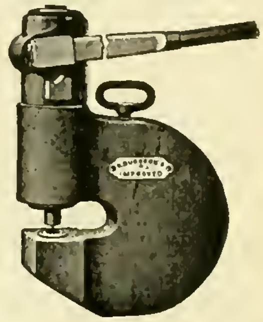

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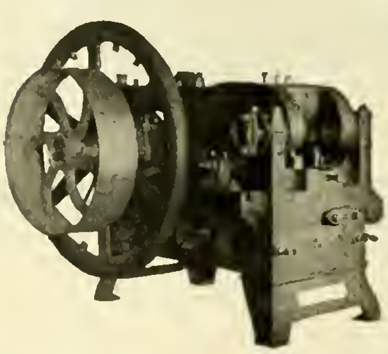

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Vol. IX. NEW YORK, JUNE, 1896. No. 6.

New Erie Passenger Engine.

Annexed engravings are illustrations of a new type of eight-wheel passenger engine, called "Class X," recently designed by Mr. A. E. Mitchell, superintendent of motive power of the Erie Railroad, and intended for handling the fast passenger trains that have lately been hauled by ten-wheelers. The engine shown was built in the company's shops at Susquehanna, Pa., and has every indication of being a splendid machine. The details are so large that more than 90 per cent. of the boiler pressure can be utilized in starting.

A notable feature about the engine is the large bearing and rubbing surfaces. The driving-axle journals are 12 x 8½ inches. The crank-pin bearing for back end of main rod is 6 x 6 inches, and the side-rod bearings 5½ x 4 inches. The eccentric straps have bearing 3¾ inches wide, and the link face is 3 inches wide. The truck journals are 6 x 10 inches.

inches long. The firebox, whose crown is secured by radial stays and sling stays in front, is 11 feet 5$\frac{5}{16}$ inches long and 39⅛ inches wide. The grate area is 36.5 square feet. The heating surface of the tubes is 1,589.5 square feet, and of the firebox 172.4 square feet, giving a total heating surface of 1,761.9 square feet.

A novelty about the engine is the size of ports, the steam ports being 1⅜ x 21 inches. The exhaust port is 3½ inches wide and the same length as the steam

ERIE EXPRESS ENGINE, BUILT AT SUSQUEHANNA SHOPS.

have been worked out with great skill, with a view to combine efficiency in train-pulling with durability in service and freedom from the minor troubles which delay trains.

The engine has cylinders 19 x 24 inches, and driving wheels 76 inches. The boiler pressure is 180 pounds per square inch. Figured by the Master Mechanics' Association formula for traction, which allows 85 per cent. of the boiler pressure, this engine can exert a tractive force of 13,698 pounds, and has a co-efficient of adhesion of 6.5, the weight on drivers being 90,250 pounds. The steam passages and ports

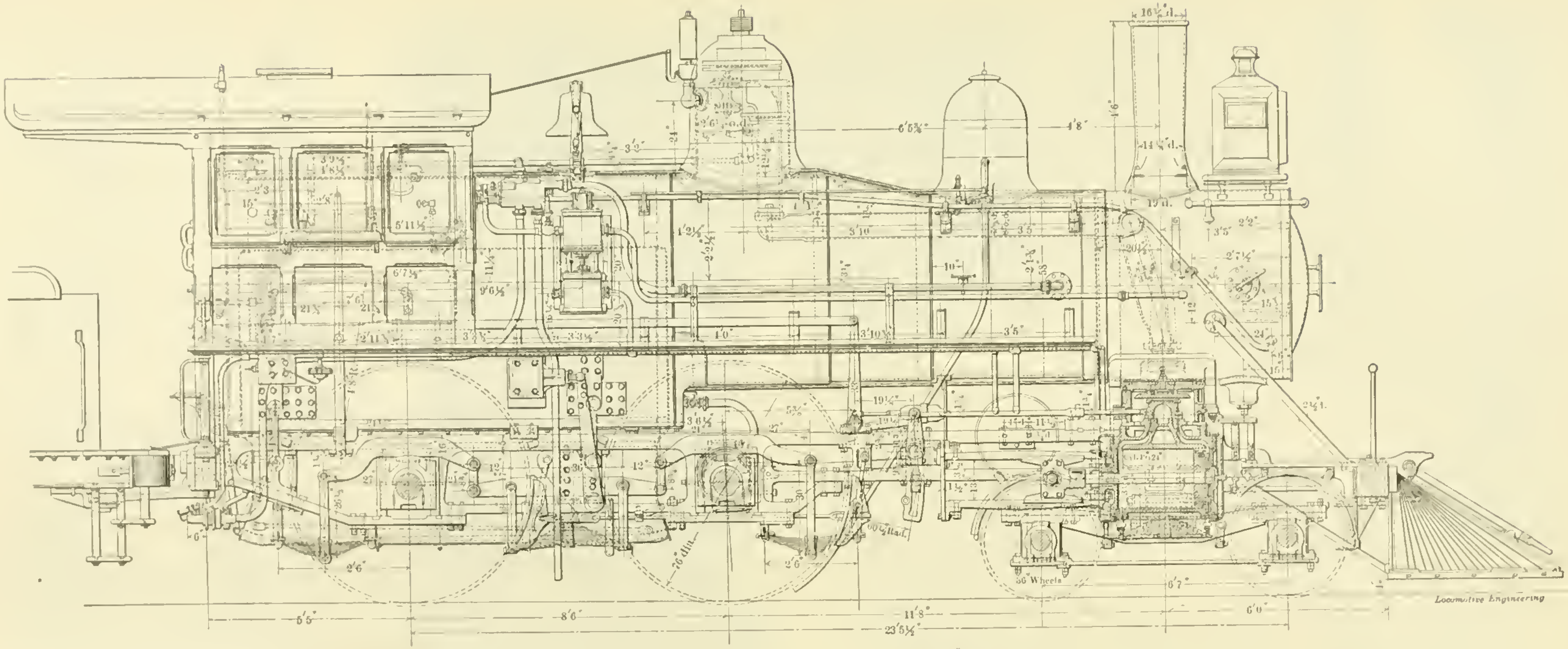
The total weight of the engine is 133,550 pounds, 90,250 of that being upon the drivers and 43,300 resting on the truck. The total wheel base is 23 feet 5½ inches, the rigid wheel base being 8 feet 6 inches.

As will be seen by the engravings, the boiler is of the extended wagon-top kind, designed for burning anthracite coal; but, unlike most anthracite-burning boilers, the firebox of this one has shaking grates. The boiler is 58 inches diameter at the outside course, made of carbon steel $\frac{11}{16}$ inches thick. The tube sheets are ⅝ inch thick. The boiler holds 264 tubes, 2 inches outside diameter and 11 feet 6

ports. The valves have $1\frac{1}{16}$ inch outside lap, have no inside lap, and are set line and line in full gear. They are balanced by the American balance.

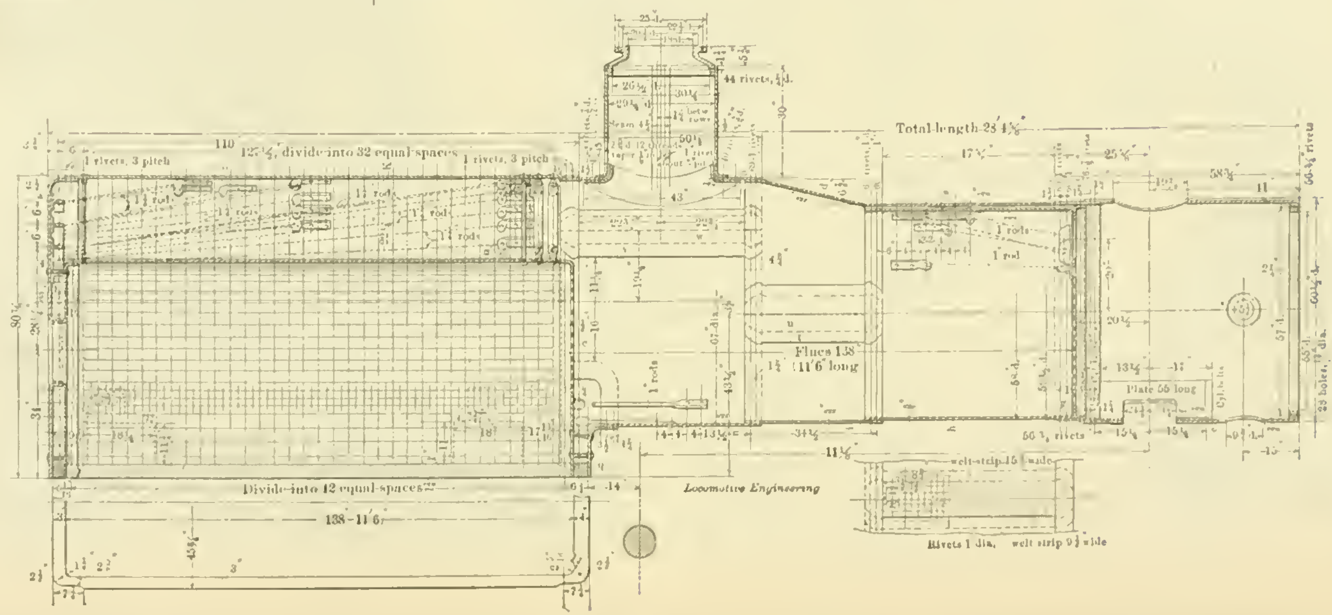
The frames have some novel features, which can be seen from a study of the engraving. It will be seen that they are double to the front of the cylinders, after the style of moguls and ten-wheelers, and are remarkably well fastened. Stationary wedges are used, but the back jaw is tapered the same as when a movable wedge was employed.

The tender is designed to carry 4,500 gallons of water and 9 tons of coal. It

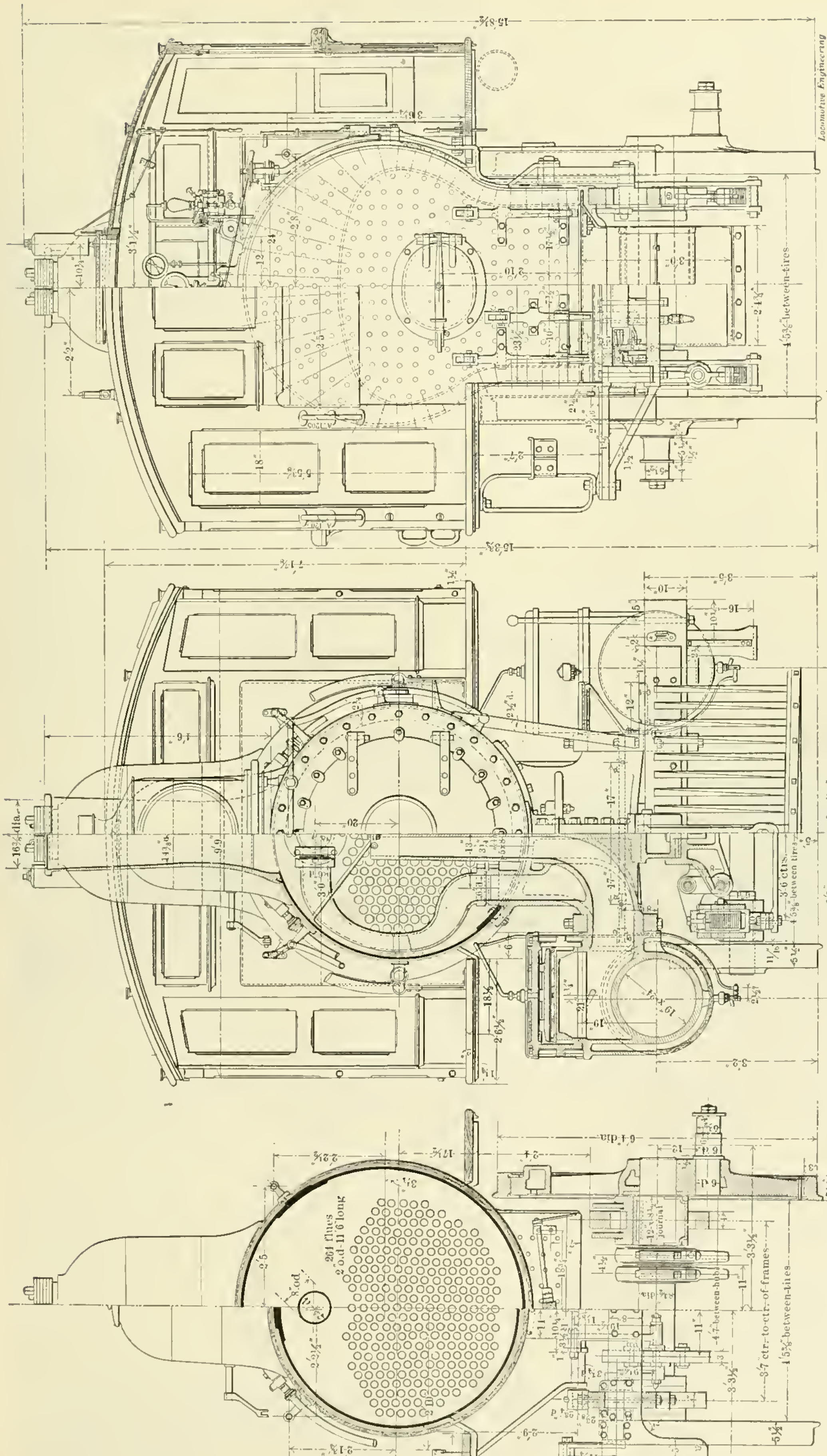


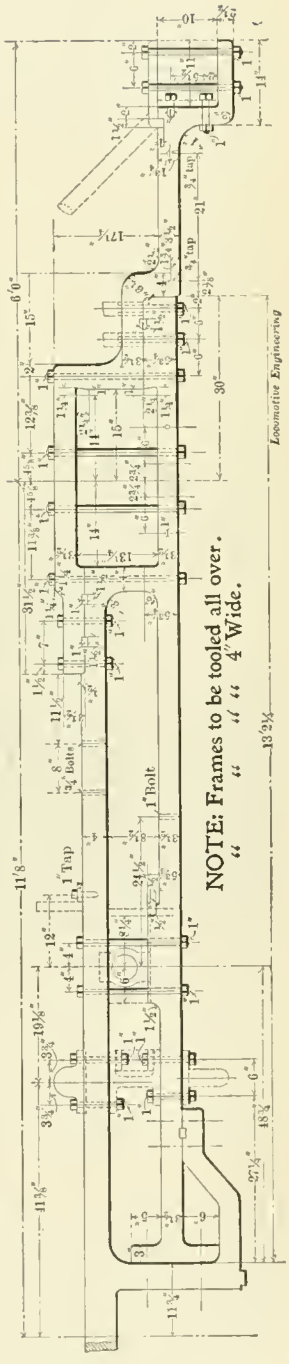
has an iron frame made of channels 10 inches deep, and is carried on Fox pressed-steel trucks.

Westinghouse American automatic brakes are applied to drivers and tender. United States rod packing is used, Metropolitan injectors, Nathan lubricators and Leach sanding apparatus.



A rather unique method of bending pipe is followed by Mr. Thomas Fildes, master mechanic of the Lake Shore & Michigan Southern at Englewood, Ill. He has dies made of wood faced with iron bands. The work of bending is done in a bulldozer, and is reported to be quite as satisfactory as the compressed-air apparatus used in some shops for the same purpose.


Locomotive Engineering
261 Flues 2" o.d. 11' 6" long
6' 4" ctr. to ctr. of cylinders
4' 5⅜" between tires


Locomotive Engineering
NOTE: Frames to be tooled all over.
" " " 4" Wide.

New Central of New Jersey Express Locomotive.

There are two competing railroad routes between New York and Philadelphia—one is the Pennsylvania Railroad; the other is formed by the Central Railroad of New Jersey and the Philadelphia & Reading. There is always active competition between these two routes, but it never assumes the form of rate-cutting. The pretence of each is that it can beat the other in speed. The ambition of both appears to be to run the distance of 90 miles in as many minutes while hauling a train of seven or eight heavy cars. Neither of the companies are doing this regularly just yet, but they are trying to do it. The problem of getting over the division at the speed named has led to not a few new designs of locomotives being brought out by all the railroad companies interested.

The latest design converted into working form, with hopes behind of superior power and speed, is the engine shown in the accompanying engraving, which was built by the Baldwin Locomotive Works for the Central Railroad of New Jersey. The engine was built to conform to the ideas of Mr. C. A. Thompson, superintendent of motive power of the Central Railroad of New Jersey.

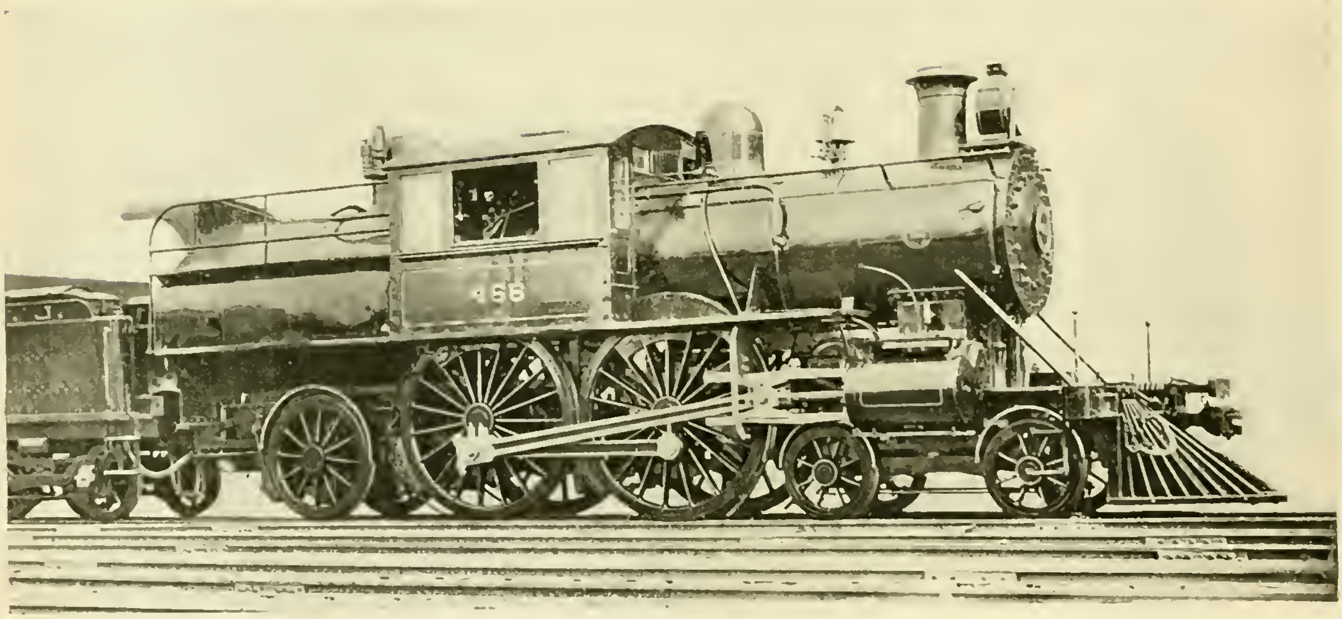
The cylinders are 18¾ x 26 inches, and the driving wheels are 84¼ inches diameter on tread. The total weight of the engine is 141,000 pounds, of which 80,000 pounds rest on the driving wheels. The driving axle journals are 8½ x 12 inches, and the distance between driving-wheel centers is 87 inches.

The boiler is made of steel ⅝ inch thick and is 58¾ inches diameter at smokebox. It is of the Wootten type, with firebox 113⅞ x 96 inches, has a short combustion chamber and tubes 13 feet long. There are 278 tubes 1¾ inches diameter.

The engine has been furnished with all the most approved appliances for promoting convenience and comfort in operating. Its striking peculiarity is the enormous boiler. As the boiler is the mainspring of a locomotive's action, it may safely be concluded that this engine will do some record-breaking.

The engine has piston valves 12 inches diameter, with a 6½-inch travel.

Two of these engines were built in May and are in service, the only difference in them being that the other one is a Vauclain compound.



LATEST FAST EXPRESS ENGINE, C. R. R. OF N. J.

Traction of Locomotives.

A committee has been appointed by the Franklin Institute of Philadelphia to formulate a simple method of finding the tractive power of locomotives. There seemed to be doubts entertained of the correctness of the common formula, which is, square the diameter of the cylinder in inches, multiply by the length of stroke in inches, divide by the diameter of driving wheels in inches and multiply by boiler pressure. We understand that the engineering department of Purdue University have tested this formula for tractive force with their experimental locomotive and found it to be correct.

It does not seem to be a philosophical way of figuring, as one naturally supposes that the area of both pistons should be taken and the distance calculated through which the pressure on the same is applied. It happens, however, that the formula gives these calculations in condensed form.

Some Interesting Items from India.

For our full-page collection of pictures from India we are indebted to Mr. Phillip A. Hyde, who is in charge of the locomotive department for a district of the East Bengal State Railway in India.

By-the-way, we might mention that Mr. Hyde saw in "Locomotive Engineering" the experience of James Skeevers, concerning the checking of train delays by use of a Boyer speed recorder, and immediately sent a draft on New York City to "Locomotive Engineering," for $125, with which to buy one of these recorders for that very purpose; and yet some people do not believe that it pays to advertise.

Our pictures show some very pleasant-looking places for a torrid climate. There is also a collection of mishaps such as are bound to occur on every railroad.

Referring to the pictures by letters, the following explanation was attached to the photographs:

A—A meeting-place; mixed train on siding.

B—Our flyer at a watering station.

C—Water tower and crane.

D—A local train.

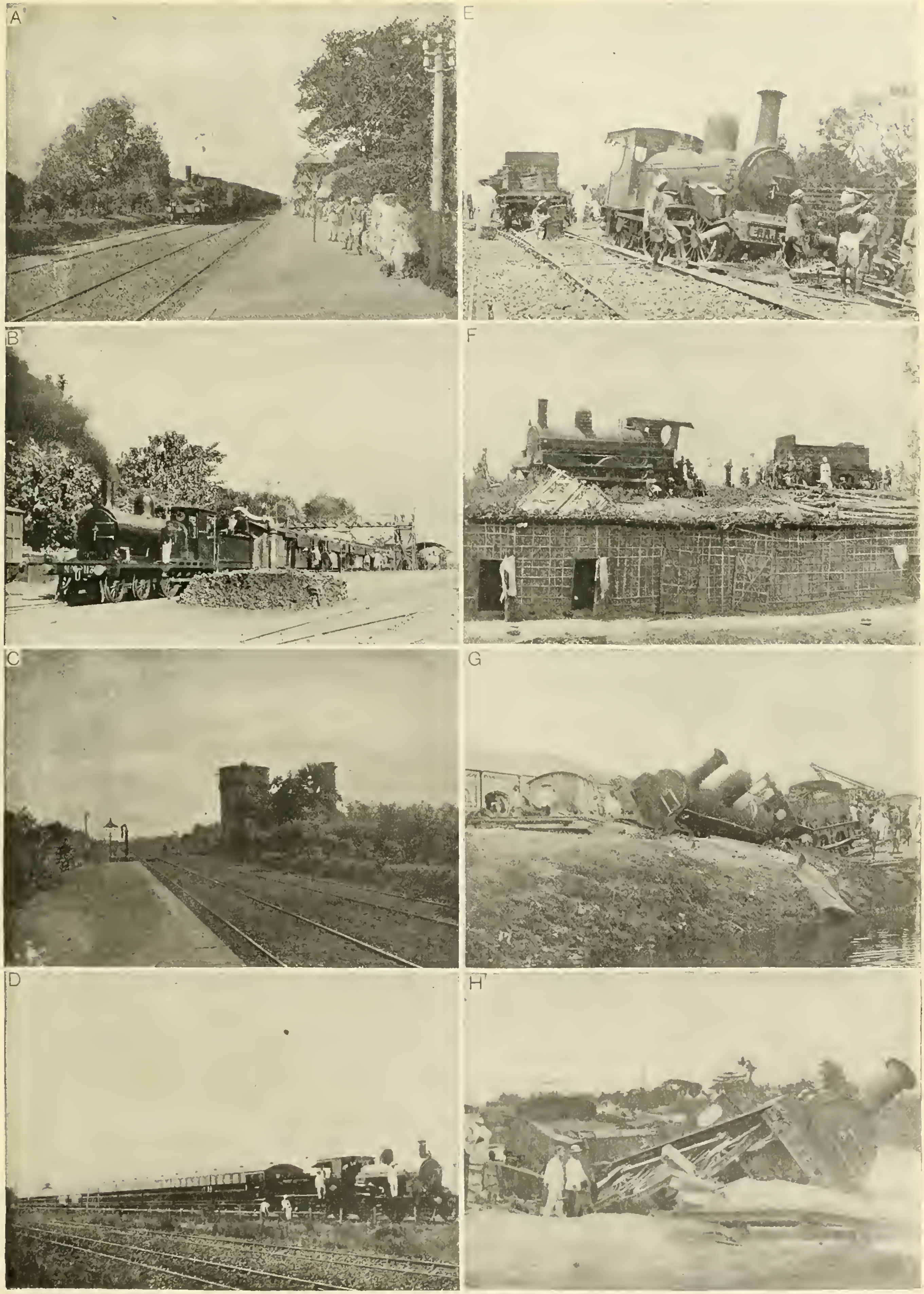
E—Same as F, on other side.

F—Two engines met at cross-over, owing to driver disregarding signal; signal cabin knocked down and lying beside track.

G—Driver, instead of stopping for pilot, ran on and into an unfinished siding. Engine and tender turned over, killing driver, two firemen and a guard, all of whom were on engine.

H—Same as G, on other side.

The fastest vessel afloat is the British torpedo-boat destroyer "Desperate," which on a trial trip steamed at the rate of 31.035 knots or 35.7 miles per hour.



SCENES ON THE EASTERN BENGAL RAILWAY, INDIA.

Wheeling & Lake Erie Ten-Wheelers.

The annexed illustration shows the general appearance of a lot of ten-wheelers recently built by the Cooke Locomotive Works, Paterson, N. J., for the Wheeling & Lake Erie. The leading general dimensions are:

Total weight in working order, 119,000 pounds.

Total weight on drivers, 91,000 pounds.

Total weight on truck, 28,000 pounds.

Loaded weight of tender, 80,000 pounds.

Total wheel base of engine, 21 feet 5 inches.

Driving-wheel base, 11 feet.

Wheel base of engine and tender, 47 feet 9 inches.

Cylinder, 19 x 26.

Driving wheels, 56 inches diameter.

Engine-truck wheels, 28 inches diameter.

Driving-axle journal, 8 x 8⅞ inches.

Engine-truck axle journal, 5 x 9¾ inches.

Boiler type, straight top.

Boiler, working pressure, 160 pounds.

Boiler, diameter first course, 60⅛ inches outside.

Boiler, firebox length, 108 inches outside.

Boiler, firebox width, 33¾ inches.

Boiler tubes, number, 242.

Boiler tubes, diameter and length, 2 inches diameter, 12 feet 5 inches long.

Boiler, thickness of shell, 9-16 inch.

Boiler, heating surface tubes, 1,573 square feet.

Boiler, heating surface firebox, 154 square feet.

Boiler, heating surface, Total, 1,727 square feet.

Boiler, grate surface, 25 feet.

Slide valve, Richardson balanced.

Slide-valve travel, 5½ inches.

Steam ports, 1⅝ x 18.

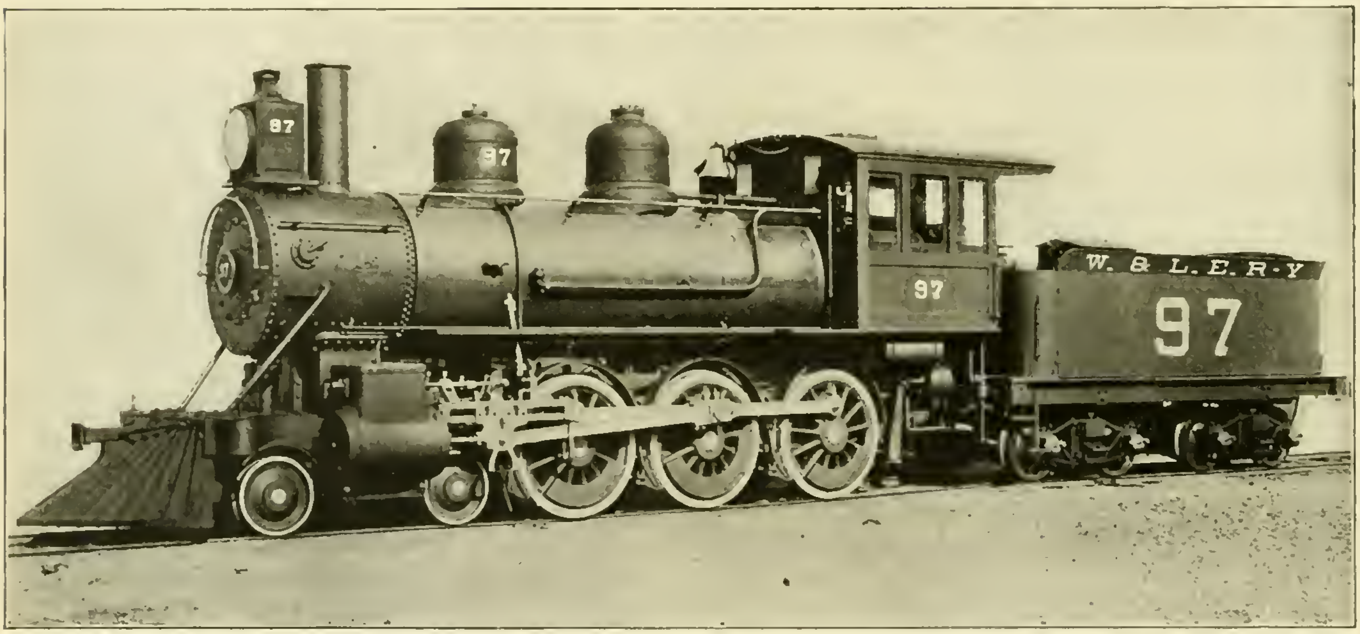
Exhaust ports, 3 x 18.

Lap, 13-16 inch.

Exhaust pipe, single.

Water capacity of tender, 3,700 gallons.

Coal capacity of tender, 6½ tons.



WHEELING & LAKE ERIE TEN-WHEELER.

Railway Discipline in France.

In the December issue of "Locomotive Engineering" was published an illustration of a very striking accident which happened in a railway station at Paris, where the locomotive of a passenger train ran through the end of the station building and fell down into a street twenty feet below the level of the track.

The particulars of the trial of the engine driver and guard for negligence in entering the station at reckless speed, reveal some curiosities of French railway rules and methods of discipline. The driver was sentenced to two months' imprisonment and the guard to pay a fine of 25 francs, both sentences being subject to a First Offenders' Act, according to which the culprits escape their penalties if they do not again come before the court foı five years. This system of punishment closely resembles that coming into vogue in this country, in imitation of Brown's "Discipline Without Suspension," only in France a magistrate deals with the case.

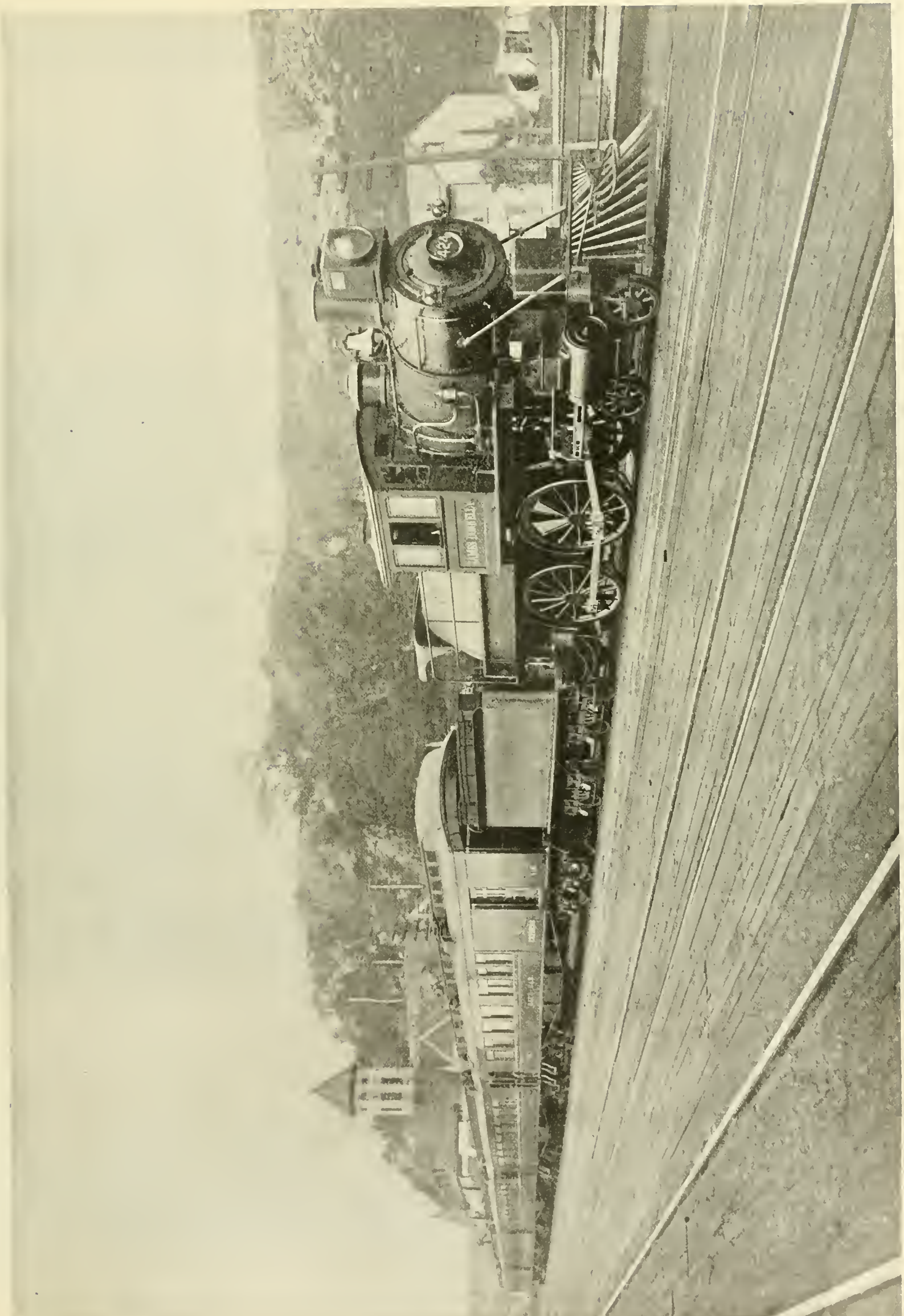
The trial revealed some curious rules that exist on French railways concerning the handling of air brakes. The Court, in giving judgment, stated that the driver had, in defiance of his instructions relating to the entering of terminal stations, relied on the continuous brake to bring the train to rest, in place of on the hand brakes; that he lost time in whistling for hand brakes, and did not repeat the whistle until he had called the attention of the conductor. The latter also disobeyed rules, in that he did not open his Westinghouse brake valve on hearing the whistle, but put on the hand brake immediately; but this fault was considered trivial, in view of the fact that the general use of the automatic brake has led to the almost complete abandonment of the old brake signals.

Black Diamond Express.

The Lehigh Valley Railroad, which has always been considered strictly a coal-carrying road, has in late years been developing some passenger business, especially since its line was built through to Buffalo. Probably no road between New York City and Buffalo passes through such beautiful scenery as the Lehigh Valley, and it is expected that this fact will make it a popular route between these two cities.

On Monday, the 18th of May, they put on what they call their "Black Diamond Express," a very handsome train, which is shown in our full-page engraving opposite. This photograph was taken at Easton, Pa., by Mr. W. F. Blauvelt, the well-known amateur photographer, who has supplied "Locomotive Engineering" with so many interesting railroad subjects.

Mr. Robert Miller, superintendent of motive power of the Michigan Central, has been making tests of the hauling capacity of locomotives on certain divisions, to find out what type of engine is best adapted for the work to be done. The company intend ordering new locomotives in the near future.



BLACK DIAMOND EXPRESS, LEHIGH VALLEY RAILROAD, AT EASTON PA.

Damage Done by Worn Tires.

There was a very good report on Hollow Tires read at the last Roadmasters' Convention. The principal part of the report reads:

"The damage to spring-rail frogs from this cause consists mainly in battering and shearing off the wing and point. It is on this class of frogs that the greatest danger of derailment from hollow tires exists, for in trailing the frog the tendency of the hollow tire is to crowd the spring wing out; the gage is thereby widened and the result is derailment. Again, each time an engine with hollow tires crosses a spring frog, a severe blow is delivered to both the point and the wing rail; this, when given to the spring wing, after a time causes it to become bent or strained, which retards the free and natural action of the spring, so that the spring wing cannot be depended upon to close properly after the switch is used; and here lurks danger of derailment, which, when traced to its primary cause, invariably points to the hollow tire. The swing given to a locomotive with hollow tires, when running over a frog, causes the gage of both the track and guard rail to be affected, and the general line of the frog to become ruined, thereby necessitating frequent re-adjustment.

"As a measure of safety, when hollow tires are allowed to run, the spring rail should be planed down where the tire first comes into contact with it; this will allow the wheel to mount the wing without so great a chance of the wing being crowded out and the engine derailed. There should also be a flaring opening left at the point, so the flange would be started in before putting any pressure on the spring wing, thus relieving the guard rail. The damage to rigid frogs by hollow tires is of the same nature as to spring frogs, but the danger of derailment is not nearly so great. The effect of hollow tires on split switches is about the same as on spring frogs, there being great danger of derailment when a locomotive with badly-worn tires trails through. If these switches were never used by engines with bad tires, it would not be necessary to elevate the point above the stock rail; but, under the existing circumstances, we think the point should be planed so that it is not less than one-quarter (¼) inch lower than the stock rail at that point, and rising gradually until it is not less than one-quarter (¼) inch higher than the stock rail at a point where planing of switch rail ends."

The hard times which have oppressed railroad companies for three years have been responsible for the introduction of various expensive practices that cannot be given up too soon. The zeal for cheapening apparent cost is in many ways accumulating heavy deferred expenditures that must eventually be met at a high sacrifice. There are many roads that are now doing a good business, with rolling stock unfit for the work, and yet the shops of these roads are run on short time and short-handed. Hand-in-hand with the running down of rolling stock, we find the track in bad condition, with few men to prevent it from getting worse. It is understood that where this condition of things prevails the inspiration comes from directors who are more interested in stock speculations than in keeping the property in safe condition or in promoting its future prosperity.

TWO VIEWS OF THE SCHENECTADY LOCOMOTIVE WORKS.

GREAT EASTERN RAILWAY. "CONTINENTAL" TRAIN WITH OIL-BURNING ENGINE.

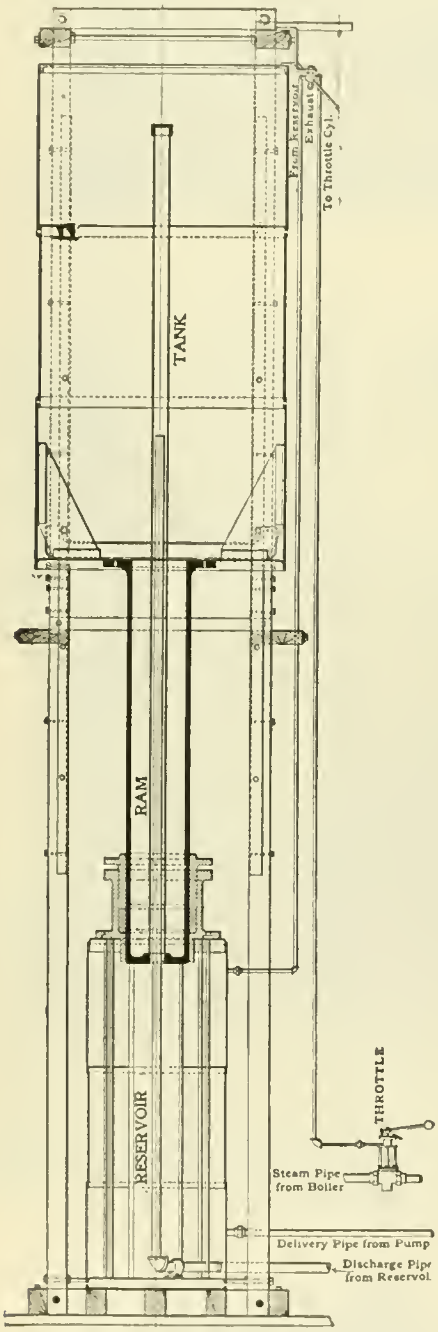
SOUTH EASTERN RAILWAY. BOAT MAIL AT FULL SPEED PASSING DOVER CLIFFS.

SOUTH EASTERN RAILWAY. CLUB TRAIN. AMERICAN CARS.

SOME TYPICAL ENGLISH RAILWAY TRAINS.

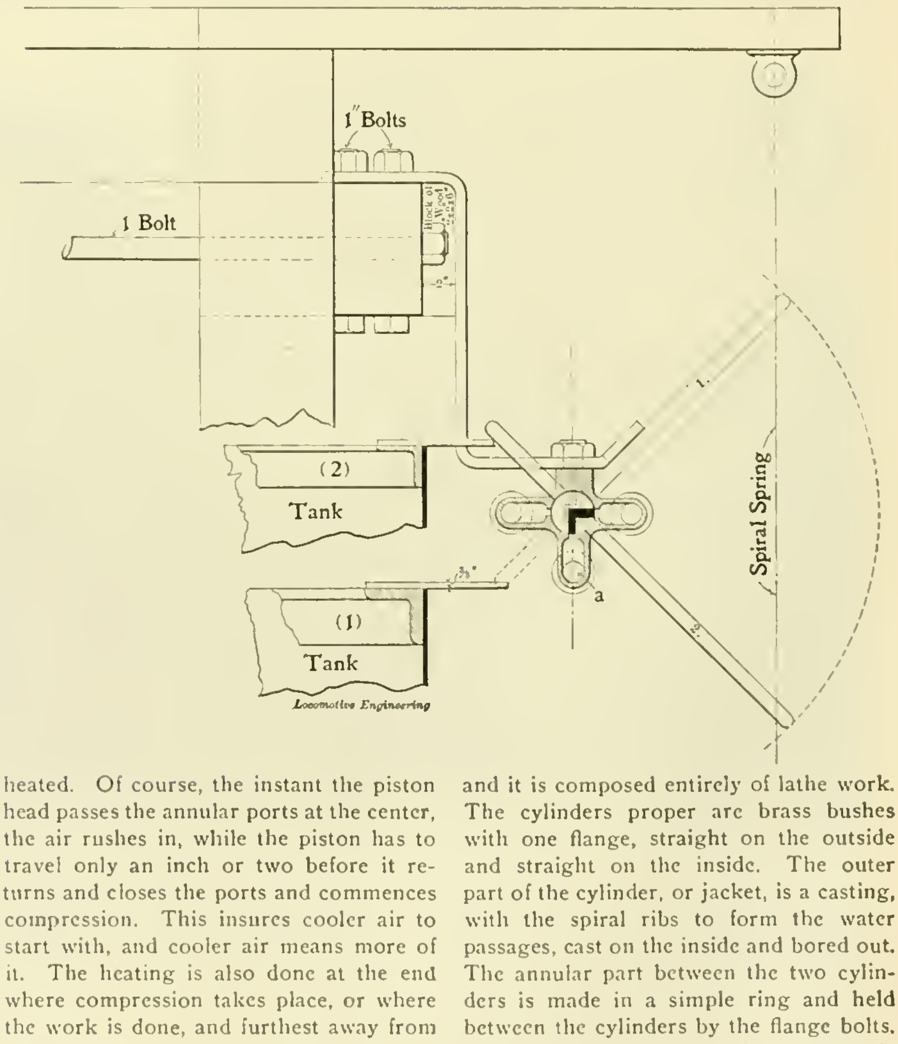
A New Air Compressor and Accumulator.

Herewith will be found the engraving of a very ingenious air compressor recently devised by Mr. Herbert Roberts, mechanical superintendent of the Chicago & Grand Trunk Railroad at Detroit, Mich. We also present an engraving of the accumulator used in connection with his shop practice.



Mr. Roberts' compressor is unique in that it consists of two single-acting cylinders placed tandem. The inlet ports are annular and extend entirely around the center of the cylinder, or rather in a ring between the two cylinders, the piston head occupying just one-half of the cylinder, as will be seen by engraving. This does away with the necessity for inlet valves. There are no outlet valves proper, but the entire head lifts off the cylinder. This head contains a stuffing box to pack the piston rod, which runs entirely through both heads, and a coiled spring holds it against the end of the cylinder. When the piston makes a stroke it comes up to and touches this head, so that there is no clearance whatever. The head, of course, is lifted off when the air is compressed past it, and the spring seats it when the piston leaves. As the piston recedes from the head, it commences to form a vacuum behind it, and there is a constant load of perhaps 12 to 14 pounds on the motor, but the designer of this compressor thinks this disadvantage is overcome by the advantage of getting a large volume of air into the cylinder very quickly—before it can be heated. Of course, the instant the piston head passes the annular ports at the center, the air rushes in, while the piston has to travel only an inch or two before it returns and closes the ports and commences compression. This insures cooler air to start with, and cooler air means more of it. The heating is also done at the end where compression takes place, or where the work is done, and furthest away from the inlet ports.

The plans for cooling the compressor are complete and unique. As will be seen by the engraving, there is a supply tank for water situated above the compressor. The water flows from this down through the 1-inch pipe, past the check valve and into a pump chamber, the plunger of which is composed of the tail rod of the compressor. The piston rod is hollow, as is also the piston head. A constant stream of water is thus pumped through the rod, which keeps the stuffing boxes cool, and into the piston head and on through the rod, almost to the connection with the motor. Here a stop cock is located and a hose connection made to the return system to the tank. The amount of water that is allowed to pass through the piston rod is regulated by opening or closing this little cock.



Water from the pump that passes through the second check above and goes through the larger pipes, is connected to the water jacket of the cylinder; goes around them in a spiral form, making five turns to each of the cylinders, or ten in all; and returns by the system, as shown. It will be seen that the coolest parts of the cylinders are those which the water strikes first in its passage near the center, and where the air is first taken in.

This little machine is very simply made, and it is composed entirely of lathe work. The cylinders proper are brass bushes with one flange, straight on the outside and straight on the inside. The outer part of the cylinder, or jacket, is a casting, with the spiral ribs to form the water passages, cast on the inside and bored out. The annular part between the two cylinders is made in a simple ring and held between the cylinders by the flange bolts. The cylinder heads, or valves, are made of the lightest possible steel castings.

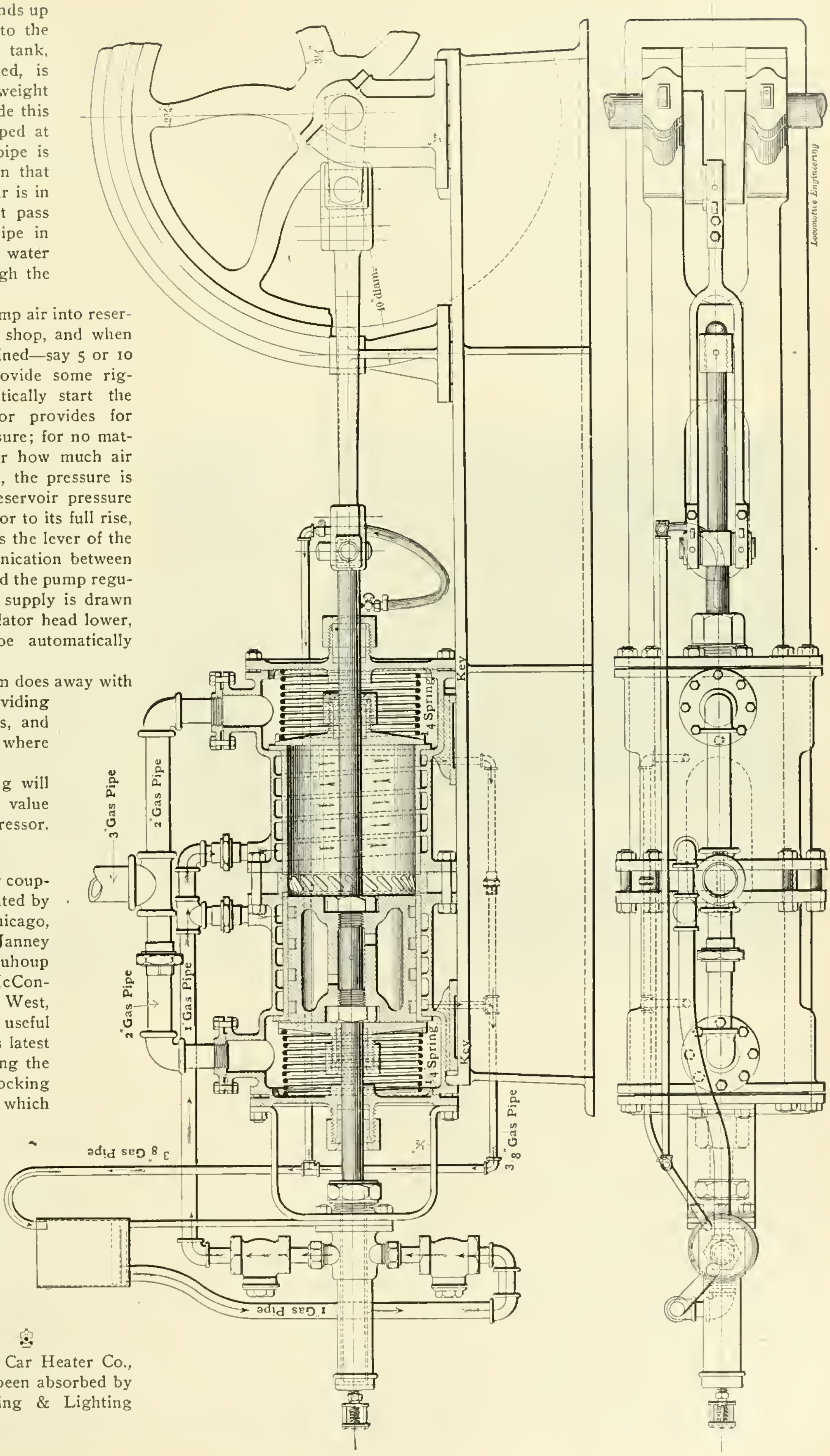
This is the first motor made by Mr. Roberts, and was run by a belt. Since then he has applied a steam cylinder to run direct. It gives very good satisfaction, and is a simple and cheap affair to build.

Instead of pumping air into extremely large tanks, Mr. Roberts uses an accumulator, the same as used for heavy hydraulic work. His manner of making this is shown very plainly in our engraving. There is a heavy reservoir at the bottom with a cast-iron ram. This ram has a connection at the bottom to receive a 3-inch pipe, which extends up through the ram and into the water tank above. This tank, it should be remembered, is simply placed there as weight on top of the ram. Inside this long pipe, which is capped at the top, the discharge pipe is placed; so it will be seen that no matter how hot the air is in the accumulator, it must pass up through the large pipe in the ram and the tank of water above flows down through the delivery pipe.

The usual plan is to pump air into reservoirs placed around the shop, and when a certain amount is obtained—say 5 or 10 pounds or more—to provide some rigging that will automatically start the pumps. The accumulator provides for absolutely constant pressure; for no matter where the ram is, or how much air there is in the reservoir, the pressure is the same. When the reservoir pressure has forced the accumulator to its full rise, the top of the ram strikes the lever of the valve that opens communication between the air in the reservoir and the pump regulator. The moment the supply is drawn down it lets the accumulator head lower, and the pump will be automatically started again.

The accumulator system does away with the necessity for providing very large storage tanks, and is especially useful where crowded for room.

The separate engraving will show the details of the value that regulates the compressor.



An improvement in car couplers has lately been patented by Harry C. Buhoup, of Chicago, and assigned to the Janney Coupler people. Mr. Buhoup is representative of the McConway & Torley Co. in the West, and has invented several useful appliances for cars. His latest invention is for supporting the coupler pin in an unlocking position—an operation which is performed in a simple and ingenious fashion.

The Canadian Government has introduced an eight-hour system into all offices and works that are under its control.

The Martin Anti-Fire Car Heater Co., of Dunkirk, N. Y., has been absorbed by the Consolidated Heating & Lighting Co.

A Substitute for the Pinch Bar.

Mr. F. C. Emery, of Wilmerding, Pa., writes as follows:

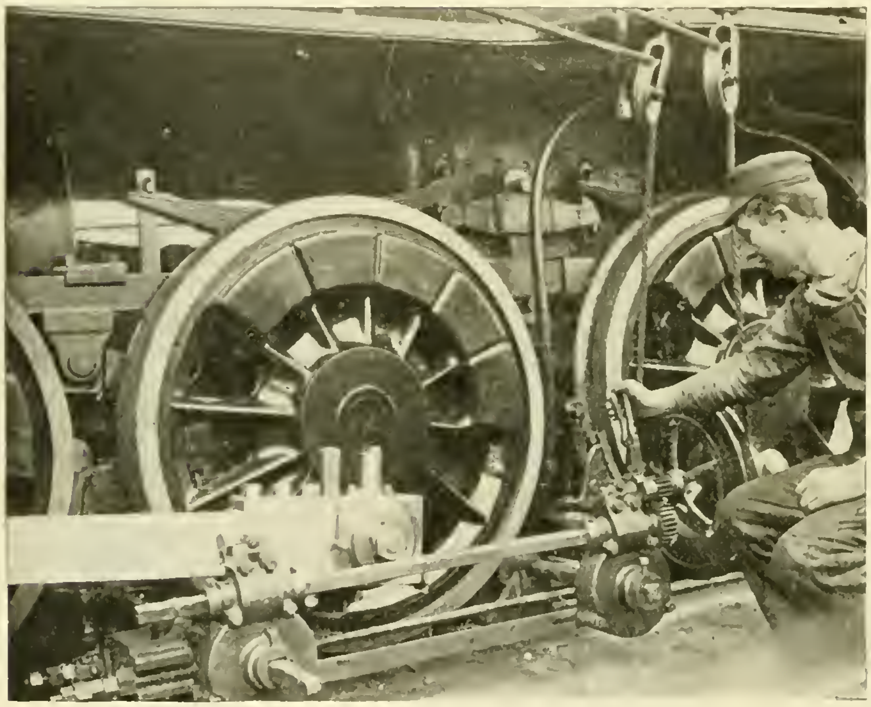
While paying a visit to the A. V. Ry. shops at Verona, Pa., a short time ago, I saw in operation a device that, to me, was especially commendable.

How many of your machinist readers are to-day stoop-shouldered from having to "pinch" an engine around over the shop (and yard), setting her valves?

Mr. J. C. Glass, master mechanic, has obviated this trouble in a way that is applicable to all shops that are not already equipped with some device for this purpose. He mounts the main driver of the engine on four rollers, adjustable to any wheel—a device familiar to many; but to the ends of the shafts passing through these rollers he has mounted worm wheels which engage with worms driven by a square shaft, on the end of which is carried a small lever and pair of reversing gears, the entire machine being driven by rope transmission from any convenient shaft. A boy operating the lever can bring the wheel to within a sixteenth of the center, and then with a slight turn of the square shaft with a monkey wrench bring it to exactly the right point.

A small rotary air motor could be substituted for the rope transmission, which would make it especially convenient for roundhouse work.

This shop is remarkably well equipped with labor-saving devices similar to the above. All flues are cut off for removal from the boiler, and new flues cut before insertion by the rope transmission.



SUBSTITUTE FOR PINCH BAR.

The Illinois Central Repair Shops.

Railroad men interested in engineering establishments, visiting Chicago, have generally considered that the most interesting place to be seen in the neighborhood was the Pullman Car Works. If they are wisely advised now, they will go and see the magnificent shops built by the Illinois Central Railroad Company for locomotive and car repairs, at Burnside, in the neighborhood of Chicago. The designers of these shops evidently studied the arrangement of all the best railroad repair shops in the country, and made use of all the features that promoted convenience and economy. To walk leisurely through the shops is the work of half a day. At the end of the journey the impression conveyed to me was that they were the best heated and lighted shops I had ever seen, and that it would be difficult to improve on the arrangements for handling material. Quite a number of details seemed capable of improvement, but the shortcomings result from "hard times" and the unwillingness of the company to spend money not imperatively necessary.

The buildings are all of brick with substantial stone foundations, and they are all set well apart, and are served by transfer tables operated by Gibbs electric motors. The windows are large and numerous, and all the buildings are also lighted from the top by monitor roofs or glass covering. The Sturtevant system of heating is used throughout, and, of course, gives entire satisfaction. Part of the heating is done by exhaust steam, and where that is not sufficient, direct steam is employed. An idea of the magnitude of the operation of heating these shops may be formed from the fact that one shop alone is 100 x 502 feet and requires 12,000 feet of piping. Some of the other buildings have 14,500 feet of heater pipes. The first cost of this heating equipment is considerable, but Mr. J. W. Luttrell, the master mechanic in charge, believes that it was an investment which will pay itself in a very short time, owing to the extra work done by workmen when they are kept comfortable. Mechanics working on cold metal lose considerable time keeping their hands warm when a shop is badly heated.

The principal attraction of the establishment to me was the machine and erecting shop, where they repair about forty locomotives a month, half of them receiving heavy general repairs. Mr. Place, the general foreman, deserves credit for the systematic fashion in which the work is pushed, and for the variety of mechanical devices for saving human muscle. The most conspicuous feature about the shop is the number of air hoists employed. They went into these devices very systematically. A Rand compound air compressor supplies air, which is used for a great variety of purposes besides hoisting, such as the driving of portable motors of various kinds, for drilling, tapping, riveting, boring, etc. The shops are provided with an excellent incandescent electric plant, which is also utilized for operating Gibbs electric motors that drive tools not constantly in use. By putting seventeen air hoists in the machine shop, they saved the pay of nineteen laborers, besides getting the work of putting articles on machines much more promptly.

The weak point of the erecting shop is the want of overhead cranes. The shop was built with supports for traveling cranes, but the cranes were left out, owing to the times being too hard. It is certain that no private company would attempt to run a shop of that kind without overhead cranes, if they had to increase their capital stock to raise the money. It seems to us that railroad companies ought to follow a similar policy. If there were less than half the engines that pass through these shops jacked up every month, overhead cranes would pay the company handsomely on the investment. The expense and loss of time incurred in jacking up engines and lowering them again makes a big bill at the end of each month; and when to that is added the labor of men in taking off and putting on cabs, dome caps and covers, sandboxes, smokestacks and boilers, the saving from the use of traveling cranes can readily be computed. Air hoists have done much in this shop to reduce the inconveniences due to the want of traveling cranes, but they cannot lift locomotives or boilers.

The tools in the shops are well grouped to finish the work on certain parts with the least possible amount of handling. A practice which was new to me is in vogue here. They have the shop divided into stations, so that the messenger boys who carry tools from the tool-room will know where to go when a tool is called for. All the machine tools are numbered, and are used to identify the stations. For instance, Planer No. 1 is the center of Station No. 1. When a workman, say on Station No. 70, wishes to receive a tool, he touches an annunciator, and the man in the tool-room knows that axle Lathe No. 69 is the center of the station where the tool must be sent.

Mr. Luttrell has a system of telephones in his office which is highly convenient. He can put himself in communication with any one of his foremen, cutting off all the others, and he can connect with the whole of the telephones in the works. When there is any information to be given to all the foremen, he calls them to the telephones and talks to them. Sometimes they discuss subjects together over the telephone, just as men do in a meeting.

Several engines in the shop were having their cylinders bushed down from 19 to 18 inches diameter. The engines that had been changed in this way were reported to be doing more work than they were capable of doing when the cylinders were too large for the boiler and the weight on drivers. There was a tendency on this road for a time to make parts of brass that were formerly made of cast iron. They have a goodly number of brass eccentric straps, axle boxes, gibs, etc., but they are not pursuing that policy any longer. Mr. Luttrell finds that cast iron is strong enough and wears better than brass; but, then, care must be exercised to get the right kind of cast iron.

I saw them using a revolving disk for cutting off flue ends, which does remarkably quick work. Two men can cut 1,500 ends off in ten hours.

The foreman had high praise for a portable tapping and drilling machine made at the Kellogg Machine & Boiler Works, Athens, Pa. They have several Baird machines for boiler work, and all the calking, heading flues, etc., seems to be done by the Chicago Pneumatic Tool Co.'s apparatus. All the hydraulic presses have air connections which force up the water at the beginning and save the time lost by the slow process of pumping.

In their finely arranged oil-house, air pressure is employed to force the oil from the storage tanks in the cellar. The air is not put upon the surface of the whole tank, as is done in some places. It is applied to a stand-pipe about 6 inches diameter, which extends from the bottom to the top of the oil tank and is closed at the top. The connecting pipe that leads to the oil faucet upstairs is attached to the lower part of the stand-pipe. Oil is admitted to the stand-pipe through a small check valve, which closes when air pressure is applied. If by any accident the faucet should be left open, no more oil would be forced out than that which was in the stand-pipe.

The roundhouse connected with these shops is about the cleanest and neatest kept place in Illinois, and reflects the greatest credit on Mr. J. F. Barton, the foreman. The boiler-cleaning and firing-up arrangements are as near perfection as they can be made. The water run out of boilers to be washed out is passed through filters, and run into a reservoir to be used over again. The whole of the rain that falls upon the roofs of the huge buildings is run into reservoirs and pumped up into the water tank.

The various car shops seem to be as well arranged as those for iron-working. The planing mill is particularly worthy of inspection, on account of the systematic arrangement of tools, for its neatness, and for the manner in which the work is done. The passenger-car repair shop and paint shop are both sufficiently wide to admit of two cars at once on each track. The tracks are well apart, and there is plenty of room all round the cars for workmen, tools and material. The paint shop has a capacity of fifty cars a month, and is provided with every convenience for facilitating the work. Compressed air has been utilized for cleaning purposes, and it is used in connection with a torch for burning off paint. They are unusually busy in the passenger paint shop, because they are changing from the yellow which was the time-honored color of the Illinois passenger equipment, to the Pullman color.

SOMEBODY BLUNDERED.

To go into details of the car department would take more room than I can devote to it at present. I hope to return to the subject again. In connection with my visit to these shops, I have to acknowledge the pleasant courtesies of Mr. F. W. Brazier, the able general foreman.

A. S.

New Rock Island Locomotive.

The Chicago, Rock Island & Pacific have just put into service a new form of eight-wheeled passenger engine, which promises to make a fine record in hauling the heavy fast passenger trains for which the road is noted. In designing the engine, Mr. George F. Wilson said that his idea was to have something that would pull a passenger train at an average speed of 70 miles an hour for 181 miles, the distance between Chicago and Rock Island. Writing about the engine, Mr. Wilson says:

"In designing the engine, special care has been taken to get a large and effective heating surface, a good valve motion and large bearing surface on journals, and last but not least, a light engine. There are no novelties about this engine, but we have used what long experience has proven to be good on this road. The tender holds 4,000 gallons of water and 8 tons of coal. Tank built with sloping sides so that the coal will slide towards the fire-door. Coal gate of the A., T. & S. F. R. R. standard. Tender truck, C., R. I. & P. standard with the exception of wheels, which are Paige, 36-inch diameter. Engine truck has 36-inch Paige wheels.

"Some dimensions for this engine are as follows:

"Gage of track, 4 feet 8½ inches.

"Cylinders, 19½ x 26 inches.

"Drivers, 6 feet 5 inches diameter.

"Steel centers, 6 feet diameter.

"Tires, Krupp crucible steel, 3 inches thick.

"Wheel base of engine, 23 feet 1½ inches.

"Wheel base of drivers, 8 feet 6 inches.

"Wheel base of truck, 6 feet 3 inches.

"Wheel base of tender, 15 feet 10 inches.

"Wheel base of truck, 5 feet.

"Total for engine and tender, 48 feet 5½ inches.

"Total length engine and tender, 59 feet 8⅞ inches.

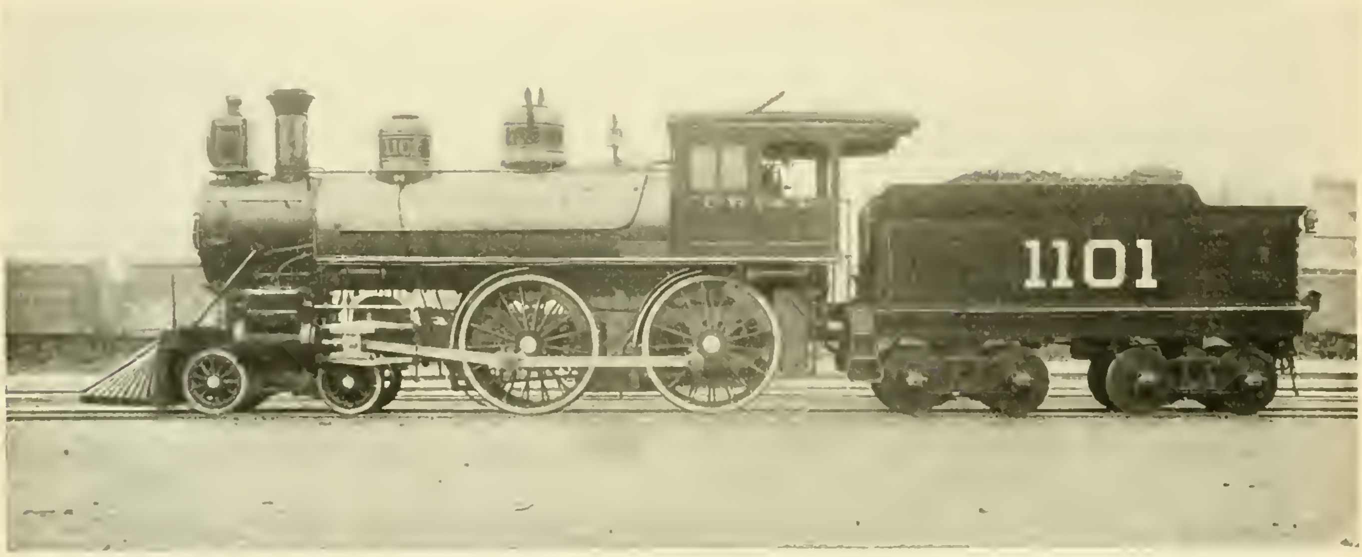
"Weight on drivers, 83,000 pounds.

"Weight on trucks, 42,000 pounds.

"Total weight on drivers and trucks, 125,000 pounds.

"Weight of tender loaded, 78,000 pounds.

"Boiler, radial stay with extended wagon top. Material, Carbon steel, smallest course, 61 inches diameter; 296 tubes 2 inches, 11 feet 7 inches long. Firebox length, 9 feet; width, 2 feet 8⅞ inches; height, 6 feet 7¾ inches at front. 190 pounds working pressure. Three 3-inch tubes to carry brick arch. Shaking grate in two sections, C., R. I. & P. standard, for burning Illinois coal. Crossheads of steel castings. Slide valve, Richardson balance, with open top. Steam ports in cylinder, 1½ x 20 inches. Exhaust, 3½ x 20 inches. Driving boxes cast iron, with bearings of C., R. I. & P. bronze. Axles of Midvale steel, 9 inches diameter; journals, 12 inches; side rods of steel fluted. Main rods and frames of best hammered iron. Crank pin, steel. Coffin process. American air brake on drivers, tender and engine trucks."



NEW ROCK ISLAND LOCOMOTIVE, BUILT AT THE CHICAGO SHOPS.

Journal-Burnishing Tool.

Mr. L. Bartlett, division master mechanic in charge of the Missouri Pacific shops at St. Louis, says, in the course of a personal letter:

"In your May issue of 'Locomotive Engineering' I note you have a description of a roller for burnishing car-axle journals, which was designed by one D. H. Teas, foreman of the New Haven & Harlem shops, New Haven. This tool has a history, so far as I am individually concerned. Some three or four years ago, in looking for some means to improve the condition of car journals, it occurred to me that a burnisher might produce the proper surface. Walking through the shop, I called one of the men to go to the brass lathe and get me a burnisher, a hand-tool. I applied it to a journal of an axle then running in the lathe, and found that the surface produced by the burnisher was one that was required; and I instructed the foreman to make a temporary roller and try it, which was done. The results obtained by the temporary roller were so perfect that I had a proper tool made for this service.

"Believing we had a good thing, I attempted to patent same, but found that the old adage was true in this case as in many others, 'There is nothing new under the sun'; for in attempting to procure a patent, that office informed me a patent had been granted some years before for a roller to burnish cotton-mill spindles. The tool has been in use by many of the railroads in the West, and also the car-builders, both street and railroad, all proclaiming it to be one of the nicest tools for putting a finish upon car journals that has been found."

We understand that the Northern Pacific are about to change, in their shops at Brainerd, four of their standard mogul 18 x 24 engines into compounds. They will all be different types—Richmond, Schenectady, Brooks and Pittsburgh. The intention is to put them into service, running against simple engines of the same type, and make comparisons between the compounds themselves and between the simple engines. Three of the consolidation engines belonging to the road, of their old pattern, are also about to be changed into Vauclain compounds.

The United States shipped more railway equipment to foreign countries in 1895 than for any two years previous.

Kinks at the Oneonta Shops—Delaware & Hudson Canal Company.

During a recent visit to the above shops we were strongly reminded that there was something distinctively original in the way work was handled in that remarkably neat plant; in fact, it was so apparent in every operation going on as to engage the attention of anyone interested in shop work. The cause for this is easily traceable to the head of the motive power department, Mr. R. C. Blackall, who has always made it a point to encourage head work as well as some other kinds.

A center drill and countersink which will make a center of a proper depth and correct angle is shown herewith, and it is seen to be a little affair that will do business. It has two cutting devices at the centering end, each independent of the other. The spindle *A* is fitted with a drill socketed in the usual manner, and speeded up and driven by the pulley shown at the end; it is fed by means of the hand wheel next to the pulley. The fluted reamer is made with a 60-degree taper, and is secured to the sleeve *B*, which revolves outside of the drill spindle, receiving its motion from the pulley shown at the left.

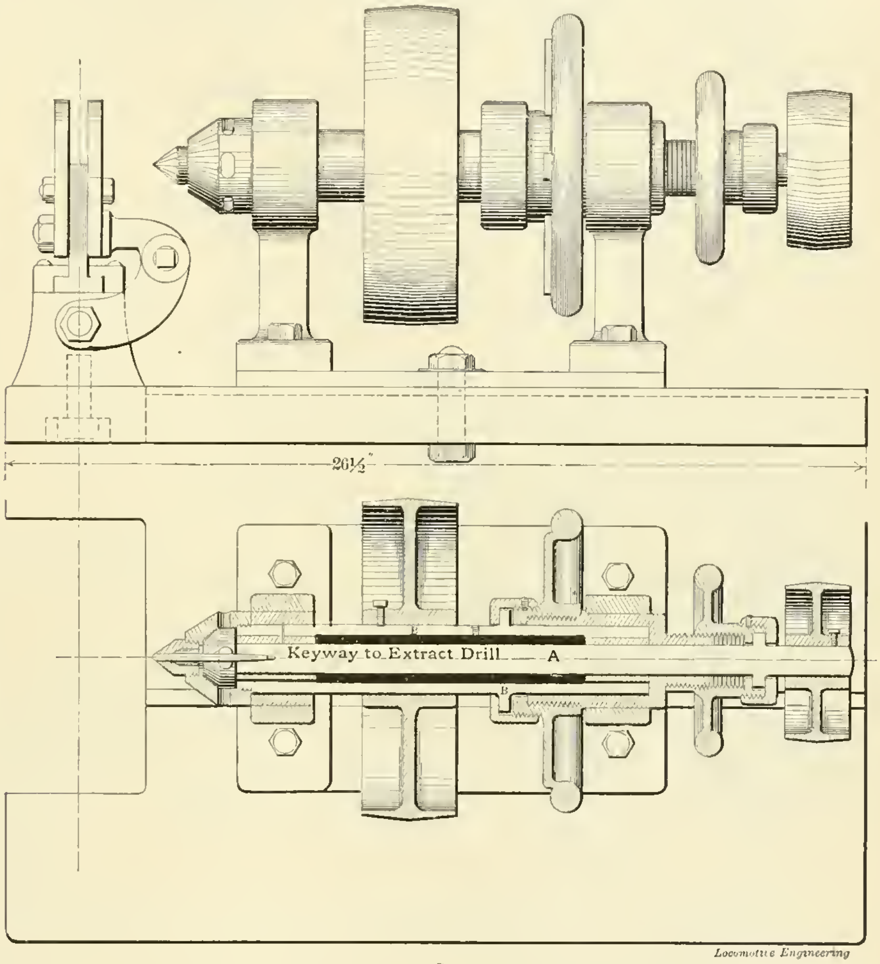
The customary centering jaws, actuated by right and left-hand screws, are a part of this equipment, of course, without which a tool of this kind would not be a very important factor; but the centering portion of the affair is founded on correct principles, as is evident by the way it handles work. The philosophy of the thing is embodied in the independent cutting parts; for it is well understood by those who have crumbled off the point of the solid center reamer, that a speed that is correct for the point is much too fast for the outer cutting edges. The proper speed for all parts of the reamer is under the control of the operator with this machine.

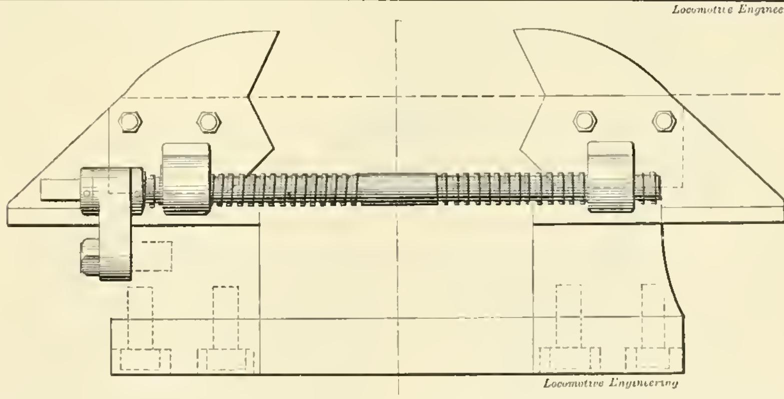
The hook jack illustrated is one of the handiest roundhouse tools we have ever seen for taking out a driving spring. It is made up of two hooks to pass over the top of an equalizer, and two similar hooks to pass under the lower section of a main frame. A cross-bar on each pair of hooks is large enough to form a nut, in which works a right and left-handed screw fitted with a ratchet. A few turns of the screw, it is seen, will suffice to pull down the equalizer and release the gib at top of same; that is what the device was made for, and it does the work in a most satisfactory manner.

Another roundhouse accessory of no mean value is shown in the reamer for cleaning out exhaust nozzles. This tool is operated from the top of the stack—no front-end door to open or netting to remove. It is made very light—the body ¾-inch gas pipe, and the reamer end of $\frac{3}{16}$ × ¾-inch steel, with flexible blades. The tool is easy to handle and a good thing.

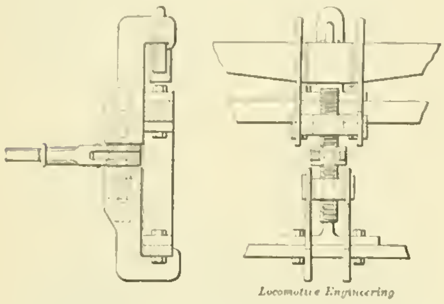
They have a device here for lining up guides, which reduces that operation to its lowest terms, and insures absolute truth in alignment of guides with the bore of cylinder. The illustration shows a star frame with four arms, which are secured to the cylinder head studs at the front end. The gland shown has a tapered body which fits into the stuffing box of the back head, and is thus self-centering, leaving the only adjustment to be made at the star in front, which has a movable bush at its center for the purpose, and this bush is centered with the counterbore of the cylinder.

Fitting into the bush and gland is a 1½-inch round steel rod, and this rod has sufficient length to have a bearing in the star and gland, and at the same time extend to the extreme end of the guides to be lined up. At the crosshead end of the rod there is a sliding ring having an outer diameter and length equal to the crosshead fit of the piston, and it is this ring that tells at once, when the crosshead is in place, which guides need the liners, by moving the ring to the crosshead and noting its position with reference to the piston fit. This scheme has so many advantages over the old-time line stretched through a cylinder, that even a rough adjustment with it gives a better alignment of the crosshead and cylinder than the best work in the old way; and, again, there is no fear of a line being moved or cut with this device.





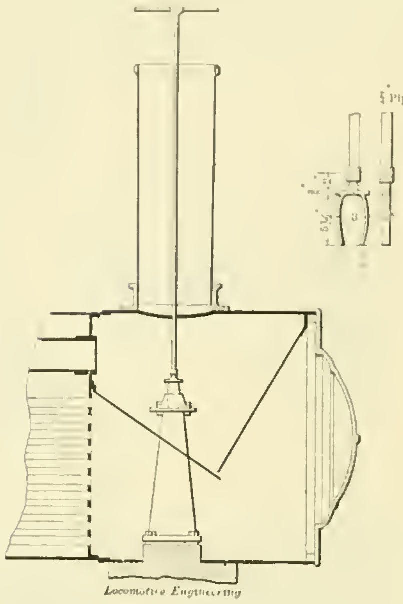
In a great many shops—too many—the truck-wheel press and its surroundings are hardly beauteous enough to inspire a lasting respect in the observer. A dark corner, lots of grease, and blocking by the cord, is generally the fate of this tool; and with that picture in the mental plate-holder, it is a matter deserving of favorable comment when a tool of this kind is found out in the open, minus the blocking, and clean. At these shops a wheel



press was seen in operation that could do work, simply because the floor around it was cleared of all useless impedimenta, and the machine had all its accessories in places convenient to handle.

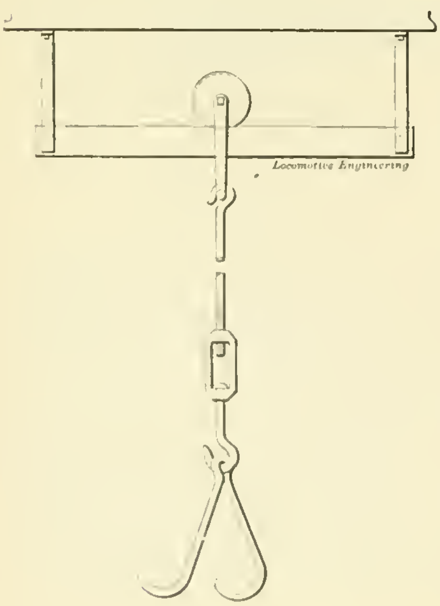
All the U-shaped iron filling blocks and tools required to remove or put on wheels, are fitted with an eye-bolt, by which they are suspended with small chains passing over sheaves above the machine; and having counterbalances at the opposite end of chain, they are brought into action at once when needed, and put up out of the way with equal facility when not wanted. Compare this way of getting out work with the one where everything is lying around loose on the floor.

Another interesting thing was on exhibition at this tool, in the shape of a single-wheel trolley placed above and just in front of the machine, used for the purpose of rolling mounted wheels in and out of the machine. The double hook or bale, shown at the lower end, takes hold of the axle, and a pull by the one man who handles the machine places the wheels in the proper positon before the ram. Com-



mon practice in this case is to roll the wheels to the machine on skids or blocking, and fall over the latter at stated intervals.

Among the facilities for handling work at the wheel press, perhaps the two little platform carriages which support the wheels in the machine take rank with the best of those noted. They are made with four small wheels and a wrought-iron top, and roll on the base of the machine frame. Mounted wheels being rolled on these platforms are easily adjusted to position longitudinally, and that by a mere touch. The old pinching-into-line process does not compare favorably with this mechanical idea.

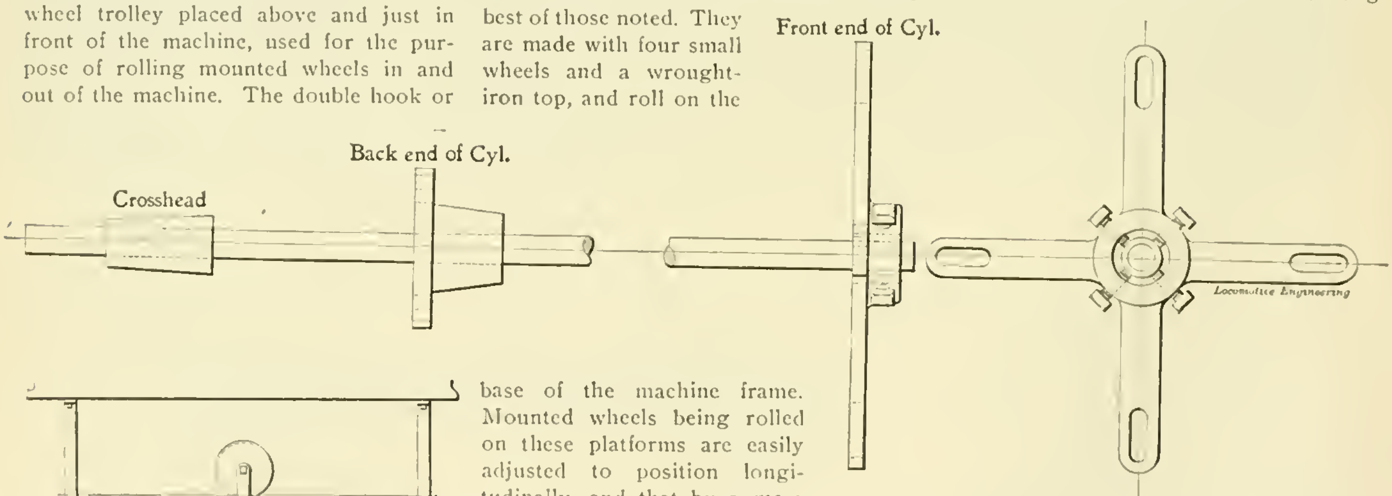


Master Mechanic Smith has not failed in carrying out his instructions, to do work on correct labor-saving lines, as the few samples touched upon here will attest. Who shall say that the large conservatory and beautiful display of flowers seen here are not largely responsible for the birth of these kinks? Pleasant shop surroundings are certainly not conducive to poor head-work. O. H. R.

Check is almost as powerful as brains When brains and check are combined they are invincible.

One of the worst and most persistent attempted steals ever put before Congress is the Nicaragua Canal Bill. The promoters of that enterprise wish the United States to guarantee bonds to the extent of $100,000,000. The scheme has been persistently pushed for years and appears to have a great deal of political backing. A commission of engineers was appointed some time ago to examine the proposed route and report on the enterprise. This report, submitted a short time ago, was decidedly adverse to the scheme, and many people expected that we would hear no more of the Nicaragua Canal Bill for some time to come, but it appears to display as much vitality as it had before the commission of experts reported the scheme to be almost impracticable. The people who are pushing that enterprise are not so much interested in making a short cut for vessels between the Atlantic and Pacific as in the probabilities of securing something for nothing. There are mighty possibilities of boodle in a scheme which pledges the credit of the United States for a hundred millions of dollars.

"They have in use in the Atchison, Topeka & Santa Fé shops at Topeka, Kan.," says the "Master Mechanic," "a plan for planing the cylinder saddle to the radius of the smokebox. A heavy planer with two heads is employed to do the work. One head is fitted with a long



tool so set that the distance from the point of the tool to the center of the swivel of the head is equal to the radius of the smokebox. This head is clamped in correct position on the cross-bar, and the bolts that ordinarily prevent swiveling are loosened. The tool is then connected by a special kink with the other tool post and the feed put on this second head. It does no cutting itself, but it feeds the radial device in the other head. The work done this way is much more rapid than chipping, and the finish is more accurate."

J. C. Clifford has been appointed Supt. of M. P. of the C., L. S. & E. Ry.

An Automatically Closing Steam Fountain that Will Close.

BY JOHN A. HILL.

The frightful tortures of enginemen by scalding have long been deplored by everybody, but there seems to have been a hopeless surrender to the belief that it could not be helped; that it was one of the dangers of the business that must be taken into consideration.

Perhaps that is true, but I do not believe it. Many attempts have been made to lessen this danger, and in a limited way they are successful. For instance, the inside-closing check is a success and a great safeguard. It closes when the injector is shut off, and will close when the pipe is knocked off, because it is protected, for one thing; but the principal reason it may be trusted is that it does close every time the injector is used. It is working all the time and is to be depended upon.

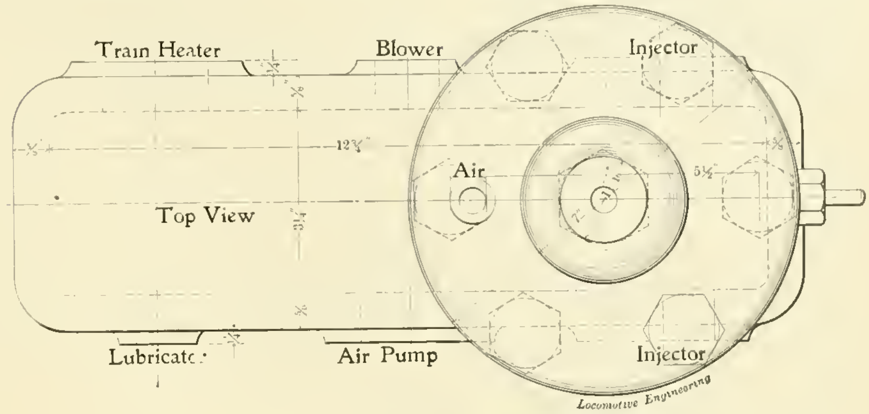
Not so the ordinary automatic device to prevent accidents—it is not reliable. It is not expected to close except there is an accident—then it fails. Why? Because it has become corroded or scaled up; and even if it did close, there is no likelihood that it would close tight.

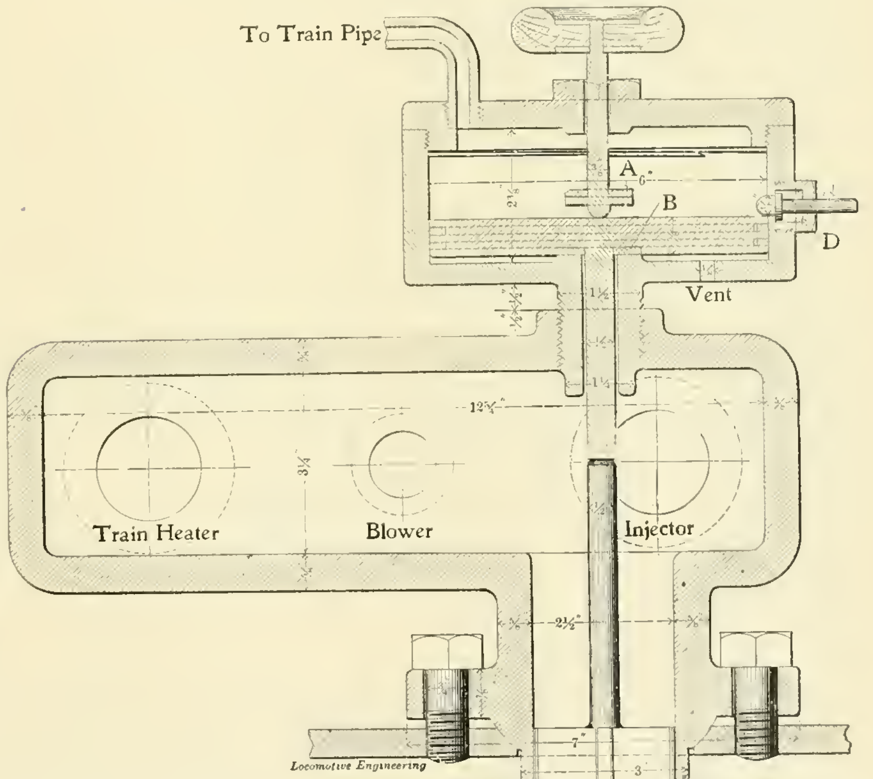
The general practice in modern engines is to use a fountain for all cocks in the cab except gage cocks, instead of tapping to the boiler direct. This is good practice and convenient. One dry pipe to dome does for all steam supply.

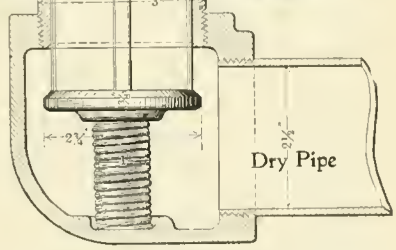
Most fountains have one large valve to shut off the steam; this admits of regrinding the valves or renewing them while steam is on the boiler. Some have a check valve that is supposed to close automatically if the fountain is broken off. This is worse than useless—the valve is never used, and can be depended upon to fail when needed worst—for one cock broken off will scald and kill just as fast as more; and if one or all of the cocks in the cab were broken off the fountain, this automatic valve will remain open and deal out murder just the same as a fountain without this attachment.

What is wanted is a valve that will close; one that is closed every day; one that will close in every accident, whether anything is broken or not—a valve that takes no chances. I present here a sketch of such a valve. I believe that this device will do all this and can be relied upon. It leaves nothing to the engineer; it is entirely automatic; it is used every day, and is in the habit of being closed. It is cheap, has no packed joints, and will show itself when it is out of order.

Any form of fountain may be used. I show the device attached to the commonest form. The inside check valve is the usual one, and is here shown with a spring under it. This is not necessarily essential; it would probably work as well depending on boiler pressure alone. My improvement is in the device above this valve.







It is perfectly safe to say that no accident of a serious nature can occur on an engine with air brakes, without the brakes being applied full—if the engineer does not do it, the train pipe is broken somewhere and the brakes go on. I utilize this to shut off the steam from the fountain. A little cylinder is arranged above the fountain and over the check valve, as shown; air from the train pipe is piped to top of this, and this air holds the valve open. Reduce this air below a given pressure—say forty pounds—and the valve will close.

The emergency application is made every day somewhere, around tanks and coal chutes, if not on the road, and the valve is operated and kept in condition. The engineer can't help it; if the emergency goes on, his steam supply goes off.

In firing up a cold engine, it becomes necessary to open this valve before the pump can be started or the blower used. Instead of using a valve that could be left open and defeat the aim of the whole device, I provide a threadless stem, A, through the top cylinder head, with which the piston can be pushed down; and a small plug piston on the side of the cylinder, that can be pushed in, by hand, and that catches above and holds the piston down and the valve open. When the proper pressure of air has accumulated in the train pipe, the air will push the piston down further, and will also act on the plug piston to force it out of the way. Thus, the device takes care of itself and requires no attention from the crew—they can't leave the station without a proper supply of air in the train pipe; and if they have this, the safety device is in working condition.

I avoid all packed stems by the use of

washers of Jenkins metal or vulcanized fiber—one on the stem under the piston will pack the lower end of the cylinder against steam when the valve is open; another on the push-down stem, and one on the piston plug on the side, do away with all necessity for any other packing.

An opening is made in the lower head of cylinder. If steam shows there when piston is down, it denotes a leaky gasket under piston; if air shows, it tells of leaky packing on the piston head itself; if steam shows there when piston is up, it tells at once that the safety check itself wants grinding in.

This device, I feel sure, if used would decrease the number of awful accidents to enginemen by scalding. The tortures these poor fellows are often called upon to bear are no credit to our railroad managements, nor to our civilization—because the public hear little of them is the reason something has not been done to prevent such deaths. If every railroad manager in the land could witness just one slow execution by the agonizing tortures of escaping steam—as I have witnessed them—there would be no lack of effort or expense to stop these murders.

I feel that this invention will be of more service to the men who earn their living on locomotives than of pecuniary advantage to the railroads themselves, and therefore do not intend to patent it, but offer it for what good it will do, hoping for its trial and adoption. God knows! a thousand of them are cheaper than one life. I feel sure it will save life; and if I can only hear of but a single case where one of my fellow enginemen has been saved from the tortures of hell by this device, I shall feel more than repaid.

A British Consul in Japan writes in this style about railway supplies for Japan: "There is imperative need of active measures on the part of British manufacturers of railway material if they wish to maintain and advance their own interests. The monopoly Great Britain has hitherto enjoyed in Japan of supplying railway material is threatened, and Americans and others are losing no opportunity to secure an entry for their wares by offering special attractions. The local representatives of American manufacturers are assiduous in pressing the claims of their principals, and it is urged that our manufacturers of railway material would find it advantageous to be represented in a similar manner, as there are indications of considerable activity in railway enterprise."

There appears to be something the matter with the postal arrangements in South Africa. We have more complaints from subscribers in South Africa not receiving their papers regularly than we have from any other country outside of the United States.

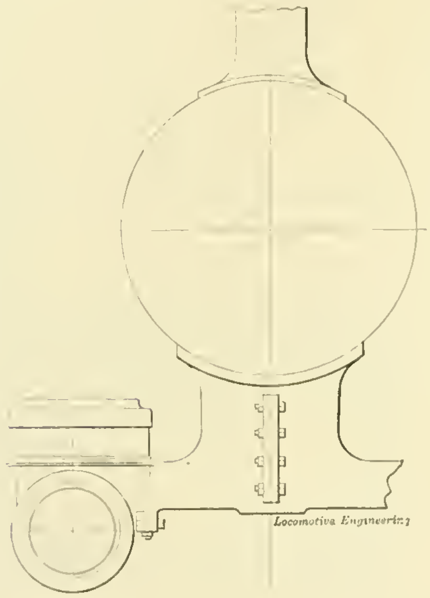
Jim Skeevers' Object Lessons.

Piston Fits The Worship of the Standard Idol—A Revolution in Cylinder Design—Frames and Binders.

BY JOHN ALEXANDER.

The general manager's car was on the tail end of No. 3 Saturday, and at Granger he caught sight of Skeevers climbing onto the smoker—he sent his porter after him.

"Skeevers," said the old man benignly, "I jest want to 'gas' with you from here in; we'll have a bit of supper here and, well, perhaps I'll open the safe. Oh! ye needn't laugh—they are there! I keep 'em locked from Snowball here. The Sphinx left most of a box when he used the car last; he told me they were fifty-five a hundred—but such cigars you never put your lip over, Skeevers; finest thing I ever—what the devil is up now?"



HALF SADDLE CYLINDER.

"Emergency for something," said Skeevers, rubbing his head where it hit the partition.

The old man pushed a dent out of his hat, replaced it on his head, and followed Skeevers to the ground and "up ahead."

The engineer and fireman were taking down a valve stem—the right-hand piston rod had broken in the crosshead keyway and taken out the front head slick and clean.

Skeevers went up behind Murray and asked: "Can you handle 'em over Hardscrabble Hill, Jerry?"

"If they don't stop me at Lowers, and I get a swing at 'em, I'll get over with one side; but, Jim, you know how like a log Old Frosty's hearse pulls?"

"Well, by ginger spruce!" exclaimed the general manager. Mr. Wider was originally from Connecticut, and on rare occasions some of the strange oaths of that strange country would escape him.

"Oh! howdy do?" said Murray, with a smile; "didn't know you was around—but, Mr. Wider, that car of yours does pull awful. Blow the whistle, Billy; we're ready, and the whole trainfull of people are on the ground."

"Old Frosty" and Skeevers went back and climbed on the smoker, never a word being spoken until they had walked back to the private car.

" 'Old Frosty' and his hearse!' " exclaimed the old man—"well, by ginger spruce!—oh! say——" Then he went over and fumbled with the lock of the little safe in the corner.

"Take one of them, Skeevers; wash your mouth out and taste the nectar of the gods—I guess it's nectar, 'er nicotine, 'er sumpthin' else—its good, anyway, especially for a 'hearse.' " Then he laughed loud and long.

"I tell ye, Skeevers, it takes the boys to name things and name 'em right—'Old Frosty and the hearse'—well, by ginger sp——ho, ho! Say Skeevers, I forgot—ain't we a breakin' altogether more pistons than the law allows—'pears to me I hear of a case about twice a week."

"I think about three a week would be nearer the truth," said Skeevers, blowing a couple of blue rings above his head.

"You're so darn cool I dassent jump on ye, Skeevers; for I know you've got one of them object lessons around to floor me with. I'll bet I can guess it, too—Shaver's poor material, ain't it, now?"

"No; I think that the fault is entirely that of the head of the mechanical department."

"Well, by gum! that's refreshing, anyhow—why don't ye stop it? You're a great standard man; why don't ye get to a standard on this piston-rod business?"

"We are to a standard—that's what's the matter."

"I smell one of your object lessons. Let her all out now Skeevers."

"Mr. Wider, our pistons all break in the crosshead keyway, or just outside the crosshead—never broke one anywhere else. We have used all kinds of material—good, bad and indifferent. That piston rod that broke on this engine was Coffin toughened steel; ordered it myself. When we use that, or Taylor iron, or any good material, we have less breaks than with poorer materials—but good materials can't make up for bad design, can it?"

"No; that's a law."

"Well, sir, if there is one thing about the ordinary American locomotive that shows bad engineering it's the crosshead fit of piston rods. Ours is the usual stiff taper with a square shoulder and a key—worst thing that could be gotten up if we tried. In the first place, we reduce the area of the rod about a quarter to make the taper; then we leave a square shoulder so the rod can break easy; then we cut a keyway through the already reduced section, reducing it nearly a half, making a sure breaking point; then we drive a key, with a very slight taper, through the keyway, and pull that rod into the crosshead, putting a breaking strain on the rod before the steam is used at all. I'd be willing to warrant every one of them to break—there's something the matter with those that don't. On some roads they just taper the fit without cutting down a shoulder, without letting the rod bottom; others have a short stiff taper back of the keyway—but they all have the key, and the initial strain, and trouble."

"Well, Skeevers, if a bridge engineer found a girder too light for the load, he'd increase the size—why don't you make a bigger rod at the fit?"

"Ah! there is where our sacred standard gets in its work. We have standard crosshead reamers—probably cost a hundred dollars—Massey made them eighteen years ago. Every shop has a stub-end standard sample fit for piston rods, and a square block of cast iron with a standard reamed crosshead hole, all fitted with a standard key. Every engine this company owns has that standard-size piston rods except those last moguls—I let the builders put their own there to see what modern practice is—it's no better than ours. Massey's standard fit was adopted when the largest engine on the road was a 17 x 24 eight-wheeler, carrying a boiler pressure of 140 pounds. Our 19 x 24 ten-wheelers carrying 190, have the standard piston fit—and I am ashamed to say it."

"Why don't you throw the gum-sizzled reamers away and make 'em bigger?"

"Can't do it; crossheads are nearly all of cast iron, and the piston bosses are as light as they ought to be now—a new standard fit means new crossheads, and new crossheads means a big appropriation to cover the expense."

"That's different," remarked the old man, thoughtfully.

Skeevers and "Old Frosty" smoked in silence for ten minutes; then the old man broke out:

"For the Lord's sake, Skeevers, let's don't have standard fits on these ten new engines we're talking of—I ain't so sure I won't commence having fits of some kind myself."

"I shall ask you to approve of several innovations on those engines before the order is given."

"I'll do it now; what kind of piston rod fits will you suggest, though?"

"Well, I have several plans: One of them is to leave the rod straight, cut a standard thread on it, make the crosshead in halves, tap threads in the crosshead fit and clamp it onto the rod by four bolts. Another is to make the rod perfectly straight, let it bottom in the hole and use the same key we do now. Perhaps this last is the best and cheapest; the strain of the key would be back of the keyway, it would cause no bursting strain on the crosshead boss, and it would be strong like this"—Skeevers took out his notebook to make a sketch, the old man looking over his shoulder as he turned the pages.

"Hi, there, Jim! what's that ye got there?"

"Well, to tell the truth, Mr. Wider, its a collection of innovations that I didn't intend to show you yet; just some stray ideas in memorandum form that I hope some day to find a chance to try, but not yet."

"More 'O. L.'s,' hey?" asked the general manager.

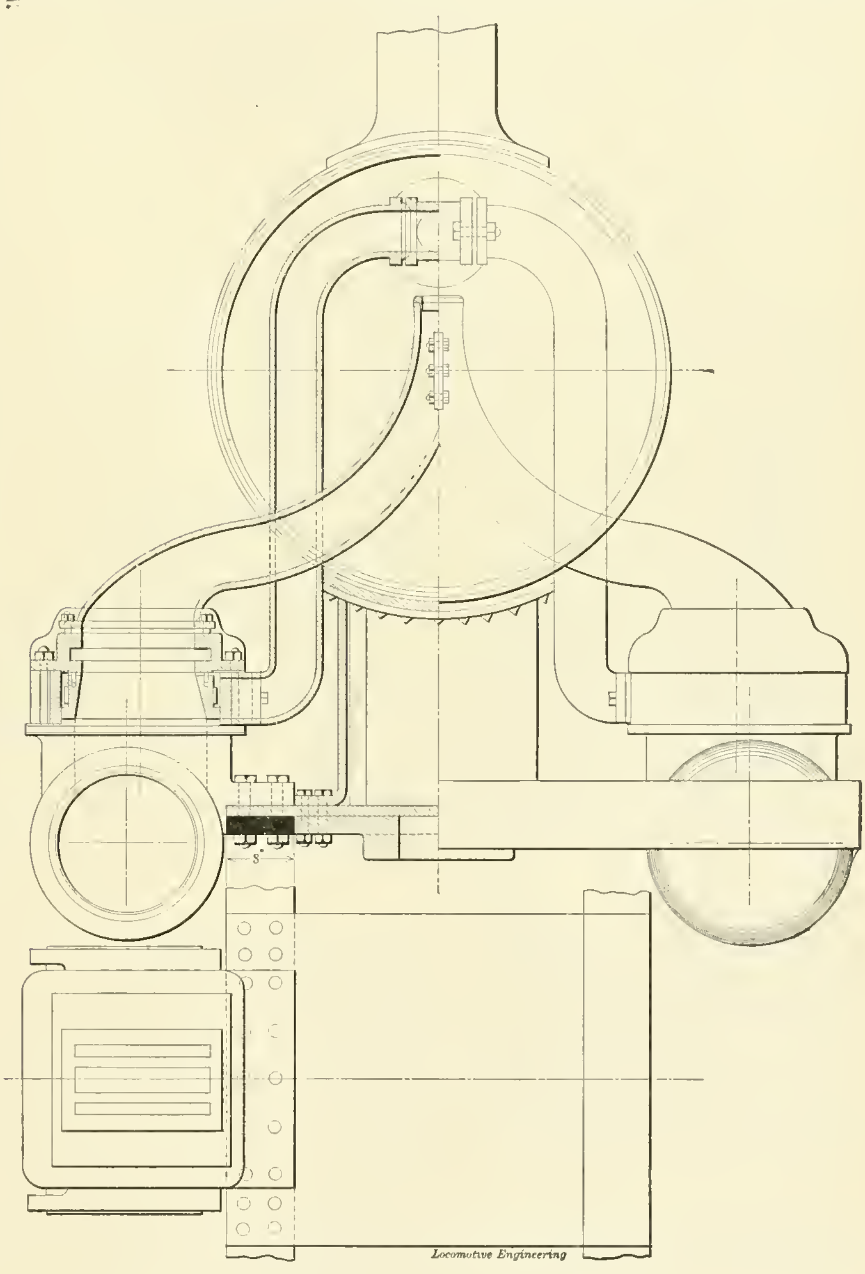
"'O. L.'s?'" asked Skeevers, taking his cigar out of his mouth and looking at the old man.

"Yes, yes; 'O. L.'s'—object lessons, of course.

"Oh!" said Skeevers.

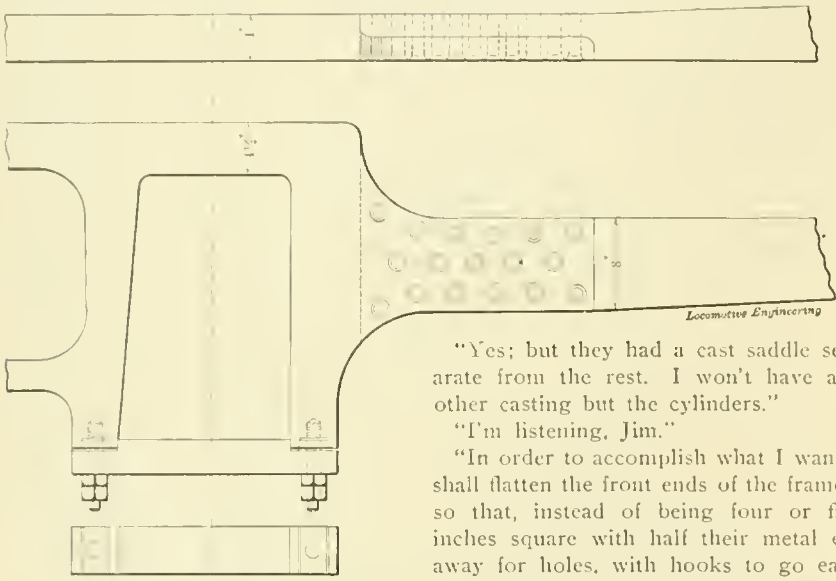
"Well?" said Wider.

"I don't suppose you have a very good idea how much trouble we have from cracked cylinder saddles, cylinders loose on frames, frames broken, steam pipes leaking and other diseases due in a large measure, I think, to the general use of the half-saddle cylinder. Now, there is a sketch of a half saddle engine as usually made. The lightest part of the affair is at the joint where frame is fastened on. Through this casting there is a cored hole that forms part of the steam pipe, another one that forms the exhaust passage, and four holes for the bolts that fasten on the frame. In making this an expensive pattern is necessary and an expensive casting produced. This must be planed at the joint with its mate and bolted together. It must be planed at the frame fit and on the seat, to say nothing about steam and exhaust pipe fits and stud holes; but most expensive of all is the fit of the saddles to the smoke arch—



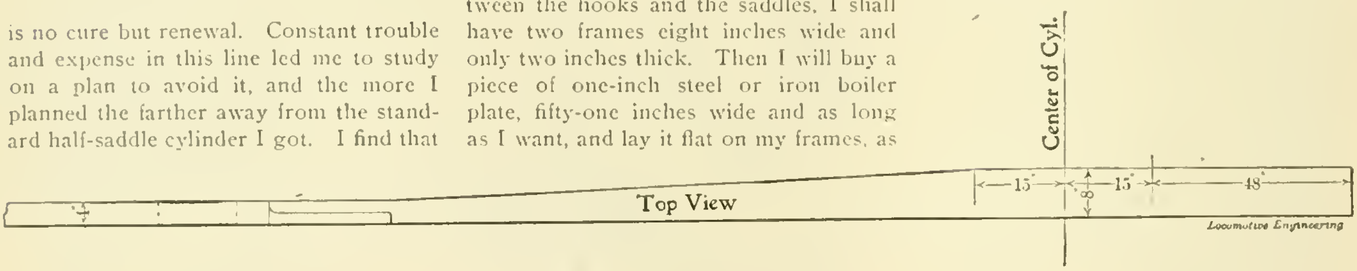
SKEEVERS' CYLINDER SCHEME.

which must be done by hand. If anything happens to the cylinder—well, take the '86,' in the shop now; struck a car and cracked cylinder—all the joints and fittings must be made anew, a new saddle supplied, the engine pulled apart, and the loss of its use for two weeks or more. After about two years' service our big engines commence to crack their saddles—and there



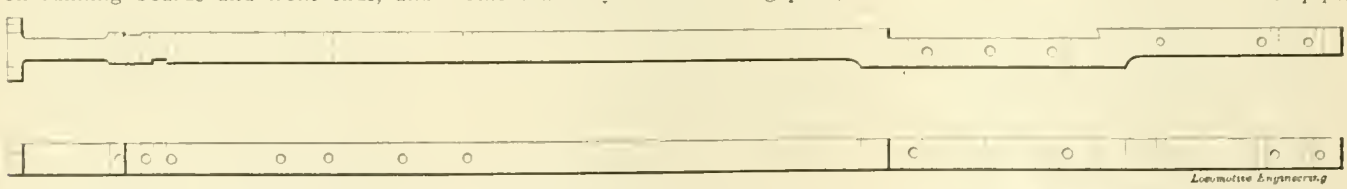
SKEEVERS' FRAME.

is no cure but renewal. Constant trouble and expense in this line led me to study on a plan to avoid it, and the more I planned the farther away from the standard half-saddle cylinder I got. I find that



SKEEVERS' DESIGN OF FRAME.

our old eight-wheelers do not break saddles nor get frames loose, while all the '180' class do, as well as all our moguls. 'Why?' I asked myself. Well, sir, I went out and spent the best part of a day lying on running boards and front ends, and



THE OLD STYLE OF FRAME.

came home convinced that it is caused primarily by the constant weave come-and-go of the frames; the engine on one side jerks the frame toward the cylinder in one direction, and the other side shoves them apart, and then they reverse—you can see 'em move. 'But why didn't the old engines do the same?' you may ask? Because they couldn't; the frames were tied together by long, heavy trusses at each end! The big deck plate saved the old engines. The new ones, with long fireboxes on top of the frames, have only a narrow tail piece. Those two Roger moguls have an angle iron bolted on back of cylinder saddles, and a flat piece of boiler iron riveted to it and the frame, makes the cylinder saddle longer, but not long enough. I propose to cast the cylinders separate from the saddle——"

"That's what our old Schenectady engines had," said Mr. Wider.

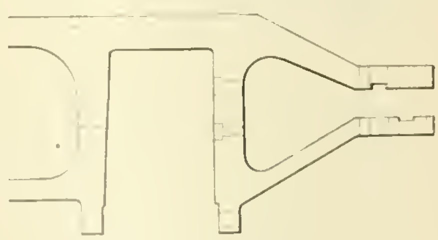
"Yes; but they had a cast saddle separate from the rest. I won't have any other casting but the cylinders."

"I'm listening, Jim."

"In order to accomplish what I want I shall flatten the front ends of the frames; so that, instead of being four or five inches square with half their metal cut away for holes, with hooks to go each side of the saddle and wedges to go between the hooks and the saddles, I shall have two frames eight inches wide and only two inches thick. Then I will buy a piece of one-inch steel or iron boiler plate, fifty-one inches wide and as long as I want, and lay it flat on my frames, as you see it in the sketch. Then I will cast my cylinder, without saddle, but with a long lug, or rib, on one side; this rib will be eight inches or more wide and will be planed up on the under side. This I will lay flat on the big plate, and bolt the three together with bolts one-and-an-eighth or one-and-a-quarter in diameter. Don't you see I will have room to stagger my bolts? They will be short and large, and the holes can be easily reamed. I will be able to put in fifteen or twenty instead of four, and will have three or four times the strength of the ordinary cylinder fastening. You see, the deck plate, or whatever you may call it, can be as long as there is room for or as is required; the lugs on side of cylinder can be longer than the cylinder if it is thought necessary. Just see how easy it is to put on a new cylinder if one gets broken. Just see what a truss that inch plate is—edgewise, remember; all the work is done on it edgewise. Why, sir, you couldn't budge that kind of a lay-out with four times the pressure in cylinders four times as big. You couldn't——"

"But, hold on, Skeevers; where's your saddle, and what is that sewer on top of the steam chest for?"

"Oh, yes; why, properly speaking, there will be no saddle, as we know it. On the bottom of the smoke arch, which will not be all cut away as it is now, we will rivet—rivet, mind you—two flanged steel plates practically the shape of the sides of our present saddle; these two sheets of pressed steel will have flanges at the bottom that set down flat on the deck plate, and their edges will abut against the cylinder lugs. I will hold them down with four or six bolts; the front and back can be closed by plates of any thickness, either fastened to the side pieces or not. When I want to take my boiler off, I shall take out the bottom bolts, knock off her rear anchors and lift it off—saddle and all—with the crane. One saddle fitted in boiler shop when the engine is new will outlast the boiler; the center plate can be wide enough to fill between the frames if necessary. My steam pipes will come from the nigger-head straight toward the bottom of arch, and then turn, going through side or arch, and have a ground joint on side of chest. That 'sewer' is the exhaust pipe.



The valve will be balanced and the back cut out of it; and the exhaust steam, instead of going up under the valve, down into the exhaust port into the saddle, and then up to the nozzle, will come up out of the cylinder, up through the valve, and up through the pipe and the stack—no turns, no baffles. This may not look pretty, but it's ideal piping. Don't you see that there isn't a trap or a pocket in it anywhere. A drop of water in either the steam or exhaust pipe must run, by gravity, into the cylinder and out of the cylinder cock. I may have to make my valve a little larger; but if I do, I will shorten my steam ports and decrease the useless clearance. I think such a plan would stop all trouble with cracked cylinders; stop leaky steam pipes and broken frames from cylinders getting loose; reduce the expense of replacing a broken cylinder by half; be lighter and better and —well, homelier than anything we've got. What do you think?"

"Sure it would know it belonged to the railroad when it looked in the glass?"

"I think perhaps it would recognize itself as a locomotive."

"Don't think it would suck cows, or nothin' like that, Skeevers?"

"Alas and alack!" exclaimed the designer, in mock despair. "I knew you would not see the improvement—plain as it is. I am like all the rest of the benefactors of mankind—ridiculed, laughed at. Why, Mr. Wider, in the language of Colonel Sellers, 'there's millions in it;' millions of kegs of dollars—and two, twelve-inch bungholes in each keg!"

"Take another cigar, my boy; it will quiet your nerves," said Old Frosty. "Lemme see that sketch again. Looks kinder English, 'er French, 'er some kind of foreign—say, Skeevers, I want one of them to run on that club train—them anglo-maniacs that smoke pipes, roll up their pants and play golf. Bet you it would just tickle 'em to death—we could name her 'Prince of Wales,' or 'Lord Algernon,' or something—but say, Jim, what kind of a checker-board is this?"

"That is the front frame of the 'Prince of Wales.' You see, it will be 2 x 8 in front and I taper it back, keeping the same area of metal, and near the jaw widen it in a vertical direction, cut away half of it and do the same for the frame ahead of the jaw, and bolt them together with short stiff bolts. I have then a frame with twice the strength of the ordinary frame, without keys, with less fitting than the old splice, as shown in the sketch below. I can take that apart easily, and it is not in the way of anything. Again, it lets me widen the foot of the jaw and cut a wide slot, say 2½ inches, clear across it to take in a lip I will make on my binder. Did you ever notice our regular binder? Well, it is heavy; but we cut it almost half in two to make a fit over the end of the jaw, then we bore a hole in the weakest point to hold it up—it's no wonder they are chronically loose. My binder will have a stud hole through the strongest part—where the rib is—and the rest of it will be straight. I will put one big stud there, and it will pull up right in the proper spot, and keep pulling."

"Do all these changes necessarily go with the new cylinder rig?"

"No; but they are in the line of improvement."

"Skeevers," said the old man, solemnly, "you may now kneel down and receive my blessing; I'll just have one of the new engines built your way."

"You go down East with a drawing of that in your pocket and the builders will have you put in the asylum."

"Well, what would you do?"

"I'd quietly put it on the '38;' she's in with both cylinders and her front frames smashed up, anyway, and we can experiment with her."

"Do that, Skeevers; do that. Be quiet about it, though, and for Heaven's sake don't say I told you to!"

"If I rebuild the '38,' she will be the worst example of anti-standards of the G. A. L. that you ever saw!"

"Standards be cussed, by ginger spruce! We'll show 'em some standards that ain't so old as Methuseler! But, Skeevers, listen; if the Sphinx should happen out and I wasn't here?"

"I'd have to say it was the invention of an outsider—one of our biggest shippers, and——Well, here we are, home again, sir,"

"Say, Skeevers, don't forget, if any of them reporter cusses come around, jest tell 'em—hem! lemme see—well, that we expect to have the yellow fever down on the Gulf branch this year, and that this thing is an automatic sewer deodorizer and atmospheric disinfector, and that the G. A. L. proposes to take care of its patrons, body and soul, yellow fever or no yellow fever!"

Who Can Tell Which Side of a Balance Valve Is Blowing?

In the course of a discussion at the New England Railroad Club, Mr. S. D. Hutchins, President of the Air-Brake Association, raised a question about valve strips leaking which was not answered. If any one of our larger constituency can answer the problem offered for solution, we should like to hear the explanation. Mr. Hutchins said:

"The great trouble with the Richardson valve, from the practical standpoint, is that the balance strips are liable to leak, and I would like to ask somebody if he knows of any really accurate way to determine which side they are leaking on without going into a careful research. It is a fact that the outside end strip of a valve drops down, I will say, nine times to one of any of the other strips, and we cannot tell, of course, which side it is on. The small hole down through the valve, to carry that steam off, is not large enough. It is only half an inch, and it creates a tremendous friction there, and it is a pretty hard matter to decide.

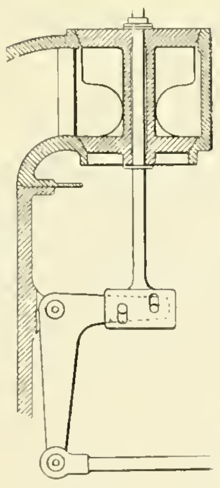
"Of course, it is a delicate matter for an engineer to go into a terminal and report valves blowing without being able to say which side it is on, and I have seen it occur very often that good engineers have reported the blow on the wrong side. After carefully looking into the matter, inquiring and discussing it among good practical men, I do not know of any practical way to determine which side a balance strip is leaking on. If there is anybody present who can give me information on that point, I should be pleased to have him do so."

No one attempted to explain.

Improvement in Throttle-Valve Connections.

Our sketch shows the principle of a neat little improvement in throttle-valve moving mechanism, recently patented by Mr. Kenneth Rushton, a draftsman at the Baldwin Locomotive Works, and now used on their engines.

The short arm of the bell crank has two pins in it, some distance apart, and the fork on the lower end of stem has two slots in which the pins move.



When the valve is closed, the pin nearest the fulcrum is in contact, or nearly in contact, with the top of its slot; and when the stem pulls the long arm of the bell crank, this pin engages with the upper end of the slot and the valve is lifted. The leverage is greatest here, as the difference in length of arms of the crank is greatest.

Once the valve is up, it is partially balanced and is easier to move; then the second pin engages and lifts the valve faster, while the first pin moves idly in its slot.

This arrangement gives the greatest leverage to do the hardest work, and then increases the leverage to cause a quick opening.

A new style of rod packing has been patented by Samuel Hughes, Charleston, S. C. It consists of a fibrous cord made up of two separate interwoven strands, held together by netted wire. Over this is a series of hemp strands and a series of asbestos strands, the material of both series being loosely disposed, and the two materials are plaited together so that the strands of one series will alternate with the strands of the other.

Fitchburg Shops at Keene, N. H.

The Fitchburg Railroad Co., having found their old Charlestown shops entirely inadequate to the demands on their facilities for locomotive repairs, have for some time been engaged in perfecting a model little plant at Keene, N. H., which it is intended shall embody the best modern conveniences and labor-saving devices for repair work.

The old shops were abandoned before the new were ready for occupation, making complications that required good generalship to surmount. Indeed, the tools were running and work going on for a time, while there was no covering but that of the broad canopy of blue above.

Through the courtesy of Mr. John Medway, superintendent of motive power, we present an illustration of the improvements, in which the solid lines show the old buildings utilized in the development of the new order of things, and the dotted lines represent the new work.

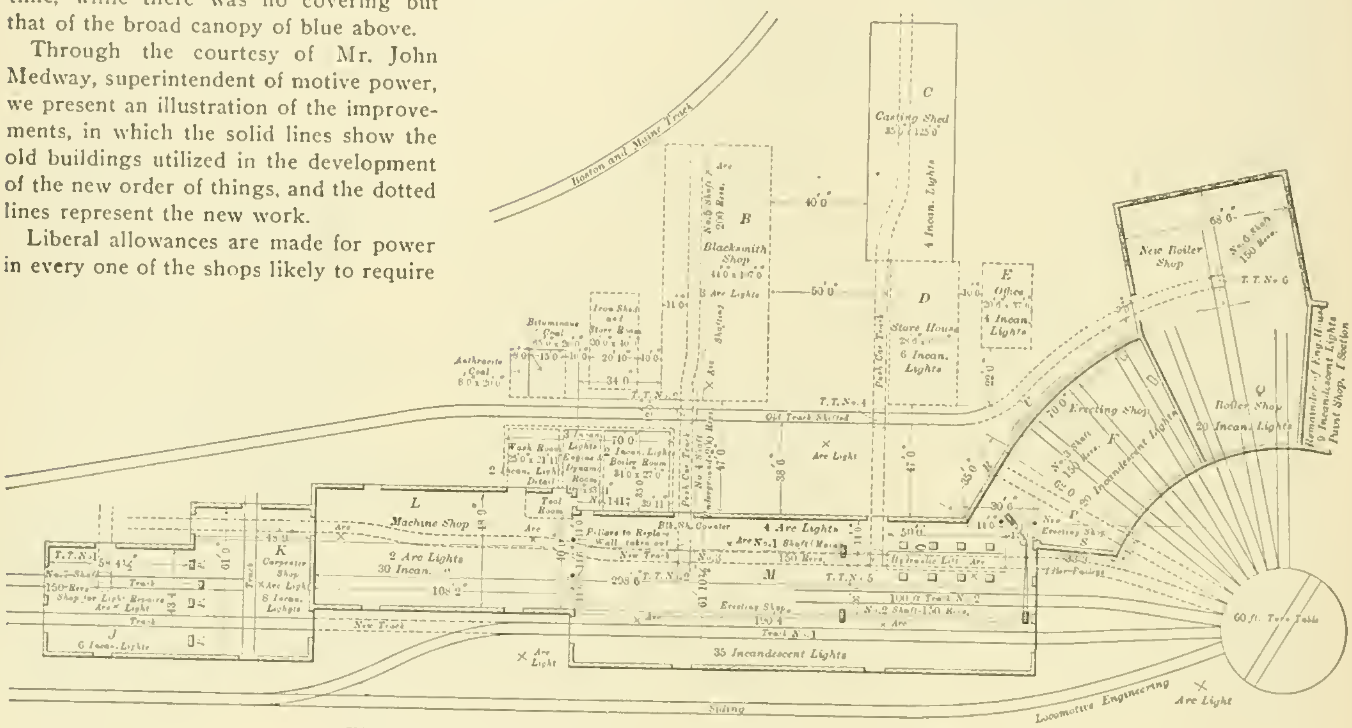
Liberal allowances are made for power in every one of the shops likely to require it, as is shown by the lines of shafting, placed with no stingy hand. A close inspection will show that nothing is left undone in the direction of providing for power tools.

One section of the roundhouse is taken for the paint shop, another for the boiler shop, and a third for an erecting shop; and all will be found well fitted for the purposes named. Another and larger erecting shop, 62 x 190 feet, having two tracks running full length, and another one partially through, will be the scene of operations for heavy repairs. In this shop is located a hydraulic lift for removing wheels, the track from this lift extending through the machine shop, which forms a part of the erecting shop. This machine shop is 49 x 102 feet and is an ideal little place for the location of tools. At the opposite end of this shop comes another erecting shop with two tracks; one end of this is used for a carpenter shop. It is at once apparent that there are no restrictions as to space for both general and light repairs.

A blacksmith shop 44 x 107 feet, located at a central point and convenient of access from all the shops, shows that the future has been peered into a little. This is a new structure situated 47 feet from the erecting shop and at right angles to the latter; it will receive power by means of shafting passing across between the shops through a conduit.

An important part of the new plant is the casting shed 35 x 125 feet, and the storehouse situated next to the office. This shed will save a good deal of tribulation when the snow flies. Relief from the troubles incident to digging castings out of the snow is generally one of the very last things considered in arranging the details of a new plant. The storage of coal and wrought iron has also been provided for with the same care.

The shops are admirably lighted by electricity, and an examination of the engraving will show that thought has been laid out here by practical minds, and that few things are lacking to economically and comfortably care for the 209 engines on the Fitchburg.



FITCHBURG RAILROAD LOCOMOTIVE SHOPS, KEENE, N. H.

A subscriber in India sends us a problem to work out which has been puzzling him. The subscription price for "Locomotive Engineering" costs him 10 rupees. He sent to America for a book costing \$2 and agreed to pay the postage, for which he was charged 6 rupees 13 annas. The problem he sends is: "If \$2 plus postage costs 6 rupees 13 annas, how is it that \$2 minus postage costs 10 rupees?"

A case lately decided in an English police court gives a significant sign of the difference in the spirit of the laws in England and America. A timber merchant was prosecuted by a railway company for making a false declaration of the weight of goods given for transportation. He was heavily fined. It would be a long time before an American police court would fine any one for attempting to cheat a railroad company.

While all other branches of industry in Great Britain are unusually prosperous, the tinplate trade in Wales is suffering from great depression. The workmen have submitted to repeated reductions of wages, while wages in all other trades are going up. The principal cause of the depression in the tinplate trade is the loss of the American market. The much-abused McKinley Tariff enabled Americans to establish manufactories of tinplate, and they are now supplying the market in spite of a reduced tariff.

It costs about \$7.50 per quarter to carefully inspect the staybolts in a locomotive firebox. This is \$30 per year per engine—a pretty heavy item of expense. Why would not hollow staybolts save a good deal of this? In a great measure they inspect themselves.

"Jim Skeevers' Object Lesson on Staybolts" has been issued in book form by the Acme Machinery Co., of Cleveland, O., who offer to send a copy free to any railroad man who mentions that he saw their advertisement in "Locomotive Engineering." Send for it—and put in a stamp.

AIR-BRAKE DEPARTMENT

Conducted by F. M. NELLIS.

Danny Dugan's Air-Brake School.

The Instructor, Pro Tem.—Danny's Explanation of the Triple Valve.

"Say, youse, dere's nottin' but trubble cummin' me way. I dodges it, but it gives me de upper cut. Dat's on de level. See?

"Say, t'ings 'as been comin' rocky fur us orphans since Mr. Jennings chases hisself t' Boston t' chew de rag wid dem Air Brake 'Sociashin fellys, an' dat goes. See?

"Wot's crooked? Wot t'ell? W'y, de whole game's rotten. Every t'ing's rotten since dat stiff uv a Tompkins chases hisself here. See?

"Youse hain't on? Wot t'ell? Isn't youse on dat w'en Mr. Jennings chases over t' de rag-chewin' bee at Boston, dat dat mug uv a Tompkins, wot's de air-brake 'structor fer de fellys on de Terminal, he chases here? W'y, yes dat's wot's rotten. See?

"Say, dat mug Tompkins is bug-house, an' dat's on de level. See?

"Wot? Youse ain't onto 'bug-house?' W'y, dat means 'no good.' See? Tompkins is bug-house.

"Say, Scissors, an' Eddie Morris, an' de udder fellys wot trots in me class, calls 'im Mr. Tompkins. Nit! Wese 'as re-organized 'is name. Wese calls 'im 'Know - All - Stuck - on - Hisself - Pimpkins.' See? Wot t'ell?

"Dat Pimpkins is de worst bug-house stiff I ever sees, an' dat goes. See?

"Wot did Pimpkins do t' me? Wot t'ell? W'y, he trun me down. 'E trun down Scissors, an' Eddie Morris, an' Fiddle Face Farley, an' me an' de rest o' de gang. Trun us all down hard. Dat's right. See?

"Wot for? W'y, cos wese wasn't ont' dem highfalutin' words. Pimpkins uses dem big words wot wese ain't onto. 'E sez: ekulizin' an' ekulizashun an' ekulibrimbum, an' all dat sort o' stuff. Den, cos wese ain't onto dem words, 'e sez, sez 'e: 'Youse ain't on. Youse ain't been 'structed right.' See? Wot t'ell?

"Say, wese fellys ain't stuck on de size o' de mor'gage wot wese has on de air-brake biz; but fur Pimpkins t' trow defleckshuns on Mr. Jennings made de gang hot, an' dat's right. See?

"Say, youse orter see Scissors. Say, Scissors 'ud hock 'is watch for Mr. Jennings. Scissors, 'e sez t' me, sez 'e: 'Danny, if youse fellys stay wid me I'll put dat stiff's nose out o' joint, or my hair ain't red.' But Tom Blair, one o' de old engineers, caught on t' de game, an' called us down.

"Say, Scissors an' me cum near givin' dat stiff de new work. Wese 'ud t'umped 'is frame.

"Pimpkins, 'e t'inks dat 'e's got a lead-pipe cinch on de air-brake biz. W'en Mr. Jennings chases t' de air-brake fellys' meetin', den Pimpkins, 'e stands pat. 'E don't draw no cards. See? 'E knows it all. 'E don't need t' know no more. Nit!

"Say, I'm dead stuck on dem air-brake fellys. Dey doesn't do a t'ing but chase t' de conventions and cough up all dey knows, an' den goes off t' learn more. Wese fellys wot trots in de five-minit class gits de good o' dem meetin's. See?

"How does Pimpkins 'struct? Wot t'ell. 'E don't 'struct. 'E makes youse feel how much 'e knows. 'E don't learn youse nottin'. Mr. Jennings teaches youse lots. Pimpkins gives youse de glad hand an' marble heart. Mr. Jennings is right people, an' gives youse de glad hand an' welcome heart. See?

"Say, Mr. Jennings is always glad t' see youse comin' t' de air-brake joint. An' he savvies 'ow t' chin wid youse, too, and dat goes. See?

"W'en Mr. Jennings tells you somet'ink, youse catches on, an' don't loose yer grip afterwards. See? Now, den, Pimpkins he tries t' look dignified an' wise like a owl. Say, dat gives me a pain. Instead o' lookin' dignified 'e looks like a kid, wots learnin' t' smoke an' gits sick. See?

"Mr. Jennings don't look dat way. 'E looks as dough he's glad t' see youse. 'E knows wot youse needs, an' 'e knows 'ow t' give it t' all different kinds o' fellys. 'E don't try t' string youse, an' make youse feel little. See?

"I put youse onto 'ow 'e calls de straight air brake de brewery an' de auddermaddick brake wuz de saloon. I t'ought so. Well, dis is de way wot he tells Eddie an' Scissors, an' de rest o' de fellys in me class, about de workin' o' de triple valve.

" 'E sez, sez 'e: 'Dere's a piston wot 'as a pressure on bote sides uv it. De pressure wots on de side wots flat is de train-pipe pressure. De pressure on de side wots got de piston stem an' slide valve is de zallery razzerboy pressure. Now, w'en dese pressures is bote even, de piston can't move; cos w'y, de bote de same strengt'. W'en one is stronger dan de udder, den de strong one will push de piston against de weaker pressure. Just like a man an' a boy pushin'. Now, den, we starts wid de zallary razzerboy an' de train-pipe pressures bote even. De piston don't move. Now, den, we makes de train-pipe pressure weaker by lettin' some out. Den de zallary razzerboy pressure is strongest o' de two, an' won't do a t'ing but push de piston against de train-pipe pressure. Den de slide valve lets air t'rough its port t' de brake cylinder, an' sets de brake. See?

"Say, dat's all right. 'Now, den, w'en we wants t' let de brake off we gits some high pressure from de main drum wots on de engine, to come back and help de train-pipe pressure push de piston back again against de zallary razzerboy pressure. An' de two o' dem can outpush de zallary razzerboy pressure, too.' See?

"Say, none o' de gang could catch ont' dat at first, so Mr. Jennings saw dat wese wan't on, an' den 'e sez, sez 'e—all dis time 'is eyes wuz a twinklin'. Den he sez, sez 'e: 'Listen, fellys, I'm goin' t' make it so dead easy youse can't help catching' on.' Den dis is wot 'e said:

"Sez 'e: 'W'en de triple piston's up, de brake's off. W'en its down, de brake's on. Fur de piston t' come down train-pipe pressure must be de weakest. W'en it's down, an' wants to go up, de train-pipe must get some squezzed air from de main drum t' help it. W'en de piston's up, an' stays up, de pressures on bote sides is even, de brakes is off, an' every t'ing's lovely.' See?

"Den Mr. Jennings laughs, and sez, sez 'e: 'A farmer buys a pig. Den de farmer, 'e puts dis pig in a pen wots right next door to a cabbage patch. Now, den, dere's a gate between de farmer's front yard and de pen. Den dere's anudder gate between de pig pen and cabbage patch, an' den anudder gate from de cabbage patch t' de road.' See?

" 'Now, dis farmer had dese gates coupled together wid iron rods, so dat w'en de gate from de cabbage patch int' de road was open, de gate between de farmer's front yard and de pig pen, an' de gate between de pig pen an' cabbage patch, wuz closed.' See? 'Now, den, w'en de gate between the farmer's yard an' de pig pen, an' de one between de pen an' de cabbage patch, wuz open, de one from de cabbage patch int' de road wuz shut.' See? Say, dat farmer wuz a crank, but 'e 'ad t' fix dem gates dat way fur 'is bizness. Wot t' ell?

"Say, Mr. Jennings keeps a straight face, but his eyes twinkles an' 'e sez, sez 'e 'Now, den, de pig's in de pen. 'E squints t'rough de board fence int' de cabbage patch, and sez to hisself, sez 'e: Wow! Wow! get ont' dem cabbages. Say, I won't do a t'ing t' dem. Hully Gee! wot a tapioca. Den 'e puts 'is snout t'rough de crack an' begins to figure 'ow 'e kin get at dem cabbages. 'E finds de gate an' pushes it, but it won't open; cos w'y, it must open int' de pen. 'E noses about some more, an' finds dat if 'e pushes open de gate int' de farmer's yard, dat dat will open de gate int' de cabbage patch. Wot t'ell? dat pig's on.

"'Hully Gee,' sez de pig, 'dat farmer's dead green t' put me in here near dem cabbages, wot's chust me size. T'ell wid winegar and sugar! I'll take me cabbage straight, an' wid dat he tries to push open de farmer's front-yard gate, but it don't push.' See? 'Wot t'ell's wrong? sez de pig. Den 'e looks around an' finds de farmer's kid's holdin' de gate shut from de yard side an' keepin' cases on 'im. Den de pig looks t'rough de crack at de cabbages, an' grunts. Den he pushes de gate again, but de kid is chust as strong as de pig, and de gate stays shut.' See?

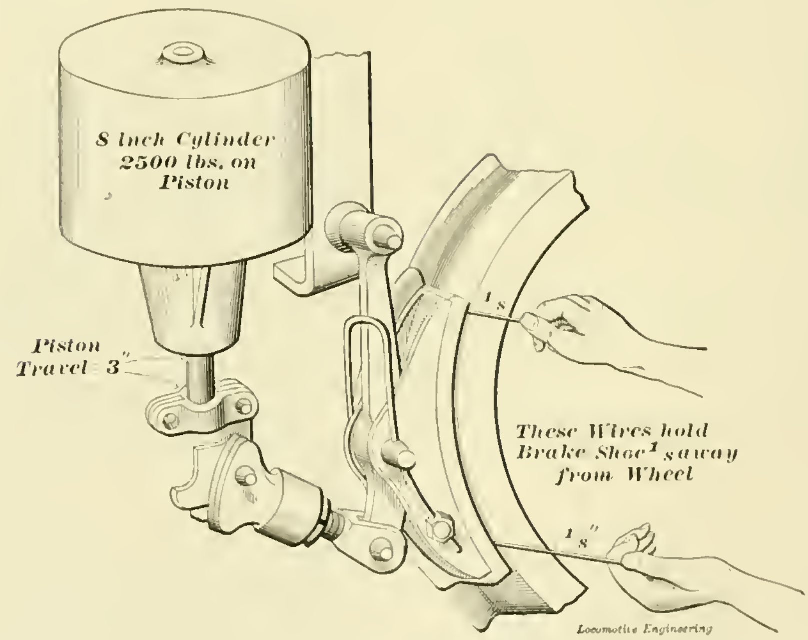
"'After a w'ile de kid sits down wid 'is back against de gate, an' shoots craps wid some odder kids. De pig sees dat he's stronger dan de kid now, an' pushes de gate open into de yard. Dis opens de gate from de pen int' de cabbage patch, an' de pig chases in. De kid begins to howl, an' de ol' man wot's in de wood-shed comes chasin' out, an' helps de kid t' push de gate shut. Dis shuts de gate from de pen into de cabbage patch, an' opens de gate from de cabbage patch int' de road.' See? 'De pig hears de ol' man cuff de kid's ears, an' hears de kid howl, so 'e gits scared, an' chases t'rough de gate down de road t' any ol' place.' Wot t'ell?

"'De ol' man chases down de road, t' beat de band, an' catches de pig an' brings 'im back t' de pen. 'E don't bring 'im t'rough de cabbage patch, but brings 'im int' de wood-shed an' t'rough de front yard, and den him an' de kid kicks de pig t'rough de gate int' de pen. Get t'ell in der, says dey t' de pig.' See?

"Say, youse orter see Scissors look. 'E t'ought 'e wuz de pig, I guess.

"'Now, den,' sez Mr. Jennings, 'youse can savvy dat de pig pen is de zallary razzerboy. De farmer's front yard is de train pipe, de cabbage patch is de brake cylinder, de pig is de zallery razzerboy pressure, an' de kid is de train pipe pressure. De pig wants t' get int' de cabbage patch chust like de zallery razzerboy pressure watches its chance t' get int' de brake cylinder. So long as de kid 'tended t' business, de pig wuz in de soup; but w'en de kid went t' shootin' craps, de pig wuz de best man an' pushed open de gate, an' got int' de cabbage patch.' See? 'De odder kids wot pulled de farmer's kid int' a crap game wuz de reduction in train-pipe pressure. De ol' man helpin' de kid shut de gate wuz de excess pressure from de main drum. De farmer chasin' de pig down de road an' catchin' 'im was de pump pumpin' air. Youse can see dat de farmer didn't take de pig back t' de pen t'rough de cabbage patch, but drags 'im t'rough de wood-shed, wots de main drum; den t'rough de front yard, wots de train pipe; an' den him an' de kid fires de pig t'rough de gate, wots de triple valve, int' de pen, wots de zallery razzerboy. W'en dey kicks de pig int' de pen, dat wuz re-chargin' de zallery razzerboy.'

"Say, youse, Mr. Jennings, wid 'is stories about de pig and cabbage patch, an' de brewery an' saloons, wins hands down over 'Know-All-Stuck-on-Hisself-Pimpkins,' an' 'is dignity an' 'is four an' a half t' one big words. See?



WAHLERT'S RULE FOR CALCULATING CAM DRIVER BRAKE LEVERAGE.

A Simple Rule.

Mr. H. A. Wahlert, St. Louis, Mo., sends the following simple and reliable rule for determining the brake power delivered by a cam brake:

Take two wires and place them between the brake shoe and the wheel, as shown in the sketch. Apply the brakes fully, and then measure the piston travel. Now release the brakes, recharge, and then apply fully again. Measure the piston travel again, and note how much more it has increased. Divide the additional travel, had upon removing the wires, by the thickness of the wire, and multiply this by the value of the cylinder. The result is the braking power on each brake shoe.

EXAMPLE.

Thickness of wires, ⅛ inch.

Piston travel with wires inserted as in sketch, 3 inches.

Piston travel with wires removed, 3½ inches.

Value of 8-inch cylinder, 2,500 pounds.

3½ inches — 3 inches = ½ inch.

½ inch ÷ ⅛ inch = 4.

4 × 2,500 pounds = 10,000 pounds on each brake shoe.

10,000 pounds × 4 = 40,000 pounds on all four brake shoes.

The simplicity of Mr. Wahlert's rule makes it particularly valuable to practical air-brake men. It is one thing to design a new cam brake by tedious use of lines and circles, and quite another to quickly figure in a simple manner the brake power being developed by an old cam brake in service.

Change in Location of the Leakage Groove.

Having been called upon to supply a quantity of freight-car brake apparatus for cars requiring the cylinder to be turned upside down, as compared with the ordinary method of attaching it to cars, and believing that future occasions would require them to supply more or less apparatus where the cylinders would be similarly applied, the Westinghouse Air-Brake Company has concluded, in order to avoid confusion in ordering such apparatus or repair parts, to place the leakage groove in all brake cylinders at one side of the bore of the cylinder, instead of the top, as has been their uniform custom heretofore.

The "living pictures" exhibited elsewhere in this department are actual living things, and are doubtless duplicated many times in everyday railroad life.

Principle of Wahlert's Rule.

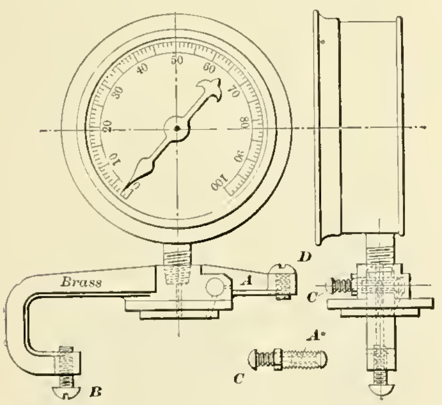
Wahlert's rule is based on the principle that the movement of the ends of a lever must be proportionate to their lengths, and that the power applied and delivered is indirectly proportionate to these lengths. For example: A lever 25 inches in length, and having its fulcrum at 20 inches, is a 4 to 1 lever. We know that a weight of 100 pounds on the long end will balance a weight of 400 pounds on the short end. We also know that with the same lever doing work, the long end of the lever must travel through four times the space that the short end will travel; hence, if we know the leverage, we can easily compute the distance traveled by both ends of the lever. If, on the other hand, we have the distances traveled by both ends of the lever, we can easily compute the leverage.

In the example accompanying Wahlert's rule, the additional piston travel of ½-inch represents the movement of the long end of the lever, and the distance between the shoe and wheel, made by the ⅛-inch wire, represents the movement of the short end of the lever. The leverage is 4 to 1, and, therefore, a force of 2,500 pounds applied at the piston will deliver four times that force, or 10,000 pounds, at the brake shoe.

A Handy Test Gage.

A test gage, which, by means of adjusting screws, *B* and *D*, can be adapted to either an air brake or signal hose, is shown herewith, and is the invention of C. C. Farmer, general air-brake inspector of the M. K. & T. Ry. at Parsons, Kan.

C is a button-head valve, and is held seated by a small spiral spring under the



head. When it is desired to discharge a small amount of pressure from the pipe to which the gage is attached, such as is done to make the leakage test of the signal valve, the valve is pushed inward and the escape of pressure is had through the small port *A*.

This is a handy and compact little device, and it, or its equivalent, should be in the hands of every roundhouse air-brake repairman.

Living Pictures--A Reminiscence of the Air-Brake Men's Convention.

"While you are discussing broken drawheads and other breakages attributable to the air brake," said a member to a group in the office of the hotel in Boston during the Air-Brake Men's Convention there, "let me tell you that, of course, we know considerable damage is done through the use and misuse of the brake; but when an air-brake discussion comes up in some of the railroad clubs there is always some one of pessimistic views who believes that the brake does more damage than it is worth. He shows up all the faults, but he overlooks the virtues.

"Now, we have all seen diagrams and figures, showing in what short distances a train may be stopped with air brakes; and we have also read the statistics that prove a railroad will receive a 40 per cent. return on its investment if it equips its freight trains with air brakes. That is all very true and good; but it does not carry conviction to the minds of doubting Thomases as would an occurrence which happened on our road the other day, which is as follows:

"The —— Railroad crosses our tracks at ——, and semaphore signals are used to govern the movement of trains over this crossing, which is in yard limits. In some unaccountable manner the engineers of two opposing freight trains approaching the crossing, understood they each had the right of way, and each did not discover, on account of an intervening building, that an opposing train was near until they were within collision limits. The —— Railroad engineer whistled for brakes while his train took the crossing at a six-mile-an-hour speed. Our train was approaching at about eight miles an hour and was within three coal-car lengths before the engineer applied the emergency brake. Our heavy consolidated engine and forty empty coal cars, all air-braked, were brought to a stand-still, and the pilot of our engine cleared the ——Railroad train less than eighteen inches as it passed. Our fellows jumped, of course. The signal man and both crews had war for about five minutes, but there was no report made.

"I have seen fine living pictures on the stage; but they were all ink blots as compared to this living picture, that showed what the air brakes could do in close quarters."

"That's all right," spoke up one of the group; "but let me tell you of another living picture. On one of our heavy grades, several miles from the top, is a station located very close to the edge of a bluff that rises almost perpendicular from a valley about two hundred feet below. East and west of this station the right of way is sufficiently wide for our double tracks only. At the station, however, Nature has provided room for the building and a short spur track in addition to that occupied by the main line. The spur track holds three cars, has a derailing switch and is entered from the east-bound or down-grade track. West-bound trains working on this spur track must cross over to the east-bound track.

"A west-bound train recently had occasion to cross over and take a car from this track. So, after sending out a flagman, they proceeded with the work. After finishing, they crossed back again, closing all switches except that from the east-bound track to the spur. The man closing the switches, in his anxiety to close the derailing switch, which was the unusual one, and was therefore uppermost in his mind, neglected to close the east-bound main track switch; the one, of all others, that should be closed. That was a bad job; but, nevertheless, it was done. The flagmen were called in just as an east-bound air-braked stock train hove in sight. The flagman signaled it ahead. The engineer answered the signal, released his air, and sped on towards the open switch that was set to lead him over the bluff to the valley below. Simultaneously, both crews discovered the open switch, but no one could reach it before the east-bound train got there. The engineer applied his emergency and got down on the step, determined to hang on until the last moment. Say, I wasn't there; but our fellows that were, told me it was the most exciting contest they ever saw. The big engine and train of stock seemed determined to go down over the bluff, and the air brakes seemed as equally determined to prevent it if possible. The fellows on the west-bound track were sick. In fact, all hands on both trains were sick, for they all knew the place. Well, the air brakes had the better of it, and stopped with the engine pilot a short distance from the derailing switch.

"Previous to this, we had trouble in getting our air-braked cars switched ahead; the transportation department thought it too expensive, and the train crews didn't think it worth while; but now all of our men, and especially these two crews, insist on placing every air-braked car ahead and using them all. For certain reasons, which you will understand, no report of this occurrence ever reached headquarters."

A good pressure-recorder card is indisputable evidence that an engineer is skilled in handling the brake, and should be accepted as a recommendation in preference to a letter which states that he has handled the air brake for twenty years or so.

Brodnax's "horse" is a good scheme, and is worthy of adoption by other instructors. A great many men can tell someone else how to remove and replace a piston, yet they are unable to perform the trick themselves. These object-lessons are particularly valuable.

The Pressure Recorder.

Probably the most interesting air brake information recently presented to those interested in air brakes and their workings is that contained in the train pipe pressure recording cards taken by M. E. McKee, of the Great Northern Railway, and Geo. R. Parker of the St. Paul & Duluth Railroad. The following extract from a paper read by Mr. Parker before the Northwest Railroad Club explains the reading of the cards and the machine for taking them.

The recorder has two movements; one is a rotary movement produced by clock-works situated behind the card and revolving it, making one revolution in 12 hours, thereby constantly presenting new surface to pen or pencil. The second movement is obtained by using a Bourdon spring tube, such as is used in steam pressure gages. It is made in the form of a semi-circle, one end being rigid, the other free to move. The tube is connected to train line, and springs by increasing or decreasing the pressure, thereby producing a movement at free end of tube. This movement is communicated to the rocker that holds pen or pencil arm, and pen or pencil records on the card the pressure in train line.

The cards also show the time of application by means of the clock movement, so that we can on the card, by the aid of time card or train sheet, select and name the station stops. It will also show if brakes have been applied between regular station stops.

The recorder is placed in the saloon of rear coach in train, making connections to train pipe by placing a tee in pipe to conductor's valve, and by means of a small hose connect tee to the nipple situated outside of the recorder box, and by closing and locking box everything inside is out of sight and out of reach, so that it cannot be tampered with.

The card has a series of circular lines equal distances apart, also a number of curvated lines extending from center to circumference. The circular lines are the pressure lines from zero to 110 pounds, the distance between the lines being equal to 10 pounds. The curvated lines are the time lines, and can be divided into as many parts as desired.

This presents a very instructing study, as the lines upon card, whether upward or downward, short or long, light or heavy, have all their own tale to tell. The tale they tell is a truthful one, and there is no room for argument, for they settle any and every question; what the train line pressure was, what the operations were in applying or releasing the brake. We can also ascertain from the card imperfections in engineer's brake valve and pump governor, such as rotary or excess pressure valves leaking, excess pressure valve gummed or fast upon its seat, feed valve piston tardy in its movements, governor not responding to an increase or decrease of pressure.

The recorder card will assist in locating when and where wheels were spotted by sliding; in fact, it was a serious repetition of slid flat wheels in a Great Northern coach, while running over a foreign line, that led to the adoption of the pressure recorder as being valuable when applied to the operation of air-brakes. The car referred to ran over a part of the Great Northern line, and at a certain point was transferred to a foreign line. On several occasions, when coach was returned, at point of transfer it was discovered, or had been reported, that wheels were spotted by sliding. Mr. J. O. Pattee, superintendent of motive power of the Great Northern Railway, resolved, if possible, to find the cause, and locate where and by whom wheels were spotted. Mr. Pattee did so by adopting and using a pressure recorder. By placing the recorder in coach, the recorder card showed the train line pressure to be from 65 to 70 pounds while coach was on home line, handled by four different engines, and 115 pounds when on foreign line. Thus the recorder card decided conclusively who had to pay for the wheels.

We will begin with No. 1, and follow the recorder line for a short distance, thereby enabling us to ascertain what the line indicates. The line begins at 1:10 P. M. at or near zero, and is maintained there until 1:50, showing clock movement while train pipe has no pressure. At this point train pipe is charged as shown by line, running from zero to maximum pressure maintained in train pipe. A reduction from pressure in train pipe, as shown by line, indicates that brakes are applied, while a return to a maximum pressure indicates that brakes have been released.

The first application of brakes on card No. 1 is the test application, the lines showing a reduction of 13 pounds. The distance between the application and release lines shows how long brakes remained applied. This distance is not exceeded by any application on the card. When making terminal tests, it is not enough to know that the brakes apply, and release, but it is also necessary to know that they hold after being applied. The length of time should be determined by what may be expected when running.

Card No. 1 was taken from Train No. 3, of July 22, 1895, having four cars in train, all quick action triple valves, E-6 brake valve and driver brakes; leaving St. Paul at 2:15 P. M., arriving in Duluth at 6:45 P. M., a distance of 152 miles. The card shows, in 4½ hours, nineteen applications of the brake, and each application shows that brake valve was handled intelligently by engineer. The only serious objection on the card being too high train line pressure.

Card No. 2 is a defect card, filled in and signed by proper authority; not from a defective equipment, but by and from a defective operator. The appearance would indicate that brakes may have been operated with an angle-cock instead of an E-6 brake valve. I will read a portion of the defect card: One hundred pounds main reservoir pressure, excessive reductions when applying brakes, brake valve handle on release position long enough to charge train pipe to main reservoir pressure—this pressure holding feed valve upon its seat by moving handle to running position, thus recharging auxiliary reservoirs from a charged train pipe when it should be from main reservoir through brake valve, by feed valve being held open by diaphragm movement produced by tension of feed valve spring, thus enabling feed valve to measure and supply all demands. When feed valve was permitted to do its work, it was done properly, as shown by the lines in several places where train line pressure is recorded, for when brake valve handle was allowed to remain on running position for some time, the pressure in train line was maintained without any irregularities.

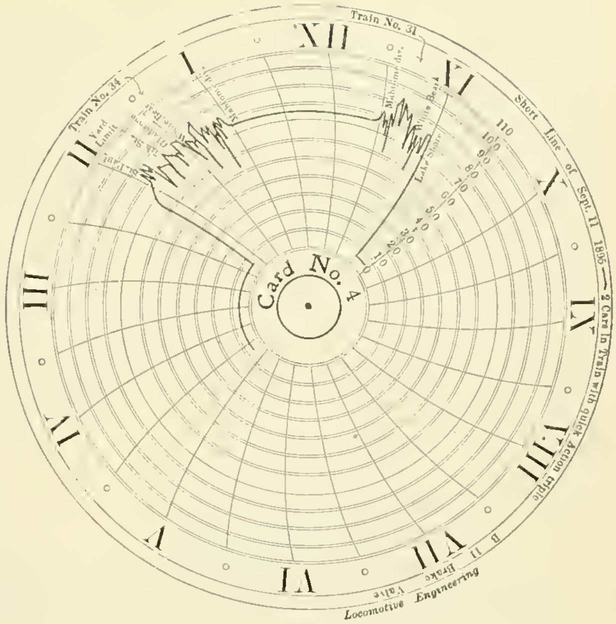
Before card was taken, engineer complained that brakes were sticking, and he could not make time; the card corroborates the complaint, and shows that the complainer is responsible for it, as the card shows reductions from excessive train line pressure. Sometimes the reduction, as shown by line, is rapid because the pressure is flowing into auxiliary reservoirs, and after reservoirs are charged the reduction is much slower, which is due to leakage, as shown by curve. We would not be surprised if brakes did creep on.

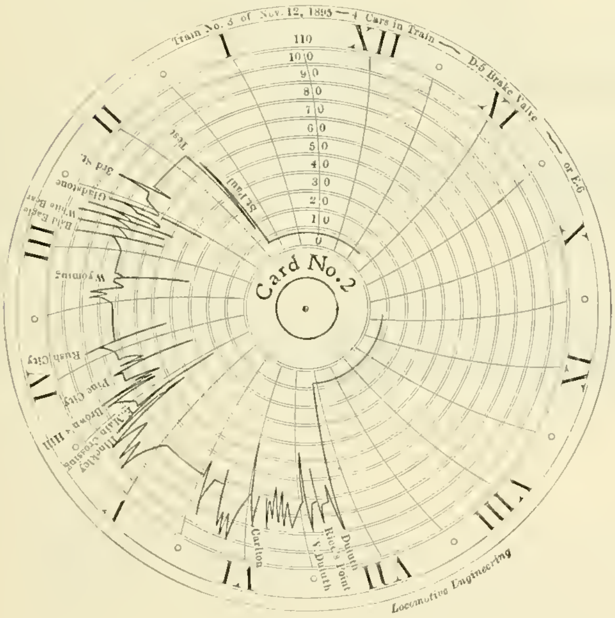
Cards Nos. 3 and 4 were taken from a train on short runs, frequent stops, platforms short, two cars in train, quick action triples, no driver brakes, and B-11 brake valve—an undesirable combination. Cards 3 and 4 show very irregular operations. The engineer seemed to have no special place at any time for brake valve handle; he may have left it on release or on running positions, as his fancy dictated, and excess pressure valve may not have been free to operate.

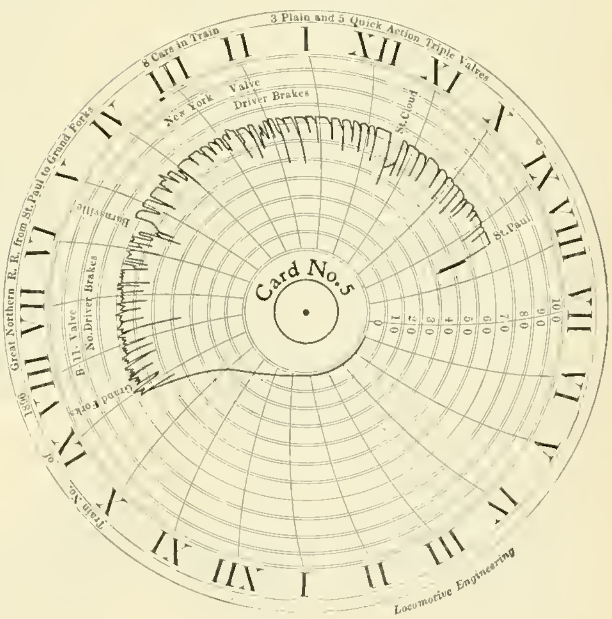
One thing is worthy of notice on a part of this run, covering a distance of one and one-half miles, inside yard limits, on grade that averaged 68 feet per mile, and railroad crossing at bottom of grade. Card No. 3 shows brakes were applied three times in rapid succession. A reduction of 15 pounds was made for first application, then brakes were released. Another reduction of 29 pounds was made for second application, then released. For the last application a reduction of 49 pounds was made. Crossing is reached, and with the aid of reverse lever train is stopped.

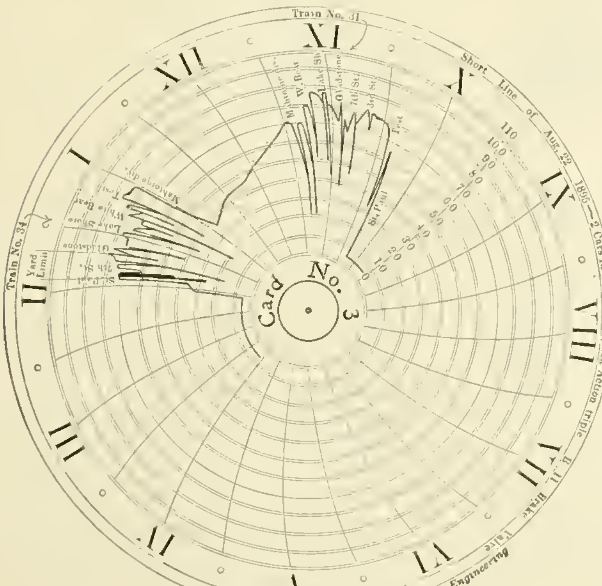
Card No. 3 is before school time, while card No. 4 is two weeks after, showing considerable improvement, especially at place previously mentioned. All conditions being the same, an 8-pound reduction, instead of 15, is made, and brakes

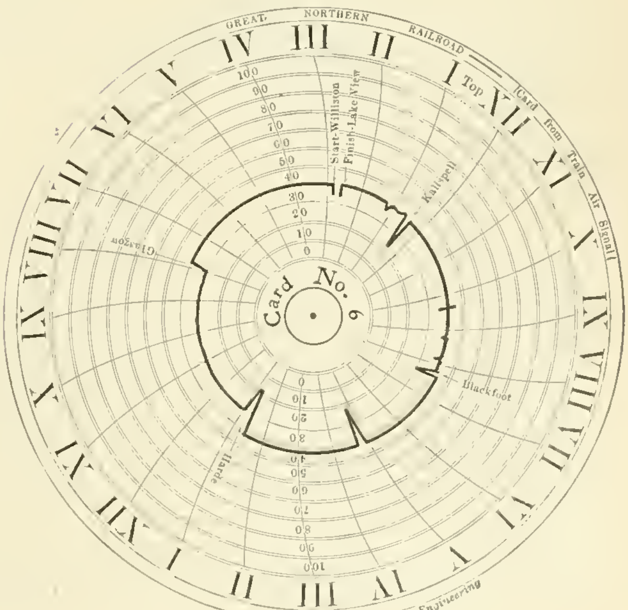

Train No. 3 of July 22, 1895—4 Cars in Train—D-5 Brake Valve—or E-6
Card No. 1
St. Paul
Test
3rd St.
Gladstone
White Bear
Wyoming
Rush City
Pine City
Mission Creek
Hinckley
Main Crossing
West Duluth
Rice's Point
Duluth
Locomotive Engineering


Train No. 31
Train No. 34
Short Line of Sept. 11 1895—2 Cars in Train with quick Action triple
B 11 Brake Valve
Card No. 4
Yard Limit
St. Paul
Lake Shore
Locomotive Engineering


Train No. 3 of Nov. 12, 1895—4 Cars in Train—D-5 Brake Valve—or E-6
Card No. 2
St. Paul
Test
3rd St.
Gladstone
White Bear
Bald Eagle
Wyoming
Rush City
Pine City
Brown's Hill
Main Crossing
Hinckley
Carlton
W. Duluth
Rice's Point
Duluth
Locomotive Engineering


Great Northern R. R. from St. Paul to Grand Forks
8 Cars in Train
3 Plain and 5 Quick Action Triple Valves
New York Valve
Driver Brakes
No. Driver Brakes
B. 11. Valve
Card No. 5
St. Cloud
St. Paul
Barnesville
Grand Forks
Locomotive Engineering


Train No. 31
Train No. 34
Short Line of Aug. 22 1895—2 Cars in Train with quick Action triple
B 11 Brake Valve
Card No. 3
Yard Limit
St. Paul
Gladstone
White Bear
Lake Shore
Mahtomedi
Test
Locomotive Engineering


GREAT NORTHERN RAILROAD
Top Card from Train Air Signal
Card No. 6
Start-Williston
Finish-Lake View
Kalispell
Glasgow
Blackfoot
Havre
Locomotive Engineering

are held on with sufficient force to check speed of train on grade, also steadying train on curves, some of them reverse curves. Therefore, it is entirely unnecessary to release brakes, but, instead, a further reduction of 6 pounds is made, thus adding to the force already applied, this force being sufficient to stop train at crossing without using reverse lever. Is there anyone who will say that an air-brake school and a little schooling is a failure?

Card No. 5 is from the Great Northern Railway. These cards move much slower, revolving once in 24 hours. This accounts for the recorded lines being much nearer each other, showing the desirability of having a more rapidly moving card.

No. 5 was taken from an eight-car train running over two divisions, from St. Paul to Grand Forks. Cars were equipped with three plain triple valves and five quick action; piston travel was adjusted before leaving St. Paul.

Over the first division, from St. Paul to Barnesville, a New York brake valve was used, and from Barnesville to Grand Forks a Westinghouse B-11.

The record is a good one. If all records taken were like this one, there would not be much to justify us in using the pressure recorder. When the B-11 brake valve was used, the record upon card indicates that governor was not responding as it should, or excess pressure valve was gummy.

Card No. 6 is taken from train air signal. It shows three things: where and when whistle was sounded, the different pressures maintained by reducing valves on different engines, and also the condition of reducing valves by recording a wavy line.

When we began to use the recorder we found it necessary to make it clear to engineers that we were not after them, but after their lack of knowledge on air-brake matters, and that the recorder was merely a means to an end in instructing them generally on any errors that the cards may show. When this is understood, engineers usually take kindly to it, and even invite its use, so that instructing engineers from their recorded errors and failures becomes a pleasant instead of an unpleasant duty.

An Up-to-Date Air-Brake Instruction Book.

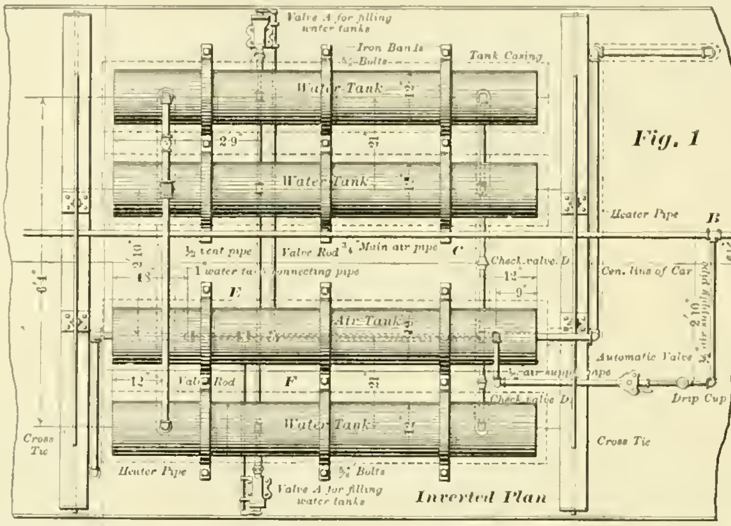
The report of the proceedings of the third annual convention of the Air-Brake Men's Association, now in the "Locomotive Engineering" press, will be a 6 x 9-inch book of 250 pages, and will contain more solid air-brake information to the square inch than any air-brake book ever published.

Send to Secretary P. M. Kilroy, Pine Bluff, Ark., for a copy at the following rates: Paper binding, 50 cents; flexible leather, 75 cents, and seal binding, $1.

The Water Raising System on Sleeping Cars.

The following report was read before the Air-Brake Men's Convention in Boston, and is the only treatise published on this interesting and important subject:

Many an air-brake man seeking an acquaintance with the water-raising system on the modern sleeping car has been repelled in his efforts by being confronted with a confusing mass of pipes radiating in all directions, and which, if followed up, would be found to abruptly end at some impenetrable point; thus bringing



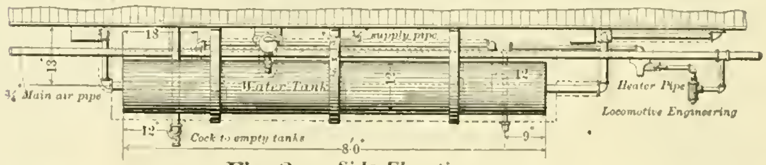


Fig. 2 *Side Elevation*

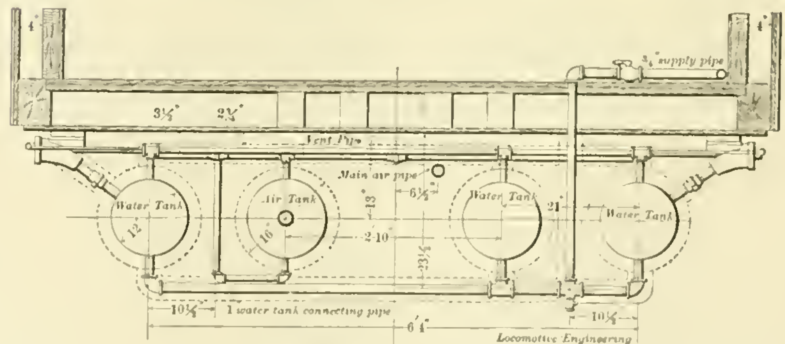


Fig. 3

to a close an unfruitful investigation. It is hoped, however, that the following report of the committee will supply the information denied the investigator under the sleeping car. It is also hoped that many former mysterious actions of the air brake will be cleared up by a thorough understanding of the water-raising system, and that the offender will be brought to justice.

As a rule, the special appliances that operate by compressed air draw their supply of pressure from the main reservoir, and are confined to the locomotive. The system employed on sleeping cars for forcing water by compressed air, however, must necessarily draw its supply of pressure from either the auxiliary reservoir or the train pipe, even though it is known that the sensitiveness of the triple valve, and the effect produced upon the brakes by any variation of these pressures, render the latter dangerous ground to trespass upon.

Although the water-raising system is only an alien and a parasite, the fact that it is frequently responsible for certain erratic and apparently mysterious actions of the brakes demands that it should be as thoroughly understood by air-brake men as though it were a component part of the air-brake system.

A design which causes pressure to be taken from the air-brake system at an inopportune time, or one that, through slip-shod methods of maintenance will permit air pressure to return and will allow water to leak into the brake system, is a serious menace to safety. The designer of such a system, and he who employs an inefficient system of inspection and maintenance, are equally responsible with the careless architect who erects a massive superstructure on an insecure foundation. The tenable objections raised by responsible air-brake men, however, are not so much against the design as they are against the negligent methods employed for inspecting and maintaining these devices. The development of the system designed to force water from the tanks underneath the car to the basins at the same time the auxiliary reservoirs of the brake system received their supply; the engineer, in the meantime, no doubt wondering where all of his pressure was going. Possibly, at the end of the trip he reported, on the roundhouse repair book, the familiar phrase: "Pump won't make air."

Check valves D and the automatic valve (illustrated in Fig. 7) were designed to prevent the return of pressure from the air and water tanks to the train pipe at B; but experience proved they were inefficient under unfavorable conditions, such as dirt collecting on their seats, and, in consequence, the brakes were released by the air-tank pressure leaking back through the valves, and increasing the train-line pressure after the brakes had been set. This trouble first manifested itself on mountain grades where it was necessary to hold on brakes for long distances. Complaints came from the engineer that some certain opposing influence was working against him which would mysteriously release his brakes shortly after he applied them. Water also leaked back into the air-brake system, frequently freezing up the triples and partially or wholly obstructing the passage of air in the train pipe.

The system was used for some time before its evil influence upon the air brake was finally traced to its true source; and the trouble had from the start was classed with those other apparently mysterious actions of the brake then common because of the limited acquaintance many

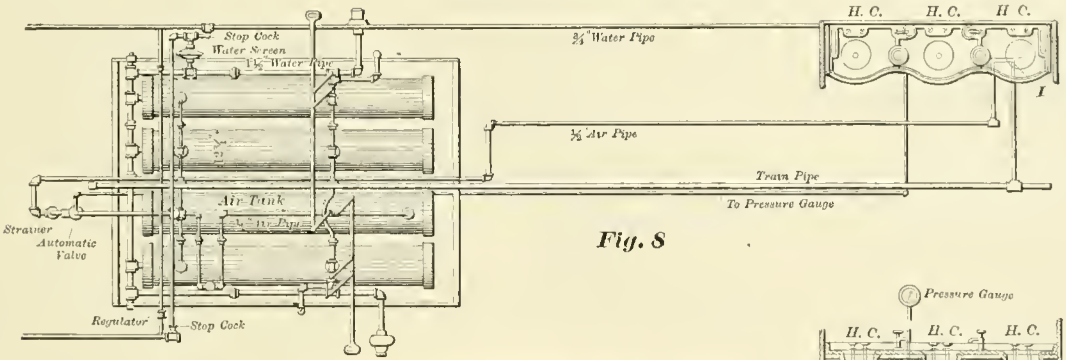


Fig. 8

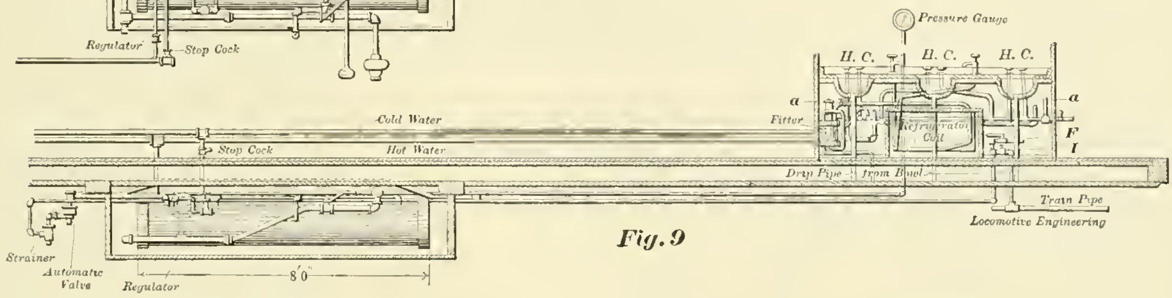


Fig. 9

above has brought out designs which, with a reasonable amount of attention, will cause little if any trouble from the source mentioned; but which will, with the present inefficient system of inspection and maintenance, prove as disastrous as the crudest early designs.

Instead of following up the development of the water-raising system through its numerous minor changes, and dragging through a mass of unimportant matter, it is believed advantageous to combine and treat it under the four separate heads, as follows:

FIRST METHOD.

The simple hand-pump was abandoned in favor of this method, which was more in keeping with the other luxurious effects of the modern sleeping car. The first method is shown in cuts 1, 2 and 3. As will be seen by reference to Figs. 1 and 3 the pressure was taken direct from the train pipe at B, and passed through the supply pipe, drip cup and automatic valve to the air tank, entering at under side and passing out through connecting pipe C and check valve D to the upper side of the water tanks. Thus, an air pressure was had on top of the water in the tanks, which forced the water out at the bottom through the water-tank connecting pipe to the supply up inside of the car, as per Fig. 3.

To refill the water tanks, valves E and F were closed, thus holding the air-tank pressure confined. Cap was then removed from the filling valve A, allowing the air pressure in the water tanks to escape to the atmosphere and prepare the water tanks to receive their supply.

The air and water tanks, which had capacities about equal to an ordinary main reservoir, were served with pressure

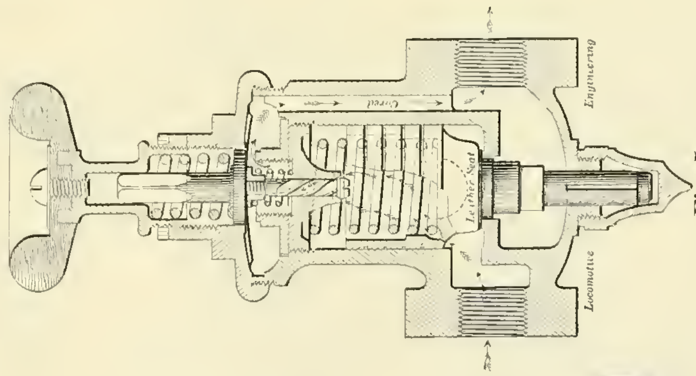


Fig. 5

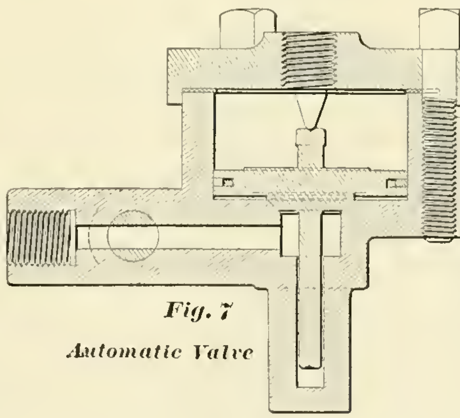


Fig. 7
Automatic Valve

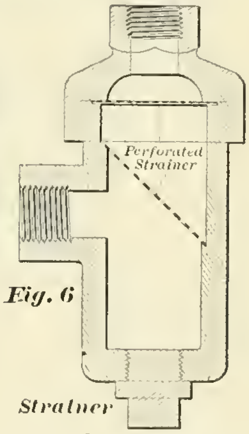


Fig. 6
Strainer

air-brake men and others had with the water-raising system, and was accepted by the uninitiated in a matter-of-fact way. The gravity of the situation was truly alarming.

SECOND METHOD.

This system is shown by Figs. 8 and 9, and is somewhat similar to the first one; yet considerably different from it. Pressure is still taken from the train pipe, but it is done in a little different manner; and, according to instructions, by opening the shut-off cock *I* only at such times that the train may be stopping for several minutes at a station. One forward step, however, is made in the recognition of the fact that pressure must not be taken from the air-brake system at any and at all times.

Several cocks are located in the proper pipes and connected to the tank lever, so that when the latter is pulled out to refill the water tanks, communication between the air tanks and water tanks, and water tanks and distributing pipes, will be closed; and the supply pipe to the water tanks, and water tanks through the vent pipe to the atmosphere, will be open. When the lever is pushed in, the combination will be reversed. A regulator is interposed in a pipe between the air tank and water tank to reduce the force of the water delivered at the basins inside of the car, and thus prevent splashing of the water when the faucets are opened.

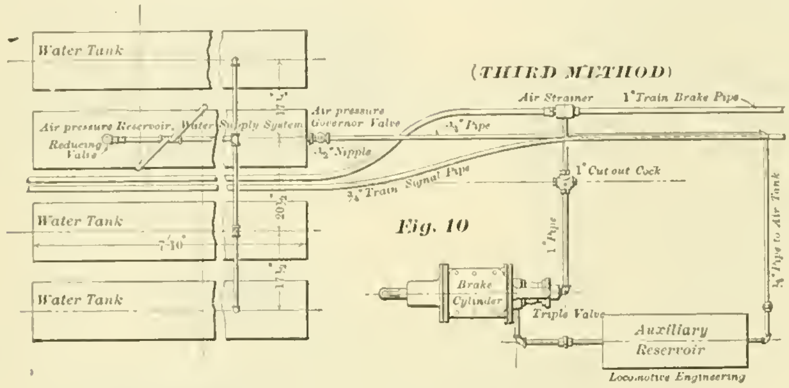
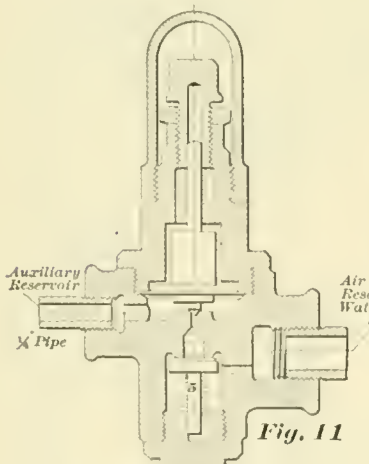
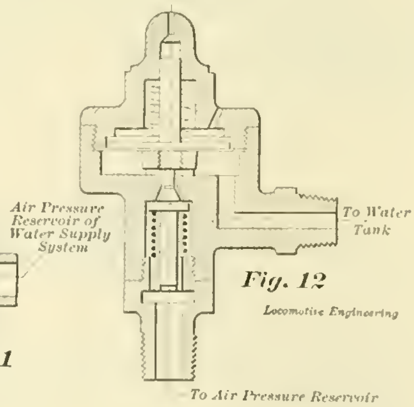


Fig. 10



Air Pressure Governor Valve, for Water Supply System



Reducing Valve

Fig. 5 shows this valve in section. Figs. 6 and 7 show drip cup or strainer and automatic valve in section. *F* in Fig. 9 is a stop cock to which the hand pump may be attached when the pressure from the train pipe is not obtainable. *I* in Fig. 9 is the shut-off cock between the train pipe and water-raising system that must be kept closed while the train is running, and can be opened to replenish the air tank when the train is standing still.

If the instructions which required that the shut-off cock *I* should not be opened while the train was in motion had been strictly adhered to, this system would have been fairly satisfactory. The shut-off cock *I* was too easy of access, however, and the hand-pumping process too tedious to permit of this rule being obeyed; and when pressure was low in the water system, either from leakage in the pipes, neglect to charge at the proper time, or unusual amount of water used, the conductor and porter would frequently resort to shut-off cock *I*, regardless of the order issued and the effect had upon the brakes. Many engineers will, doubtless, recollect instances when their train was mysteriously brought to a standstill which investigation failed to provide a reason for, but which could have been traced to stop cock *I* had the sleeping car employés been honest. Sometimes the thieves were sufficiently skilful to make the steal without being detected; while others opened the cock suddenly, not knowing what the result would be, and thereby made an emergency application of the brakes.

The regulator was erratic in its action, and would frequently close of its own accord, shutting off the air pressure necessary to raise the water to the basins. Stopcock *I* was frequently found partially, and in most instances, wide open; and if the non-return automatic valve failed to seat properly, which was frequently the case, this system reverted to a parity with the First Method, with all of its attendant shortcomings.

THIRD METHOD.

Fig. 10 is a general outline sketch of a radical change in the method employed to obtain the air pressure for the water-raising system, and shows, on its face, a recognition of the shortcomings of the train-pipe source of supply.

The pressure in this system is taken from the auxiliary reservoir, passes through the air-pressure governor valve (shown in section, Fig. 11) to the air tank, thence through the reducing valve (shown in section, Fig. 12) to the water tanks. The air-pressure governor valve is adjusted at 60 pounds, and will not permit the diaphragm valve to unseat until that amount has first been accumulated in the auxiliary reservoir, thus depriving the water system of pressure until a sufficient charge has been accumulated with which to test brakes. The reducing valve replaces the regulator *R* in the second system, and is adjusted to permit but 20 pounds pressure in the water tanks. The feed port in the triple valve restricts the passage of air from the train pipe to the water-raising system, and the air-pressure governor valve prohibits pressure from passing to the air tanks until a sufficient amount to test brakes and operate them under ordinary conditions has been accumulated in the auxiliary reservoir. The connections to lever *L* and the other parts of the water system remain the same as in the Second Method.

This is a good design, and while not entirely free from objections, its superiority over the preceding forms will be recognized. With the air-pressure governor valve and the reducing valve in good condition, but one objection can be raised against it, viz.: With the auxiliary reservoir charged to 65 or 70 pounds, and a light reduction in train-pipe pressure be made to apply the brakes before the air tank has fed up to about 60 pounds, the feed from the auxiliary reservoir into the air tank will continue, and thereby "bleed off" that brake. With the present inefficient system of inspection and maintenance of the water system, however, this design is capable of committing more costly and serious depredations than the former methods. Should the non-return check valve in the air-pressure governor valve (No. 5 in Fig. 11) seat improperly, the air tank will have a direct communication with the auxiliary reservoir, and by adding its volume to that of the latter, will cause skidded wheels.

In one of the largest terminal passenger yards in the country, a prominent inspector informs the committee that in nearly every instance where wheels are removed from sleeping cars on account of being skidded, he almost invariably finds the valve 5 seating improperly, and that he remedies the trouble by a few minutes' work. Private car lines and railroad companies might bear this in mind when settling claims. Water will also leak into the auxiliary reservoir, with the usual consequences, if the valve 5 seats poorly.

FOURTH METHOD.

Thus far, no material changes have been made in the water-supply system—all changes having been confined to the air-pressure system.

The air-pressure governor valve and the reducing valve are the same in this system as in the preceding one; but in Fig. 13, which shows the single-tank system, a very considerable change in the water-supply system is made. Economy in space, on account of gas tanks and other modern appliances being added under the cars, has made it necessary to combine into one the volume of the three former tanks used, and to place it tandem with the air tank. The tank lever and its attachments are abandoned, and a combination cock, with two separate passages through its key and six connections leading from its body, is used in its place. A shaft and bevel gear are used to rotate the key. When the cock is in normal position, pressure enters from the air-tank pipe *C*, passes out at *D*, and is delivered to the water tank at *E*. Air-pressure openings at *F* and *G*, and water openings at *A* and *B*, are closed.

To refill the water tank, a wrench is is placed on shaft *X*, and through the medium of the bevel gear the key of the combination cock is made to rotate a quarter turn, which breaks the described combination, and communication between the filling pipe *A* and water-tank pipe *B* is made through the upper passage of the key. The air passage through the lower part of the key between pipes *C* and *D* is closed, and pressure is vented from the water tank to the atmosphere through pipes *F* and *G*.

The design of the combination cock is mechanically weak, and wear will allow the water and air pressure to mingle; but so long as valve 5 seats properly, the trouble thereby caused will be confined to leakage, which, of course, must be supplied by a tax on the air pump of the locomotive. If valve 5 does not seat tightly, the leakage in the combination cock will undoubtedly result in large quantities of water going to the auxiliary reservoir, as experience has proven.

CONCLUSION.

A device has not achieved success when it merely accomplishes the purpose for which it was designed; its functions must be performed without hampering or perverting the service of other associated devices. The water-raising system, therefore, cannot be called a success until a system of inspection and maintenance shall have been established whereby water and back pressure will be prohibited from leaking into the air-brake system.

The present system of inspection and maintenance, if any system can be said to truly exist, is sadly inefficient. Observations have failed to bring to light any instance where systematic attention is paid to the pressure valves of the water-raising system from the time the car leaves the shop until it returns. It is also a noticeable fact that the employés, to whom is intrusted the maintenance of the water system, have an inferior knowledge of the air-pressure part of it. The air-pressure governor valve and the reducing valve are frequently hidden in some almost inaccessible place. One inspector reports having been obliged to saw a hole in the wooden casing of the air tank in order to reach the valves; and that on several occasions he found the mechanism of the reducing valve so badly corroded that it crumbled to pieces in his hand.

It is important that the reducing valve be kept in operative condition; it should be adjusted and kept at 20 pounds, which is sufficient pressure to raise water from the tanks to the basins. However, it is frequently inoperative, and, in consequence, permits full air-tank pressure to be carried on the water tanks. This is so common that smart passengers have learned to stand off from the basin while opening the faucet, in order to avoid being splashed. Besides causing the splashing, which is an annoyance to passengers, the high pressure on the water tanks is an extravagance which must be met by an extra tax on the air pumps. The following graphic illustration shows that about three times as much work is required by the air pump to supply pressure to the water-raising system at 70 pounds as at 20 pounds. A passenger arising from his berth in a sleeping car in the morning, will use about a gallon and a half of water in washing. To fill the space vacated by the water with air pressure at 20 pounds will require 817 cubic inches of air at atmospheric pressure, and 2.6 strokes of an 8-inch pump must be made to compress it. At 70 pounds, almost 2,000 cubic inches of free air will be required, and 6.4 strokes must be made to compress it.

A duplex gage should be located in the wash-room of each car, and the red hand connected to the air-tank pressure and the black hand to the water-tank pressure. Some railroads have required a single gage to be placed in the car; but unless attached to the water-tank pressure, it is of no practical use whatever. The duplex gage, showing both air-tank and water-tank pressures, has certain decided advantages readily recognized.

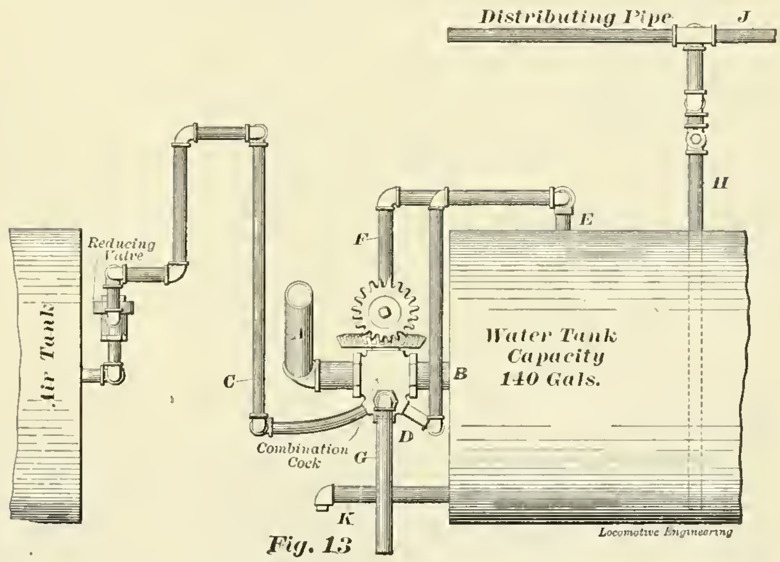


Fig. 13

TESTING.

To test the reducing valve, charge air tank and water tanks, and note the pressure shown on the black hand of the gage in the smoking-room. This gage should not show more than 20 pounds pressure.

To test the air-pressure governor valve, charge the air tank and water tanks. The black hand on gage in the wash-room should show 20 pounds, and the red hand should show 70 pounds. Close the angle cocks on both ends of car, separate the hose, and drain all air pressure from the auxiliary reservoir and train pipe at the release valve in the auxiliary; then close the release valve for a few minutes, after which open it again. If no pressure has collected, the non-return check valve 5 is tight. A gage screwed into the auxiliary reservoir will tell at what pressure the air-pressure governor valve is adjusted.

TROUBLES, THEIR SYMPTOMS AND CURES.

Should air pressure escape, but no water be obtained when the faucet is opened, water tanks are empty. Refilling will correct.

Should no air pressure and no water escape when faucet is open, first examine the cut-out cocks in the water system, then examine the air-pressure governor valve and reducing valve, and the water strainer. Be sure all cocks are open.

When a weak flow of water is had, examine the pressure-reducing valve first: then other points as per the preceding paragraph.

A strong flow at the basins, causing splashing, is caused by too high pressure on the water tanks. Examine reducing valve; it probably needs adjustment or cleaning.

RECOMMENDATIONS.

In conclusion, your committee would make the following recommendations:

First—That all water-raising systems using the First and Second Methods be changed to the Third Method.

Second—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.

Third—That the reducing valve be regulated to permit but 20 pounds of air pressure on the water tanks.

Fourth—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 stenciled on the door of the box containing them.

Fifth—That the air tank be drained by removing the drain plug each trip.

Sixth—That especial attention be given to the proper seating of non-return check valve 5.

Seventh—That the combination cock be kept ground in, and the water valves and pipes be kept tight.

Eighth—That a card of instructions be issued for the information and government of employés whose duty it is to care for the system.

Ninth—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.

Air-Brake Slack Adjusters.

The fact that the new Black Diamond Express, recently put in service on the Lehigh Valley road, are equipped with McKee slack adjusters, seems to indicate that the experimental stage of the adjuster is passing, and that the service trials to which it has been subjected during the past three or four years are sufficiently satisfactory to warrant the adjuster becoming a full-fledged article of commerce.

There is no doubt in the minds of persons familiar with the details of air-brake service that a good slack adjuster will add greatly to the efficiency of the air brake, more particularly so on cars that have long runs and touch infrequently at home points. There are some skeptics, however, who believe that the old method of taking up slack by hand is "good enough," and that automatic slack adjusters are mere vanities or luxuries; but there is a surprise in store for these people, which they will see if they take the trouble to figure out the difference in brake power delivered to the wheels at minimum and maximum piston travels. In these days of high speeds and fast trains there is no time to take up slack by hand, and there should be no minimum and maximum piston travel—it should be constant at its highest efficiency.

Mr. S. D. Hutchins, the popular president of the Air-Brake Men's Association, and engineer of the Big Four's "Southwest Limited," has accepted the position of assistant instructor in the Westinghouse Air Brake Company's Instruction Car, to succeed Mr. Robert Burgess, who has been promoted to supervision of the company's interests in the Southern district, with headquarters at Atlanta, Ga. The Westinghouse Air Brake Company gets a good man, and the Air-Brake Association loses one of the best presiding officers that ever wielded a gavel. The "Judge" must take his place among ordinary men in future conventions, as the Air-Brake Men's constitution requires that, to be eligible to hold office, a man must be in the employ of a railroad company. The president's mantle will fall on the shoulders of First Vice-President M. E. McKee, of the Great Northern Rail-Way, St. Paul, Minn.

All air-brake men should post up on the water-raising system in sleeping cars; for while it is not a part of the air-brake system, it takes its pressure from the air brake, and has an influence and effect upon the working of the brakes that all air-brake men should understand. An extract, which explains this system, is made from the Air-Brake Men's proceedings, and appears elsewhere in this department.

A pressure recorder placed on the signal line, and having a card that would revolve once over a division, would show up the careless work of those conductors that make a practice of hanging onto the cord when giving a signal. The rule of some is "the madder you get the harder and longer you pull." Such conductors would take a worse card than No. 3.

POINTERS.

Wahlert's rule will be welcomed by those who have mastered plain leverage, but who have struck a snag in figuring cam-brake leverage.

The St. Paul & Duluth Railroad should have faultless air-brake service from the combined use of their cylinder-pressure indicator cards and the train-pipe pressure recorder.

Robert Burgess, chairman of the Air Brake Men's Committee on Progressive Form of Questions and Answers, carried off the palm for hard work performed. He deserves unusual credit.

The air brake has probably been the saving grace in many instances that cannot be made public. Many railroad men could tell equally good stories of "living pictures" were they so inclined.

The pressure recorder not only gives testimony as to how the air brakes are handled, but will also tell the time consumed at stations. It will deal a death blow to "conversation" and "visit" stops.

The cam is guilty of many intrigues with inexperienced workmen. It is ofttimes used when it is the proper length over all, regardless of the radius of its face, which is the all-important consideration.

All letters and articles should be accompanied by the writer's full name and address, in order that additional data, which is frequently needed before a reply can be made, may be obtained without delay.

Knowledge is gained by application. Let each man having an engine equipped with a cam brake apply Wahlert's rule, and thereby learn just what it is doing. Some startling disclosures will no doubt be made.

No engine builder would attempt to sell an engine to-day without first showing indicator cards taken from it to prove how efficient it is. A good pressure-recorder card is undisputable evidence of an engineer's skill.

While some men would be surprised at the poor pressure-recorder card taken from their trains, there are others who would really be surprised at the good work they were doing, and don't know it. Which class are you in?

Look out for the report of the proceedings of the Air-Brake Men's Boston Convention. It is an up-to-date instruction book, and is being gotten out by "Locomotive Engineering" in its customary tasty and attractive manner.

The Westinghouse Air-Brake Company evidently believes the Air-Brake

Association is the proper place to find good air-brake men. Both Robert Burgess and S. D. Hutchins were presidents of that organization at the time they accepted Westinghouse employ.

We would advise air-brake men not to rush hurriedly over the indicator cards of piston travel and brake-cylinder pressures published in last month's issue. They are not pictures; they are graphics, containing a solid column of printed matter each, and must be given careful study in order that their full contents may become known. For these cards we are indebted to F. B. Farmer, chairman of the Air-Brake Men's Committee on Piston Travel.

The introduction of their cylinder-pressure indicator cards and train-pipe pressure recording cards would seem to signify that the Westerners have yet considerable undeveloped air-brake resources, and that they are determined to retain their acknowledged supremacy in air-brake practice; but, judging from the active interest now being taken in air-brake matters by some certain Eastern railroad officials, the Westerners will have to hustle to retain their reputation.

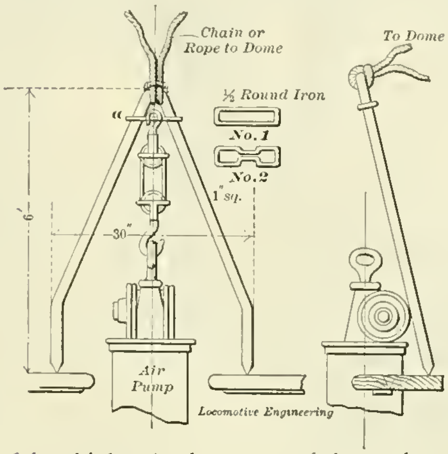
The engines of the crack ocean liner "Campania" to-day develops 30,000 horsepower on the same amount of fuel required by the engines of the Great Eastern forty years ago to develop 8,000 horse-power. This improvement is due to the use of the indicator, which has pointed out the faults and directed betterments. While the air-brake service on many roads is quite creditable, and we cannot therefore reasonably expect such enormous improvement as that above cited, yet there remains on some roads much to be done to bring the air-brake service up to its highest efficiency; and there would seem no more efficient and satisfactory manner to do this than by the use of a train-pipe pressure recorder.

CORRESPONDENCE.

A Device for Hoisting Air Pumps.

Editors:

In answer to your request in the February number of "Locomotive Engineering," requesting a simple way to lift an air pump, I inclose a sketch of a frame for the purpose. It is of 1-inch square iron,



6 feet high. At the vertex of the angle a piece of round iron is shaped as Fig. 1, and put on the frame and bent as Fig. 2. It is a cheap concern, and little trouble to make. An eye-bolt is made with threads turned the same as reversing valve cap.

LEROY M. CARLTON.
Air-Brake Inspector.

Eagle Grove, Ia.

Southern Railway Air-Brake Instruction Car No. 108.

Air-Brake Instruction Car No. 108, of the Southern Railway, was built at the Manchester shops, Va., in the early part of 1895, under the direction of the writer, who is now in charge of the same.

One of the first things to be noted on entering the car is the steel boiler, 32 inches outside diameter, with seventy-eight 2-inch tubes. This boiler has a record of steam in nine minutes from cold water. It has a drop grate, and, with swinging trap in ash pan, allows ashes to be discharged at once, through a chute in the floor, to the outside. Water for supplying the boiler is carried in two tanks arranged longitudinally on either side of the car, between the tie timbers, as shown in photograph. The boiler is fed by a 2 x 1⅛ x 2¾-inch duplex Worthington pump. Where air can be gotten from yard plant conveniently it can be attached to steam chest of pump; and when boiler is washed out, it can be easily filled by running pump with air pressure. This is found to be very convenient.

Next is an 8-inch pump for supplying air pressure; and next after this is the main reservoir, to which an E-6 brake valve is attached. The train pipe leading from the same, in crossing to the opposite side of the car, passes underneath the floor—the driver, tender and passenger-car brakes, in regular order, being attached to the same. This pipe continues 50 feet beyond the passenger brake, in order that the full effect of quick action may be shown. Directly under the passenger brake is a branch that passes through the floor, and is the beginning of the pipe for a 16-car freight train. The stop cocks are so arranged that either a 16-car freight or a 1-car passenger train may be put into operation. The same driver and tender brake are used for both trains. The freight train consists of sixteen freight brakes, eight of which are located on either side of the car, against the wall, leaving one wide aisle down through the middle of the car.

The arrangement of piping under the car, for the 16-car freight train, is one of the cleverest pieces of mechanism about the car. There are no short return bends used. On one end the return is made with a half circle of 14½-inch radius, while the other end is made with a quarter bend of the same radius and an L. By this arrangement the frictional resistance is materially reduced. Each car has its full length of pipe, hose, strainers, stop

THE OFFICE.

INSTRUCTION ROOM.

cocks, etc., being the same as in regular service. The arrangement of piping in the clear story, for signals for an 8-car passenger train, is worthy of special notice. Like the piping for the 16-car freight train, this has no short return bend, but one half circle for both ends—one 4½-inch and the other 5¾-inch radius.

The car has a seating capacity of thirty-six men, this number of camp-stools being carried. The sections of the parts of the brake and signal apparatus being brought before the class in regular routine, are placed upon the table shown in the end of the car. Even the old three-way cock has its place among the other sections, as our idea is that it is easiest to master the brake by carrying it through the different stages of evolution. After the lecture is over, the men are divided into classes of six and carried into the office for examination. The office has an upper and lower berth, not shown in the photograph, and is altogether quite tastily fitted up. Oak graining, cherry molding, brass fittings, etc., make it quite cosy and inhabitable.

We are paying close attention to the care of passenger and freight brakes, and believe that one of the most important factors is the proper education of the men put in charge of same. For this reason I have rigged up what is known as the "horse." On the afternoon on which it is known that the "horse" is going to be brought out, quite a number may be found in the car who are not repairmen. The "horse" is no other than a freight cylinder, auxiliary reservoir and triple valve mounted on a trestle, which, when not in use, is taken apart and put in the locker under the work bench, and when wanted, is brought out and put together by two repairmen who are chosen from the class for that purpose, while two others put together the frame with four legs and two cross-bars, to which this cylinder and auxiliary are swung. This frame is made rigid by cross-bracing on the two sides and ends, and, when in position, the center of the cylinder stands about the same distance from the floor as the standard cylinder from the track. The first thing done is to remove cylinder and clean same. Each man is fully drilled in this. Then by a section of hose the apparatus is supplied with air; and the same being operated by the engineer's valve, then one by one the defective parts are substituted and the effect noted closely. The men being fully instructed beforehand by section—and these same defects having been explained to them—the object-lesson is very impressive.

W. F. Brodnax,
Gen. A. B. Insp. & Inst., Southern Ry.
Richmond, Va.

INSTRUCTION ROOM.

Expensive Air-Brake Men.

Editors:

That excellent paper, "Qualifications of a Superintendent of Air Brakes," read by Mr. F. B. Farmer before the Northwest Railroad Club, points out some valuable lessons.

From among other valuable things set forth by Mr. Farmer, I would like to quote the following: "Improperly made repairs, new material used when old is yet serviceable, and old retained when worn out," etc. "An inexperienced air-brake machinist will prove to be an expensive man to any railway company. Air-brake repairs, when made by an inexperienced machinist, are costly and soon run up into dollars."

Personal experience and observation have proven to my satisfaction that air-brake work on running repairs, made by a man not thoroughly posted on the air-brake system, is unsatisfactory and particularly expensive. Such a machinist will not understand the numerous insufficient reports made out by some engineers, and instead of locating the trouble readily, as an experienced man would do, he makes the repairs by using a lot of new material from the store-room without ever knowing the true cause of the trouble. All his work will be done in a like manner, or after useless and costly experimenting. Much good material is thus displaced and thrown away. Who can deny that this man will be an expensive luxury?

A supposed leaky rotary in a D-5 brake valve, faced off in a true lathe and carefully scraped and seated, was reported still leaking. The real cause of the trouble was that the brake valve had been located too close to the boiler, and the lower gasket 61 had burned out, allowing pressure from the main reservoir to pass to top of piston 47, and then to the train-pipe. Another rotary that did leak was held to its seat by several washers. The leak was still there. Still another rotary was held to its seat by copper strips fitted in the keyway, clamping it to its seat—"didn't work just right."

Two particular D-8 valves gave trouble from brakes releasing slowly. Examination showed that some random experimenting had been done, as the excess pressure valve in one had been put in wrong end foremost, and was badly gummed up. The excess valve in the other had notches filed in its seat so the air could pass by, thus destroying the excess pressure feature.

The cases above cited actually occurred, and would seem sufficient to demonstrate that inexperienced men on air-brake work are expensive. Mr. Farmer is certainly familiar with the subject on which he so ably wrote.

Ralph E. State.
Big Four Railway.
Bellefontaine, O.

Proposed Plan to Insure Quick Action on Double-Head Trains.

Editors:

Much has been written on the subject of failure to obtain emergency action of the brakes from the forward engine on trains hauled by double-headers, and I believe the general supposition is that the trouble lay in the elbows of train pipe. However, I am prepared to set that theory aside, and can prove by actual test where the trouble lies and also furnish the remedy. The cause of the non-emergency action of brakes on double-headers is due to the dead end of train pipe which runs forward to pilot; and in appyling the emergency, the air in the dead end of pipe expanding against the air coming from train pipe to cars, momentarily restricts its flow toward engineer's brake valve, thus destroying the quick action of triples.

In piping engines (no matter on which side you run the train pipe), place the branch to driver-brake triple as far back toward engineer's brake valve as possible, and instead of putting stop cock at pilot as usual, place it just in front of branch to driver-brake triple; thus you still have your pipe to pilot, but you only charge it as far as driver brake. In this way you do away with almost all of the dead end of pipe, and in addition to obtaining the emergency function of the brake from forward engine in double-headers, you will notice a marked improvement in emergency braking on trains hauled by one engine—that is, the brakes respond more readily.

Since July, 1895, I have gone into some exhaustive experiments in the line of double-headers, and have never had the semblance of a failure to obtain emergency action, excepting in one instance, where we had a car with 14-inch brake cylinder on head of train next to the engines. In this instance I only got partial emergency, due to the condition of the brake cylinder on this car, which in a service application failed to work after a 12-pound reduction on the gage; and after being forced to move by the additional pressure in an emergency application, the piston groaned and scraped like a pump without oil.

This will no doubt be interesting to your readers, and valuable as well if my advice is followed strictly to the letter.

M. H. Neff,
Pittsburg & Western Shops.
Allegheny, Pa.

[To obtain quick action, a sufficiently quick reduction of a certain amount must be made at the triple valve. Anything that will prevent this required reduction will prevent the quick-action application. Very crooked piping, undue use of L's in piping, too great a distance between venting point and triple valve, and insufficient or too slow reduction of train-pipe pressure—in fact, anything that will interfere with the travel of the column of air in the train pipe at time—will destroy quick action.

Quite some time ago, difficulty was had on certain engines running double head trains. Subsequent investigation and experiments proved that the failure to obtain the quick action from the leading engine was due to the very crooked piping on the engines, that prevented sufficient freedom of exhaust at the brake valve. This piping was duplicated in the shop, and no better results were obtained than on the engine. A similar length of piping, erected with unnecessary bends and turns, eliminated the trouble. This latter system of piping was then placed on the locomotive and tender, and the quick action was obtained.

Our correspondent's plan of placing the cut-out cock just ahead of the branch pipe to the driver brake would, no doubt, assist quick action where trouble or failure was had in obtaining it, but it would increase the likelihood of getting quick action with a single engine on a one or two car train when the application was made in the service position.—Ed.]

With the same force applied, a long, slim wedge will split a log with greater ease than a short, blunt wedge. A cam is merely a rolling wedge.

QUESTIONS AND ANSWERS

On Air-Brake Subjects.

(36) R. H. L., Jersey City, N. J., asks:

When putting new leather packings in brake cylinders, should the smooth or rough side be put next to the cylinder? A.—The rough or flesh side always.

(37) J. B., Pittsburgh, Pa., asks:

Is it necessary, when cleaning a triple valve, to put oil on the quick-action valves? Does not oil injure the rubber-seated emergency valve? A.—1. No. 2. Yes; keep all oil away from it.

(38) J. B. D., Arkansas City, Kan., asks:

If I connect a Westinghouse pump to a small drum, and arrange a second pump to pump out of the first drum into the second drum, would I not get a higher pressure than if each pump pumped into its own drum? A.—Yes; almost double the pressure. By using a third pump in multiple with the first two, you would obtain still higher pressure. This system is in service in many shop and yard plants where the steam pressure is not sufficiently high to pump the desired pressure of air.

(39) H. R., Missoula, Mont., writes:

Take the following case: The train pipe and auxiliary reservoirs of a train, engine and tender are charged to 70 pounds. There are 80 pounds in the main reservoir of the engine. We now couple on a helper engine ahead, that has a pressure of 80 pounds in the train pipe and 90 pounds in the main reservoir. The brakes on the helper engine are cut out. The stop cocks in the train pipes under both brake valves are cut in. Would coupling on the helper engine apply brakes on the train? If so, why? A.—No; for the mere coupling-on would increase rather than reduce train-pipe pressure in the train. Should the train pipe be very short, however, there is a possibility of the equalizing piston in the brake valve of the second engine rising up against the gasket and remaining until the train-pipe pressure would be sufficiently reduced to set the brakes. But the mere act of the helper engine coupling on under the conditions described would not set the brakes.

(40) R. Q., Cincinnati, O., writes:

1. What is the exact measurement of the stop pin in 6 and 8-inch Westinghouse pumps? If none, how do you tell if they are right? 2. Will you please mention some good books on air-brake practice, especially on repair work. 3. In your educational chart, presented with the April number, is shown the governor connected with the reservoir. Is that not a mistake, or is that the way the connection is made with an engineer's valve with the feed-valve attachment? We have no such valves here yet, and I may be wrong. A.—1. Your better plan would be to make the stop pin long enough so that it will stop the main valve when the lower packing ring extends about one-third or one-half of its width through the bush into the exhaust port. The stop pin should not touch the main valve when the pump is running. It is only intended to prevent the main valve from dropping down too far when the steam is shut off. 2. Get a copy of the Air-Brake Men's proceedings each year. 3. Where the brake valves with feed-valve attachments are used, the pump governor is connected to the main reservoir.

(41) J. T. T., Macon, Ga., asks:

If a reservoir 12 inches in diameter and 33 inches long will equalize into a cylinder

10 inches in diameter with 8-inch piston travel from 70 pounds to 50 pounds, what will the same reservoir equalize at into a cylinder 12 inches in diameter and 8-inch piston travel, and which will give the greater pressure on brake shoes? A.—According to rule given in answer to Question 29, if the pressure in a 12 x 33 auxiliary reservoir, charged to 70 pounds, were allowed to expand into a 10-inch brake cylinder whose piston travel is adjusted at 8 inches, we would get 55 pounds pressure to the square inch on the piston. By deducting 10 per cent. for losses due to piping and cooling of the air through expansion, we would have about 50 pounds on the piston, which is approximately the result obtained in practice. By employing the same rule, we find that if 70 pounds pressure in a 12 x 33 auxiliary reservoir were expanded into a 12-inch brake cylinder whose piston travels 8 inches, that about 52 pounds computed, or 47 pounds actual pressure would be obtained. The total piston pressure on the 10-inch piston would approximate 4,000 pounds, and that on the 12-inch would be about 4,900 pounds, or a difference of about 20 per cent. in favor of the latter. The greater area of the 12-inch piston more than offsets the loss in the pressure expanding into a larger cylinder.

(42) B. W. S., Huntingburg, Ind., writes:

On page 268 of your March number, in commenting on the Hurst pressure-retaining device, you say that the maintenance of hose is by far the greater expense in keeping brakes in order, etc. Why not use a lower pressure for operating the brakes, especially when it can be done as efficiently with low as with high pressure? This would reduce the bursting of hose to almost nothing. A.—If we carry a lower pressure we will reduce our braking power. If the pressure is cut down, and we wish to keep the brake power unchanged, a cylinder of greater diameter or a higher total leverage must be employed. Leverage cannot be used advantageously above a certain point, say ten or eleven to one, as the shoes will rub and bind on the wheels if the piston travel is adjusted to the proper limit. The only recourse, then, is a larger cylinder. Assuming that the pressure be cut down from 70 to 35, and that instead of 50 pounds we would get but 25 pounds in the cylinder, then we would require a 14-inch cylinder where now a 10-inch is used. The additional cost of larger apparatus would exceed the amount saved in hose by cutting down the pressure. While a lower pressure would reduce the number of hose bursted, it would include only a comparatively small percentage of the number of hose removed. Age, chafing, kinking and pulling apart by force cause a greater number of hose to burst than high air pressure.

(43) A. B. L., New Haven, Conn., asks:

1. Did the Westinghouse Air-Brake Co. ever use a triple that had no graduating valve? 2. If so, how did the triple graduate? 3. A live lever measures 18 inches from the top hole to the brake beam, and 6 inches from there to the bottom rod hole. Is that a three to one lever or not? 4 Why? A.—1. Yes; the first style of the present form of plain triple had no graduating valve. 2. The slide valve between the collars on the piston stem fitted tightly, and moved every time the piston moved. To open the graduating port, the piston and slide valve would descend and compress the graduating spring when a reduction was made in the train-pipe pressure. When the auxiliary reservoir pressure had fed sufficient to the cylinder to make it slightly lower than the combined strength of the train-pipe pressure and the graduating spring, the piston and slide valve would move upwards and close the graduating port. 3. It is a four to one lever. 4. The proportion of a lever is determined by the number of times it multiplies the power. In this case the pressure delivered at the brake beam is four times the pull on the top rod; hence, it is a four to one lever. If 100 pounds be applied at the top end, there will be a pressure of 400 pounds delivered at the brake beam, and a pull of 300 on the bottom rod. If the brake beam were connected to the lower hole in the lever, and the pull rod connected in the middle hole, as it is in some inside-hung brakes, the lever would be three to one.

Speaks for Itself.

The following extract from an exchange shows what can be done with air brakes if they are switched ahead and used, and what must be done to keep up with the procession:

"It is a significant fact that for two years past all through freight trains on the New York Central and Hudson River Railroad have been controlled by air brakes, to the absolute exclusion of all forms of hand brakes.

"This is an object lesson well worth mastering by every thoughtful railway manager, and by every subordinate who aspires to better rank."

Would not a certificate of rating, showing an engineer's knowledge of the construction and operation of the air brake, duly signed by a responsible air-brake instructor, and accompanied by a good train-pipe pressure recorder card, be a more valuable recommendation than a statement of the mere number of years a man has handled the air brake?

The Louisville, New Albany & Chicago are putting air brakes on eleven freight cars per day, and they intend keeping on at this rate until all the freight cars are provided with air brakes.

A driver brake should brake to 75 per cent. of the weight on the drivers. Apply Wahlert's rule, and see if your engine is braking right.

Random experimenting and wasteful use of repair material by inexperienced men is an expensive method of maintaining brakes.

Roads having trouble from roughly handled trains would do well to employ a pressure recorder.

Slide-Valve Lead.

The old fallacy that a locomotive could not run freely unless the valves were set with considerable lead is slowly losing its adherents. The present state of the art was well covered by Mr. Henry Bartlett, superintendent of motive power of the Boston & Maine, in some remarks made at the New England Railroad Club. He said:

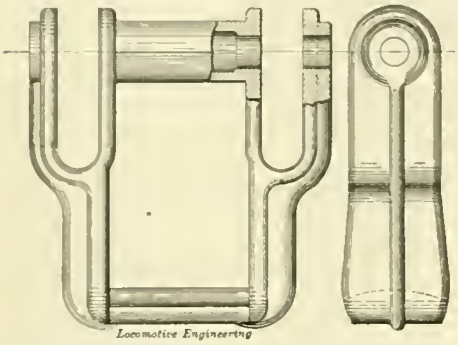
"It used to be the supposition that in order to make an engine work smoothly you must have a certain amount of lead. That this is not true is pretty well known now everywhere. This is pretty well illustrated by the smooth riding of an engine shut off at high speed. If properly balanced, the engine probably runs as smoothly as ever it did in its existence. Ten years ago it was the practice to give an eighth of an inch lead. It has been gradually cut down to a sixteenth and a thirty-second, and in some cases to zero. This has resulted in great improvement to the engine. There is no doubt that lead has been very injurious to the operation of engines. It has caused probably more wear and tear to the valve gear, and more expense for repairs than anything else. I have no doubt the practice of throttling engines is attributable to a great extent to excessive lead. On some new engines which we have just designed, and which we are just receiving at the present time, we have given this a good deal of attention. These valves have five and three-quarter inches travel and one inch outside lap. We were very particular to see that these valves had only a thirty-second of an inch lead in the full gear forward, and only five-sixteenths inch lead at a quarter cut-off. From further study of this matter, and since indicating these engines, I am confident we can go still further in this matter of reducing lead to advantage, and we are going to try some engines with the lead cut down to zero in full gear forward, and with one-quarter inch lead at quarter cut-off. I am quite confident that is going to make still smarter engines than we have now, and will result in some economy of fuel, too.

"Still another point, which has not been spoken of this evening, is inside clearance on the back edge of the exhaust. You who are familiar with indicator diagrams know that the exhaust takes place at unequal points, if the valves cut off equally back and front, due to the effect of angularity of the main rod. By advancing the exhaust on the back edge by the proper amount of clearance, the compression is equalized in both ends of the cylinder, and it is more easy to make the valves sound square."

Get your articles in early. "Locomotive Engineering" goes to press on the 15th.

Lindstrom's Locomotive Truck Spring Hanger and Truck Journal Box.

The spring hanger shown in the annexed engraving was designed by Mr. C. Lindstrom, master mechanic of the Illinois Central at Vicksburg, Miss. It is made of malleable iron, and its tensile strength exceeds 50 tons. It provides a perfectly free oscillating and true bearing-seat for the locomotive truck springs, and will not twist the springs, as is inevitably the case with the old and expensive wrought-iron devices, which are uneven,



and as a consequence the springs get twisted and the weight of the engine is not distributed equally on all spring-bearing surfaces. This twisting of the springs so often repeated causes them to break, notwithstanding the fact that the limit of elasticity has not been exceeded.

It will make the weight of the engine bear on the outside as well as on the inside of the truck equalizers, assuring the latter a vertical position by means of the additional outside jaws on this device.

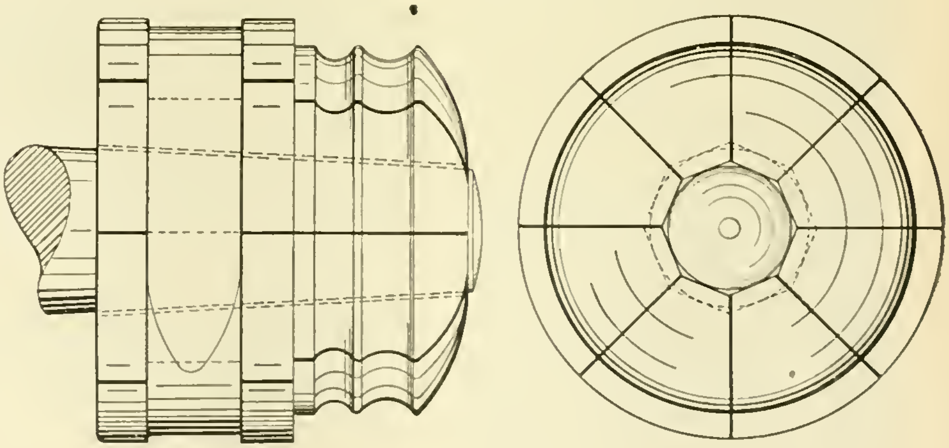
Too Much Scrap Heap.

The desire that prevails with the heads of mechanical departments, to make as good a record as possible in keeping down operating expenses, is apt to defeat itself if not intelligently restrained. Among the cheapening practices that have come greatly into vogue during the last few years, none has more prominence than that of turning the iron scrap heap into a steady source of supply for new work. Within the month we have been shown operations in blacksmith shops employed to utilize scrap which must have cost more than what the finished article could have been bought for. Those who are drawing largely upon their scrap would do well to watch closely the actual cost of their finished forgings.

Some remarks made by Mr. R. A. Mould, blacksmith foreman of the Erie shops at Galion, O., at the Master Blacksmiths' Convention, are worthy of consideration, coming as they do from a man well informed on his business. He said:

"I think we lay too much stress upon the scrap pile as railroad repair shops. I think we are troubled with more or less desire to get more out of the scrap pile with the amount of labor we have to do it than is rightfully and justly expected of us. I, for my own part, find that it is an injury to our business to handle the scrap pile too much. At the present price of iron, on our system I find that the scrap is almost worth as much as the new iron, within a small fraction. Therefore, I believe that the sooner you get rid of the scrap, and put it on the market, you save the company money, time and labor, and get a better production from the labor they give you to get out the work with. I believe this holds good in every class of material, not only as to iron, but steel.

"I find that when our cars come in off the division, which is once a month, the sooner I get at that scrap pile and get it out of the way, and place it on the market as scrap, the better off I am, and so is the company. Of course, when we go through the material, we take out the bolts and many various pieces of bars and arch bars, that could be utilized with a good pair of shears, as well as new iron. But the remainder is of no benefit to your company, and you as workmen ought to get rid of it and keep your place as free from it as possible. It is an economical view of it to handle it as little as possible. I have seen scrap piles every pound of which was worth two pounds of new iron, on account of the time and labor spent in working it over. I do not allow any of the company's money put into labor that does not bring forth a good result for the company. I believe you should take good care of the material given you by the company to work with."



Beading Flues Inside the Flue Sheet.

In the May number of "Locomotive Engineering" there appears an illustration of an improved method of setting flues, designed and patented by Mr. Jno. R. Lowrey, boiler manufacturer, of Omaha, Neb. Claims are made that the method of boring an annular groove inside the flue sheet, and rolling the bead into the groove, prevents the bead from getting burned out. The claim seems to be well founded, and we have no doubt whatever that tubes set in this way will run longer without leakage than those set in the usual fashion. We were rather proud of having first been the means of directing the attention of railroad men to this radical improvement, until we happened to call at the office of T. Prosser & Son, New York.

"You get out a first-class paper and keep up its attractions," remarked Mr. Prosser; "but you are away behind on methods of setting flues."

"How is that? We pride ourselves on having just shown up the very latest and improved plan for setting flues so that the bead can't burn off."

"Your pride will get a fall if you puff that plan as new. Why, the boilers in Noah's ark had their flues set that way."

We were willing to accept testimony that belonged to more recent times, and it was promptly given. Mr. Prosser went to a case in his office, and took out an expander for setting flues with a bead in the middle of the flue sheet. Stamped on the expander was "Patented by T. Prosser, 1849." We promptly wilted, for the expander was made to do the identical operation patented by Mr. Lowrey in this year of grace. Now we feel like challenging the Patent Office examiners to mortal combat.

A picture of the Prosser expander is shown in the accompanying cut.

The march of improvement is going steadily on in the N. Y., N. H. & H. shops at New Haven, under the guidance of Mr. Henney's master touch. Gradual disappearance of the antiquated tools that always stand in the way of improvement, marks the advent of modern methods and silently points to the fact that new conditions cannot be successfully met by the old tools. The new equipment going in there comprises a 72-inch Pond planer, a 40-inch Pond planer, a 30-inch Pond planer, a 72-inch vertical boring machine and a driving-wheel press—all with the latest modern appointments. These tools, together with the new Niles cylinder borer recently put in, make a pretty neat showing. A new drop pit is nearing completion in the roundhouse—another evidence that the best is not too good for a good road.

CAR DEPARTMENT.

Conducted by ORVILLE H. REYNOLDS, M. E.

New York, New Haven & Hartford 60,000-pound Coal Cars.

The standard 30-foot coal car of 60,000 pounds capacity, illustrated in this issue, was designed and patented by Mr. E. E. Pratt, superintendent of buildings of the New York, New Haven & Hartford Railroad. It has been in service more than two years, under the hardest possible conditions, hauling coal, in construction work and in excavator work, in all of which it has demonstrated its value to the construction department and also to the traffic officials.

There are many features about it that show originality in reaching an end, and some of them will be widely copied after the patent expires, if not before, as most good things are. The folding sides and the manner of securing them, both shut and open, will attract the attention of the carman at once.

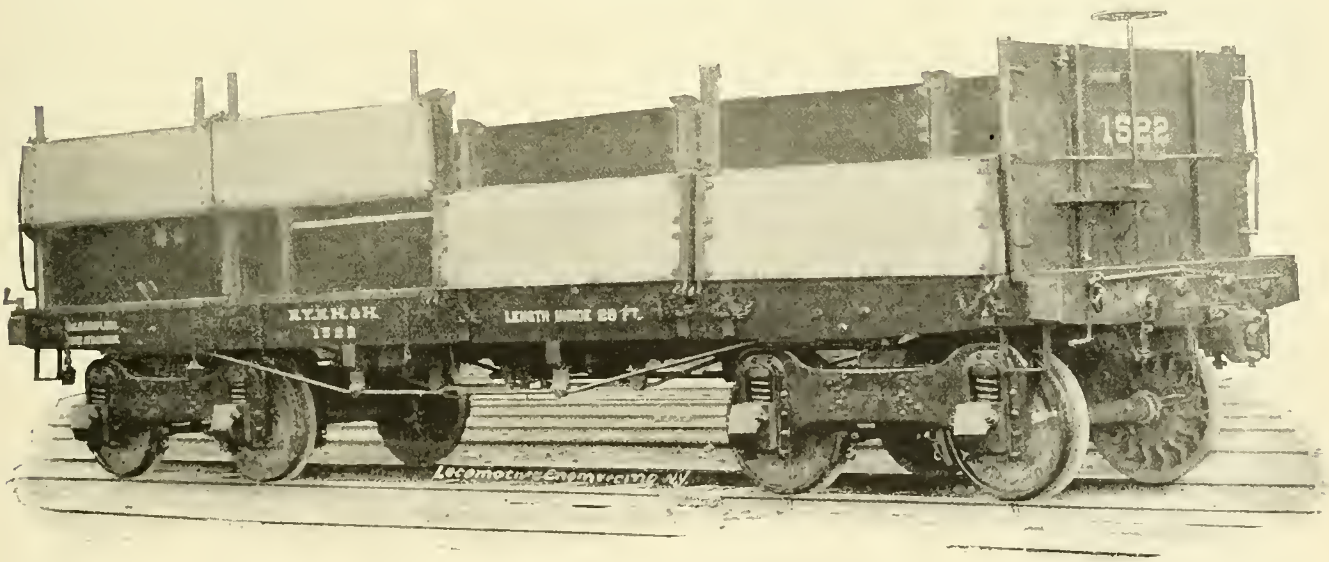
The gondola sides, 48 inches high, are hinged in the center, on a 1¼-inch round rod running the full length of car; the upper half of the sides being arranged to fall at any one of the panels, and the lower half to raise, alternately, as shown in the perspective and transverse sectional views. To prevent bulging at the ends, there is a truss rod with turnbuckle.

The side posts are of malleable iron, made in T-section, with the flange facing outward to afford a flat surface for the folding sides; the web projecting toward the inside is deep at the bottom and tapers to the top, making a strong and light section to resist the bulging tendency of the load, and this it does perfectly by aid of a brace at the bottom of the post, which is cored to receive a bar passing under the sill and acting as a stiffener to the post.

All fittings of the upper side sections are of malleable iron; these sections are secured by a sliding hook, the shank of which is rectangular in shape, and fits loosely in the socket that is bolted to the sides, the hook dropping over the top of the side posts when the sections are in the raised position, and locking them securely in that position by gravity alone. When the top is lowered this same hook is in an inverted position, and then engages with a small malleable pocket which is bolted to the sill, and thus locks the section open. The same hooks also lock the lower sections in the open position when raised, having a special notch in their under faces for the purpose; the lower sections are also firmly secured shut when down, by means of a malleable wedge bearing against the wrought-iron hinge which extends down on the sill and enters the frame to receive the wedge.

All the parts are self-contained and designed to be positive in their action, without complications that are likely to interfere with ease of manipulation. On account of the facility with which these cars are unloaded, they have an advantage over the regulation gondola with the solid sides, for the reason that it is not necessary to lift a shovelful of material to the height of the sides, as in the old cars.

There are four 1¼-inch truss rods with enlarged ends, to carry the body and load; the two inner rods passing through the end sills, and the two outer ones immediately under the outside sills stop off just back of the body bolsters, having flat ends with a lug turned up which the sills are mortised to receive. The flat ends are bolted to the sills by three bolts through each foot.

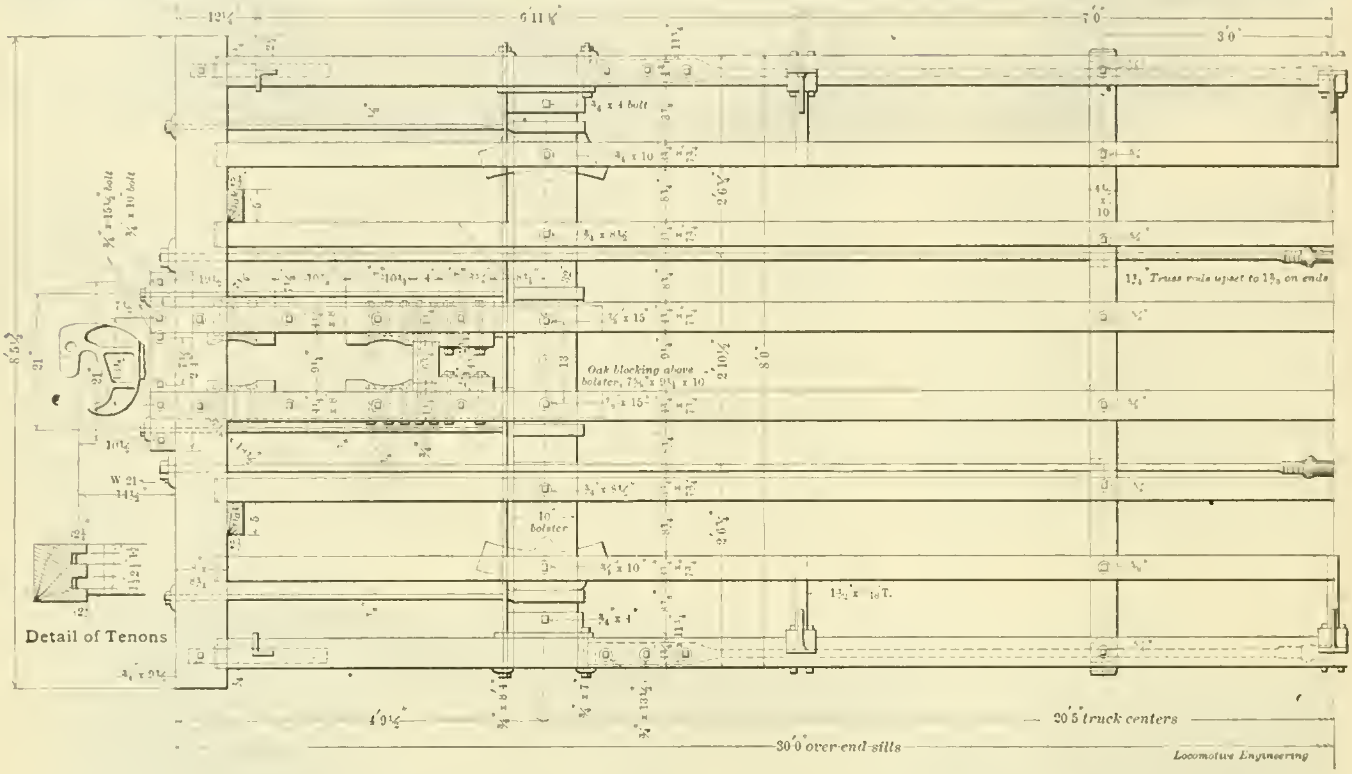


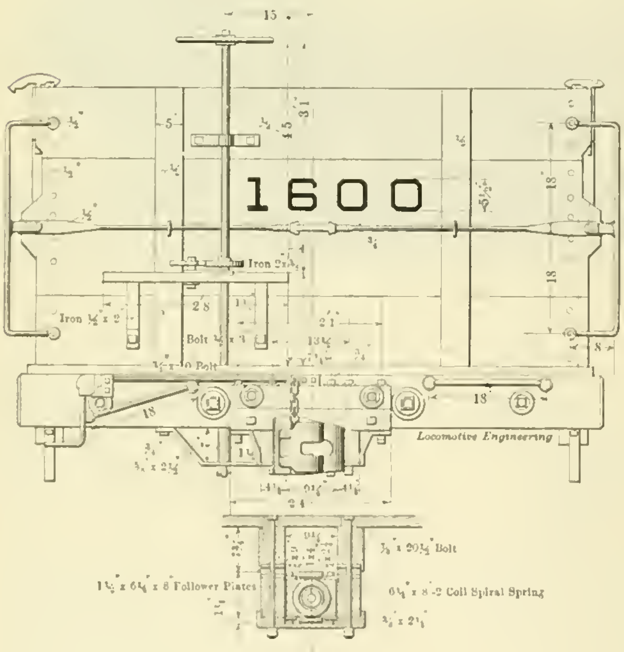
NEW YORK, NEW HAVEN & HARTFORD SIXTY THOUSAND-POUND COAL CAR, FOLDING SIDES.

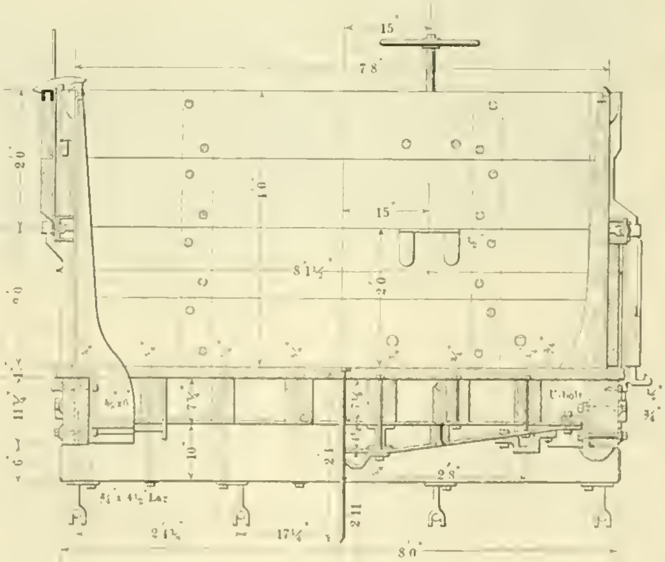
Much attention has been given to the draft rigging to insure something like stability to the best-abused part of a car, as will be seen; the rear draft lugs are solid back to the bolsters, and are secured by nine bolts through each lug, besides the two rods holding the spacing blocks between. The lugs cover an exceptional area on the draft timbers, and the latter will be longer-lived in consequence.

An additional element of strength is found in the two draw rods with hooked ends, which engage with the top and bottom plates of the body bolster, and pass through the end sills and buffer blocks just outside of the center sills; and the two similar rods hooked over the top bolster plates and passing through the end sill between the outside and intermediate sills.

Everything possible has been done apparently to keep down weight, as the car







only weighs 24,800 pounds. The sides and ends are very light, being made of 1¾-inch spruce, while all the long sills are pine. The body bolsters also partake of these light characteristics, being made of two pieces of ⅝ x 10-inch steel. These bolsters should cause a spasm of remorse to rack the conscience of advocates of the heavy types, when they think of their prodigal waste of material as compared with these trim affairs that stand up under the most trying conditions of service, with the side bearings well apart.

There are a number of unique things about this car, and many points strange in gondola construction, all of which are well shown in the engravings and will prove of interest. There are 200 cars of this type now on the Boston & Maine, and 1,000 in commission on the road named in the caption of this article.

The inventor, while his official title shows no connection with the rolling-stock department, is one of our veteran master car-builders, having held that position twenty-three years on the New England Railroad. As his last work shows, he keeps well up with the progress of car construction.

With all our reputed ideas of progress, the United States, so far as matters which the Government controls, is the most conservative civilized country in the world. As an example of this we might mention that no important changes have been introduced in the Navy relating to engineers since steam was first used as an auxiliary to aid sails. The chief engineer, who is really the most important personage on a steamer, so far as training is concerned, is dominated by every small line officer.

How Cars Are Cleaned by the Wagner Palace Car Co.

If the impression ever seizes a traveler that proper care is not exercised in the renovation of passenger cars, there is no better way to dispel the illusion than to see how thoroughly every vestige of contamination is literally wiped out at terminal points where car-cleaning is done.

The good housewife puts the microbe in quarantine semi-annually, and bases her estimate of the quality of the work by the discomfort caused to those around. Cars are cleaned every trip as thoroughly as the above, but the machinery and organization to perform this work is of such magnitude, and the system so perfect, that what is looked forward to as a terror in one case is simply an everyday occurrence in the other.

At the Mott Haven yards, where the Wagner trains are taken on arrival in New York, the "North Shore Limited" was found in a dismantled condition preparatory to its run for Chicago—carpets up, mattresses and pillows exposed to the revivifying influence of fresh air, gangs of men hustling, each with their allotted duties; and this was only one train being put in shape for the road.

This work is all handled by parties or gangs, who have a certain assignment, and who are experts in their respective lines by reason of long application. First, the deck lights and lower windows are cleaned of every particle of dirt before any attempt is made to do any washing. The carpets are then taken up and placed in a large revolving wheel having a periphery of polygonal shape covered with slats; the wheel being turned by direct connection with a small engine, makes about ten revolutions per minute; the speed is regulated so that gravity force can overcome centrifugal force and cause the carpets to drop when reaching the top of the wheel. Impact on the slats of the wheel is what takes the dirt out in a ten-minute run, and the dirt is removed by an exhaust fan and deposited on the outside of the room as fast as it is removed from the carpet. After this process all the carpets are examined for disfiguring spots, which are removed. One gang, consisting of five men, raise, clean and lay the carpets for sixty cars per day. The floors are washed with a disinfectant after a liberal scrubbing, so that a clean carpet is always laid on a clean floor.

Eight gangs, of two men each, take care of all the bedding; advantage is taken of the removal of the mattresses and pillows to clean every nook and corner of the berths, both inside and out. The only way a bug can get in here to stay is to come "incog." All the bedding is beaten until clean, and is then aired as long as possible before the train leaves the yard. One man of this gang attends to the berth fronts and nothing else.

All closets and lockers are washed as scrupulously clean as they would be if left open to observation. One gang of four men clean all the plated trimmings in the wash-room. One gang of four men take care of the brass trimmings, exclusively, except the berth fixtures, which are handled by two men.

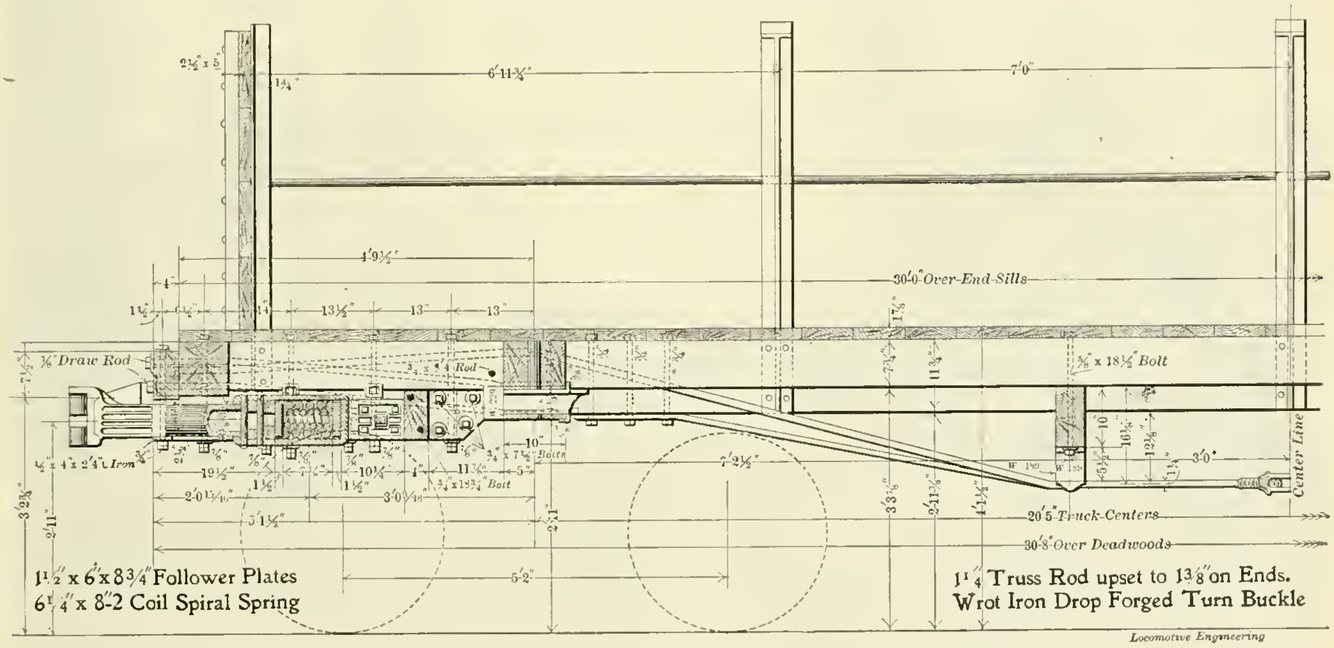
The inside windows are cleaned by a gang of five men, while four men wash the outside, and the same care is taken with the outside as with the inside, first washing clean and wiping dry with clean white cotton waste.

Particular attention is given to the water coolers, they being thoroughly washed out and wiped dry, after which they are rinsed with clean cold water.

The condition of the lavatories and cuspidors is so closely watched that absolutely no fault can be found with either; they are as clean as the most exacting could require. Three women look after these details.

The trucks are wiped and cleaned by a gang of four men, who have a quick way of giving a varnish effect to the truck gear by spraying kerosene oil over the frame and rigging, after wiping the truck, the oil quickly diffusing itself over the whole surface by its well-known faculty of covering all the territory in sight; this it does in a few minutes after the spraying, leaving the truck with the appearance of being newly varnished.

From a sanitary point of view, as well as from the esthetic side, there seems little that could be done to improve the condition of this equipment; and the Wagner people are justly proud of their well-earned reputation, won by attaining results that can only be had by the minutest attention to details, and providing facilities for doing work second to none.



Car Ventilation.

The subject of car ventilation comes up with a periodical regularity worthy of its importance as a live issue in railroad management. It commands the attention of the practical car man, and also those who harness theory to the requirements of the situation, and thus demonstrate just how many cubic feet of air it is necessary to pass through a given space in order to keep an average adult in the enjoyment of unimpaired health, under given conditions—such as the most favorable points of entry of the incoming supply to avoid disagreeable currents and drafts; the proper location of the discharge of vitiated air, whether at the end, sides or floor of car, and the cleansing of the supply before reaching the interior of the car. These are points that have all been subjected to the most searching investigation by men who are ready to affirm that their system of ventilation lacks nothing to give good and satisfactory results.

Car ventilation has been worked up on the basis of a certain quantity of air for each person, who is supposed to exhale about 0.5 of a cubic foot of carbonic acid per hour; this, however, does not represent the total vitiation of the atmosphere, for it does not take into account the emanations from the pores of the human body.

These are the data for daylight ventilation, and it can be shown mathematically that the conditions can be met with a circulation that will dilute the vitiated air to any proportion desired, the circulation depending on the means provided for receiving the pure and discharging the foul air.

In the case of a car, the conditions are greatly more favorable to ventilation than in a building, where reliance is usually placed on flues to work the change in the air by the natural difference of the outer and inner air. The moving car will take up and discharge as many cubic feet of external air as will insure pure air to its occupants, when the proper means are provided to receive and discharge it, for circulation is necessary to ventilation.

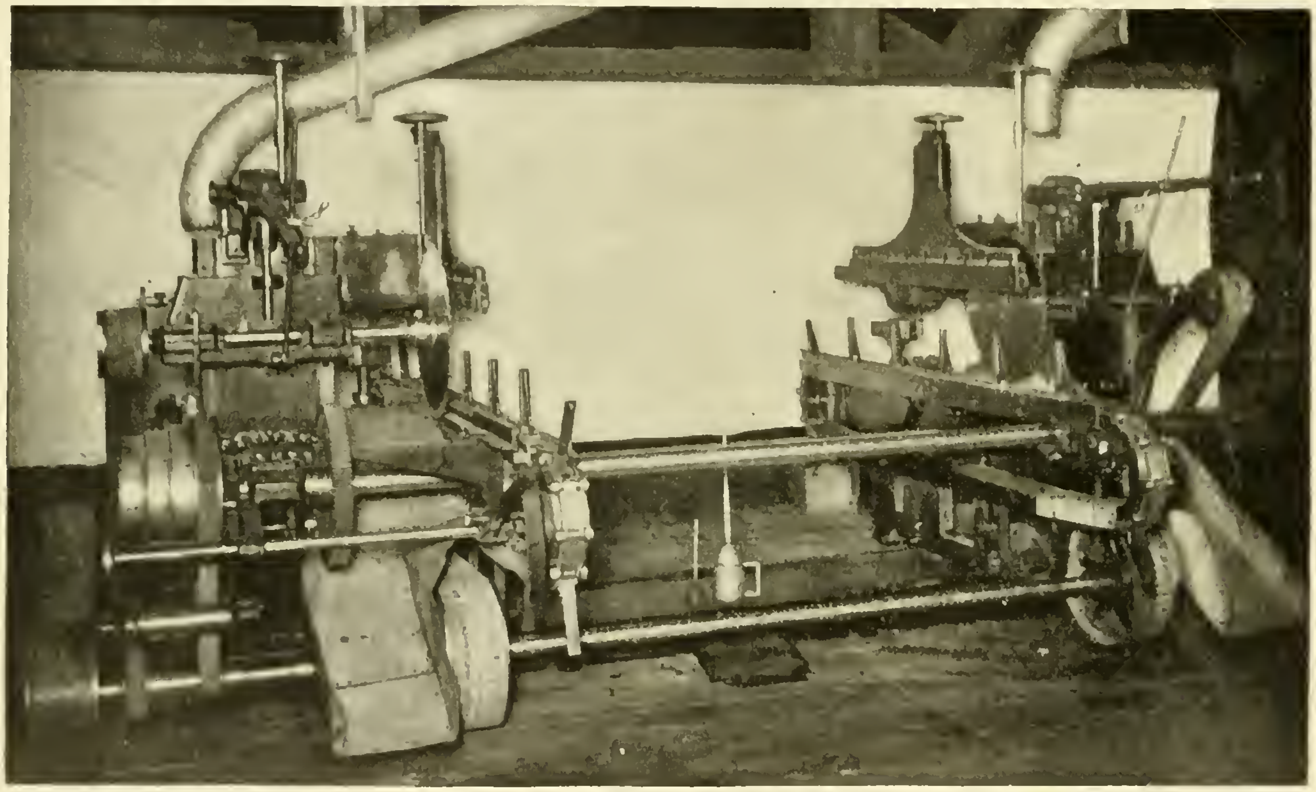
There appears to have been little attention given to the importance of registering the amount of fresh air entering a car, or any device that will automatically show how often the air is changed. A reliable meter to measure the external air passing into the car would be a valuable adjunct to even an ordinary ventilating scheme, simply because it would furnish ocular proof that air was in circulation, and thus manacle the fresh-air crank.

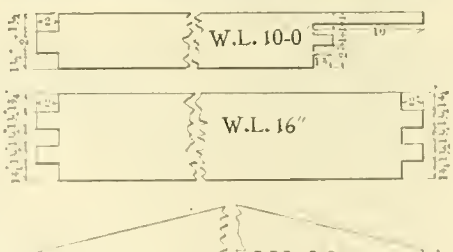
As the case stands at the present time, it would seem that there was not so much need of better appliances for ventilating cars as there is of making proper use of those now doing duty as such. Automatic regulation of the quantity of air displaced in a car is, in our opinion, what is needed at this time, more than any device to assist or furnish the supply.

The periodical agitations in favor of improved methods for ventilation of cars, arise in a great measure from the diversity of individual tastes. The average car is better heated and ventilated than the ordinary house but one seldom makes a journey on a railroad train without meeting people who complain about the ventilating or the heating. One person feels stifled if a current of fresh air is not perceptible to the senses, and another has a horror of drafts and perceives visions of pneumonia and other disorders in every breath of cool air. While this diversity of taste exists, there will always be heard complaints about the ventilation of cars. The appliances used to regulate the admission of air to cars are by no means perfect, but perfection will not put an end to the complaints of irascible travelers.

Double Tenoning Machine.

The subject of our illustration is one of the greatest importance to car men. It is a machine designed to reduce the cost of tenoning car work, and the samples of work shown give a clear idea of the capabilities of the machine.





In the upper view of the samples is seen a piece of intricate shape, and one likely to cause some misgivings to the man with the older and simpler machine for this work, but the lip and tenon on one end, and the tenon on the opposite end are all made at one operation on this machine, automatically cutting the piece to the exact length, and of course producing exact duplication of parts.

The second view is a brake hanger block; the third view is a carlin, and the fourth is an end plate—all done with the same facility and accuracy as the piece first noted; the automatic features of the machine making it absolutely impossible to turn out bad work.

The builders in their description of the machine say: "The machine is fitted with four mandrels, each carrying two cutter heads, making a cut 12 inches long. There are also two upright mandrels, each carrying cutter heads which can be taken off at the will of the operator; also two saw mandrels, the saw blades being adjustable along the ways so as to cut off the tenons to the proper length. These saw mandrels are adjustable vertically, and run independently, consequently the machine can be used as a double cut-off saw. It makes no difference how long the tenon is required to be, within the limit of the extreme cut, namely 12 inches.

"The sectional pressure bars are for holding the stock down to the traveling bed, also for the slight variation in the thickness of stock. The dogs, which are attached to the endless chain, are very rigid and of sufficient height to suit the different kinds of work to be cut, and the machine can be brought as close as 8 inches, and as wide apart as 10 feet, and can be made longer according to order.

"There are four changes of feed, and the feed is controlled by a binder handy to the operator. The belt that drives the cutter head mandrels, is furnished with a binder in the usual way, and is ample to take the heaviest kind of a cut.

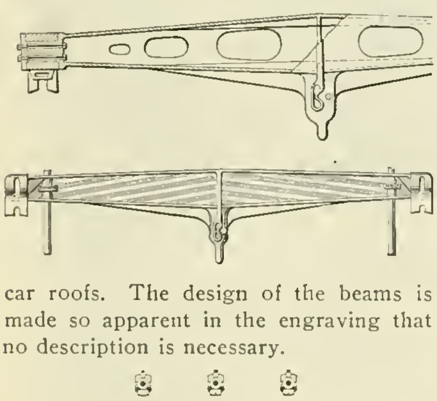
"A pair of knives to each head is furnished with the machine, eight in number, also side spurs to same, and two gaining or grooving heads and knives, besides the upright mandrel, automatic feed, sectional pressure bars, countershaft and automatic device for moving the adjustable housings back and forth along the ways."

This machine is certainly one of the best and most useful additions to car shop tools that has appeared up to the present time. The work shown herewith was turned out by the Terre Haute car works, which are equipped with this machine.

This machine was built by J. A. Fay & Egan Co., Cincinnati, O.

New Brake Beams.

The brake beams herewith illustrated have been invented by Mr. Frank L. Lamkey, of St. Louis, and will be put on the market by Mr. P. H. Murphy, of East St. Louis, the well-known maker of



car roofs. The design of the beams is made so apparent in the engraving that no description is necessary.

A car belonging to the Chicago, Burlington & Quincy, designed to carry 60,000 pounds, carried a load of pig iron which weighed over 100,000 pounds. The car was not damaged. This ought not to be used as an argument in favor of increasing the capacity of cars. A freight car is already in too many instances a battering ram for track and bridges.

Fastening Piston Rods.

BY F. A. HALSEY.

While this subject is up for discussion, will someone please rise and explain the reason for the conventional taper fit between piston rod and crosshead hub in engines using keyed-in rods.

A good many engines have been built from my designs in which this fit was made straight, and if there is any objection to the arrangement it has not come to my knowledge.

I cannot see that the taper fit accomplishes any good purpose whatever, while it does accomplish the distinctly bad purpose of throwing a heavy and useless bursting strain on the crosshead hub. A taper fit is an expensive one to make, especially in this case, where the rod must be of a given length outside the crosshead boss—the matter being aggravated by the drawing of the rod into the hole by the draft of the key. Considerable cutting and trying is therefore necessary.

The straight rods are turned full size to the end without any shoulder whatever, and bottom on the bottom of the hole in the crosshead boss. They are made an easy sliding fit, which makes removal at any time a simple matter. The great advantage of the straight fit, however, is that it permits the rod to be boldly cut to length and finished at the first handling.

This avoidance of repeatedly putting together and taking apart, is one of the sources of shop economy which is not worked as it should be. It is carried to an extent in some shops which the old-time, cut-and-dry machinist would not believe possible, and there is no more fruitful field for a designer to study than to so lay out his work as to encourage it.

In the case of the fit in the piston, there is some excuse for the taper. At that end the rod cannot be made to bottom on its end. To forge on a collar is expensive, while to turn down for a shoulder of sufficient area reduces the area of the section of the rod. This area is still further reduced by the keyway or the threads for the nut, leaving a small net section, unless the rod is of excessive diameter to begin with; but if anyone can give any excuse for the taper fit, or any objection to the straight one, at the crosshead end, he will afford me information which I have searched for in vain.—"American Machinist."

A committee of the Central Railroad Club have been investigating the effect on track and bridges of salt water drippings from refrigerator cars. The decision reached was that considerable damage results from this cause. Recommendations were made that tanks be provided to hold the drippings until they can be run off at regular stopping points.

Snowdon Mountain Railway.

Among the most stupendous enterprises undertaken to make the pursuit of pleasure easy, has been the building of mountain railways, to enable tourists to reach the summit of mountains without the labor of climbing. One of the first enterprises of this character was the Mount Washington Railroad, which was chartered as early as 1858. The line was not opened until 1872, but even then it was the pioneer mountain tourist railway, and its success led the way to similar enterprises in other parts of the world. The most famous of these railroads is the Righi-Vitznau Riggenbach ladder-rack line in Switzerland.

The people of Great Britain are famous mountain climbers, but they have been very conservative about building mountain railroads in their own country. Two years ago, however, on the completion of one of the London & Northwestern branches into Wales, an Act of Parliament was secured for permission to build a railroad to the top of Snowdon, the highest mountain in Wales, and in fact the highest mountain south of the Tweed. The railway does not ascend to a very great altitude, compared to other mountain railways, for it climbs only 3,140 feet; but it passes through remarkably attractive scenery, and gives views of the surrounding country that are likely to make the line highly popular with tourists.

The road was finished and ready for business in March last, and was duly inspected by the Inspector for the Board of Trade and considered safe in every respect. The line is built on what is called the "Abt System"—the same as the railway up Pike's Peak, which forms a permanent double steel rack, secured in the middle of the track, in which a gearing wheel on the locomotive engages. The locomotives employed on that railroad were built by the Société Suisse pour le Construction de Locomotives et de Machines, Winterthur, Switzerland, who have built more mountain locomotives than any other company in the world. An elevation of the locomotives is shown in Fig. 1.

The engineers who build mountain railroads are so strongly impressed with the necessity for everything being secured against accident, that very few accidents have occurred on roads of that kind—in fact, they have hitherto been practically unknown; yet, on this Snowdon Railway, built under the supervision of the very best English engineers, rigidly inspected by officials trained to such work, a very serious accident happened on the first trip made over the road. A party of engineers and officials went safely to the top of the mountain on two trains, and nothing could be felt during the journey that indicated anything being wrong with the track. On the descent of the first locomotive and train down the mountain, the locomotive gearing mounted the rack or became derailed, the engine rose at a tangent from a curve, and toppled off the embankment and rolled down a precipitous slope, the engine being left in the condition shown in Fig. 2. The boiler landed a long way from the engine, badly smashed. The car did not go off the rails, there being no coupling. The manager of the company

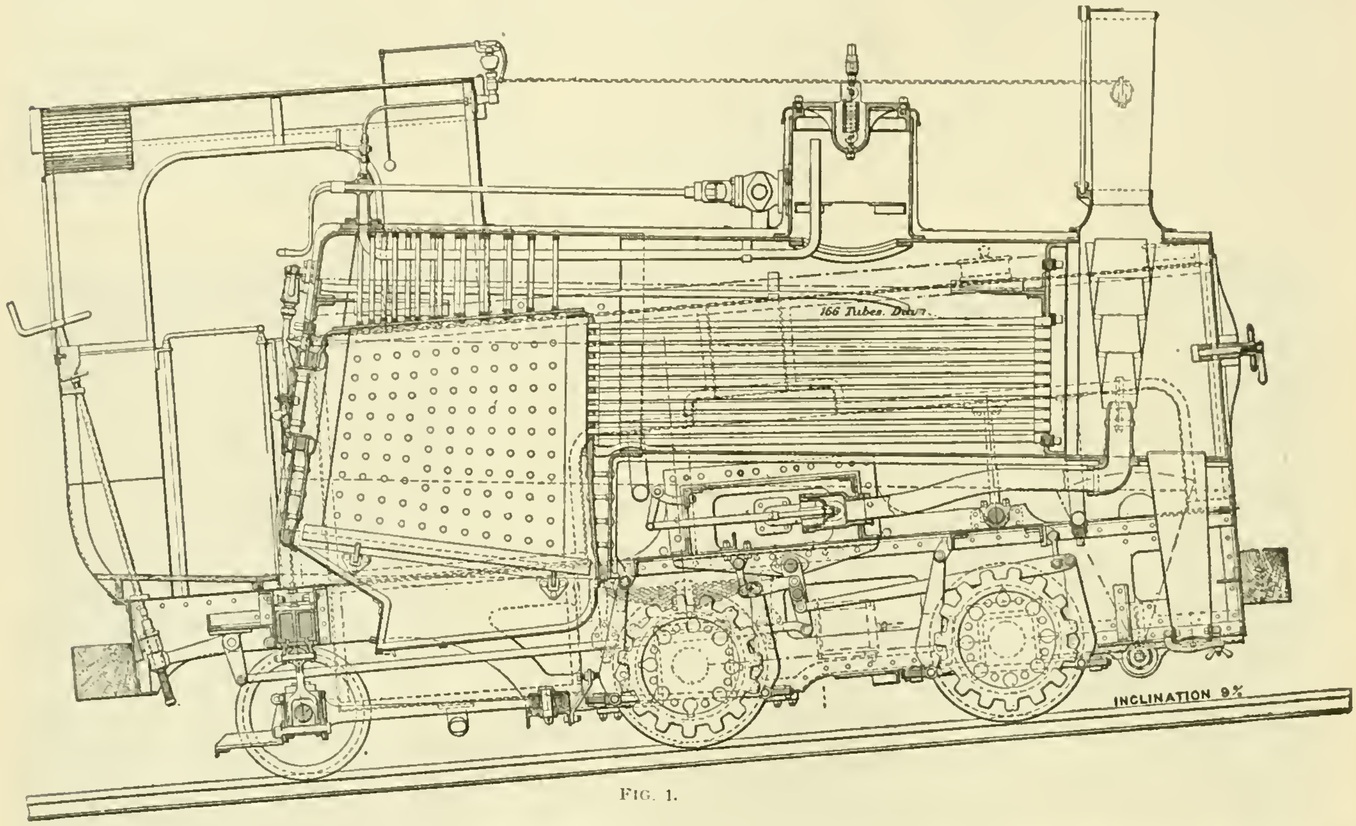


FIG. 1.

applied the brakes, and the car stopped without accident. The engineer and fireman managed to jump off the engine and escaped without much injury, but two passengers, who insisted on jumping from the cars were severely injured, one of them fatally. The engine, in rolling down the mountain side, caught the electric wire used for signaling, and the second train coming down the grade ran into the cars that were standing on the track unprotected and made a very bad smash, although nobody was injured.

The accident has led to a somewhat heated discussion in the English engineering papers about the advantages and disadvantages of various kinds of racks for mountain railways, and the Government Inspectors have been attacked for being inefficient. The illustrations and the facts concerning the accident have been taken from the pages of "Engineering."

FIG. 2.

Away back twenty years or more ago, George Cole was running the "118" on the Falls division of the New York Central. One day, while on the Cincinnati Express, this engine—a 15 x 22-inch, 5½-foot wheel, Schenectady—broke both driving axles at each end—four straight breaks—leaving all the drivers free to hunt a corn field except for the rods. The engine did not turn over. We have never heard of another breakdown of this kind or so lucky a one.

Reports say that the operating of the Metropolitan Railroad in Chicago by electricity is far from being satisfactory, there being numerous delays owing to defects of the electrical mechanism. The inclination to use electricity for elevated roads is, nevertheless, on the increase. It appears to us that a good part of this arises from the sentiment that the use of electricity represents advanced progress, more than that it represents a means of money-saving. The elevated railroad companies of New York and vicinity have been very much importuned to adopt electricity for motive power, and some of the leading stockholders have been inclined to favor the change, but there is no electric company that will give any guarantee of saving through the use of electric motors.

Extended Front Ends.

Editors:

In reply to your favor of the 4th inst., would say that the first extended front ends were placed upon the Hartford & New Haven Railroad in 1865, and have been in successful operation on that road ever since. In 1868 all of their engines (about thirty in number) were equipped with this extended front end, which was originally put on by Mr. E. M. Reed, who was then superintendent of the road, he being a practical mechanical engineer.

This was before the consolidation with the New York & New Haven road. At the time of the consolidation, Mr. Reed was appointed general superintendent, and he had the extended front end placed upon all locomotives on the New York & New Haven division, and also on the Shore Line.

JOHN HENNEY, JR.,
Supt. Motive Power.

New Haven, Conn.

The First Extension Fronts.

Editors:

Your article on Extension Fronts, giving credit to Mr. Waitt and others for the design of the modern extension front, attracted my eye on opening the paper. I am one of the old fogies that don't believe much "credit" is due anybody for this invention; the short front was all right if they had put a straight stack on it.

But credit should be given where due, and it is history that John Thompson, master mechanic of the Eastern Railroad, put the first extension on in 1862—just twenty years before Mr. Waitt "designed" the original extension. These fronts were used several years and taken off, then revived and used again, and again discarded before Mr. Waitt, or Mr. Pillsbury, or anybody else invented them over again.

Several neighboring roads imitated Mr. Thompson's design—notably the Hartford & New Haven—and stuck to them better than he did; for on the New York, New Haven & Hartford, of which the above road is now a part, they have been in continuous use since 1865.

That there is nothing new under the sun seems to apply to extensions—anyway, not new at as recent a date as 1883.

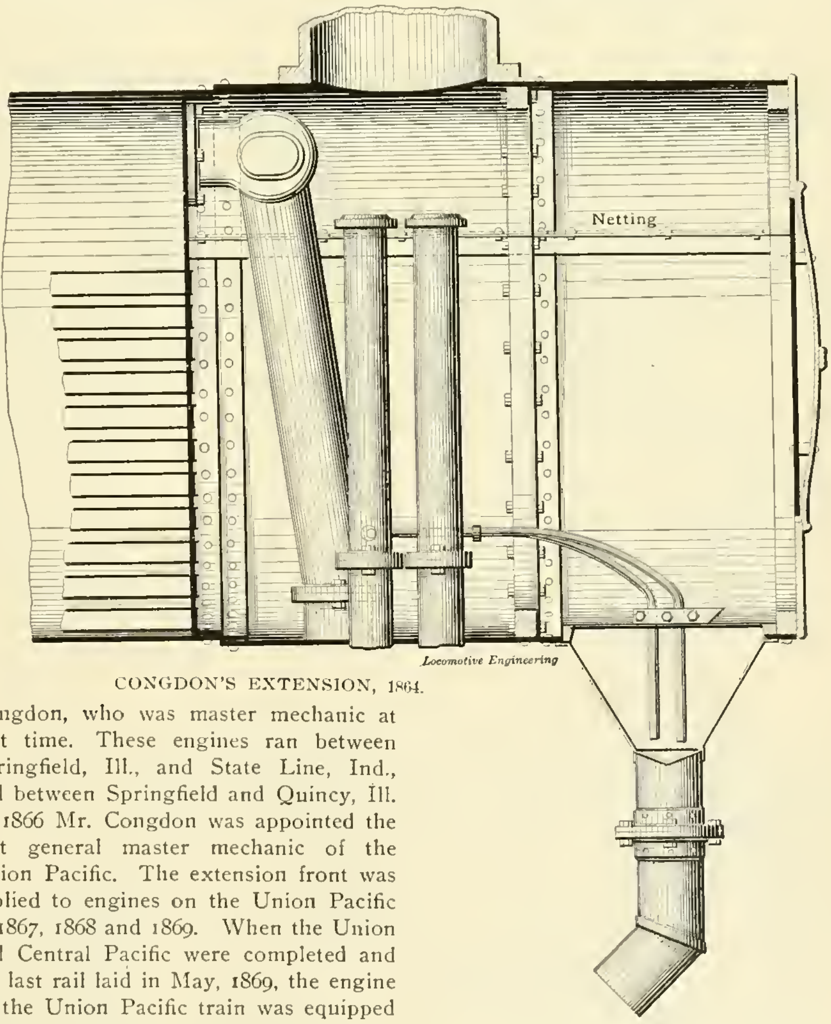
AMOS KELLOGG.

Pittsburgh, Pa.

Congdon's Extension Front.

Editors:

Referring to the article in May "Locomotive Engineering" on "The Original Extension Front," desire to say, among the records of this office is a tracing of an extension front patented by Mr. I. H. Congdon in 1864. This device was placed on some locomotives on the Great Western Railroad (now Wabash), at Springfield, Ill., in 1864 or 1865, by Mr. I. H. Congdon, who was master mechanic at that time. These engines ran between Springfield, Ill., and State Line, Ind., and between Springfield and Quincy, Ill. In 1866 Mr. Congdon was appointed the first general master mechanic of the Union Pacific. The extension front was applied to engines on the Union Pacific in 1867, 1868 and 1869. When the Union and Central Pacific were completed and the last rail laid in May, 1869, the engine on the Union Pacific train was equipped with this extension. They were in service until 1870. When Col. Hammond came to the Union Pacific as general superintendent, the extensions were taken off and the diamond stack used on the C., B. & Q. Ry. applied.



CONGDON'S EXTENSION, 1864.

The inclosed blueprint is from original tracing. By this device the sparks were discharged from the extension through a hopper to the ground. A steam jet through a three-quarter inch pipe taken from each exhaust pipe, formed a current drawing the sparks forward and down the discharge pipe.

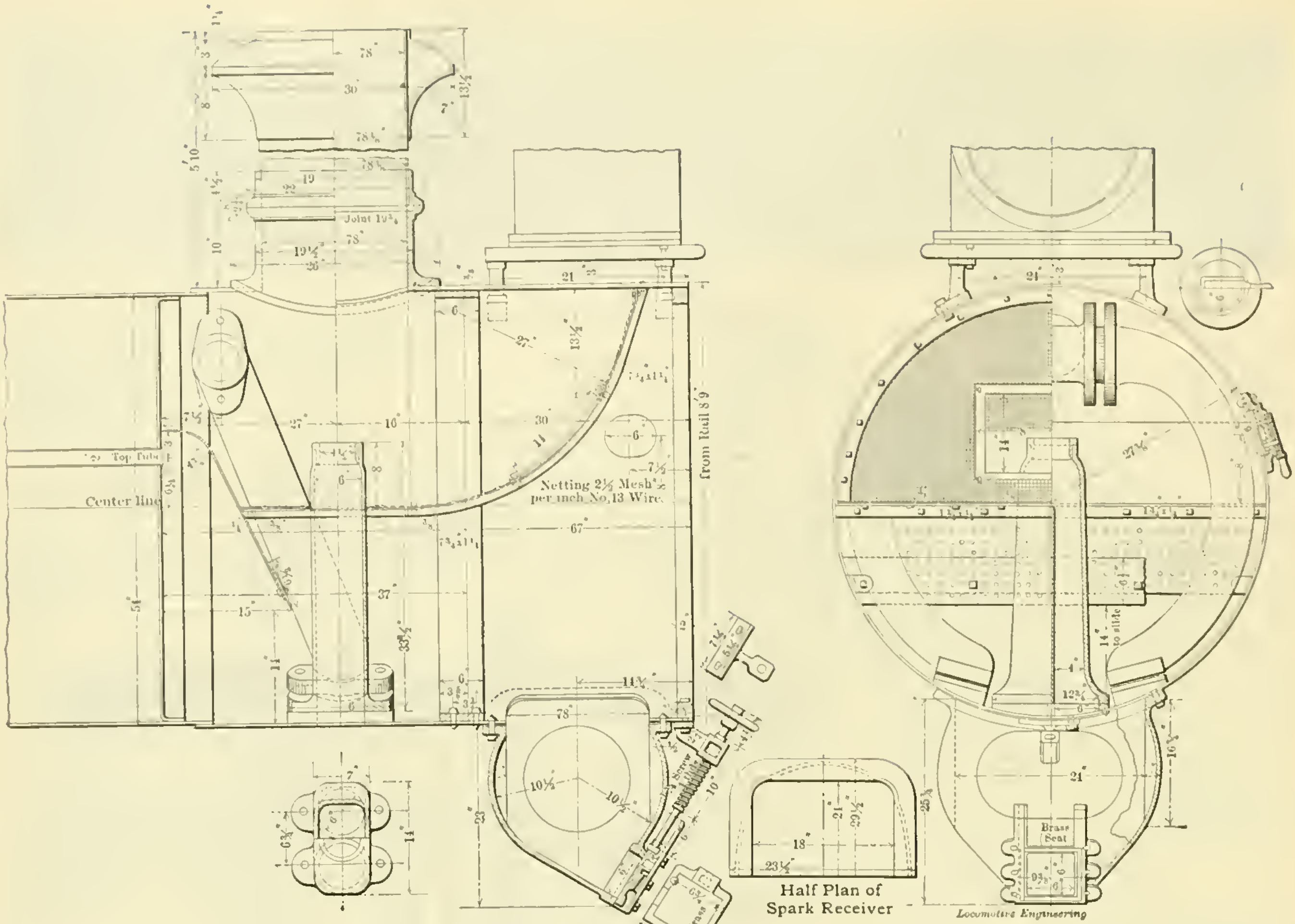
J. H. McCONNELL,
Supt. M. P. & M.

Omaha, Neb.

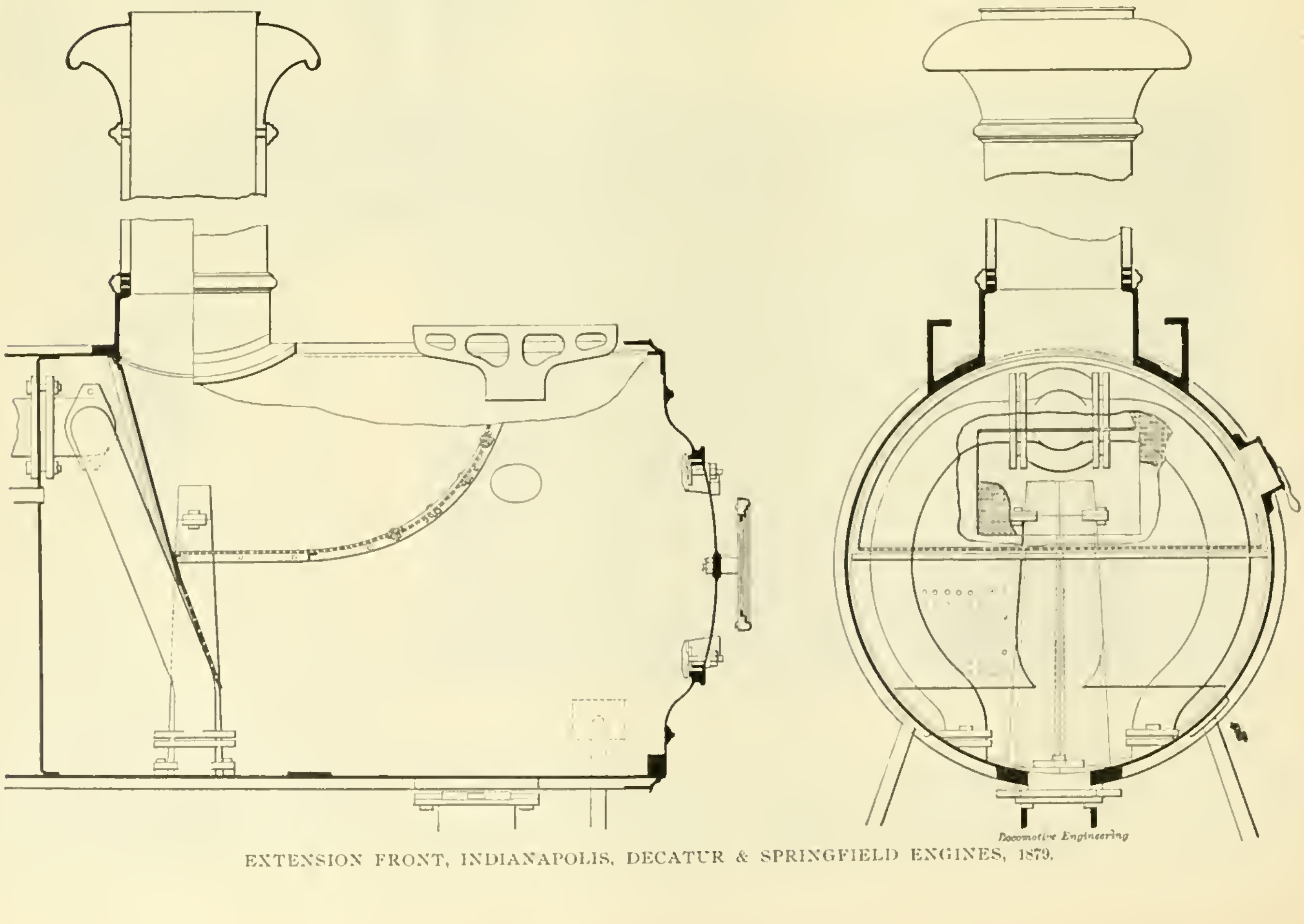
"The Original Extension Front."

Editors:

Your May issue received last night, just about the time our force left the office, and I seized upon the opportunity to scan its pages and was soon in a quite reminiscent mood. The caption "The Original Extension Front" caught my eye, and reading along until I came to the date "1882," I at once set it down as a misprint and considered it as meaning "1862;" and reading the strictures that followed on the present devices, I naturally reviewed the different devices that



LOUISVILLE & NASHVILLE EXTENSION, 1882, EXTRA CINDER RECEPTACLE.

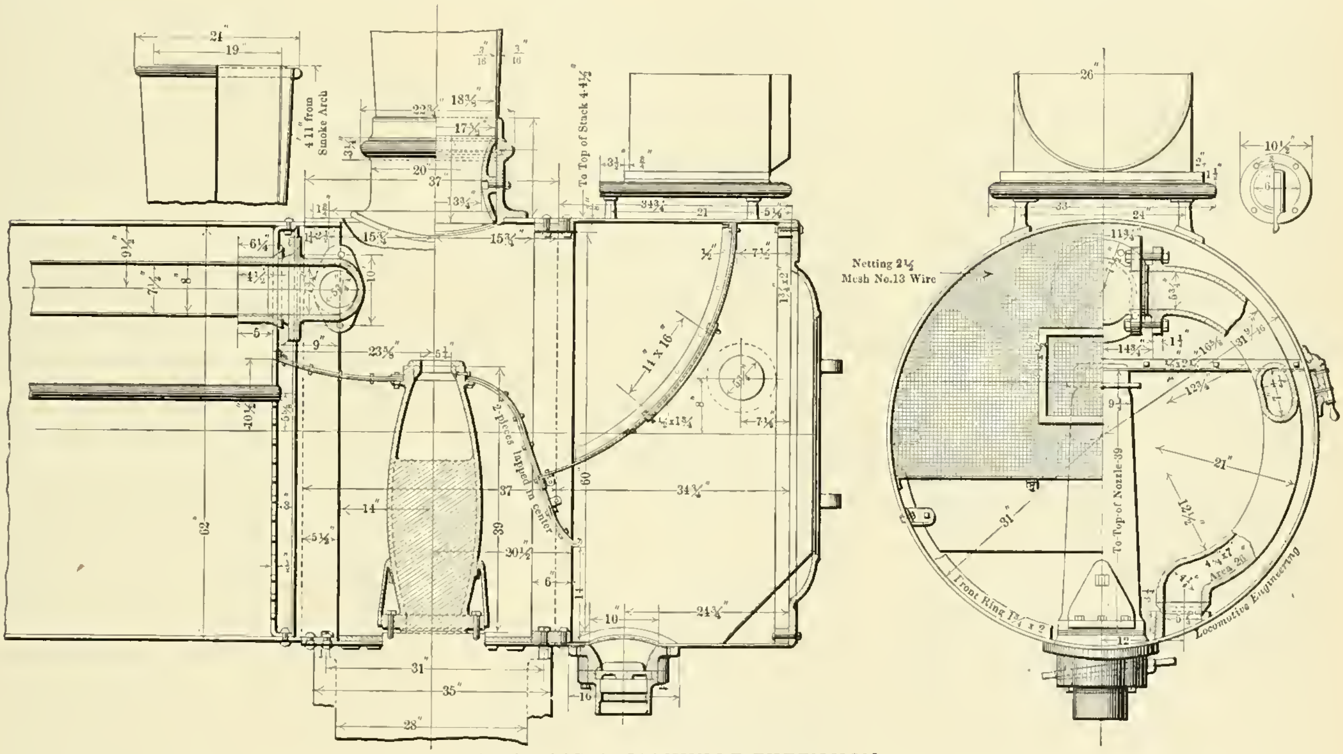


EXTENSION FRONT, INDIANAPOLIS, DECATUR & SPRINGFIELD ENGINES, 1879.

have come under my observation and been experimented with by me. These embrace the diaphragm sheet starting just above the upper row of flues and by a reverse curve extending to within 18 inches of the front, and 14 inches from the bottom of the arch; back to the plate extending from above the top row of flues horizontally to a couple of inches beyond the exhaust pipe, and with a diaphragm set at all sorts of angles. In fact, with this same plate and diaphragm came the introduction of a second diaphragm some 9 inches from the flue sheet at the top, and 16 inches at the bottom, making two diaphragm plates, with a solid horizontal sheet running from the flue sheet to the front plate with netting beyond. Then there was the single diaphragm plate, starting from above the top row of flues on a nine-inch radius and extending out at the bottom to rest against the exhaust pipe, and in some cases encircling and extending beyond the exhaust pipes. In the time when we had right and left-hand cylinders, with the steam pipe back of the exhaust pipe, the diaphragm was formed by a plate extending horizontally from the top row of flues to beyond the steam pipes, with a diaphragm plate extending from that down on the face of the steam pipe and back of the exhaust pipes. My mind naturally dwelt on the varied results I obtained from all these different devices, or rather arrangements, of diaphragm plate.

Referring to the stricture of Mr. Waitt, I will say that it has not been altogether a matter of choice, abandoning to a great extent the original design, in which the extension front is intended to be a spark arrester; but the necessities of our present service called for us to run with our engines working to their full capacity, 180 miles and upwards, without an opportunity to clean the front end, and consequently the "unwritten principle" has come to the front, of circulating the sparks in the front end until they are broken, to the extent that they can be thrown out without danger of conflagration. I could agree with him that the most economical arrangement of the diaphragm that we have ever had was such as adapted the front end as a veritable spark arrester. At the same time, in my opinion, a great deal of this "spark-arresting," so-called, came from the benefit derived from the volume of space in the front end, which acted as a vacuum chamber; whereby, instead of a sharp, snapping action of the fire, the action of the exhaust was distributed by the time it reached the fire, by the creation of the vacuum in the arch, and the shock, so to speak, was taken off the fire, the same as the vacuum chamber on a pump takes it off of the suction pipe, and no doubt catching the sparks in the front end; but we did not take near as many out of the firebox.

I do not think that anyone who has ever run the diamond stack would undertake to say that the ordinary front end would receive and hold all the sparks that were thrown out of the top of the stack in going 50 miles. I have found that a great deal of this benefit can be retained with a diaphragm on front of the exhaust pipe, and which does break up and throw out the sparks, keeping the front end clean; my course of reasoning being, that with the extreme long front end the draft had to be made strong enough in order to clean out the sparks, so that the force of the draft was not broken, or made continuous to so great an extent as it would be with the shorter front end; and I proved this to my own satisfaction by the introduction of a sheet in the front end arranged with studs, on the principle of a wedge bolt, in such a manner that it could be adjusted to the extent of 12 inches—or, with the ring, making 14½ inches that I could cut the arch off. I found that by shortening the arch about 11 inches from what it was originally—it having been 68 inches from the flue sheet to the front—and adjusting the diaphragm plate so that it lay within 2 inches on the top from the exhaust pipe, at an angle of about 30 degrees from the vertical, we obtained better results than with any other method that would clean the front end both as to quantity of steam made and the amount of fire thrown.



LOUISVILLE & NASHVILLE EXTENSION.

Passing along to the next paragraph, I find it reiterated that this original extension front, "designed in '82 or '83" (and from which I take it I was mistaken in considering it 1862), was the first extensively used successful spark-arresting device up to that time. This recalled to me that the first successfully used spark arrester on the Louisville & Nashville Railroad was applied in 1882 to Engine No. 94, but was fashioned after a design nearly if not quite twenty years old, so far as extension front, diaphragm, netting, etc., were concerned. Mr. Wells added an additional receptacle with the idea of providing for the 187-mile run that this engine had to make; but otherwise this front end was exactly the same as those used on what is now the Hartford division of the New

York, New Haven & Hartford Railroad (at the time known as the New Haven, Hartford & Springfield Railroad), in the sixties, and, if I am not very much mistaken, early in the sixties.

In 1884 I received a letter from Mr. James Meehan, saying that I had got him into trouble, and sending me a printed letter or circular in which certain parties claimed that he was infringing patents held by them some seven or eight years old; and as he stated that he had made no changes from the original plans, which were taken from drawings given him by me in 1879, he would like to know where this appliance originated. Mr. Wells at the same time received a similar letter or circular.

I informed them that I knew I had run an engine identically the same in every respect, as this drawing showed, several years before the date of the patent as claimed by these people, and that the same appliance had been used on engines of the Hartford road many years previous to that; and that if they would write to Mr. E. M. Reed, then vice-president of the consolidated road, they would get confirmation of the statement that I had made. I afterwards heard from Mr. Meehan that he had received information from Mr. Reed as to the age of, or the time in which these appliances had been in use—that even if they had taken out patent when first used, the patent would have expired.

Mr. John Patterson also applied the extension front end, diaphragm and netting in 1879, modified almost identically to correspond to the engraving you give.

In 1879 I had built at the Grant Locomotive Works ten engines for the Indianapolis, Decatur & Springfield Railroad, and the drawings referred to were a part of those furnished at that time for those engines to be built by; and while the newspapers and the knowing ones had a great deal to say about the Yankee ginger-bread engines, with the truck in the middle of the boiler, at the same time they were, and always have been, thoroughly and fully successful, as will be vouched for by any of the old employés of the Indianapolis, Decatur & Springfield road who are now living.

I cannot say exactly when they were introduced on the New York & New Haven division of what is now the consolidated road (at that time the New York & New Haven); but I do know that it was a long time before the consolidation of those roads. I do know that in 1876 I was running Engine No. 39, and had been running her for sometime, and that not only she, but Engine No. 8, which I ran some years before, had the extension front and diaphragms identically as shown on the drawing which I inclose you, and which drawing, if I am not very much mistaken, was made about 1870; but at that time it was not considered a new device, but almost assuredly it was considered a fully successful one, and was, if my recollection serves me right, at that time applied to every engine on the Hartford road.

As you make the statement that you are making a searching investigation of this subject, I think that you can get information from Mr. John Henney, superintendent of motive power of the consolidated road, that will place the successful operation of the extension front end with the diaphragm and netting, essentially as shown, back in the sixties; not only this, but that you will find that they were more extensively used on that road than anywhere else in the country, and adopted as the standard long before the experiments you refer to were commenced on other roads.

P. LEEDS, S. M.

Louisville, Ky.

That First Extension Front.

Editors:

I am much amused by the letter of A. M. Waitt, on page 387 of "Locomotive Engineering" for May, as to extension fronts. He talks about their being first used with "tangible results" in 1882.

Now, the Taunton Locomotive Works supplied to the Harlem road, along about 1863 to 1865, six engines with extension fronts—Nos. 29, 34, 39, 40, 41, 42—which, with one exception, used the extension fronts till they went into the scrap heap, after a service of twenty to twenty-five years. And long before 1882, the New Haven road used extension fronts. This I remember myself.

AVERY D. BROWN.

New York City.

Saw Extensions in 1876.

Editors:

In the May "Locomotive Engineering" Mr. Waitt has some interesting information about the earlier forms of extended smoke arches, but very likely it was used on other Eastern roads prior to 1882.

In the winter of 1876 I was bringing out some locomotives from the Mason Machine Works at Taunton, Mass., for the Chicago & Lake Huron Railroad, in whose service I was an engineer. While waiting in the yard at Mansfield Junction, we went down to the crossing to see the Old Colony fast steamboat train go through. The engine on this flyer had a long extension smoke arch similar—as far as outside appearance showed—to the ones used at the present day. Afterward, in February, 1877, I came down from Boston on this fast train, riding behind one of these engines; some questions were asked of the engineer in charge of her about the arrangement of netting and draft appliances, but there was not time enough before the train started to get any exact information. This extension acted as a sort of reservoir to hold cinders and sparks. It was told me that very little fire came out of the stack, and she made very little smoke—probably as much due to skillful firing as to any arrangement of front end. These long front ends were painted a bright red-lead color, which gave them a curious appearance. Very likely some of the Old Colony men of 1876 can tell you more about this style of front end.

C. B. CONGER,
Rd. F'man of Eng.

Grand Rapids, Mich.

Another Expander Experiment.

Editors:

In the April number of the "Locomotive Engineering" journal, the article of Mr. G. H. Brown, on "Effect of Tube Expanders versus Rollers," led us to experiment on this line:

April, '96, engine 168—a radial-stay, wagon-top boiler; 206 2 inch flues; flue sheet of carbon firebox steel, $\frac{7}{16}$ of an inch thick—was in shop for repairs, including new flue sheet. Before putting in the flues, a center mark was made in the flue sheet, and two circles were described with solid trams, the same as described in Mr. Brown's diagram. The flues were set with a Prosser sectional expander; rolled with a Dudgeon roller, without beaded roll referred to, and finished, beading with a Boyer pneumatic hammer. Then, trying the trams to the circles, we could find no perceptible movement of the flue sheet in any direction.

Referring to the distortion of holes in flue sheets, were the holes calipered? Our experience is that the holes are often out of round when drilled; fitting flue sheets to side and crown sheets, by using heaters, also strains and throws them out of shape. We have never found the upward distortion in the flue sheet of a crown-bar boiler, as shown in Fig. 2. With the radial-stay type, however, on cutting out the flue sheet, we have had both the wagon top and crown sheet spring up five-eighths of an inch. The flue sheet, in itself, showed no upward movement, proving that Prosser expanders did not work any evil on this point of the sheet.

CHAS. MILLER,
F'man Boiler Dep't, N. Y. C. & St. L. R. R.

Chicago, Ill.

Weakness of Arch Bars.

Editors:

Anyone would naturally suppose that after meditating on the subject of Extension Fronts, and going back to our boyhood days, that it would have been time to shut up shop and go home; but I thought I would take a glance at the "Car Department," and under that heading I found some more subjects for reminiscent cogitation.

I have a dim recollection of several years ago of someone being attacked by the technical press for being idiotic enough to place as heavy material in his lower arch bars as he did in the upper ones, at which time I believe it was figured out the number of tons of metal that he had thrown away, and I have since seen an allusion made to the same subject, in which it was claimed that he had been converted and was not following the ways of the transgressor any longer.

I read these remarks with a mental reservation that there is a great deal accredited to Providence and science that did not belong to either, from the fact that I consider nothing science except the exact truth. My observation, extending over some few years, has been that with equal members, both as to angle and the size of bars in both the upper and lower arch bars, there have been at least nine lower arch bars break to one upper one. I also notice in the blueprints that come to hand, and also the cars that come under my observation, that the shorter the upper arch bar was made the heavier it was made, and the lighter the lower one; in some instances the upper bar being made so heavy that, had the lower bar been strong enough to have broken the upper one, it would have sheared the box bolts ten times over before starting the upper bar.

Our tender trucks are made with an upper arch bar with 4-inch set, and a lower with 8-inch set; and although made of the same-sized bars, there has never been one of the upper bars break, although we have had so many of the lower ones break that we have had to increase the size of these bars. I have written different parties in regard to this matter, and the only answer I ever got was, that there must be something wrong in the angles, by which there was a constant vibration of the angle of the lower bar that did not obtain in the upper one. Be this as it may, the fact remains that we have got to have angles, and I have always been so particular that I would not accept an arch bar bent in the usual manner on a bulldozer, but always insisted on short angles being formed where the bars were bent; and also that we have but very few broken arch bars under our own equipment—in fact we might say none, except those that I speak of under our tenders. I have taken particular pains for the last several years to ask every car inspector or repairer who I thought would treasure up such points of observation, what their experience had been, and find that their experience would corroborate mine, that it was very seldom that the upper bar broke and it was quite a common occurrence to have lower ones broken.

I agree fully with Mr. Reynolds, that it is essential that a committee should be appointed who would collect data in regard to this matter, and establish something that would be a standard in the form of a diamond truck; and I would like to see their recommendation extend to the point that no car should pass unless it had arch bars of certain dimensions for certain capacities of cars, as there are altogether too many cars in this country with capacities marked on their bodies for which their trucks are not adequate.

P. Leeds, S. M.

Louisville, Ky.

Breaking a Balky Mule by Steam.

Editors:

Since the advent of air brakes I have had quite an experience in braking, but I once, years ago, departed from the art as generally employed and turned my hand to breaking a refractory mule by steam.

I was going East one day on an "extra," and upon reaching Osceola took the siding to await the passage of a westbound regular train. The "61" stood near the east end of the siding and near a road crossing. The main street of the town approached the railroad diagonally, from the southeast, until they came together, the street then extending parallel to and close to the ends of the ties up to the crossing.

As I sat lounging in the cab I observed a "Prairie schooner" coming down the street, drawn by a pair of tall, clean-limbed mules. The driver did a sort ol general delivery business between Osceola and some of the remote country towns, and on the day in question had a variety of merchandise in his wagon, weighing but a few hundred pounds. The team was moving along serenely until that part of the road paralleling the track was reached, when the "off" mule apparently changed his mind and concluded to balk.

The driver first tried moral suasion, then resorted to a formidable-looking whip, but all to no purpose; for every time the mule's "partner" endeavored to move forward, the recalcitrant one exerted his physical endeavors in an opposite direction and the wagon stood still. Directly I became interested, and, alighting from the engine, walked down the track for a better view of the struggle for supremacy. The driver belabored the mule vigorously, but to no purpose, and from sheer exhaustion finally let up in his efforts. I sized up the situation and concluded that no man would be able to cajole, intimidate or conquer that mule's obstinacy.

Just then the muleteer turned to me and remarked in somewhat forcible language that "that mule was getting worse and worse and them spells more frequent."

Said I, "I can start him for you."

"Well, I would like to see you start him or kill him."

"Got any rope?" said I.

"Nothin' but that rope on his neck and some trace chains in the wagon."

"Get them out," said I, "and we will take a pull on him with the engine." He did so and we proceeded to couple up the chains and inch rope, which was looped round the mule's neck and served as a halter; then I opened the switch and the fireman ran the engine ahead sufficiently to attach the improvised cable to a front-end brace.

Then came the tug of war. Slowly the "61" took up the slack, and as the line became taut the mule settled down on his haunches and in his sitting position endeavored to hold his ground, but to no avail, for he was slid along the hard road several rods, his "pard" meekly walking along beside him. Finally the mule regained his feet at a bound and showed an inclination to furnish his own propulsion. The procession was stopped and we disconnected; the driver drew his reins, the mules started, went over the crossing on a trot and were soon lost to view up the lane.

Some weeks later I chanced to be in Osceola, when along came the driver and his mules.

"How is your mule?" said I.

"Furst-rate; he had a sore throat, I reckon, for a few days after bucking that ingine, but he's all right now."

"Does he buck any?"

"Ain't bucked only once since you dis-ci-plined him. One day I was coming down to the village with a load of wood and he balked. I tried licking and burning grass under him, but it didn't do no good; then I unhitched the halter and got out in front of him, and the minute I began to pull on the rope the ornery fool must have thought that I was a steam ingine, for he let right up and come along and nary a bucking since."

"Say, mister," said he, as he gathered up the lines, swung his black snake and started; "if you could run that machine round through the country hereabouts, you could make your everlasting fortune learning mules common sense."

S. J. Kidder.

Chicago, Ill.

"Railroads for China."

Editors:

Your short article in April number, under heading as above, was of peculiar interest. China got humiliation at the hands of Japan because of a failure to comprehend knowledge of mechanical and engineering methods of modern warfare, in which the army is scarcely less a fighting machine than is a warship. Because of this China was buffeted about by a little nation one-fifth her own strength, numerically. This is sure to be the case —very sure.

Away back—I cannot remember dates; but most of your readers, because they are railroad men, may do so—a company secured the privilege of building a short railroad in China. It came about that some time after this short road was built I became acquainted, in a business way, with an American who was interested, not financially, in building this short road.

Chinese labor was employed and he went about daily with his spare pockets loaded with deadly weapons, mostly Colt revolvers. He remained after the completion of the road; and, associating with himself an American engineer, they obtained the privilege of surveying some of the large rivers of China, with a view to opening them up to navigation by dredging, they (the contractors) to submit to the Chinese Government just what could be accomplished by dredging and the cost of machinery, per set. The principal pieces in a set of machinery would be a four-yard dipper dredge and a derrick with a hundred-foot boom, the derrick to be self-propelling and to crawl along the bank on a temporary track as fast as the dredge worked its way up the river, reaching its long arm and pendant dumping box out to meet the dipper of the dredge as often as it came to the surface with its four to five yards of wet clay, receiving its load, swinging around, and dumping it inland as far as could be reasonably expected.

The Chinese officials expressed themselves as highly pleased with the entire operation of the machinery, and negotiations were at once begun for duplicate sets for this and other rivers. Things looked favorable to the two Americans, who did me the honor to engage me to start for China at the shortest notice. The salary proposed was flattering, and I quietly made arrangements for going. Just at this stage the Chinese Circumlocution Office got in its work. The Circumlocution Office in China is an improvement on anything of the kind in the world. There is always something covered besides delay.

Things went along with the two Americans for a full year—contracts always to be signed "next week;" then in the blandest manner imaginable they were informed that the Government would not contract for more machinery, the evident intention being to build it at the Chinese Arsenal. The American "syndicate" of two had been badly taken in by the "heathen Chinee;" spent two years time and considerable money in the interests of the Chinese Government, surveying rivers and harbors, literally for just about nothing.

Will something like this be the case with railroad syndicates in China, or, being larger, will they be better able to protect themselves?

F. F. HEMENWAY.

Brooklyn, N. Y.

The First Steel Tires Used on American Locomotives.

Editors:

Prior to and after 1850, Henry Siedle owned two forges at Gibraltar, seven miles below Reading, Pa. In one forge, scrap iron was worked up into blooms, some of which was worked up into bar or merchant iron, and the balance sold. Charcoal was used in these forges. The scrap was mixed cast and wrought iron; all steel was carefully kept out for fear of injuring the quality of the blooms.

One of the forgemen, Warren A. Lewis, discovered that by putting three or four old files or a steel frog point or two in a "loup," as they called the pile, it worked better and came to "nature" quicker. This he practiced on the sly, and soon taught the trick to his two sons, Bill and Harry, who also worked in the bloom forge with him.

Quite a pile of steel scrap that had been culled out accumulated, and the old man Lewis asked Mr. Siedle to allow him to "sink" a loup of entirely steel scrap, consisting of broken springs, old files, tool faces, etc., resulting in the prettiest bloom ever seen in the forge. Siedle took it to the merchant forge and had it drawn into bars for wagon tires, and found it superior to anything he had ever had. He at once went to the Reading Railroad shops in Reading, where he bought his scrap, and found a huge pile of old steel that there was no sale for, because it was thought useless. He offered Mr. Millholland, master mechanic of the Philadelphia & Reading, a trifling price for a few tons of it, and got it at his own figures; "could have had it all for hauling it away," as Millholland afterwards told me. This lot he used up with A No. 1 results, and went back for more. Millholland "smelled a mice" and drew the secret out of Siedle, and then refused to sell him any more scrap steel at any price, but contracted with him to work up the steel into blooms, at so much per ton, for the company's exclusive use.

At that time the company were forging their own tires from wrought scrap blooms, made in their own forge at Reading. James Mullen was foreman of the smith shop and forge, and the success of forging tire and crank axles—of which a few were used—was due to him. He did not know the word "fail." John Snyder was the boss forgeman under Mullen and —after Mullen had personally made some tires to show it could be done—made all the tires used for years, using the Kirk helve hammer, which you illustrated the other day.

As the Steel blooms were a novelty, Mullen made the tires from them personally. They were put on the Baldwin six-wheel connected engine "United States," somewhere about 1851 or 1852—engineer, Charles Carpenter, now running on Second Avenue "L" road—and were a grand success. A few sets more were made and used, and then Mr. Millholland took to the cast-iron tire, and used the steel blooms for frames, crank axles and pins, etc.

C. J. RAUCH,
Rd. F'man of Eng., "L" Rds.

New York.

Rules to Calculate Train Resistance Need to be Changed.

Editors:

Having read with very much interest the article in your April issue, page 321, I am able from my own experience and experiments to fully agree with the statement which you have made, "that the generally accepted formulæ of train resistance are very far indeed from being either correct or from giving results which agree with actual practice." For several years I was a believer in the Clark formula; but practice proved to me that when starting a train, or running at a slow speed, the formula gave the resistance as far too low, but that at all high speeds the results given by it were far too high. In short, all my experience goes to prove conclusively that the resistance of a train does not increase as the square of the speed.

Three years ago, when I was in America, I had the pleasure to ride upon the engines drawing some of the fastest and most important trains, and also to witness the taking of indicator diagrams. When riding upon locomotives, the writer then saw weights of trains conveyed, and certain speeds attained, which according to the usual formulæ could not possibly have been hauled at those speeds. In the same way, only so recently as the race to Aberdeen last year, it was proved that the engines were performing work daily which according to the formulæ they would be perfectly unable to perform under any such circumstances. My experience also proved that, weight for weight, an American train running on "bogies" and provided with central buffers, runs with very much less resistance than an ordinary English train composed of six-wheeled carriages and provided with the usual side buffers. When, therefore, we in England estimate the working of American engines, we must remember that, weight for weight, they have less resistance to overcome than the English engine; therefore, it is quite reasonable to suppose that they can, with the same weight, run at a higher speed. Rigid wheel base and side buffers have existed in England from the early days of railways, but it is an admitted fact that they both tend to largely increase train resistance.

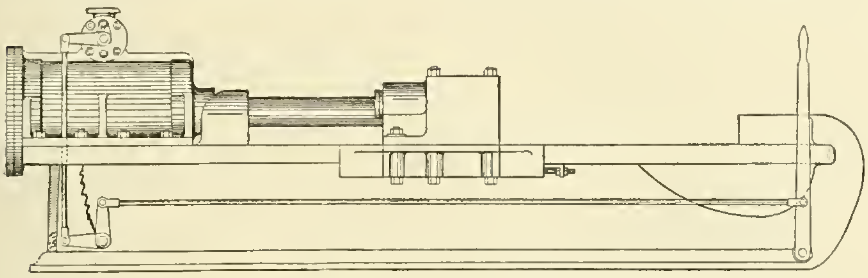
CLEMENT E. STRETTON, C. E.

Saxe-Coburg House,
Leicester, England.

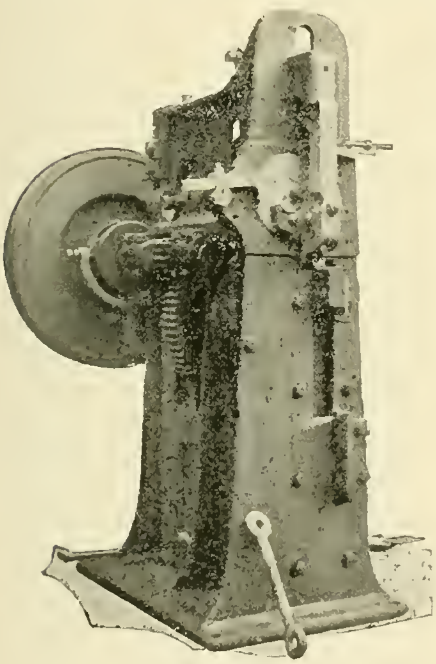
A novel form of tube expander has been invented and patented by Chas. D. Mosher, New York City. A three-roll expander is secured to the end of a mandrel which has a beveled gear on the end. This gear connects with another gear connected to a shaft gear at right angles, the shaft being operated by a crank and handle. This will enable a man expanding tubes to push in the expander and operate very conveniently by means of the crank.

Special Forging Tools.

Williams, White & Co., of Moline, Ill., are making some forging machinery that ought to form a part of every first-class blacksmith shop equipment. The tools we illustrate, and particularly desire to call attention to, are a steam bulldozer, an eyebolt machine, and a machine for rolling taper shapes.



STEAM BULLDOZER.



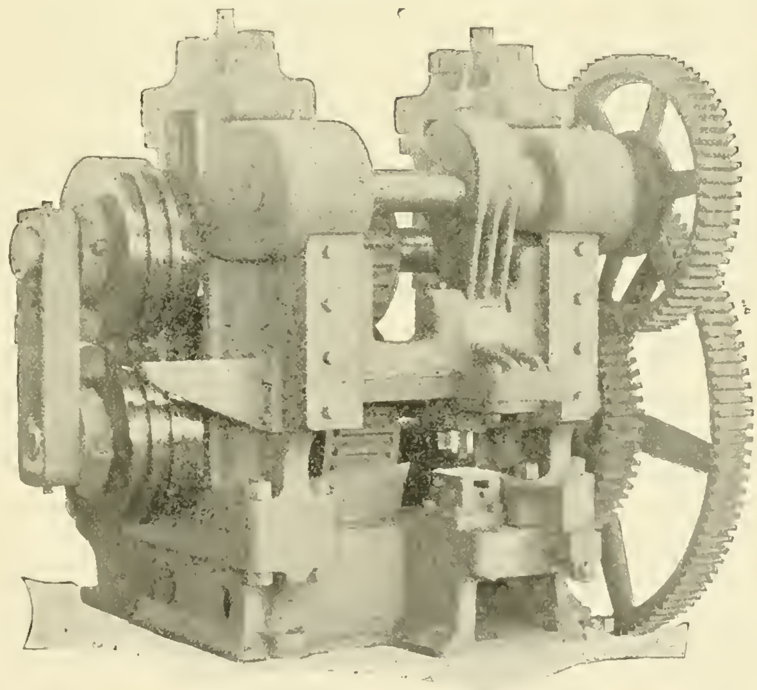
EYEBOLT MACHINE.

The builders briefly describe these machines as follows: "The steam bulldozer for forging, bending and upsetting, and other work that is done on the geared bull-dozers, will recommend itself to such shops as have steam, but are not fitted up with shafting and belt power. This type of machine is not so efficient in some respects as the geared machine that we have been making for years, but it has some advantages of its own.

"While the direct pressure is not as great as in the geared machine, yet by means of the rapidity of the motion, which is something between a blow and a push, an effect is obtained of considerable force, and the blows given in rapid succession have an intensity sufficient to cover a wide range of work.

"The eyebolt machine has an oscillating stop against which the iron is thrust, and which rotates out of the way as soon as the dies grip the iron. There is a rotating face plate on which the moving die is bolted; this face plate is placed eccentrically with the mandrel, so as to make the eye as round as possible and not too flat in shape. The overhanging steel hook on front of the machine has a movement upward and inward; it holds the shank of the eyebolt and brings it up against the stationary die, which is bolted to the face of the machine, and thus forms the neck of the eye.

"The mandrel is automatically withdrawn each time, after the eye is formed, so as to release the eye-bolt. Ordinary round steel is used for this mandrel; and as fast as it wears on the point, it can be cut off and set forward so as to bring a new part into action. The same blocks that carry the shears may be used for squeezing, bending or welding, and the machine can be adjusted so as to do good welding at the same time that it forms the eye.



TAPER ROLLING MACHINE.

"The taper-rolling machine does its work by means of eccentric-shaped rolls, a part of which are cut away to allow the operator to push in the bar against a stop or gage, but the piece may be gaged by the eye when so desired. The rolls then grip the iron and push it back to the operator, at the same time tapering or drawing it to the special shape required. These rolls are seen at the left of the machine. The punch or shear is shown at the center."

Car companies are evincing a lively interest in these taper-rolling machines, which can turn out brake levers and Christie brakehead keys at a rate and of a quality of finish absolutely impossible by any of the old methods.

The builders of these machines are having something of a boom in trade at present, the Canadian Pacific Railway having ordered two of the No. 5 bulldozers, and they are also building two of the eyebolt machines for car companies, in addition to the "Justice" hammer ordered by the Southern Railway Co.

We note some curious testimony about methods of preventing spark-throwing from locomotives, in an old English lawsuit. A report says: "It was proved by engineers and other scientific men that it was the practice to supply the chimneys of locomotive engines with wire gauze bonnets or spark-catchers, or the firebox with Venetian blinds, in order to prevent accidents of this kind, and that the engine referred to had neither of these appliances. Three engine manufacturers stated that bonnets and Venetian blinds had ceased to be in general use for the last fifteen years, except on South Wales railways, where the engines were worked at a high pressure and the line passed through a woody country, because the improved construction of locomotives rendered them unnecessary; that the spark-catcher was only in use in America, where wood was chiefly used for fuel, and that the engine in question was so made as not to require any of those appliances."

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SINCLAIR & HILL.

The Apprentice.

The general foreman of certain large railroad shops remarked to the writer a short time ago: "Our shops, as you can see, are full of apprentices—machine shop, car shops, blacksmith shop and boiler shop are swarming with young men learning the trades. There is a sentiment going the round that raising apprentices does not pay; but we have no reason to complain. These young men finish their time, and most of them remain with us or come back after they have seen a little of the outside world. They are a big improvement on the tramp mechanic." These sentiments are different from those we generally hear of in railroad shops concerning apprentices. There is a decided tendency to repeat the hackneyed talk that the day of training apprentices is past, and that railroad companies ought to hire their mechanics from the open labor market and leave the teaching of mechanics to others.

This is a contemptible way of looking at what is really an important industrial question, involving the highest kind of public duties. The tendency of all trades is to train specialists who become expert only on one or two operations. That is the class of men trained in nearly all large manufacturing establishments. They go into the shop as boys to do light work, and by degrees learn to control a few recurring operations on machines. Men raised in that way are not mechanics, and they are not capable of doing the general floor or bench work of a railroad machine shop. The youths who learn a few operations in wood-working shops, contract boiler shops, and blacksmith shops connected with manufacturing establishments, are useless in railroad shops of a kindred character.

It is therefore right, just and proper that railroad companies should bear the public burden, if any burden there is, in training men to do the work in their shops. Railroad accounts, as a rule, are not kept very close to show the value of individual workmen, and we believe that very few railroad companies can tell whether or not they have profited from the work done by the apprentices they have employed. The prejudice for and against apprentices is based mostly on personal predilection. If a railroad company can come out nearly even on apprentices they have trained, the future benefit will make the mechanic trained by their employing apprentices a paying investment.

Besides the question of profit and loss, nearly every railroad company has implied duties connected with the place where shops are located, that entitle them to do something towards training a part of the population in the mechanical arts. In a great many cases the railroad repair shops are the principal mechanical establishment in the district where they are located. Those in such districts naturally expect that as many boys will be employed to learn the business as circumstances will admit, and they have reason to feel aggrieved if the railroad company pursues an exclusive policy.

Much of the dissatisfaction heard about the success of the apprentice system is due to the mismanagement and carelessness of those who have charge of boys, presumably learning a trade in a railroad shop. The interest of the boy is very often the last thing considered by a foreman. If the youth can run a nut-tapping machine satisfactorily, he is frequently left there, or at some other operation requiring no skill, until he rebels. Those who do not rebel never get a decent chance to learn the trade. After four or five years spent on nut tappers, drilling machines and perhaps a slotter, a young man finishes his trade and finds that he knows no more than common laborers, and is worth no more to his employer. When a youth of this kind asks for journeyman's pay, he is generally permitted to quit. A foreman looks over the work he has done in training such youths, and declares apprenticeship a failure. Most of these failures result from employing incompetent or unscrupulous foremen.

The Railroad Mechanical Conventions.

The leading railroad mechanical associations, the Master Car-Builders' and Master Mechanics' Associations, will meet in convention at Saratoga, N. Y., this month, to listen to reports and to engage in discussions of subjects that are investigated for the purpose of advancing the knowledge concerning the principles, construction, repair and service of railroad rolling stock. To judge from what has been done by these associations in the past, there is no reason to doubt that the work performed at the conventions of 1896 will be profitable to railroad interests. Whether the work performed will produce the best possible results from the amount of thought, work and energy expended is another question.

Both conventions will meet with a program of work to be performed which is not consistent with the amount of time to be devoted to its consideration. The Master Car-Builders' Association will receive reports on ten subjects, besides the reports of three standing committees. In addition to this work, one whole day must be devoted to the discussion of rules of interchange of cars. When it is understood that three days of four hours each are usually devoted to the work of the Master Car-Builders' Convention, it will be understood that there will be remarkably small time for the consideration of every report that has to be read.

The most important subject that will come up for the decision of the Master Car-Builders' Convention is a proposed radical change on the rules of interchange of cars, which makes owners of cars responsible for the greater part of repairs performed on their cars when away from home. The change is known as the Chicago plan. It has been up for discussion for two years, and it was confidently expected that the convention would adopt it last year; but unexpected opposition was presented by some of the leading railroad companies. The system has been in use through mutual consent by quite a number of railroads centering in Chicago, for several years, and it is reported greatly to facilitate the movement of cars. The unexpected may happen again, and the adoption of the system be defeated at the coming convention; but we consider that the railroad companies aiding to defeat the plan, which seems based on justice and fair dealing, stand in their own light.

The Master Mechanics' Convention will receive reports of committees on fourteen subjects, besides the President's address and the reports of the Secretary and Treasurer. The time devoted to the reading and discussion of the reports, the election of new officers, and other business, is generally four hours for three days. The time at the disposal of the convention would not leave any margin for discussion if all of it were devoted to the deliberate reading of the reports. None of the subjects to be reported upon are of supreme importance; but some of the committees will submit reports which ought to receive careful consideration, and which ought to bring forth the views of the members. When a committee is calling for information on any subject under investigation, it is extremely difficult to obtain from members answers giving facts worthy of mention. Most of the circulars of inquiry are thrown into the waste basket, and there is a general tendency to leave to the chairmen of committees the whole work of preparing reports. This is not right, but it has always been this way; and no amount of scolding, complaining and denouncing those who do not perform their duty towards the associations appears to have any influence in making the members generally more ready to give their help.

About two-thirds of the subjects to be reported on at the next Master Mechanics' Convention would be better suited for noon-hour discussions than for written reports. Nearly all the reports to be submitted to both conventions relate to subjects that have been threshed over until no vitality or living grain remains in them.

At the last Master Mechanics' Convention a member rose and moved that a committee be appointed to revise the constitution. The members did not appear to know what changes were needed, and they displayed most decided opposition to any change. The writer has practically been responsible for carrying on the business of the Master Mechanics' Association for the last ten years. That experience has convinced him that a radical change in the way of carrying on the business of both associations is necessary if the organizations are to maintain their usefulness for railroad interests. Both associations were established about thirty years ago, and the leaders did the best that their limited experience suggested to formulate a profitable system of carrying on business. The interests involved the operations of railroad clubs and the past work performed have made existing methods short of present requirements. Radical changes in the constitution and by-laws ought to be adopted to enable the associations to profit from the work of specialists who have made railroad rolling-stock problems special studies.

Both associations are tyrannized over by time-honored forms. The subjects to be investigated at each convention are chosen by a committee appointed for the purpose; and at every convention members on the floor add subjects which make the program too long for the time at the disposal of the convention. The most valuable data presented at railroad meetings in the last five years have been submitted by men, who had made a special study of railroad engineering problems. Among these engineering papers that are of permanent value we might mention: "Boiler Underframing of Freight Cars," by Joughins; "Manipulation of Steel," by Fox; "Counterbalancing of Driving Wheels," by Parke, and also by Sanderson; "Steel in Car Construction," by McIlwain; "Locomotive Boilers," by Bell; "Locomotive Fuel," by Forsyth; "Distribution of Steam for High-Speed Locomotives," by Quereau, and many others. Papers of that kind would be of great value to the Master Car Builders' and Master Mechanics' Associations, but they are crowded out by reports on hackneyed subjects that occupy the whole time of the conventions.

The associations have done remarkably valuable work in the many years of their existence; but if they desire to be as useful in the future as they have been in the past, they must change to meet the progress and spirit of railroad mechanical engineering which have come around since they were organized.

Stronger Diamond Trucks Needed.

The article which appeared in the May issue of "Locomotive Engineering," on the Graphics of the Arch Bar, has attracted considerable attention and has excited a great deal of discussion among railroad men. One letter appears on the subject in our correspondence department, and a feeling is already manifest in different quarters to bring the subject before the next Master Car-Builders' Convention. A well-known master mechanic and car builder, writing on the subject, says:

"In relation to the relative proportion between top and bottom arch bars of diamond trucks, the universal practice is to make the top arch bar the heavier, and in almost every instance the bottom bar is the one that breaks. The top arch bar is the one that is always in compression, and should be only heavy enough to keep it from buckling. The lower arch bar has a tensile strain; and as there is a good deal of metal cut away for the column bolt-holes, it most always gives way at that point.

"It may be that this matter has been up before the convention already; but if this is not the case, I think it would be a good idea to have a committee appointed to make tests, so that we might get better proportions than we have at the present time. Of course, if the matter was taken up, it would take in the tie strap as well as the arch bars. A great many cars are running now with the tie straps breaking or stretched, so that they leave the oil box badly canted. It is frequently noticed in our iron body bolsters that the top part of the truss is what gives way. Here the conditions are reversed to what they are in the truck, the bottom part of the bolsters being in compression and the top has the tensile strain."

It would certainly be a good plan to have a committee of the Master Car-Builders' Convention appointed to investigate the diamond truck; but we do not believe that tests are necessary. The strains to which a diamond truck is subjected can be figured out without any great difficulty, and they will be done, if the right committee is appointed, with comparatively small labor.

In connection with our article on the Graphics of the Arch Bar, we urged that action be taken by the Master Car-Builders' Association, with a view of having a standard arch adopted that would cover all conditions for an arch-bar truck. There are, however, two serious obstacles to surmount in doing this—first, the various depths of truck bolsters which pass between the arch bars; and second, the height of springs for these bolsters. This difficulty might be overcome by intelligent action, and an arch bar designed that would meet with the approval of the majority of those interested.

A satisfactory design should not only deal with the form and shape of the arch, but should show also the dimensions of all the members entering into its construction, for the reason that, without figures, there are many who are likely to continue the old order of things, and give sizes to the parts that will defeat the object sought of making a sufficiently strong truck. An arch-bar truck designed for 60,000-pound loads, and the strength properly calculated for each member, would be an achievement that the association might be proud of, and a drawing of such a truck, with its stamp of approval, would stand as an index of progress among the best things recently done by the association.

The Extension Front Question.

The article which appeared in the May issue of "Locomotive Engineering," from Mr. A. M. Waitt, of the Lake Shore & Michigan Southern, claiming to be the designer of the first successful extension front for locomotives, has brought upon our heads a flood of correspondence which we were not prepared for. We have no doubt that Mr. Waitt made his statements in good faith, and that he sincerely believes that the extension front which he designed was the first to work with entire satisfaction. He does not claim to have designed the first extension front, but acknowledges that there had previously been experiments with extension fronts both with straight and diamond stacks, but that they were unsatisfactory. Some of our correspondents have evidently misunderstood Mr. Waitt's letter, and supposed that he claimed to be the designer of the first extension put upon a locomotive.

Apart from the personal misunderstanding, the discussion has brought out some interesting historical facts and letters that most railroad men will read with interest. We do not believe that the end of improving the extension front is by any means appointed division master mechanic, with reached yet, for some of those in use are far from being satisfactory. In connection with the improving of the extension front, we would direct attention to what Mr. P. Leeds says about the experiments he made to find out what length produced the best results. There are probably many extension fronts in use that are too long. It would cost little to try the experiments made by Mr. Leeds, and it might be the means of reducing the coal consumption. The size of smokebox that was most satisfactory for his engines, might not be by any means suitable for locomotives operated under different conditions; hence the necessity for independent investigation.

For years the industry and ingenuity of inventors seemed to be devoted more to the designing of car couplers than to anything else. The production of new and improved car couplers is by no means ended to-day, as the weekly record of the Patent Office can testify, but the inventors in this line are not now very conspicuous. The invention that now monopolizes inventive industry is a fender for street cars. The Patent Office is hauling in lots of gold from this class of inventors at present. Of course, every patentee of a car fender thinks that he has got a perfect protection against people being run over by street cars, but the slaughter goes on all over the land. The multitude of inventors do not appear yet to have devised a car fender that is entirely efficient.

BOOK REVIEWS.

"Electricity up to Date; for Light, Power and Traction." By John B. Verity. New York: Frederick Warne & Co., Publishers. Price $1.

This book treats in a very interesting manner the development of electricity and electrical apparatus from the time when the first dawnings of this force were manifest until the present year of grace. The tentative steps are recorded and the most modern electrical appliances are illustrated and briefly described. The scope of the work is very wide, for it appears to deal with every department of science or industry to which electricity has been applied.

"Water and Gas Works Appliances" is the title of a book recently published by D. W. Wood & Co., Philadelphia. The purpose of the book is to supply information to parties who contemplate the building of water and gas works, and also to direct attention to the apparatus and appliances used in water and gas works handled by the publishers. The information given is very full and apparently reliable. The book is sent free to those interested.

The Baldwin Locomotive Works are at work on 60 compound consolidations for Russia. They will be shipped without tenders.

PERSONAL.

Mr. Fred Salisbury has been appointed engine dispatcher at Jackson, Mich.

Mr. P. M. Hammett has been appointed division master mechanic of the Boston & Maine, with headquarters at Boston.

Mr. C. H. Barnes, division master mechanic of the Boston & Albany, has been transferred from Boston to Springfield.

Mr. Frank Singer has been appointed master mechanic of the Midland Terminal Railway, with headquarters at Gillett, Colo.

Mr. Walter Layman has been appointed master mechanic of the Ohio River Railroad, with headquarters at Parkersburg, W. Va.

Mr. D. A. Smith has been appointed division master mechanic of the Boston & Maine, with headquarters at Somerville, Mass.

Mr. Ernest Messmer has been appointed foreman of the Lake Erie & Western Railroad at Muncie, Ind., succeeding Mr. J. T. Clark.

Mr. H. G. Hudson, of the Bellefontaine shops of the Big Four, has been appointed general foreman of the company's shops at Wabash, Ind.

Mr. W. A. Wolford has been appointed general foreman of the Bellefontaine shops of the Big Four. He was formerly a foreman in the Wabash shops.

Mr. Charles H. Grundy has been appointed general manager of the Marshfield & Southeastern, with headquarters at Marshfield, Wis., in place of Mr. A. A. Hopkins.

Mr. Henry M. Shepard has been appointed superintendent of the Unadilla Valley, in place of Mr. Charles N. Chevalier, resigned. Headquarters, New Berlin, N. Y.

Mr. M. F. Bonzano, late general superintendent of the South Jersey, has been appointed general manager of the Chattanooga Southern, with headquarters at Chattanooga, Tenn.

Mr. Wellington Sprague has been appointed superintendent of the Quebec division of the Maine Central, with office at Lancaster, N. H., in place of Mr. Geo. F. Black, transferred.

Mr. J. H. Hill, formerly secretary to General Manager Purdy of the Missouri, Kansas & Texas, has been appointed general manager of the Galveston, Houston & Henderson, with headquarters at Galveston, Tex.

Mr. Frank J. Zerbee, who has been general foreman of the Bellefontaine shops of the Big Four for the past year, has been transferred to the Michigan shops, with the title of master mechanic—office at Wabash, Ind.

Mr. Thos. J. Hennessey, traveling engineer of the Michigan Central, has been headquarters at Jackson, Mich. Mr. Hennessey was formerly general foreman at the same point.

Mr. Charles L. Martine, assistant superintendent of the Rumford Falls & Rangeley Lakes, has been appointed superintendent of that road, to succeed Mr. L. L. Lincoln, resigned. Headquarters, Rumford Falls, Me.

Mr. James McLaughlin, recently with the Philadelphia Engineering Works, has been elected secretary and treasurer of the Barr Pumping Company, Philadelphia. Mr. W. W. Lindsay is the general manager of the latter company.

Mr. John Medway, superintendent of motive power of the Fitchburg Railroad, has gone to Europe to make the "Grand Tour." He expects to see all the valuable features of the railroad shops noted for their progressive tendencies.

Mr. W. Cockfield has resigned as locomotive and car superintendent of the Interoceanic Railway, to accept the position of master mechanic on the San Luis division of the Mexican Central, with headquarters at San Luis Potosi, Mex.

Mr. Robert Burgess, assistant to Instructor F. M. Nellis on the Westinghouse Car, was married on May 12th to Miss Dora Gilmore, of Red Bluff, Cal. Mr. Burgess will represent the Westinghouse Air-Brake Co., at Atlanta, Ga.

Mr. T. E. Adams, late master mechanic at Barnesville, on the Great Northern Railway, has been promoted to be division superintendent of the Dakota division on the same road. Mr. Adams is one of the old-time engineers on that road, and his promotion is a well-deserved recognition of good work well done.

Mr. E. D. Bronner, the well-known master car-builder of the Michigan Central, has been appointed assistant superintendent of motive power of the road, with headquarters at Detroit, Mich. This is a change that has come about through the appointment of Mr. Robt. Miller to the position of superintendent of motive power.

Mr. Lucas Van Allen, for four years trainmaster of the Buffalo division of the Lehigh Valley, has been appointed superintendent of that division, with headquarters at Buffalo, N. Y., to succeed Mr. C. A. Beach, who resigned some time ago. Mr. Van Allen was formerly for ten years train dispatcher on the Buffalo division of the Erie.

Mr. Parley I. Perrin, long superintendent of the Taunton Locomotive Works, died at Taunton last month, in the eighty-fourth year of his age. He joined the Taunton Locomotive Works as draftsman and foreman in 1846. In time he was made superintendent, and eventually agent and treasurer—the position he held until he retired from active work.

Mr. E. V. Sedgwick, formerly master mechanic of the Mexican Central, and afterward for a short time locomotive and car superintendent of the Interoceanic Railway, has been appointed superintendent of motive power and machinery and superintendent of transportation of the latter road, and has resigned his positon with the Compañia de Ferrocarriles Industriales.

General Manager Hays, of the Grand Trunk, issues circulars sometimes that are calculated to make worn-out railroad men on less fortunate roads heavy with envy. He intimates appointments made to fill positions of men superannuated. The latest case of this kind is a notice that Mr. A. Butze has been appointed purchasing agent, in place of Mr. John Taylor, superannuated.

Mr. J. E. Cannon, one of the oldest engineers on the Great Northern Railway, with reference to service, has been promoted to the position of master mechanic on that road at Barnesville, Minn. The promotion of Mr. Cannon makes the tenth engineer taken from the ranks for elevation in the six years past—certainly a flattering tribute to the ability of the Great Northern engineers.

Mr. J. T. Odell has been elected president of the Butler & Pittsburgh Railroad, with headquarters at Pittsburgh. That railroad is an enterprise connected with the Carnegie steel interests, and is undertaken for the purpose of putting various steel works in Pittsburgh into close communication with Lake Erie. Mr. Odell has been for the last three years general manager of the New York & New England, and previous to that was on the Baltimore & Ohio.

Mr. W. H. Thomas, superintendent of motive power of the Southern Railway, announces that on account of the consolidation of the Southern Railway Company's shops at Atlanta, Ga., the jurisdiction of Mr. W. H. Hudson, master mechanic, is extended over the Third Motive Power Division between Atlanta and Central; and the jurisdiction of Mr. W. H. Owens, master mechanic, is extended over the Third Motive Power Division between Charlotte and Central.

Mr. C. P. Krauth, the genial treasurer of the McConway & Torley Co., Pittsburgh, has suffered a very severe attack of la grippe, and is still in very precarious health in consequence. He took a trip down the Mississippi River from Pittsburgh to New Orleans for the benefit of his health, and was greatly improved thereby. The trip occupied two weeks. He is now sojourning at Atlantic City, and expects to be well enough to attend the railway conventions at Saratoga.

Mr. S. D. Hutchins, the well-known engineer of the Big Four road and president of the Air-Brake Men's Association, has resigned his position to accept the position of assistant air-brake instructor on the Westinghouse Instruction Car. F. M. Nellis will have a good partner on the car now, and, he hopes, one not likely to get married on him, as Mr. Robert Burgess has. Sam's many friends among the enginemen of this country will have a chance to see him oftener than they formerly had.

Mr. Harry A Norton, who is at present traveling in Mexico in the interests of the Norton ball-bearing railway jacks, and "Sure Drop" track jacks, manufactured by A. O. Norton, of Boston, Mass., is meeting with good success in that country and sending in some good orders. He is expected home in time for the convention in June. Mr. Norton is an expert amateur photographer, and he expects to show his friends numerous amusing photographs illustrating life and scenes in Mexico.

Mr. W. F. Bradley, superintendent of the Toledo, Ann Arbor & North Michigan Railroad, has passed through a serious illness, but is able to be in his office again. Mr. Bradley takes a great deal of interest in the training of apprentices and in plans for the elevation of workmen. He has been much disappointed that his illness has prevented him from making the full investigations he wished to carry out in connection with a report to the Master Mechanics' Association on the Apprentice Boy.

Mr. C. H. Doebler has been appointed master mechanic of the Wabash Railroad at Fort Wayne, Ind., succeeding Mr. F. W. Morse, appointed superintendent of motive power of the Grand Trunk Railway. Mr. Doebler has been for the last five years master mechanic on the Big Four, with headquarters at Wabash, Ind. He is a graduate of the University of Pennsylvania, and entered the machine shops of the Pennsylvania Railroad at Fort Wayne after leaving college, and worked in the different positions until he was appointed master mechanic of the Big Four.

Mr. Harvey Middleton, general superintendent of motive power of the Baltimore & Ohio, announces several changes in the personnel of the mechanical department. Mr. A. J. Cromwell, superintendent of motive power, lines east of the Ohio River, has been relieved from active duty, and granted leave of absence for two months. Mr. I. N. Kalbaugh, formerly of Pittsburgh Division, takes Mr. Cromwell's place. Mr. Thomas Trezise has been appointed master mechanic of the Pittsburgh Division, with headquarters at Glenwood, Pa. Mr. W. H. Harrison, Jr., has been appointed division master mechanic at Newark, O., in place of Mr. E. L. Weisgerber, who has been appointed master mechanic at Mt. Clare shops in Baltimore, in place of Mr. S. B. Crawford, resigned.

In June, 1868, a meeting of twenty railway master mechanics was held at Cleveland, O., for the purpose of organizing an association of men belonging to their business. They signed a call inviting the master mechanics of the United States and Canada to meet in convention at Cleveland in the following September. Of the men who signed the call only four are now alive. They are Mr. Reuben Wells, now superintendent of the Rogers Locomotive Works; Mr. Wm. Swanston, master mechanic of the Pennsylvania Railroad at Indianapolis, Ind.; Mr. Jacob Losey, now superintendent of an iron forge at Louisville, Ky.; and Mr. Frederick Grinnell, now a millionaire and man of leisure at New Bedford, Mass. Mr. Grinnell was the first secretary. He was then master mechanic of the Atlantic & Great Western, now the N. Y., P. & O. portion of the Erie. He did not become a millionaire working as a master mechanic.

The Board of Directors of the Manhattan Elevated Railroad have appointed Mr. W. J. Fransioli acting general manager, in place of Colonel Hain, deceased. The appointment is an eminently sensible one, and will insure the carrying on of the business of the system in the able manner it has been conducted for the last fifteen years. Mr. Fransioli has been private secretary to Colonel Hain for seven years, and is thoroughly conversant with all the details of management. During the last two years he has practically been acting manager, for Colonel Hain's health unfitted him from active duties a great part of the time. Mr. Fransioli began work on the Elevated Railroad fifteen years ago as ticket operator and station agent. The accurate manner in which he performed his duties commended him for higher duties, and he was transferred to the general manager's office. The appointment is very popular with the employés of the system, who feared that a stranger might come in and bring a following with him.

About the time we last went to press, Mr. F. W. Morse, division master mechanic of the Wabash at Fort Wayne, Ind., was appointed superintendent of motive power and rolling stock of the Grand Trunk system, succeeding Mr. Herbert Willis, resigned. Mr. Morse is a very young man to be put into the highly important position assigned to him by General Manager Hays, but he has had an excellent mechanical training, and we have no doubt but what he will make a success in his new position. We have heard it said that, before Mr. Hays left the Wabash, the general manager of another railroad, who was looking for a head of his mechanical department, asked Mr. Hays' opinion of Mr. Morse. Mr. Hays answered favorably, but, recognizing the ability of his division master mechanic at Fort Wayne, wrote to him not to accept an appointment from any other road without consulting him. The negotiations that eventually led Mr. Hays to Montreal were then pending, and Mr. Hays wished to obtain the assistance of Mr. Morse. It is understood that Mr. Morse will make a searching investigation into the expense of manufacturing railroad supplies, which is done in the Grand Trunk shops to an extent far beyond anything done in other shops on this continent.

Franklin K. Hain, second vice-president and general manager of the Manhattan Railway of New York, was accidentally killed by a freight train at Clifton Springs, N. Y., last month. Three or four years ago Colonel Hain began to suffer from the effects of overwork, and he became gradually worse till about six months ago, when his suffering from nervous prostration was so great that he had to go to the country and take rest. For several months he had been in a sanitarium at Clifton Springs and was reported to be steadily improving. He was out walking when he was accidentally killed, while crossing the railroad. Colonel Hain began his railroad career by entering the Phila. & Reading shops as a machinist apprentice at Reading in 1853. After finishing his apprenticeship, he entered the United States Navy and served on shipboard for some time during the War. In 1863 he went to the Delaware & Lackawanna as draftsman, and left there to be a master mechanic of the Philadelphia & Erie, where he rose to be superintendent of motive power. From there he entered the service of the Baldwin Locomotive Works, and spent some time in Russia in the interest of this firm. In 1874 he left the Baldwin people to become superintendent of motive power of the Erie, a position he occupied for two years, and then went to be superintendent of the Keokuk & Des Moines. When that road was absorbed by the Chicago, Rock Island & Pacific, he was made a division superintendent of the latter road. In 1880 he was recommended by Mr. Morris Sellers as master mechanic to General Winslow, then general manager of the New York Elevated Railroad. He had only been performing the duties of master mechanic but a few weeks when General Winslow resigned, and he was appointed general manager in his place. Colonel Hain was very popular with all the employés of the Manhattan Elevated, and his untimely end is sincerely deplored by nearly all the men who were under his charge. Like many other successful railroad men, Col. Hain's weakness was the desire to attend to everything himself. He worked himself to death by details that might as well have been done by cheap clerks. His management of the road was highly beneficial to the company, but was of a character which soon drains the life of the strongest of men.

EQUIPMENT NOTES.

The Beech Creek Railroad have ordered 100 freight cars.

The Chicago & East Illinois have placed orders for 100 cars.

The Ohio River Railroad people have ordered four passenger cars.

The Philadelphia & Reading Railroad have ordered 15 passenger cars.

The Texas & Pacific have ordered 300 cars from the Mt. Vernon Car Works.

The Cotton Belt road are going to build large repair shops at Tyler, Tex.

The Munising Railway, which is under construction out of Cleveland, has ordered 200 flat cars.

The Lake Shore & Michigan Southern have ordered 250 freight cars from Madison Car Works.

The Pittsburgh Locomotive Works have received an order for one engine from the Dayton & Union.

Since we went to press last month, the Baltimore & Ohio have placed orders for 5,000 cars and 25 locomotives.

The Schenectady Locomotive Works are building four switching engines for the Hammond Co., of Chicago.

The Lima Locomotive & Machine Works have received an order for 50 box cars for the Atlantic & Danville.

The West Shore have ordered 250 freight cars, which will be equipped with vertical plane couplers and air brakes.

The Aberdeen & West End road of North Carolina are in the market for passenger train cars, freight cars and for locomotives.

The Burlington, Cedar Rapids & Northern are about to order 200 stock cars, three passenger engines for fast heavy freight trains, and four switching engines.

The Baldwin people have recently received orders for four locomotives from the San Francisco & San Joaquin Valley Railway, and two for the Wisconsin & Michigan.

The Delaware, Lackawanna & Western shops at Dover, N. J., are more crowded with repair work than they have been for four or five years. They are putting vertical plane couplers and air brakes on all cars that come in for repairs.

The mechanical department of the Erie have designed a new ore car of 80,000 pounds' capacity. None of the cars have been built yet, but it is expected that a trial car will soon be built in the company's shops at Susquehanna.

The Rogers Ballast Car Co. are building 400 of their combination ballast ore and coal cars for the Great Northern. The Great Northern have already a considerable number of these cars in use, and they are very much pleased with them.

Of late years the attendance of members and friends at the railroad mechanical conventions has been so large that it was difficult finding a place with a hotel that would accommodate all the people, and it has become customary to go to some watering place where very large hotels are available. There has always been a desire to have all those in attendance stay in one hotel, and the members of both associations have repeatedly sacrificed their own convenience to have their supply friends accommodated in the hotel selected as the headquarters of the meetings. They have repeatedly refused to go to places where the hotel proprietors were not willing to grant the same rates for supply men and others as they gave to members. This year we find that some of the supply men are active in recommending that people attending the convention should not stay at the hotel selected by the association. This is in bad taste, and is adopting a policy which may produce bad effects in the future.

Some months ago "Locomotive Engineering" had an article on Combustion, in which it was reasoned that anthracite coal could be burned more economically if a small proportion of bituminous coal was added to produce a luminous flame. The point was made that the flame would increase the radiation of heat to the firebox sheets, and thereby utilize a greater proportion of heat generated by the coal. The Jersey Central Railroad people tried the experiment of mixing about ten per cent. of bituminous slack with the anthracite coal, and it increased the steaming capacity of the locomotives so decidedly that the practice is now followed with all locomotives burning anthracite.

There appears to be a constant ebb and flow of railroad public opinion for and against doing manufacturing operations in railroad repair shops. We note that at present the tide is running in favor of "building our own rolling stock." We were talking to Mr. Paxson, of the P. & R., on the subject the other day. He has as much experience of doing new work on a large scale as anybody in the country. He always noticed where there was much new work under way that had to be done cheaply, that the cost of the repair work increased.

We have on hand about two thousand copies of Roger's "Air Brake Primer." This is not as good an air-brake book as it should be, and is not a good seller. We do not care to throw them away as they contain some very good information, and will give one to anybody who will send a two-cent stamp to pay for mailing.

New Baker Boiler.

There is in the Baker Car-Heater Works at Hoboken, N. J., a boiler shown in the annexed engraving, used for supplying steam to drive the machinery, which is a development of the well-known Baker heater used so much for railroad car-heating. A leading peculiarity of the Baker car-heater is compactness and the large percentage of the fuel heat imparted to the water. All kinds of pipe coils were employed as heat generators, and some of them were fairly efficient; but Mr. Baker found that a brass casting forming a top and bottom tube, with vertical tubes connecting them, made a still more efficient and compact generator. He determined to try that arrangement in a steam boiler for commercial purposes, and the boiler now in use in his works embraces the inventor's ideas of the most economical means for transforming the heat of coal into dry steam.

Mr. Baker was one of the first engineers to make a successful water-tube boiler, and therefore he is perfectly familiar with the line of improvement he is working upon. There are water-tube boilers used for supplying heat and steam for the Grand Central Station, New York, which were built by Mr. Baker thirty years ago.

The boiler in the shops at Hoboken has fourteen generators, which connect, as seen, with a combined water and steam drum. The water passes into the lower horizontal tube, which is close to the fire, and circulates up through the vertical connections into the upper tube and thence to the drum. On the top of the upper generator tube there is a lining of brick which divides the fire chamber. The fuel gases pass first below the brick and then return on the top, imparting the remaining heat to the drum and its connections.

The steam, on its way from the boiler to the engine, is passed through generators in the uptake and goes to the steam chest partly superheated.

The following are some data sent to us concerning the performance of the boiler:

Comparative Data, Baker Cast Copper Boiler, 50 H. P., and 50 H. P. Horizontal Tubular Boiler.

HORIZONTAL TUBULAR.

Cubic Feet Occupied.	Feet Heating Surface.	Weight, lbs.	Area of Grate.	Quality of Steam.
1,123	750	20,000	13 ft.	2% of Moisture
BAKER BOILER.				
366	210	6,000	13 ft.	Dry

Equivalent to a saving of 69% in space occupied and 70% in weight.

Comparative Data, Baker Cast Copper Boiler, 100 H. P., and Babcock & Wilcox 100 H. P. Boiler.

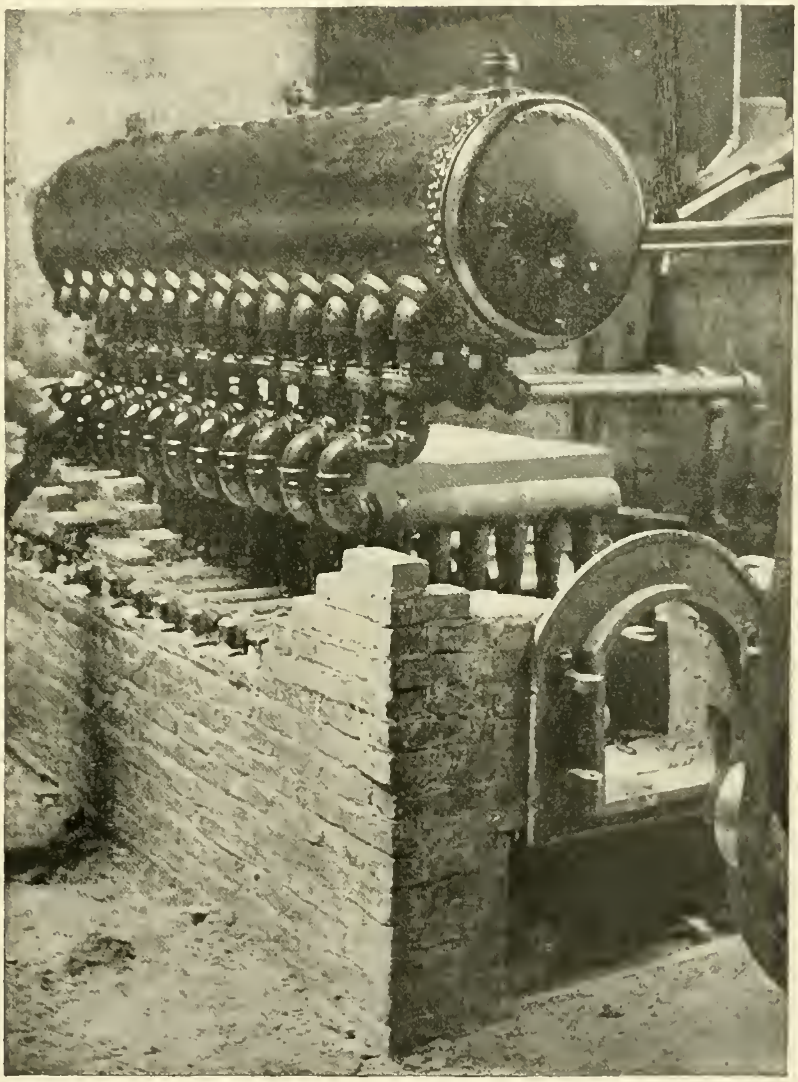
BABCOCK BOILER.

Cubic Feet Occupied.	Feet Heating Surface.	Weight. lbs.	Consumption of Fuel per H. P. per Hour.
1,970	1,148	29,000	3.75 lbs.
BAKER BOILER.			
960	420	12,000	2.50 lbs.

Equivalent to a saving of 51% in space occupied, 58% in weight, and 33% in fuel consumption.

Note.—Fuel consumption on developed H. P. shows an evaporation of 12 lbs. water per lb. coal.

Pyrometer Test of Baker Boiler.—Temp. of furnace, 2,000 degrees; temp. of chimney gases, 250 degrees; percentage of loss, 12½.



Fort Wayne Railroad Shops.

The Pennsylvania Railroad shops at Fort Wayne, Ind., are in some respects the most interesting railroad shops in the country. They were built in 1863, after designs prepared by Mr. Isaac Dripps and put up under his supervision. They formed for years the model on which repair shops were built all over the country, and it is doubtful if any better general plan has ever been devised. They were built on what is known as the parallel plan of buildings, the different shops being served by transfer tables. The transfer tables operated by hand were very troublesome, and frequently required half the shopmen to move them, which tended for a time to bring the use of transfer tables, and the plan that called for them, into disrepute; but the introduction of electric motors to drive transfer tables has overcome the objection to their use, and I notice that in the latest designs of repair shops the transfer table is an important feature.

The erecting shop and machine shop occupy a large rectangular building, with erecting pits at one side and the machine tools on the other. In many respects the shop is as good and as convenient as any shop built within the last five years. The principal drawback is want of overhead cranes—an apparatus not thought of in this country thirty-three years ago. The absence of overhead cranes is to some extent compensated for by the use of hoists and swing cranes. As they perform heavy repairs on about twenty locomotives a month, and do considerable new work, the want of traveling cranes must keep the expense higher than it might be.

Many of the machine tools are not so modern as could be desired; but one cannot watch the work going on without being convinced that few shops can compete in cost with the work turned out here. The tools are all well speeded up, and numerous labor-saving devices are in use for facilitating operations. I understand that many jigs, formers, cutters, box drills, etc., that have been illustrated as originating in other places, had their genesis in this shop, which was the pioneer in the production of truly interchangeable parts. This species of production for railroad rolling stock was developed by that superb mechanic, Mr. James M. Boon, long before any other railroad shop attempted to do such work, and before other master mechanics appreciated the advantage of interchangeability.

All the shops are very well conducted; but the blacksmith shop, which is in charge of Mr. George A. Linz, presents the most attractions to a visitor looking for novelties in mechanical operations. I have visited all the leading railroad shops and all the locomotive building shops in the country, and have always watched the methods followed in the blacksmith shops, and I frankly admit that I have never seen anything approaching the labor-saving appliances in use in the Fort Wayne shop. They not only have the ordinary run of formers used in connection with bulldozers, bolt headers, Bradley hammers and steam hammers, but they have a variety of apparatus which receive motion from the machines to which they are attached, and perform most complex operations on the hot iron or steel. This blacksmith shop is full of mechanism designed to aid the work of turning rough metal into finished shape. The inventive mechanic has made this shop the best in the country for doing iron forgings cheaply, and the brain work represented has exercised a very material influence in reducing the cost of repairs.

I cannot well go into details without drawings or photographs to aid me in describing the tools and their operations; but I shall attempt to describe how one job was done, and it is representative of many others. There is on the drawbar rigging of the Pennsylvania Railroad cars a wrought-iron sleeve 6 inches long, the hole 2⅛ inches diameter, with a flange at one end 6 inches diameter. They used to get these things made of cast steel at an expense of 60 cents each. They are now making them of wrought iron at a cost of 22 cents. They take a piece of round iron about 9 x 3½ inches, and, after heating, put it in a matrix on the anvil of the steam hammer. One blow of the hammer crushes the metal into the shape of the flanged sleeve, but solid. Another blow with the punch attached to the steam hammer, punches the hole. The blank is then taken out and the flanges pared at one operation, and the job is finished. Time, about half a minute.

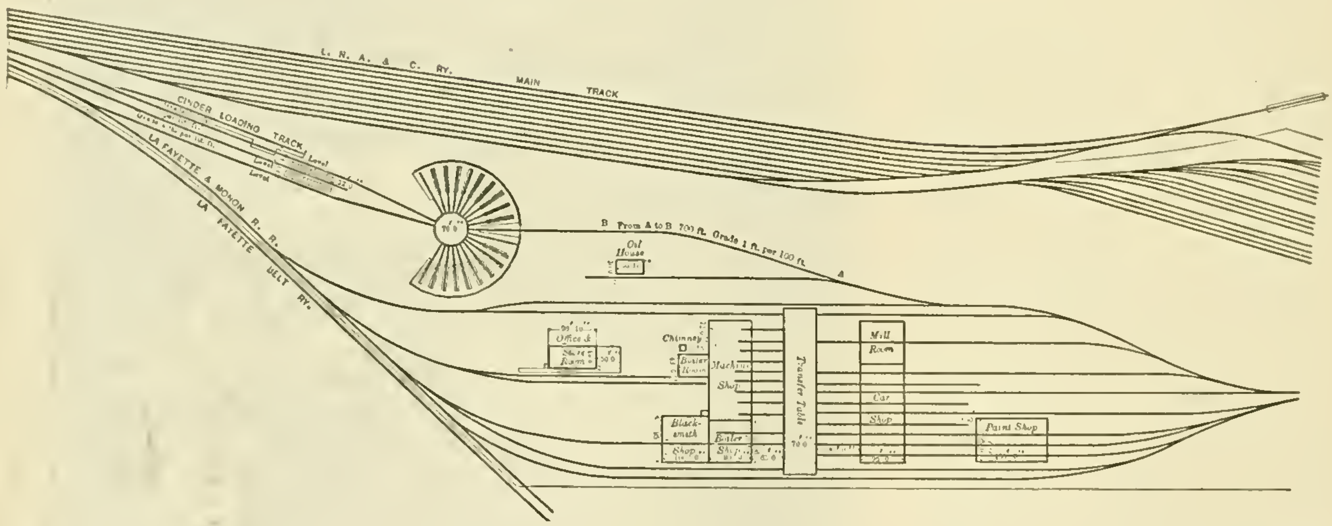
There are other attractions besides formers in this blacksmith shop. They have a special form of furnace for heating milling cutters, taps, dies and other steel pieces that require great care in tempering. It is really what metallurgists call a "muffle," being a box made of firebrick, which can be kept easily at the temperature required. The heat is so uniform that the articles nearly always come out free from distortion.

They have an apparatus for holding reamers, etc., between centers while being dipped for tempering. It guides the article straight down into the water, and it always comes out straight.

These shops have always been in charge of famous mechanics. As mentioned, they were built under the supervision of Isaac Dripps, who was in charge for several years. When he retired, full of years and rich in engineering fame, he was succeeded by James M. Boon. He, in the course of time, was called to what was considered a higher position, and F. D. Casanave took charge. The success which he achieved in the management of his curtailed department commended him for a higher position, and he was called away from Fort Wayne to be made general superintendent of motive power of the whole Pennsylvania system. His successor, George L. Potter, bids fair to make his mark as strongly as his predecessors.

While in Fort Wayne I learned of a pleasant action which was very characteristic of the Pennsylvania Railroad Company. Electricity is coming into increasing use in shops and in connection with train operating, and it was considered desirable that the chief electrician should be informed of all the latest developments in the business. The usual plan would be to employ an electrician fresh from an electric apparatus manufacturing establishment. The Pennsylvania people were more generous. They sent the electrician, who had been in their employ for years, to the Westinghouse Electric Works at Pittsburgh, and paid his salary and expenses for six months while he was getting posted.

A. S.



Louisville, New Albany & Chicago Shops.

For years the repair shops belonging to the Louisville, New Albany & Chicago Railway held the distinction of being the worst-crowded, the poorest-equipped and the most badly-arranged shops in the West for doing the work required. We know of shops to-day which are behind what the New Albany shops were at their worst, but they are on the Atlantic seaboard and are not far from congenial company. Things that are called bad in the West sometimes pass as respectable in the East; but there was little good to be said about the New Albany shops, even by means of odious comparisons, and so the time came after long waiting for new shops to be built and the old ones deserted. It was about two years ago that the management determined to build new shops at Lafayette, Ind. Plans were carefully prepared, and shops of a very convenient and substantial character were built about a year ago, which are models of convenience for a small repair plant. The arrangement of the shops can be understood very easily from an examination of the accompanying plan.

The buildings are all of red brick, set on substantial stone foundations. They have iron truss roofs, and every detail of flooring, drainage, lighting and heating is after those of the most approved in use. Mr. H. Watkeys, the master mechanic, and Mr. C. Coller, the master car builder, both speak very enthusiastically about the convenience and comfort of the new shops.

The shops of both departments are kept clean and neat, and the indications are that the work is all turned out in first-class shape.

Wages in Foreign Countries.

Some suggestive and important information is to be gathered from a book just issued by the British Board of Trade, giving the statistics of wages paid for manual labor in Great Britain. From this it seems that the average earned by men is $6.03 a week; by women, $3.08; by boys, $2.24; and by girls, $1.56. These are the averages of the wages of 816,106 persons. In Scotland the rates are lower than in England by 10, and in Ireland by some 20 per cent. The best-paid trade is that of builders, and then, in order, distillers, brewers, metal workers, engineers, saw-mill workers, coach builders and printers. Railroad men average $5 a week. The chances of earning $10 a week are not common; 37 per cent. of the printers, 33 per cent. of the tinplate workers, 13 per cent. of the ship-builders, 11 per cent. of copper and brass workers and 10 per cent. of coopers attain that amount. On the whole, the report indicates that wages in British trades are on the increase, but at a very slow rate of progress.

The wages paid to mechanics in Germany are still lower. According to a writer on German industrial matters, men working at the vise earned 15 to 21 marks ($3.60 to $5.04) per week; their foremen, $5.28 to $6.72; drillers, working on time, $3.60 to $4.56. "Piece workers" made considerably more. A specially skilled workman "would receive as much as 40 marks ($9.60) per week." It thus appears that the highest wage of the most skilled operative slightly exceeds the lowest wage for unskilled labor in this country. The home life of the men is shown to be on a plane far below that of the average wage-earner in America.

The Bass Foundry.

The Bass Foundry at Fort Wayne, Ind., which was long famous for the casting of good car wheel and other railroad castings, has been gradually expanding out into a general engineering establishment, until now the company are building some of the heaviest steam engines ever turned out on this continent. They still, however, cling to their specialty of making fine castings, and their repute in this line is so high that they make the largest castings used by such concerns as the Ellis Company, Milwaukee.

The Bass Foundry, which is now a huge concern, has a forge which is gaining repute almost equal to the foundry. Some of the forgings made are of enormous size, and they are noted for their exemption from defects. Most of the forgings are made from railroad wrought-iron scrap, which is reputed the best to be found. The company obtain most of this scrap in exchange for new wheels.

Coal Fields in China.

A recent Consular report says:

"There are symptoms indicating that the Chinese near Peking are awakening to the advantage of employing foreign engineering knowledge and machinery. Considerable coal fields extend over a vast area of the mountains north and west of the capital, at a distance of about 100 li (35 miles) from it. They have hitherto been worked by the stereotyped, irrational, mole fashion, so characteristic of Chinese. When the natives discovered the coal seams on the sides of the mountains they commenced digging into them, and in some places they have penetrated as far as 8,000 feet, in others only a few hundred feet, when they were stopped by water, with which difficulty they have been entirely unable to cope, and the mines have consequently, in many cases, been abandoned. We are glad, however, to hear that some rich Chinese, stirred by the railway movement, have entered into contracts with a foreign engineer to develop the mining possibilities of the northern districts.

"China's coal fields are exceeded by none but those in America, and in a more distant time they will have equal effect on the commerce and manufacture of the world. The cost of sea freight has been low enough to allow the coal to be carried to distant countries and sold more cheaply than coal from nearer sources, but the construction of railways, the improvement of navigable rivers and other means of transport are, in many countries, entirely altering the conditions of the coal trade, and in Japan, India, and Australia the native coal is rapidly superseding the imported coal, and the same change will eventually take place in South Africa and in China when the coal deposits are developed."

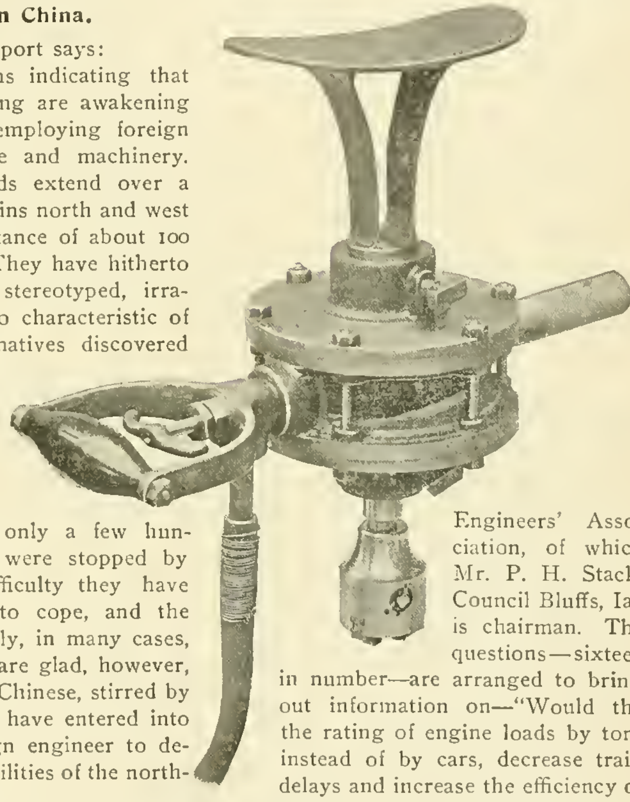
Air-Driven Breast Drill.

Chas. H, Haeseler & Co., of Philadelphia, Pa., are introducing the air-driven breast drill shown in our engraving.

This little tool is designed to take the place of the ordinary breast drill and the ratchet drill, as used for light work. It is designed to drive drills up to ½-inch in diameter, and will bore a $\frac{5}{16}$ hole through 1 inch of cast iron in 1 minute.

The machine only weighs 18 pounds, which makes it easy to handle, as no work is required of the operator except to hold it.

The drill comes complete as shown, with three-jawed chuck for holding drills up to ½ inch diameter.



The method of arranging train loads for locomotives is the subject of a circular sent out by a committee of the Traveling Engineers' Association, of which Mr. P. H. Stack, Council Bluffs, Ia., is chairman. The questions—sixteen in number—are arranged to bring out information on—"Would the the rating of engine loads by tons instead of by cars, decrease train delays and increase the efficiency of the power, and what is the best method of equalizing the difference between empties and loads?" As far as we are aware, all the railroad companies that have adopted the ton loads instead of car loads have increased the efficiency of their locomotives and improved the regularity of their train service. If the committee is able to demonstrate the extent to which this has been done, they will perform a good service for railroad companies generally.

Mr. Frank Singer, master mechanic of the Midland Terminal Railway, in a recent letter writes: "I desire that every man keep posted on the improvements that are now going on; hence, I will endeavor to have each man subscribe for your journal."

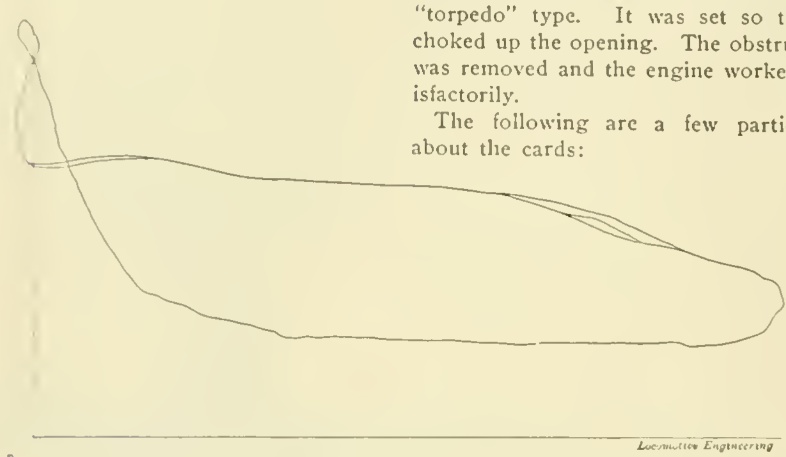
There will be a large air tool exhibit at the M. M. Association Meeting at Saratoga in June.

Where An Indicator Told Something Useful.

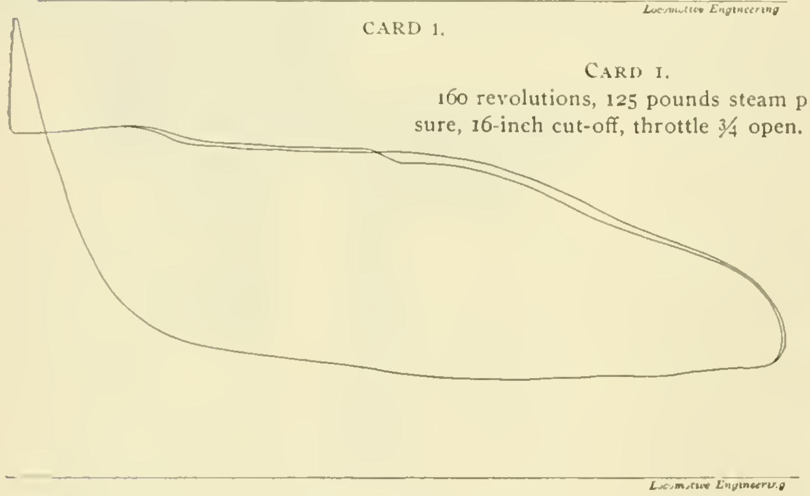
A railroad in Pennsylvania received a locomotive with cylinders 20 x 24 inches, which was built by one of the leading locomotive builders. She seemed to be a first-class engine in every respect, but when put to work she would neither run nor pull to the extent expected. The master mechanic, a very intelligent man, examined the engine very carefully and could find nothing wrong; but still it was apparent that the engine was suffering from some internal defect. As the most direct means of getting at the seat of the trouble, he borrowed a steam-engine indicator and applied it to the engine.

The indicator diagrams shown are a fair specimen of about twenty that were taken. They are full size, and were taken with a Tabor indicator spring, 64 pounds. It was apparent that the exhaust steam was meeting with some bad obstruction in its way from the cylinders to the atmosphere. A single exhaust pipe was used, and inside was a variable exhaust of the "torpedo" type. It was set so that it choked up the opening. The obstruction was removed and the engine worked satisfactorily.

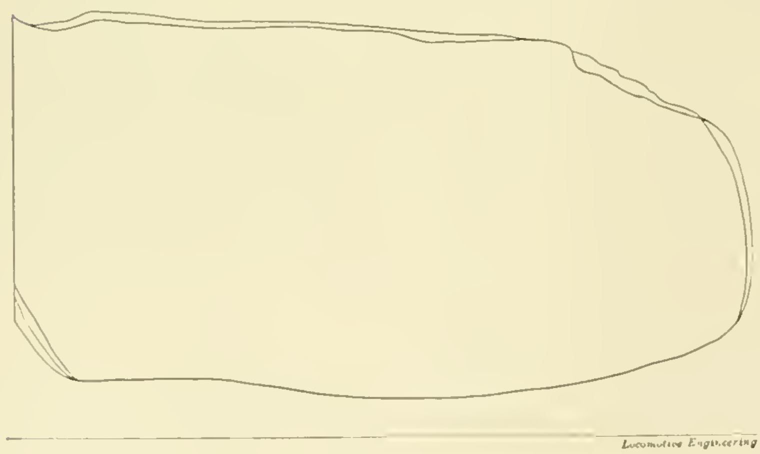
The following are a few particulars about the cards:



CARD 1.



CARD 2.



CARD 3.

CARD 1.

160 revolutions, 125 pounds steam pressure, 16-inch cut-off, throttle ¾ open.

CARD 2.

160 revolutions, 140 pounds steam pressure, 16-inch cut-off, throttle full open.

CARD 3.

110 revolutions, 160 pounds steam pressure, 20-inch cut-off, throttle full open.

More Evidence on the Age of Extensions.

Mr. A. A. Daniels, general foreman of the C. & O. S. W. shops at Paducah, Ky., writes, too late to get into the regular department, as follows:

I notice in your last number (May) that in answer to an inquiry as to when, and by whom, the extension front spark-arresting device on locomotives was first used; also noticed the article by Mr. Waitt, claiming it to be first used on the Boston and Maine road about 1880.

Now, I had always supposed this invention brought out on the old Hartford road (now the Springfield division of the New York, New Haven & Hartford Railway.) I know of this being used on the Hartford road as far back as 1870, and think it had been in use there then two or three years. I moved from Springfield to New Haven in 1875, and Mr. Kittendorf (now dead), master mechanic of that road, had the device on nearly all of the engines between New Haven and New York. Mr. Pulaski Leeds, of the L. & N., should be able to give you some information regarding it, as he was running an engine there then.

I went on the Long Island road in 1878, and out of fifty-four engines there were only three engines—Nos. 49, 17, and 34—which did not have the extension front. Mark Brear was then master mechanic, and Thos. Kearsly, now superintendent of motive power of the New England road, was then machine-shop foreman. He could probably tell you when it was first used there.

I have heard the name of the man whose invention it was supposed to be, on the Hartford road, but have forgotten; but there should be old-timers there who do know. Possibly, Mr. Henney could give you the information. Mr. Congdon, who was superintendent of motive power of the Union Pacific at one time, tried it there. I think he came from the Hartford road.

Suppose you make some inquiries on the New Haven road? You will be paid for the trouble in settling the question.

Utility of Boring and Turning Mills.

Mr. E. E. Davis, assistant superintendent of motive power of the Philadelphia & Reading, writes us:

"Since that article on the P. & R. shops in Reading appeared in "Locomotive Engineering," I have received several letters asking for information regarding the new 37-inch Bullard boring and turning mill recently placed in our Reading shops. As doubtless there are others of your readers who would like to know about the machine, I will use, with your permission, the columns of your paper to inform them.

"It seems to many people that this kind of a machine is a foreigner in locomotive work; but if I were to equip a new shop, or select some new tools for an old one, I would certainly have a few boring and turning mills and fewer lathes. I also think that one-half of the work that is now done on a lathe can be done on the mill in from one-third to one-half less time, and be more satisfactory when completed.

"The mechanics in our shops like the mill very well, as it is much more convenient to get the work on and off the table of a mill than it is to fasten it to the faceplate of a lathe. The mill is more rigid than many of the lathes, and two tools can be used on most of the work at one time.

"Then, note the difference in the cost of manufacture of work now being done on the mill that was formerly done on the lathes, planers, etc. On work taken from the lathes, such as cylinder heads, eccentrics and eccentric straps, hub liners, etc., there has been a saving of 34 per cent. Work taken from the slotting machine, such as the ends of driving-box brasses, etc., shows a difference in favor of the mill of 61 per cent. Work taken from the planer, such as facing locomotive slide valves, has been reduced 22 per cent."

During the time that the Committee of the Master Mechanics' Association on Slide Valves was experimenting on the locomotive of Purdue University, Mr. G. R. Henderson, mechanical engineer of the Norfolk & Western, delivered a highly practical address to the students. He dwelt on the difficulties they would encounter when they left college and entered upon the practical work of drawing and designing machinery. Recommendations were made that they obtain as much shop experience as practicable, which would provide guidance against expensive mistakes in the drawing office. The necessity for and importance of avoiding new designs when possible was urged upon the minds of the students, and explanations were given of the extra expense for patterns and increase of stock that resulted from the introduction of new designs. The address called forth frequent applause and seemed to be much enjoyed.

The Norfolk & Western employ only one form of coil spring for all their cars, no matter what the capacity of the car may be. They adapt the springs to the capacity of the car by the number of coils put in. For a 40,000-pound car four coils are used, for a 50,000-pound car five coils, and for a 60,000-pound car six coils.

A new track-sanding device has been invented and patented by Hugo Tirmann, Cleveland, O. It consists essentially of a sand pipe and blast chamber communicating with the sand box, having an opening at its upper chamber communicating with the receiving end of the sand pipe.

Using the Interstate Commerce Law Against American Interests.

The Interstate Commerce Law is in danger of becoming even more odious to American railroad interests in the future than it has been in the past, owing to a decision of the United States Court on an import dispute. The court has decided that a railroad company may transport imported goods at lower rates than goods originating in the United States.

Judge Harlan dissented from this decision, and expressed himself in rather plain terms about what the decision really meant. Some of his dissenting views read:

"If the discriminations shown in this case, where American goods were charged, from New Orleans to San Francisco, three or four times more than for the entire service from Liverpool through New Orleans to San Francisco, can be made, or if any difference in rates can be allowed, then all the railroads in the United States may and will indulge in like practices. If such discrimination by American railways, against goods, the product of American skill, enterprise and labor, is consistent with the Act of Congress, then the title of that act should have been one to regulate commerce to the injury of American interests and for the benefit of foreign manufacturers and dealers. It the position of the Texas & Pacific Railway Co. is sustained, inland rates on foreign goods for transportation in this country will be so much lower than rates on American goods and products that the owners of foreign goods and products may control the markets of this country, to the serious detriment of vast interests that have grown up here and in the protection of which against unjust discrimination all of our people are deeply concerned.

"Does any one suppose that if the Interstate Commerce Bill, as originally presented, had declared in express terms that an American railroad company might charge more for the transportation of American freight between two given places in this country than it charged for foreign freight between the same points, that a single legislator would have sanctioned it by his vote? Does anyone suppose that an American President would have approved such legislation? No one would expect such a bill to pass an American Congress. If not, we should not declare that Congress ever intended to produce such a result, especially when the act it has passed does not absolutely require it to be so interpreted."

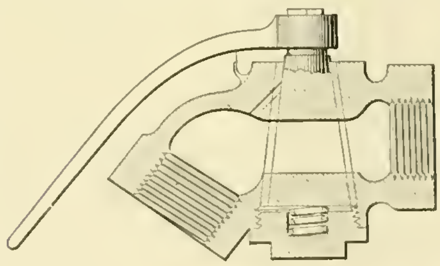
The learned justice gives an illustration of two lots of freight at New Orleans for San Francisco, one lot manufactured in this country, the other, goods of like kind, made in Europe and shipped through on a through bill of lading; and also of two passengers at New Orleans for San Francisco, one an American, the other a foreigner coming from Europe on a through ticket for San Francisco. The railroad company contends that it may, under the act to regulate commerce, carry the foreign freight or passenger from New Orleans to San Francisco for less than it charges for carrying the American freight or passenger from New Orleans to San Francisco, on the ground that, because of competitive routes from Europe to San Francisco, it will otherwise lose the traffic.

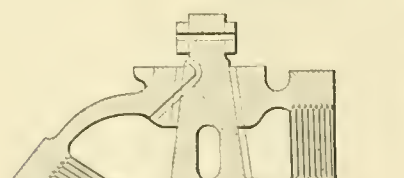
"Such an interpretation enables the great railroad corporations of this country to place American travelers, in their own country, as well as American interests of incalculable value, at the mercy of foreign capital and foreign combinations—a result never contemplated by the legislative branch of the Government.

"Congress, by enacting the Interstate Commerce Act, did not seek to favor any special class of persons, nor any particular kind of goods because of their origin. It intended that all freight of like kind, wherever originating, should be carried between the same points, in this country, on terms of equality."

A Simple and Effective Safety Angle Cock.

Skinner & Hutchins have reduced their safety angle cock to a simple form, which contains a single port and is devoid of all complicated mechanism. The accompanying cut is self-explanatory and renders further explanation unnecessary.





Locomotive Engineering

This cock has given satisfactory service trials on the Big Four road, and, in consequence, has been adopted by that system. Railroads desiring a safety angle cock should correspond with the manufacturers, who will be glad to furnish further information regarding their device.

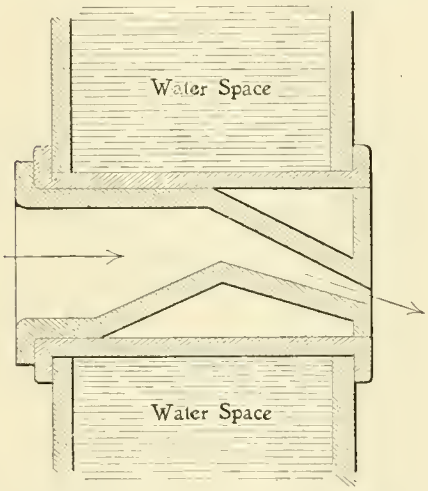
The three educational charts, engine, car and air brake sent to one address for 50 cents.

An Improvement in Combustion Flues.

On the Columbus, Sandusky & Hocking road they are using a peculiar bush in the combustion tubes on the side of the fireboxes, the design of General Foreman P. T. Bancroft, for which they claim very excellent results.

Our engraving will make the device perfectly clear. The ordinary 2-inch combustion tube is used through the side of the firebox for admitting air. Into this tube they push a cast-iron thimble, shaped as shown in our engraving. The interior of this is a nozzle, tapers toward the fire, and has a bend in it as shown. It is claimed that air is thus forced further in the fire and deflected down toward the grates, with very excellent results.

It will be plainly seen that by turning the bushing either one way or the other,



the jet can be turned not only toward the grates, but forward or back.

Our engraving shows only a cross-section of the tube. The opening of the nozzle is flat, and is perhaps somewhat larger than is shown in this view.

As this device is simply a cast-iron thimble it is extremely cheap, and if there is anything in it it is worth trying.

There are those who believe that great economy is secured by admitting air around the firebox.

Mr. Bancroft has applied for a patent on his improvement.

How to Decrease Coal Consumption.

A committee of the Traveling Engineers' Association, of which Mr. J. W. Sheldon, Renovo, Pa., is chairman, has sent out a circular to obtain information on—"What is the Best Incentive to Offer Enginemen to Decrease the Coal Consumption?" Among questions asked are:

"1. Do you allow any premiums to enginemen for economy in the use of coal? What advantages and disadvantages do you find in this method?

"2. Please give full account of computing the amount due, to whom paid, the average per month paid for highest efficiency, and the proportion of enginemen to whom premium is paid.

"3. If you do not use the premium system, what method do you use to secure the most economical use of coal?

"4. Is coal mileage per ton based on engine miles or car miles?

"5. Do you allow mileage on way freight trains for switching and other work outside of the straight mileage made?

"6. Where economy in fuel is given close attention, is the same close attention given to the condition of boiler as to scale and mud, leaky flues, defective packing or valves and other defects? That is, should not an engine crew trying to make a good record be encouraged by keeping the engine in good shape for them to do this?"

The circular intimates that the premium system has its advocates and opponents, and the committee desires to find out the impression of people informed on this subject. Economy of fuel is one of the great living questions that seems always to be with railroad companies, without receiving a satisfactory solution. The premium system has been tried repeatedly, and as often given up for various reasons.

There is no doubt whatever that much coal is wasted on account of careless firing, and on account of carelessness in the handling of locomotives; and the restraining of these loose methods is an important duty of the traveling engineers to perform. We think, however, that the root of the evil is beyond the power of the traveling engineer to remedy. It comes from the loose methods that prevail all over this continent in the measuring of coal. When the quantity of coal put upon a tender is merely an approximation of the reputed weight, it is unjust to hold any one strictly responsible for a seemingly large expenditure of fuel per mile run. If those who are responsible for the arrangement of railroad coaling stations would take up the question seriously of how the quantity of coal delivered to locomotives can be most accurately measured, their efforts might bring forth fruits in economy much greater than what is possible on the part of all other railway officials combined.

A committee of the Traveling Engineers' Association, of which Mr. M. W. Burke, Moberly, Mo., is chairman, has sent out a circular to secure information on "The Proper Operation of, Care and Instructions Concerning Sight-Feed Lubricators." This is an important subject in relation to the economy of fuel, and it has never before received much attention. The questions asked in the circular are quite comprehensive, and if responded to by members will bring forth facts which will make a valuable report for the next convention.

Universal Construction Company.

Mr. W. H. Sterling, who was long connected with the Illinois Steel Company, and is now president of the Universal Construction Company, Chicago, writes us that his company are going into the manufacture of structural steel at once, and probably bridge-building and metal-car construction. He says:

"We have leased the plant that is known as the North Works of the Illinois Steel Company, situated on the Chicago River near Elston and North avenues. It is our purpose to manufacture beams and structural material of all shapes and sizes, and of such standard quality and workmanship as shall be in every way fitted for use in first-class structures of various kinds.

"Mr. Fred Heron, general manager of our company, has been for nine years in charge of the plant of the Phœnix Iron Company, at Phœnixville, Pa., whose reputation is well established. Mr. Edward Haupt, secretary of the company, has also for many years been connected with the Phœnix Iron Company, and is thoroughly familiar with the requirements of the trade."

Increasing Foreign Demand.

The Foster Engineering Co., of Newark, N. J., in addition to their current railroad business, have recently received large orders from Europe. Amongst others they report twenty-five air-brake pump governors, and valves for the steam-heating of trains, shipped to Alex. Freedmann, of Austria. This house is probably the leading manufacturer and dealer in railway supplies on the Continent. A full line of valves has been ordered by W. H. Bailey & Co., of Manchester, England, manufacturers for the Admiralty, War and Indian offices. A good home demand is also noted for the Foster inside safety check for locomotive boilers. This increased foreign and domestic business has more than taxed the facilities of the Foster Company's works at Newark, which they have just enlarged by the addition of a new assembling and testing room and a new pattern shop.

Congress has recently passed a bill permitting the Pintsch Compressing Company to lay pipes through the streets of Washington, D. C. This will be a great convenience to the many railroads centering in Washington. Several of them use Pintsch gas, but it is such a hard matter to get any pipes laid in the streets of the Capitol City that they have been obliged to draw their supply from some other part of the road, or have plants of their own. Now all the roads centering in Washington can get Pintsch gas from one works. They will also furnish gas for lighting the buoys in the Potomac River.

The St. Louis Steam Engine Co., St. Louis, Mo., have put on the market a very neat air compressor that has some advantages over the ordinary machine for shop work. It is driven by a vertical steam engine and is itself a vertical machine, in appearance much like its motor, and located on the same base plate. The air cylinder is water-jacketed both on the heads and sides. The cranks are set quartering, so that the engine is developing the most power at the moment the compressor is required the most. One of the great advantages of this form of compressor is that it can be run at night or on holidays without running the main engine and line shaft. Many tools are now driven out of hours by small air engines, and an independent compressor at such a time is the most economical and convenient.

The Jones & Lamson Machine Company, of Springfield, Vt., have recently shipped flat turret forming lathes to the following railroads: Illinois Central, Chicago; Cleveland, Cincinnati, Chicago & St. Louis, Indianapolis; Chicago & Northwestern, Chicago; also to the Peckham Motor Truck & Wheel Company, Kingston, New York; the Cambria Iron Company, Johnstown, Pa., and the Reading Iron Company, Reading, Pa., besides two machines to a Russian gun factory and three machines to Germany.

The Grand Union Hotel (the largest hotel in the world), at Saratoga, N. Y., will open on June 15th for the Master Mechanics' and Master Builders' Conventions, and for these occasions makes a special rate of $4 per day. The Grand Union is located directly opposite headquarters of conventions, and has a number of choice apartments which may be secured for the conventions through correspondence.

Very few mechanics know how to take care of new files, or any other files for that matter. The Arcade File Works, who are manufacturers of an improved increment-cut file, have issued a little book which gives a lot of information about how to use and how to take care of files. It is given away. If you want one, write to them at 97 Chambers street, New York City.

The New York Belting & Packing Co. have equipped a train of Wagner palace cars with their rubber tiling, and it has a very handsome appearance. There are several reasons why this material will soon become popular for the covering of floors: It looks well, is particularly durable, and is far less likely than carpets to hold dirt and disease germs.

Judge Dallas, of the United States Circuit Court for the Eastern District of Pennsylvania, filed an opinion on the 6th ult., granting the Ewart Manufacturing Co. a preliminary injunction against James H. Mitchell, restraining the latter from the manufacture of an infringement of the plaintiff company's patent chain, which is known as the "Dodge Chain," and which is legally manufactured by the Link-Belt Engineering Co., of Philadelphia, and the Link-Belt Machinery Co., of Chicago.

One of the pleasantest rides in the hot season is found between Cleveland and Detroit, by Put-in Bay and Toledo, over the lines of the Detroit & Cleveland Steamboat Company. It is cheaper and cooler than railroad traveling, and the round trip makes a very nice vacation outing.

Henry L. Leach, of 176 Huron avenue, Cambridge, Mass., has gotten out a model instruction apparatus to show his pneumatic track-sander. This is a complete sander with hose connection, loaded and ready for business, and only costs $4. No air-brake instruction car or room is complete without one.

Two very attractive illustrated catalogues have been issued by B. F. Sturtevant, Boston, within the month. One deals with ventilating and heating; the otner treats of forges. As usual with catalogues published by this firm, the two latest both contain valuable information on the subject treated. That treating on heating and ventilating constitutes an epitome of information on the subject, and ought to be within reach of every official who has anything to do with the heating or ventilating of buildings.

The April issue of the Boston Belting Co.'s illustrated catalogue is a very attractive and artistic production, with the cover printed in colors. It is devoted almost exclusively to the illustration and description of rubber goods, and contains much interesting information about the care of this material.

Mr. E. S. Marshall, formerly master mechanic of the Saint Louis & Southwestern Railroad, has been made assistant manager of the Railway Equipment Company, of St. Louis, who manufacture and sell the Houston track-sanding device, the economical slack adjuster and several other railroad devices. Mr. Marshall is also manager of the railroad department of the Missouri Malleable Iron Company, of East St. Louis, Ill.

Watson & Stillman Hydraulic Company, 204 West Forty-third street, New York City, have issued a new supplementary catalog of their jacks, crank-pin presses, wheel presses and rail benders for use on railroads. It can be had on application.

We are informed that the Gould Car Coupler Co. are meeting with considerable success in the introduction of their coupler and platform on European railways. They do not despair of being able eventually to get all railway companies to abandon the use of side buffers, which increase the resistance of trains under certain circumstances.

The General Agency Company have moved from 32 Park place to 168 Broadway, where they have very pleasant quarters. This concern has within the past two years made a great success of the Smith exhaust pipe, which they have been pushing.

There are two exceptionally heavy steel castings to be seen at present in the shops of the Shickle, Harrison & Howard Iron Co., St. Louis, Mo. One is the rim of a large gear wheel, made for the Fulton Iron Works, of St. Louis. The diameter of that rim is 14 feet 4½ inches, and it weighs over 20,000 pounds. The other is a frame of 10-foot reach riveting machine, made for the Baird Portable Machine Co., Topeka, Kan.; that casting weighs over 20,000 pounds also. The Baird pneumatic riveting machine will be used mostly on locomotive boilers.

The Erie Railroad Co., after careful investigation and the consideration of a number of plans, have contracted with the Dodge Coal Storage Co., of Philadelphia, Pa., for a 150,000-ton storage plant at East Buffalo, N. Y. The coal will be stocked in nine divisions or piles, each of about 17,000 tons capacity. The plant will be constructed under the patents of the well-known Dodge system, with the latest improvements, including a complete haulage system for handling the cars. The efficiency of the Dodge system is demonstrated by the fact that every railroad using it has contracted for a second plant after more or less extended experience with the first.

We are in receipt of a very handsome catalog from Baker Brothers, of Toledo, O., describing the Colburn keyway cutter. Every shop manager who is interested in cutting keyways in some other manner than by hand should send for this catalog.

We have seen attachments to planers designed for planing links to the required radius, which were alleged to be of quite recent origin. There are a great many reputed new special tools that turn out to be very ancient when their history is traced out. We understand that the radial planing device was first gotten up by Mr. Henry Watkeys, now master mechanic of the Louisville, New Albany & Chicago. The tool was designed in 1854, and made in the Albany shops of the New York Central for the purpose of planing the first links used on the road. The engine was built in the shops at Albany, the policy of the company at that time having been to build their own engines and cars.

The publishers of "The Foundry" got out a particularly attractive number for the Foundrymen's Convention, held at Philadelphia in the middle of May. The number contains 52 pages and is elaborately illustrated, part of the advertisements being colored. The articles on Foundry Work are unusually good, and ought to be read by every intelligent foundryman. Those interested should send fifteen cents to the publishers at Detroit, Mich., to pay for a copy. We guarantee that they will be satisfied with their purchase.

There are certain locomotive designers abroad who have a great dislike to a dome on the boiler of a locomotive. The prejudice used to be stronger than it is to-day; but there are still to be seen a good many locomotives in the British Isles which have no domes. The Great Northern of England is a line where many domeless locomotives are to be seen; but we understand that the new head of the mechanical department has ordered that domes be put on all engines as they pass through the shops.

The Supreme Court of Pennsylvania has rendered a decision to the effect that a railroad company is just as much liable for damages to employés who get hurt through defects of foreign cars as they are for injuries resulting from defects of their own cars. It is one of the curiosities of law-suits that sane legal advisors should advise a railroad company to defend itself on the plea that it was not liable for damage done by foreign cars in its possession.

The gatemen of the North British Railway are complaining about insufficient wages. This is not to be wondered at when we are informed that they are paid $2.40 a week for 120 hours' work.

The B. & O. has decided to equip all its passenger locomotives with the chime whistle.

WHAT YOU WANT TO KNOW.

Questions and Answers.

(50) A. P., Peru, Mass., writes:

1. If a person desires to become a locomotive engineer, where is the best place to begin? A.—Any trunk line. 2. Can a person under twenty-one years of age go to work on any railroad in this State, or is there any law to prevent railroad companies hiring minors? A.—We cannot say.

(51) F. H. B., Brattleboro, Vt., writes:

Will you please give me the correct name of the four strips of cast iron on top of the balance valve, that slide on the bottom of the cover to steam chest? There is no one on this road that can give a correct name for them. A.—These pieces are known as balance strips when the packing is of the rectangular type, and are called balance rings when of the circular kind.

(52) L. H. W., Decatur, Ills., writes:

Will you kindly inform me if an Allen valve on a locomotive should have as much lead as a plain slide valve? If so, why? A.—It is customary to give the Allen valve the same lead as is given to the plain valve. The reason for this is, that at early points of cut-off the initial pressure falls away rapidly with the plain valve, owing to the restricted port opening; but with the Allen valve, the pressure during admission is more uniform, on account of the double opening.

(53) W. W. U. D. G., Bloomington, Ills., writes:

A friend of mine who works in the shop with me told me that the temperature of a firebox is greater on the outside than on the inside, with a live and excellent fire and the required steam pressure; he says that the water takes up the heat from the fire and thus reduces the temperature of the inside sheet. Is there anything in his statement? A.—The temperature of the inside of a firebox will range from 2,500 to 3,000 degrees Fahr., while the temperature of the water due to a steam pressure of 150 pounds to the square inch is only 365.7 degrees. This shows that the temperature of the water side of the sheet is some 2,100 degrees lower than that on the fire side.

(54) E. G. R., Mt. Savage, Md., writes:

1. Please inform me through your Question and Answer column, what tonnage ought a consolidation engine of 116,000 pounds weight, with 20 x 24-inch cylinders, 50-inch wheels and 145 pounds boiler pressure, haul up a grade averaging 168 feet per mile. The engine is a free steamer. A.—Taking the mean effective pressure at 90 per cent. of the boiler pressure, the tractive power by the formula $(.7854 \times 20^2 \times 145 \times .90 \times 24) \div 50 = 19{,}678$ pounds, and dividing this by the total resistance in pounds per ton due to gravity, plus that due to velocity, we have $19{,}678 \div 63.63 + 6.1 = 19{,}678 \div 69.73 = 282$ tons. This will include, however, both the weight of engine and train. To find the net tons, deduct the weight of engine and tender; the remainder will be tonnage at a very slow speed. 2. Is the brick arch an advantage or a disadvantage to a locomotive, considering the cost of brick, the inability of the fireman to clean flues, the choking of same, want of steam, delay, etc? A.—The brick arch has demonstrated its value on a great many roads, and is conceded to be an advantage by men who are regarded as high authority. On the other hand, there are those who look on it with disfavor. There are causes for the choking of flues and the want of steam, for which the brick arch is blameless.

From the time people first began to to travel in railroad cars until the present time there has been a demand in Great Britain for some method of heating the cars. The railway engineers for three generations declared that the only practical way to keep passengers warm in cold weather was by the use of warming-pans containing hot water, which were changed when the water became cold. These were used only in first-class carriages. The people in other classes were permitted to freeze. Every winter the newspapers were full of letters complaining about the discomfort of traveling in cold cars, but the engineers and inventors continued to look on without attempting to provide relief. The Gold Car-Heating Co., of New York, sent agents to Britain about a year ago, and last winter their system of heating was applied to about 400 cars. It is safe to say that small yeast of comfort will soon leaven the whole mass of railway carriages. Every person who rides in a comfortably warmed car is a missionary for the spread of that species of comfort. The companies which refuse to heat their cars during cold weather will find themselves the object of a hot war of words that will have a melting effect when applied long enough.

Mr. F. T. De Garmo has been appointed Eastern representative of the Chicago Pneumatic Tool Company, with offices in New York City. Mr. Wm. Mack has been appointed Western representative of the same company, with offices in Denver. These people are doing a rushing business with their pneumatic hand-hammers, and have recently shipped three hundred machines in one order to England. They are also manufacturing the Manning sandpapering machine, which was fully described in the January number of this paper, and a piston air drill, also the invention of Mr. J. H. Manning, who is division master mechanic of the Union Pacific Railroad at Omaha.

The Franklin Institute of Philadelphia has rendered the Edwin Longstreth Medal of Merit to the Cleveland Twist Drill Company for their grip socket.

INDEX TO ADVERTISEMENTS.

PAGE

Continued on page 518.

INDEX TO ADVERTISEMENTS *Continued.*

Buyers' Finding List.

Air Brake Fittings.
Crane Co., Chicago, Ill.

Air Brake Hose.
Boston Belting Co., Boston, Mass.
N. Y. Belting & Packing Co., New York.

Air Brakes.
Westinghouse Air Brake Co., Pittsburg, Pa.

Air Brake Gage.
Utica Steam Gage Co., Utica, N. Y.

Air-Brake Pump Governors.
Foster Engineering Co., Newark, N. J.

Air-Brake Filter.
Von Weisenflue Air-Brake Filter Co., Scranton, Pa.

Air Compressors.
Clayton Air Compressor Works, New York.
Ingersoll Sergeant Drill Co., N. Y. City.
Norwalk Iron Works Co., South Norwalk, Ct.
Pedrick & Ayer Co., Philadelphia, Pa.
Rand Drill Co., New York.
St. Louis Steam Engine Co., St. Louis, Mo.

Air Drilling Machine.
C. H. Haeseler & Co., Philadelphia, Pa.

Air Hoists.
Pedrick & Ayer Co., Philadelphia, Pa.
Whiting Foundry Equipment Co., Chicago, Ill.

Arch Bars.
Cambria Iron Co., Philadelphia, Pa.

Asbestos.
H. W. Johns Mfg. Co., New York.

Axles.
Cambria Iron Co., Philadelphia, Pa.
Gould Coupler Co., Buffalo, N. Y.
B. M. Jones & Co., Boston, Mass.
Krupp (T. Prosser & Son, New York).

Balanced Slide Valves.
Am. Bal. Slide Valve Co., San Francisco, Cal.
M. C. Hammett, Troy, N. Y.

Bearing Metal.
Ajax Metal Co., Philadelphia, Pa.
Paul S. Reeves, Philadelphia, Pa.
U. S. Metallic Pkg. Co., Philadelphia, Pa.

Bell Ringer.
Trumbull Mfg. Co., Warren, O.
U. S. Metallic Packing Co., Philadelphia, Pa.

Continued on page 519.

Stow Flexible Shaft Co.

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Manufacturers of
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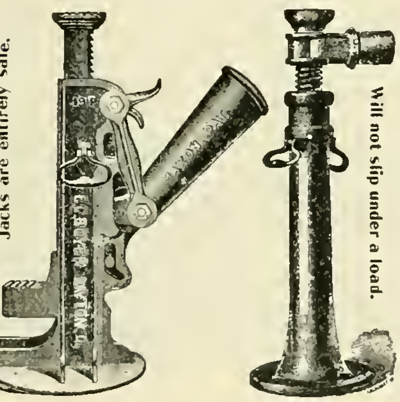

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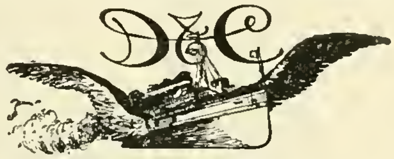

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The Detroit & Cleveland Steam Nav. Co.

The New Pullman Compartment Sleeping Cars, Cincinnati to Chicago, C. H. & D. Ry.

These cars are the finest that have ever been turned out of the Pullman shops, and are duplicates of the magnificent cars on the New York and Chicago Limited.

They are divided into nine rooms, each room containing a double lower and upper berth of the pattern used in the open sleeping car. The rooms are much larger than the staterooms in the largest steamships; each room being furnished in a different colored tapestry from its neighbor, and containing a wash-stand which is built into one corner. This wash-stand is arranged so that it is really a receptacle for hats, bonnets and small articles; also containing a clothes brush, hair brush, comb, etc., and by pulling down the metal handle a large silver wash basin is brought into position, and right above the basin are two faucets, one for hot and the other for cold water. In addition to this is a faucet connecting with a drinking fountain of ice water. In the other corner of the room is a handsomely cushioned seat, which can be turned to one side, exposing the closet.

Electric bells and every convenience that can possibly be crowded into a hotel-room are in these compartments. The prices are the same as in the standard open sleeping car, and our patrons have the choice, as we run one car of each pattern on every night train of the **C. H. & D. and Monon**, between Cincinnati and Chicago, both to accommodate those who do not know the advantages of the new car and prefer the old style on account of familiarity with them, and to enable us, except in great rushes, to give every one a lower berth.

D. G. EDWARDS,
GENERAL PASSENGER AGENT, CINCINNATI, O.

BUYERS' FINDING LIST—*Continued.*

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Boston Belting Co., Boston, Mass.
N. Y. Belting & Packing Co., New York.
Shultz Belting Co., St. Louis, Mo.

Boiler and Firebox Steel.
Shoenberger Steel Co., Pittsburg, Pa.

Boiler Checks—Inside.
Foster Engineering Co., Newark, N. J.

Boilers.
Pittsburg Locomotive Works, Pittsburg, Pa.

Boiler Iron.
Ewald Iron Co., St. Louis, Mo.

Boiler Testers.
Rue Mfg. Co., Philadelphia, Pa.

Boiler Tools.
Richard Dudgeon, New York.
Hilles & Jones Co., Wilmington, Del.
Long & Allstatter Co., Hamilton, O.

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Nathan Mfg. Co., New York.
Rue Mfg. Co., Philadelphia, Pa.

Bolsters.
Shickle, Harrison & Howard Co., St. Louis, Mo.

Bolt Machinery.
Acme Machinery Co., Cleveland, O.

Bolt Threading Machinery.
Detrick & Harvey Machine Co., Baltimore, Md.

Books.
Am. Engineering Pub. Co., Brooklyn, N. Y.
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N. W. Henley & Co., New York.
Open Court Pub. Co., Chicago, Ill.
Practical Pub. Co., E. Orange, N. J.
Philadelphia Book Co., Philadelphia, Pa.
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D. Van Nostrand Co., New York City.

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Bullard Mch. Tool Co., Bridgeport, Conn.

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Q. & C. Co., Chicago, Ill.

Brake Shoes.
Ramapo Iron Works, Hillburn, N. Y.
Ramapo Wheel & Foundry Co., Ramapo, N.Y.

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Ajax Metal Co., Inc., Philadelphia, Pa.
Paul S. Reeves, Philadelphia, Pa.

Buffers.
Gould Coupler Co., Buffalo, N. Y.

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Allison Mfg. Co., Philadelphia, Pa.
Lima Locomotive & Machine Co., Lima, O.
Ramapo Iron Works, Hillburn, N. Y.

Car Cleaner.
Aquart A. D., St. Louis, Mo.

Car Couplers.
Gould Coupler Co., Buffalo, N. Y.
McConway & Torley Co., Pittsburg, Pa.
National Malleable Castings Co., Chicago, Ill.
St. Louis Car Coupler Co., St. Louis, Mo.
Sams Automatic Coupler Co., Denver, Col.
Shickle, Harrison & Howard Iron Co., St. Louis, Mo.
Smillie Coupler & Mfg. Co., Newark, N. J.
Standard Coupler Co., New York.
Trojan Car Coupler Co., Troy, N. Y.

Car Heating.
William C. Baker, New York.
Gold Car Heating Co., New York.
Safety Car Heating & Ltg. Co., New York.

Car Lighting.
Safety Car Heating & Lighting Co., New York.

Car Paints.
Detroit White Lead Works, Detroit, Mich.

Car Replacer.
Alexander Car Replacer Mfg. Co., Scranton, Pa.

Car Roofing.
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Warren Chemical & Mfg. Co., New York.

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Car Ventilators.
M. C. Hammett, Troy, N. Y.

Car Wheels.
Kalamazoo R. R. Velocipede & Car Co., Kalamazoo, Mich.
Krupp (T. Prosser & Son, New York).
Lima Locomotive & Machine Co., Lima, O.
Ramapo Wheel & Foundry Co., Ramapo, N.Y.
Rood & Brown, Buffalo, N. Y.
Standard Steel Works, Philadelphia, Pa.
Washburn Car Wheel Co., Hartford, Conn.

Cattle Guards.
Q. & C. Co., Chicago, Ill.

Chain Pulley Blocks.
Moore Mfg. & Fdy. Co., Milwaukee, Wis.

Chime Whistles.
Crosby Steam Gage & Valve Co., Boston, Mass.

Clocks.
John J. McGrane, New York.

Coal Handling Machinery.
Link Belt Engineering Co., Philadelphia, Pa.

Coal Chutes.
Williams, White & Co., Moline, Ill.

Continued on page 520.

BUYERS FINDING LIST—*Continued.*

Correspondence Schools.
Internat'l Corres. Schools Scranton, Pa.
The Scientific Machinist Co., Cleveland, O.
Corundum Wheels.
Sterling Emery Wheel Mfg. Co., Tiffin, O.
Cranes.
Manning, Maxwell & Moore, New York.
Maris Bros., Philadelphia, Pa.
William Sellers & Co., Philadelphia, Pa.
Whiting Foundry Equipment Co.,Chicago, Ill.
R. D. Wood & Co , Philadelphia, Pa.
Crank Pin Gages.
M. C. Hammett, Troy, N. Y.
Crank Pins.
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Drills.
Cleveland Twist Drill Co., Cleveland, O.
Standard Tool Co., Cleveland, O.
Drilling Machines
J. T. Connelly, Milton, Pa.
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Electric Lighting and Power Apparatus.
Westinghouse Elec. & Mfg. Co.,Pittsburgh,Pa.
Emery Wheels.
Sterling Emery Wheel Mfg. Co , Tiffin, O.
Enamel.
Detroit White Lead Works, Detroit, Mich.
Engines.
St. Louis Steam Engine Co., St. Louis, Mo.
Engravings.
Bradley & Poates, New York.
Standard Engraving Co , New York.
Exhaust Pipe.
The General Agency Co., New York.
Expanding Mandrel.
Geo. L. Weiss, Cleveland, O.
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Arcade File Works, Anderson, Ind.
Nicholson File Co., Providence, R. I.
Filters.
A. Major, New York.
Firebrick.
Garden City Sand Co., Chicago, Ill
Fire Kindlers.
J. S. Leslie, Paterson, N. J.
Flexible Shaft.
Stow Flexible Shaft Co., Philadelphia, Pa.
Flexible Steam Joint.
Moran Flexible Steam Joint Co.,Louisville,Ky.
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Allison Mfg. Co., Philadelphia, Pa.
Tyler Tube & Pipe Co., Washington, Pa.
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Buffalo Forge Co., Buffalo, N. Y.
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Ramapo Iron Works, Hillburn, N. Y.
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Watson & Stillman, New York.
R. D. Wood & Co., Philadelphia, Pa.
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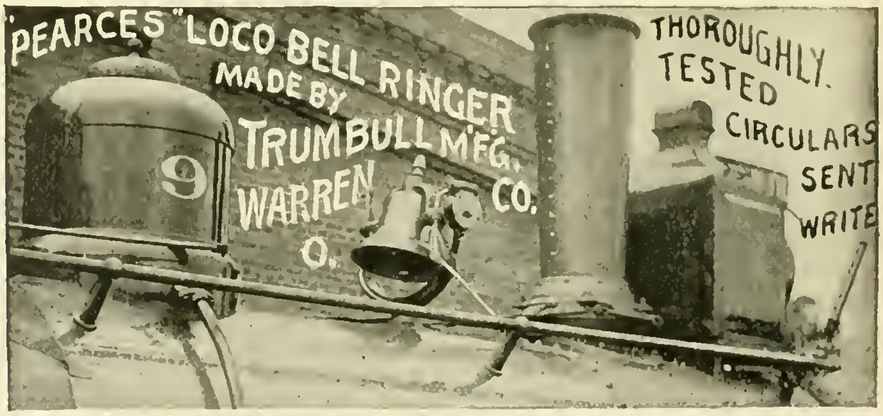
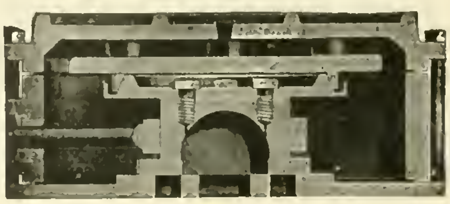
Richmond Loco. & Mch. Wks., Richmond,Va.
Rogers Locomotive Works, Paterson, N. J.
Schenectady Loco. Wks., Schenectady, N.Y.

Continued on page 521.





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Signal Oil Works, Franklin, Pa.

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Gould & Eberhardt, Newark, N. J.
Hilles & Jones Co., Wilmington, Del.
Jones & Lamson Machine Co. Springfield, Vt.
Manning, Maxwell & Moore, New York.
National Machinery Co., Tiffin, O.
Newton Machine Tool Wks., Philadelphia, Pa.
Niles Tool Works Co., Hamilton, O.
Geo. Place, New York.
Pratt & Whitney Co., Hartford Conn.
Prentiss Tool and Supply Co., New York.
William Sellers & Co., Inc., Philadelphia, Pa.

Malleable Iron.
C. E. Rood, Lancaster, N. Y.

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Armstrong Bros. Tool Co., Chicago, Ill.
Keystone Mfg. Co., Buffalo, N. Y.
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G. W. Hoffman, Indianapolis, Ind.

Metal Sawing Machines.
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Milling Machines.
Cincinnati Milling Machine Co., Cincinnati, O.
Pratt & Whitney Co., Hartford, Conn.

Mining Machinery.
Earle C. Bacon, New York.

Molding Machines.
Tabor Mfg. Co., New York City.

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H. S. Peters, Dover, N. J.

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Gould Packing Co., East Cambridge, Mass.
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Jenkins Bros., New York.
N. Y. Belting & Packing Co., New York.
U. S. Metallic Packing Co., Philadelphia, Pa.

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White Mfg. Co., Chicago, Ill.

Paints.
Standard Paint Co., New York.
Detroit White Lead Works, Detroit, Mich.
Detroit Graphite Mfg. Co., Detroit, Mich.
H. W. Johns Mfg. Co., New York.

Patents.
John Wedderburn & Co., Washington, D. C.
George P. Whittlesey, Washington, D. C.

Perforated Metal.
Aitchison Perforated Metal Co., Chicago, Ill.
A. J. Beckley & Co., Meriden, Conn.
Harrington & King Per. Metal Co.
The Hendrick Mfg. Co., Ltd., Carbondale, Pa.

Photographs.
F. Moore, London, Eng.

Pipe Threading and Cutting Machinery.
Bignall & Keeler Mfg. Co., Edwardsville, Ill.
Armstrong Mfg. Co., Bridgeport, Conn.
D. Saunders' Sons, Yonkers, N. Y.

Piston Rods.
Cambria Iron Co., Philadelphia, Pa.
B. M. Jones & Co., Boston, Mass.
Thomas Prosser & Son, New York.

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Chicago Pneumatic Tool Co., Chicago, Ill.
C. H. Haeseler & Co., Philadelphia, Pa.

Pressed Steel Materials.
Schoen Mfg. Co., Pittsburg, Pa.

Pressure Regulators.
Foster Engineering Co., Newark, N. J.
Newark Regulator Co., Newark, O.

Pump Valves.
Boston Belting Co., Boston, Mass.
N. Y. Belting & Packing Co., New York.

Punching and Shearing Machinery.
Hilles & Jones Co., Wilmington, Del.
Long & Allstatter Co., Hamilton, O.
Williams, White & Co., Moline, Ill.
R. D. Wood & Co., Philadelphia, Pa.

Railway Castings.
Shickle, Harrison & Howard Co., St. Louis, Mo.

Railway Fences.
Page Woven Wire Fence Co., Adrian, Mich.

Railway Gates.
Standard Ry. Gate Co., Saginaw, Mich.

Regulators.
Mason Regulator Co., Boston, Mass.

Replacing Frogs.
B. E. Tilden Co., Chicago, Ill.

Retaining Rings
Ramapo Wheel & Foundry Co., Ramapo, N.Y.

Rubber.
Boston Belting Co., Boston, Mass.
N. Y. Belting & Packing Co., New York.

Rust Preventing Compound.
Otto Goetze, New York.

Safety Valves
Ashton Valve Co., Boston, Mass.
Consolidated Valve Co., Bridgeport, Conn.
Crosby Steam Gage & Valve Co., Boston, Mass.

Continued on page 522.

BUYERS' FINDING LIST —*Continued.*

Sanding Apparatus
Garden City Sand Co., Chicago, Ill.
Henry L. Leach, North Cambridge, Mass.
Sherburne & Co., Boston, Mass.
Western Rly Equipment Co , St. Louis, Mo.

Shafting
William Sellers & Co., Philadelphia, Pa.

Smoke Jack.
Bruyn's Auto. Smoke Jack Co., Waverly, O.

Spark Arrester Plate.
A. J. Beckley & Co., Meriden, Conn.
Hendrick Mfg. Co., Carbondale, Pa.

Speed Recorder.
Boyer Rly. Speed Recorder Co., St. Louis, Mo.

Springs
A. French Spring Co., Pittsburg, Pa.
W. D Gibson Co., Chicago, Ill.

Spring Steel
W. D. Gibson Co., Chicago, Ill.
Thomas Prosser & Son, New York.

Stay-Bolts.
Ewald Iron Co., St. Louis, Mo.
Falls Hollow Stay-Bolt Co., Cuyahoga Falls, O
B. M. Jones & Co., Boston, Mass.

Steam Gages.
Crosby Steam Gage & Valve Co., Boston.
Utica Steam Gage Co., Utica, N. Y.

Steam Hammers
Bement, Miles & Co., Philadelphia, Pa.

Steam Hose.
Boston Belting Co., Boston, Mass.
N. Y. Belting & Packing Co., New York.

Steam Pumps.
A S. Cameron Steam Pump Works, New York

Steel.
Cambria Iron Co., Philadelphia, Pa.
Carbon Steel Co., Pittsburgh, Pa.
Ewald Iron Co., St. Louis, Mo.
B. M. Jones & Co., Boston, Mass.
Krupp (T. Prosser & Son, New York).
Latrobe Steel Co., Latrobe, Pa.
Schoen Mfg Co., Pittsburg, Pa.
Shoenberger Steel Co., Pittsburg, Pa.

Steel Castings.
Shickle, Harrison & Howard Co., St. Louis, Mo.

Steel Tired Wheels.
Krupp (T. Prosser & Son, New York).
Ramapo Wheel & Foundry Co., Ramapo, N.Y
Standard Steel Works, Philadelphia, Pa
Washburn Car Wheel Co., Hartford, Conn.

Steel Tires.
Latrobe Steel Works, Latrobe, Pa.
Krupp (T. Prosser & Son, New York).
Standard Steel Works, Philadelphia, Pa

Steel Truck Frames.
Fox Solid Pressed Steel Co., Chicago, Ill.

Stocks and Dies.
Armstrong Mfg. Co., Bridgeport, Conn.

Switches
Ramapo Iron Works, Hillburn, N. Y.

Tie Plates.
Q. & C. Co., Chicago, Ill.

Tires.
Krupp (T. Prosser & Son, New York).
Latrobe Steel Co., Philadelphia, Pa.

Tool Holders.
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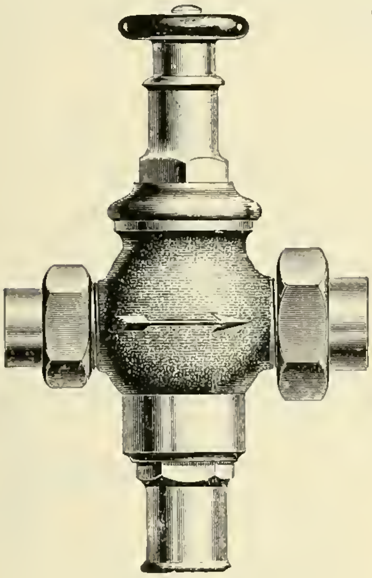

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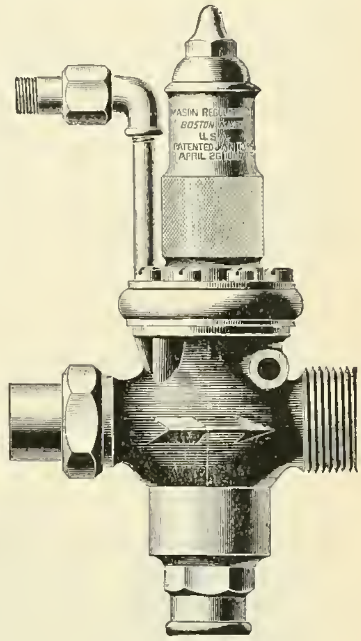

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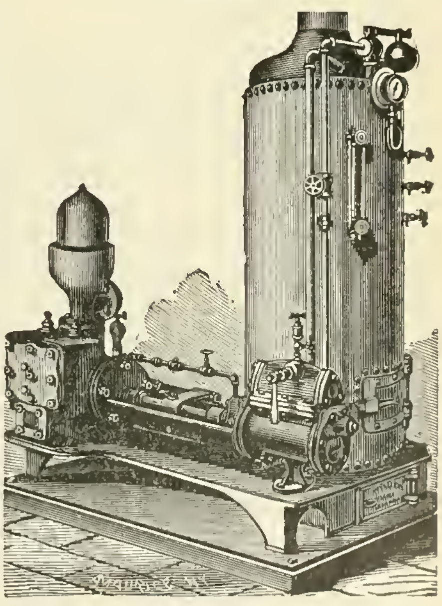

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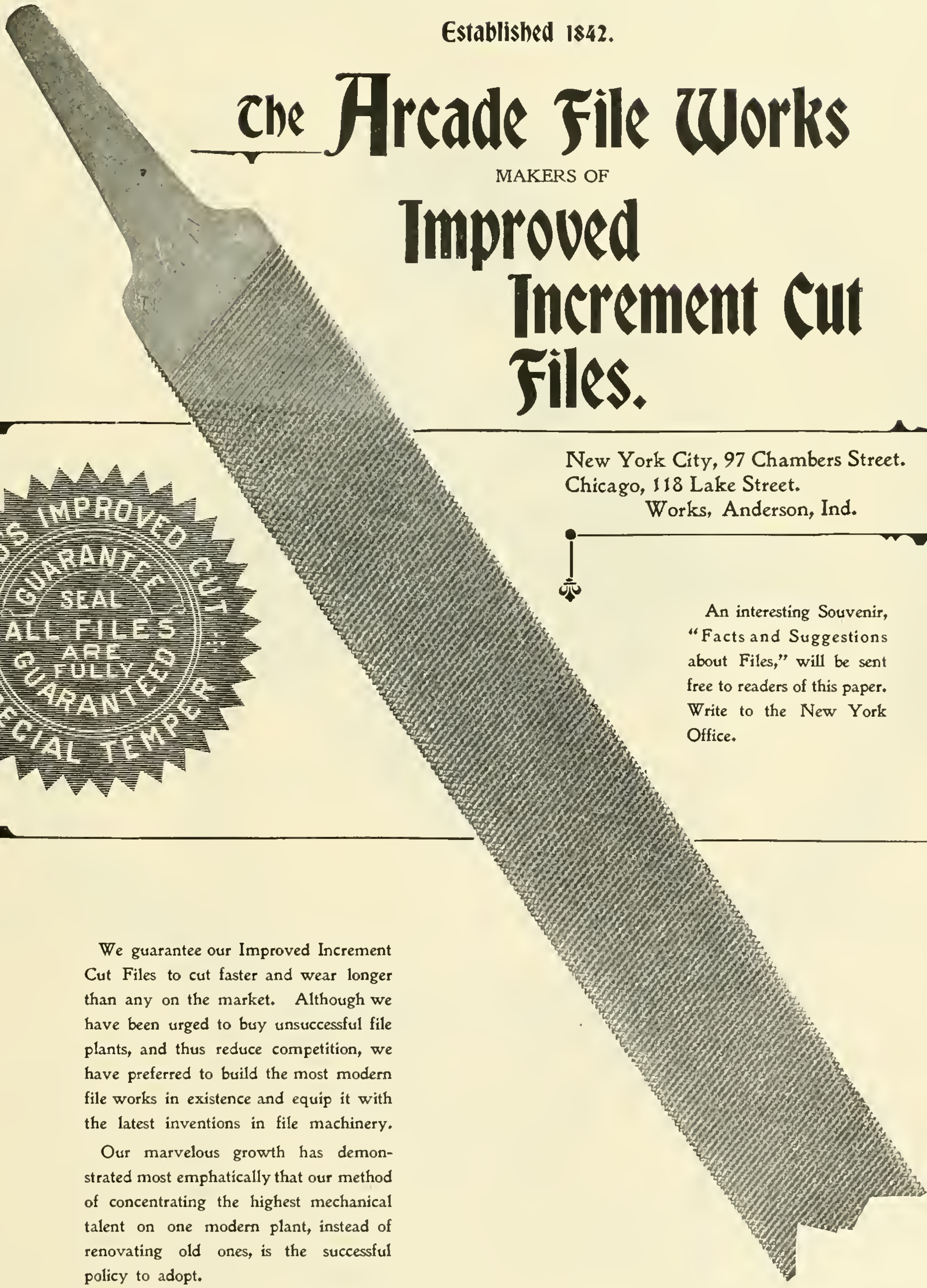

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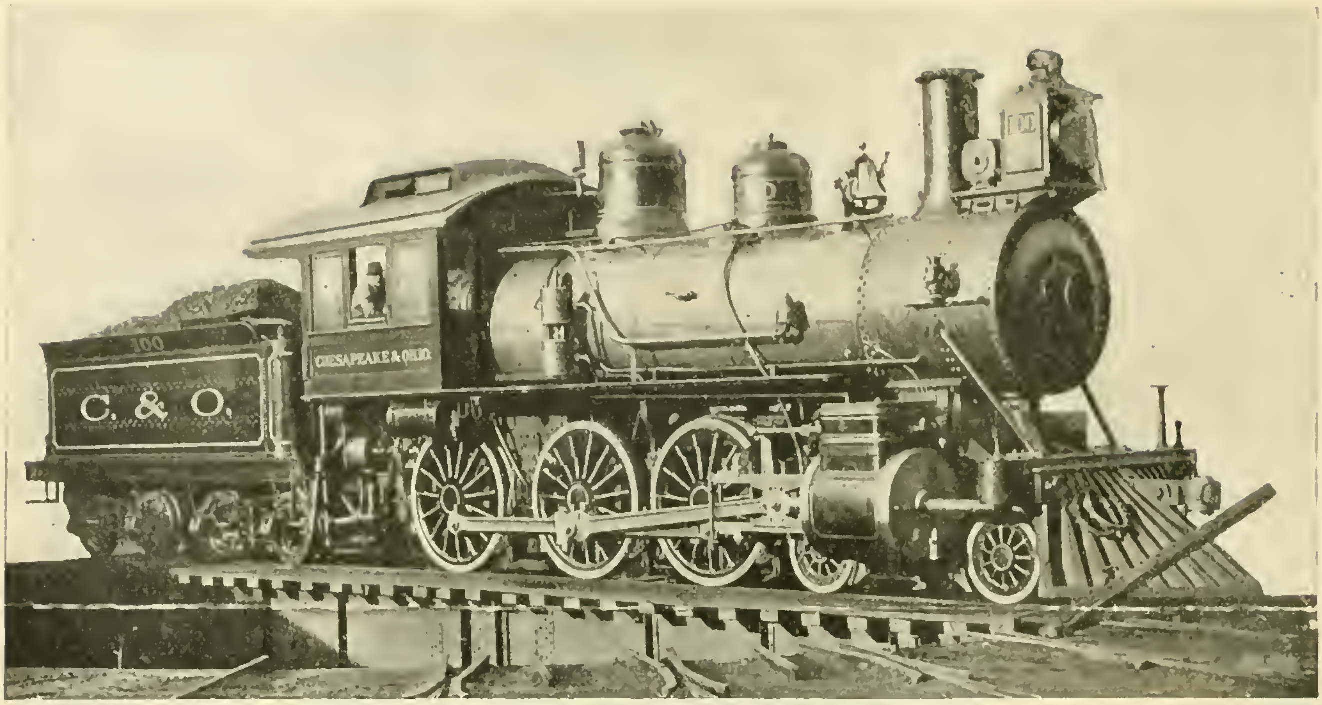

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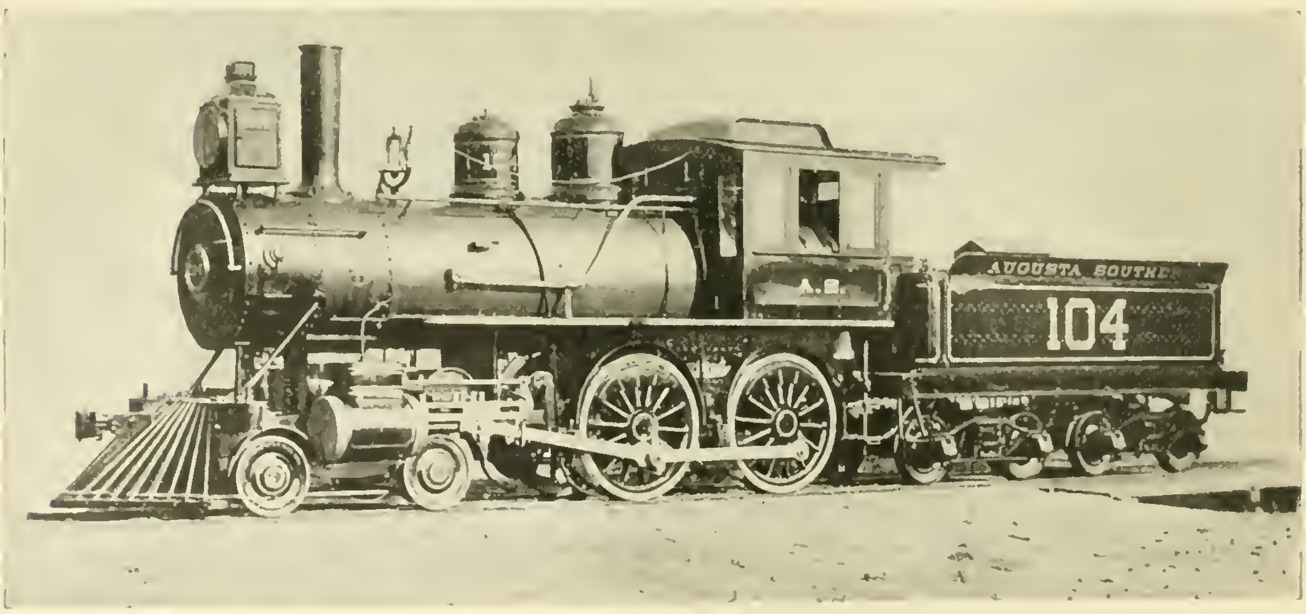

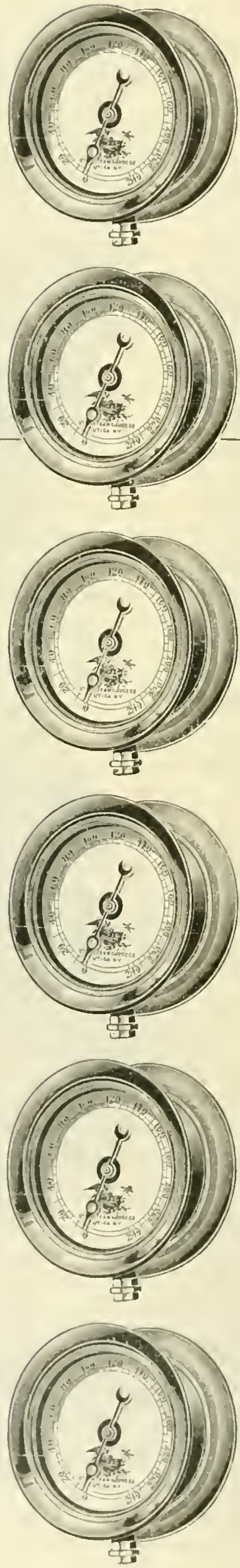

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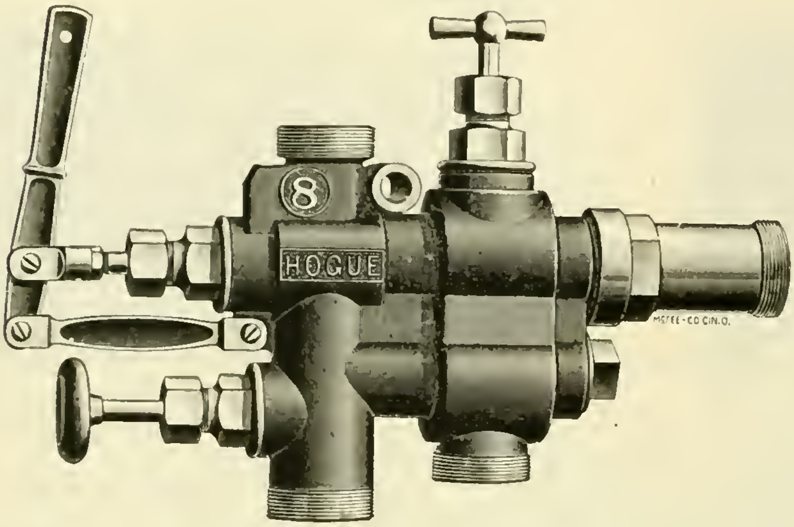

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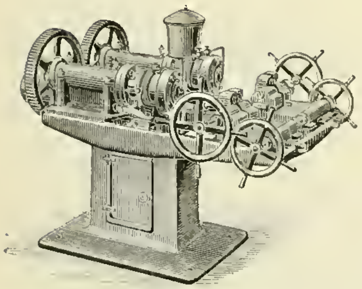

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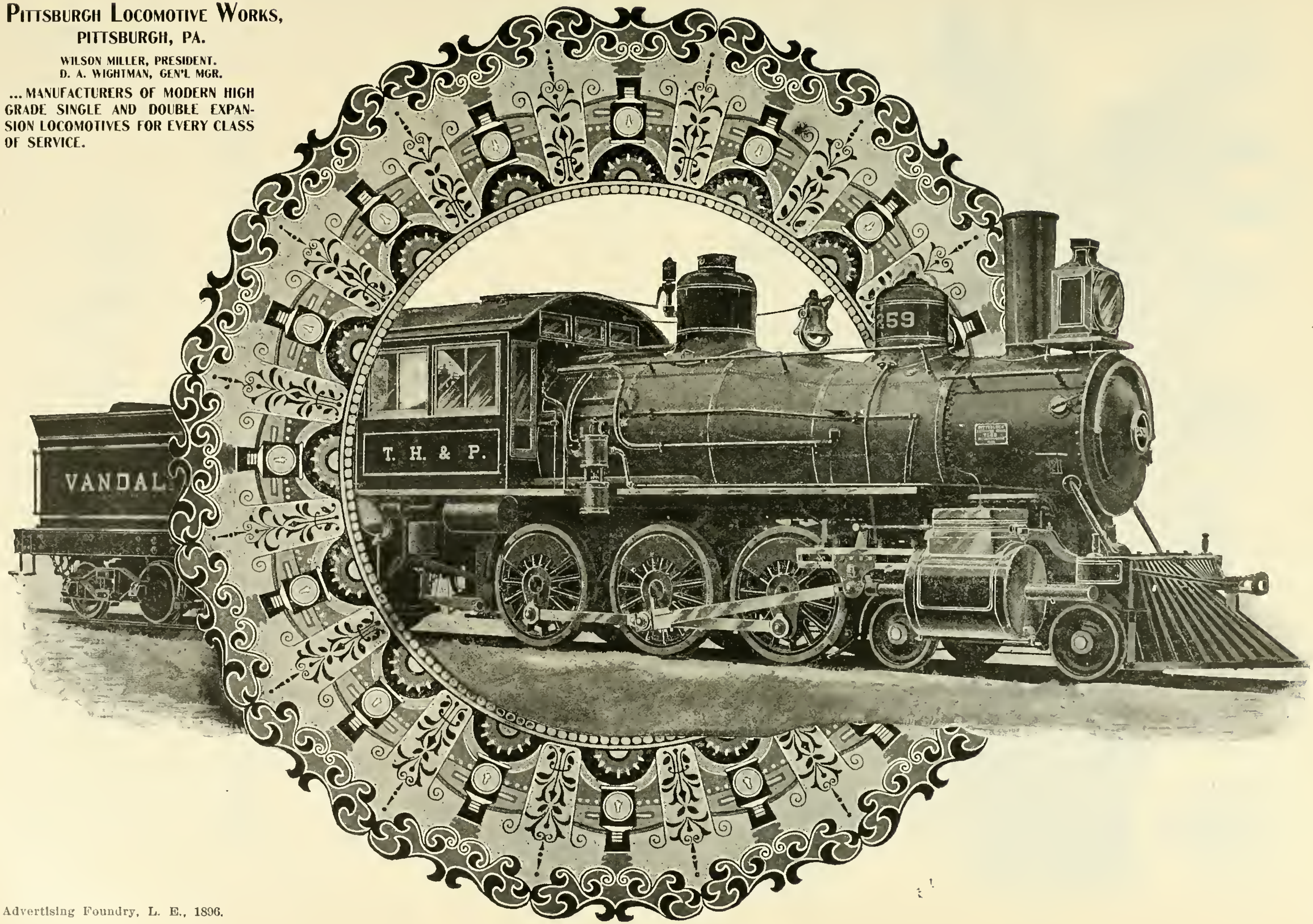
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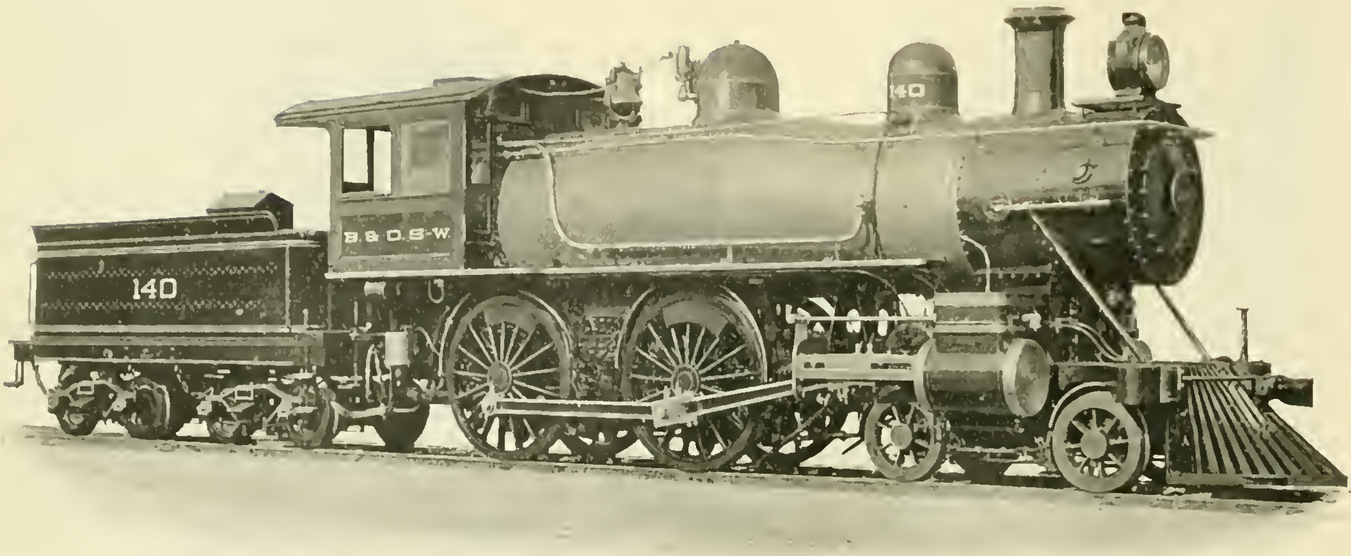
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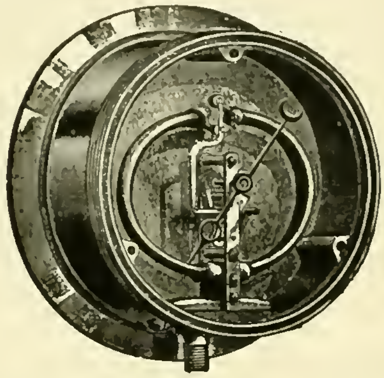

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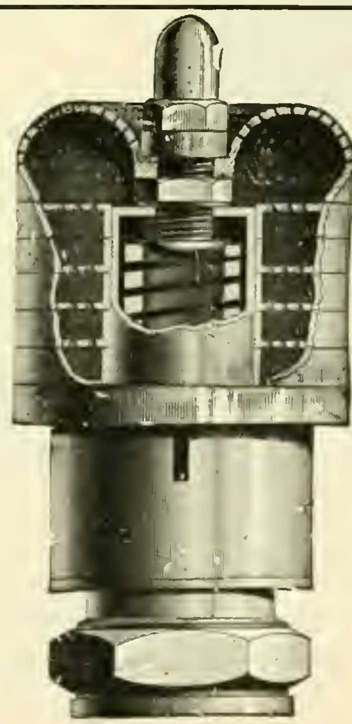

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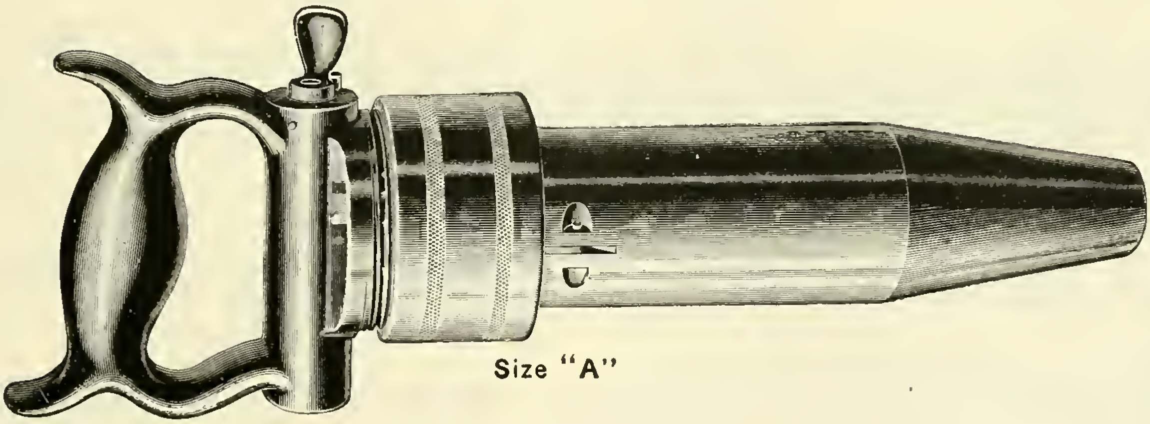

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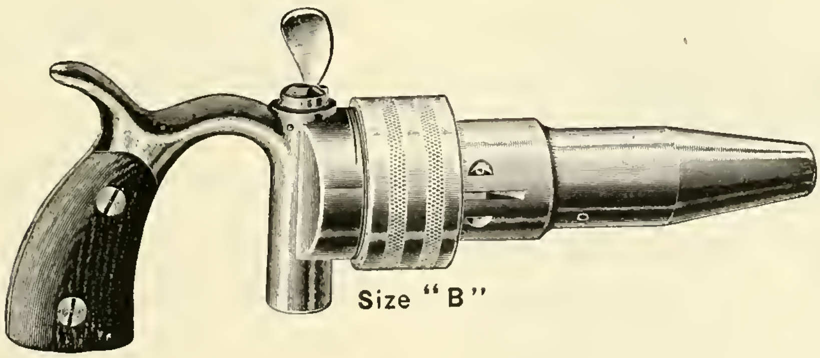

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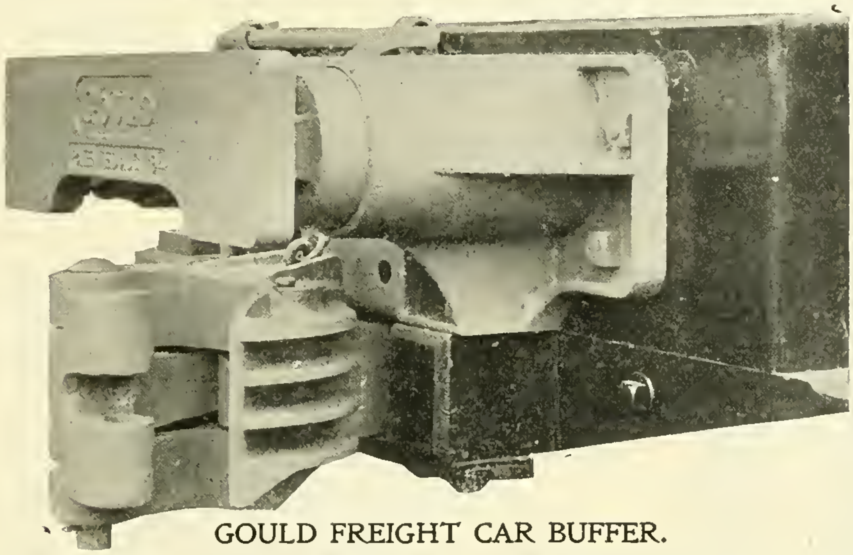

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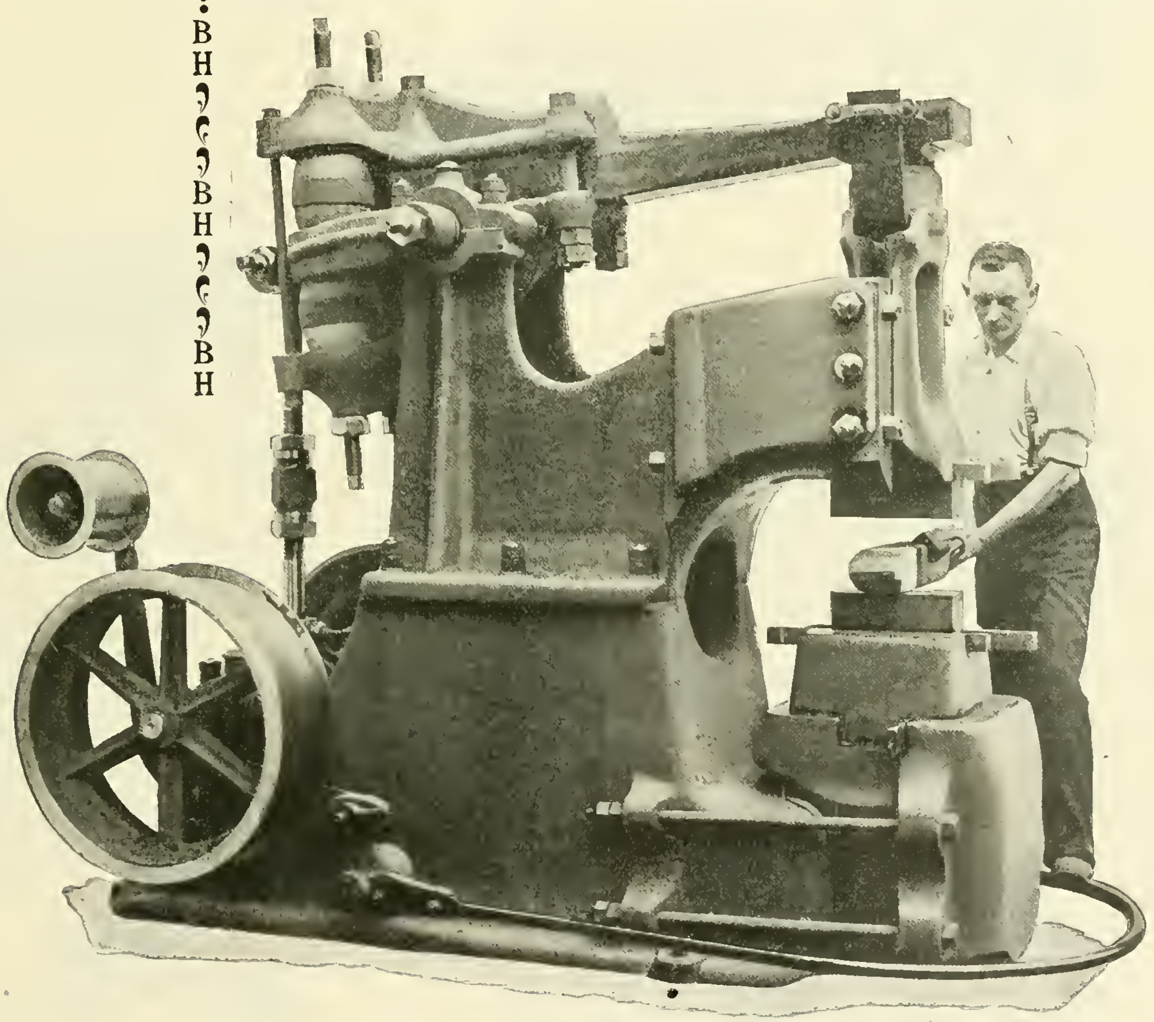

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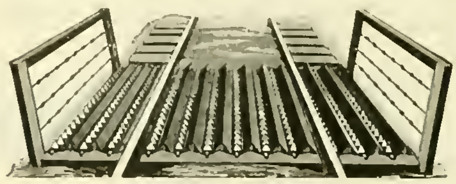

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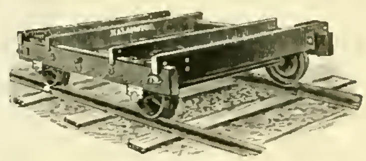

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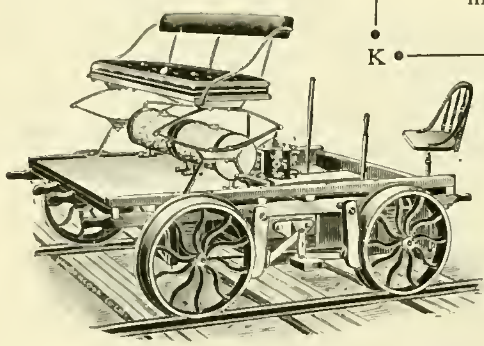

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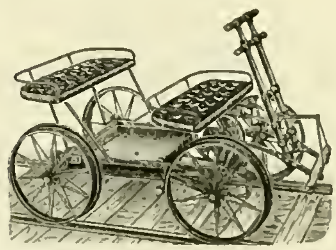

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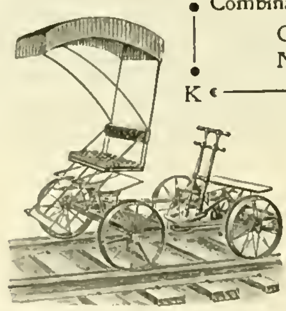
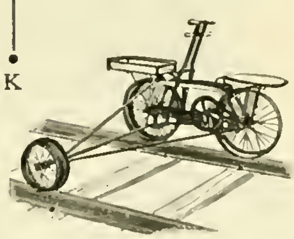


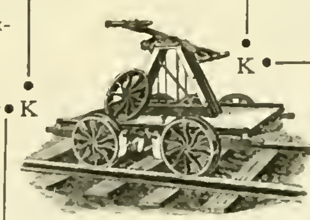
Inspection Car.

Capacity four men. Used extensively in southern countries.



1896 Ball Bearing Steel Velocipede.

Weight 90 lbs. 20 inch driving wheels with rubber cushioned tires.



1895 Standard Section Hand Car.

Net weight 500 lbs., platform 6 ft. x 4 ft. 4 in.

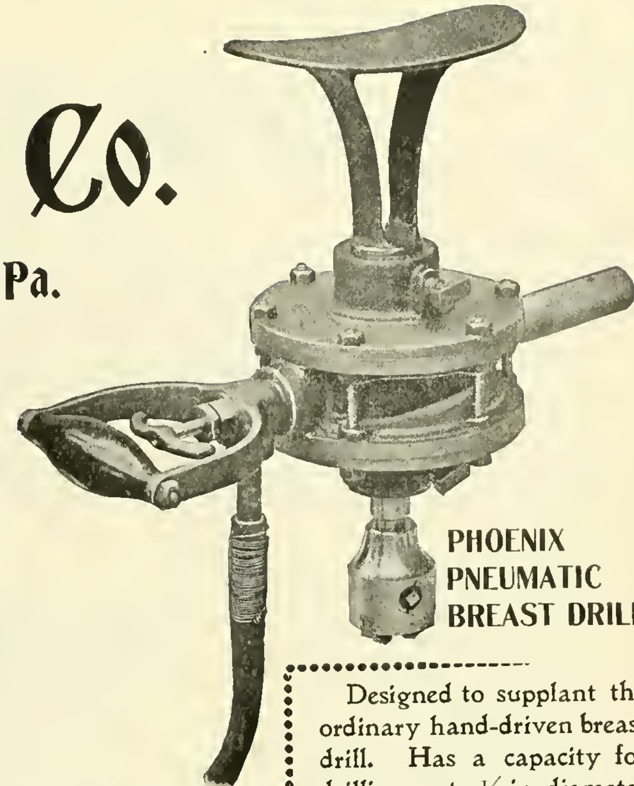
Send for our Red Catalogue, No. 10, 56 pages, 51 illustrations of the best Light Railway Cars made. Free, if you say you saw it in Locomotive Engineering.

Advertising Foundry, L. E., 1896.

C. H. Haeseler & Co.

1001 Hamilton St., Philadelphia, Pa.

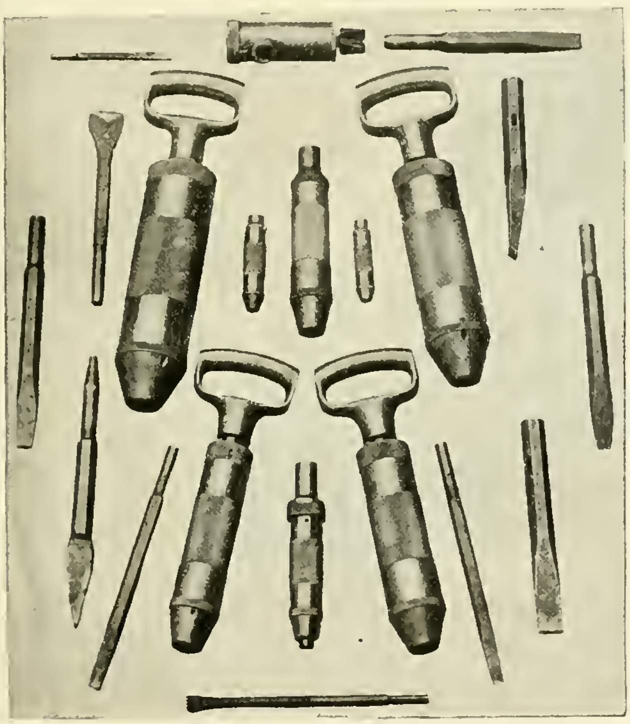
ALL TOOLS AND APPLIANCES PERTAINING TO PNEUMATIC EQUIPMENTS.



PHOENIX PNEUMATIC BREAST DRILL

Designed to supplant the ordinary hand-driven breast drill. Has a capacity for drilling up to ½ in. diameter and will drill a hole $\frac{5}{16}$ in. diameter through 1 in. cast iron in one minute.

Heavy work can be drilled without moving. Especially useful for centering and countersinking lathe work, drilling holes for small tap bolts and screws, jacketing engine cylinders, putting on name plates, etc.



KEELER PNEUMATIC TOOLS.

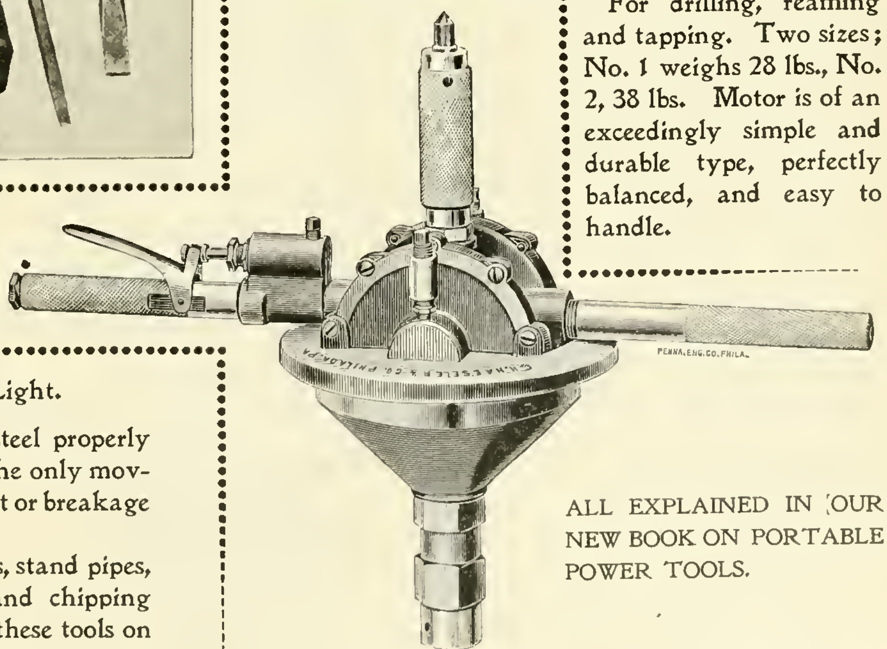
Efficient, Durable, Simple, Light.

All parts of this tool are made of steel properly tempered. The Hammer or piston is the only moving part, and all liability to derangement or breakage is reduced to a minimum.

To be used in caulking boilers, tanks, stand pipes, beading flues, die sinking, cleaning and chipping steel billets, castings, etc. We furnish these tools on trial for 10 days and guarantee to replace any damage or breakage in six months from date of purchase.

PHOENIX PORTABLE POWER TOOLS.

For drilling, reaming and tapping. Two sizes; No. 1 weighs 28 lbs., No. 2, 38 lbs. Motor is of an exceedingly simple and durable type, perfectly balanced, and easy to handle.



ALL EXPLAINED IN OUR NEW BOOK ON PORTABLE POWER TOOLS.

Advertising Foundry, L. E., 1896.

Railway and Car Shop Equipment.

Propositions

Covering entire equipment submitted. Perfect satisfaction guaranteed.

Terms

To suit purchasers. No payment required in the United States until the machinery is installed and accepted. During the last fifteen years I have equipped large numbers of railway and car shops, and in every instance entire satisfaction has been given.

George Place,
Equitable Building, 120 Broadway,
New York City.

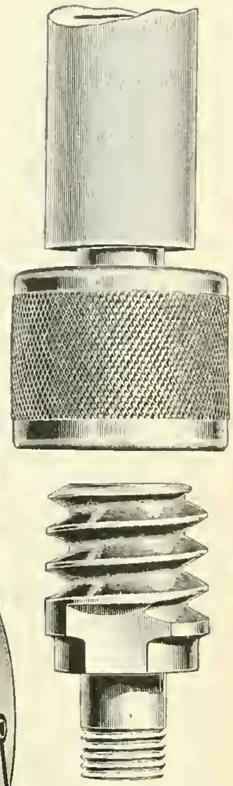
Eastern Office
J. A. Fay & Egan Co.

The most extensive builders of wood working machinery for railroad and car shops in the world.

Geo. Place, Agent.

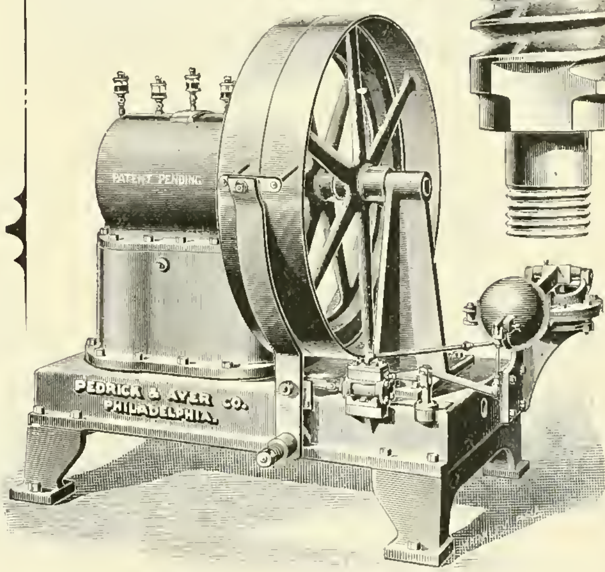
Pedrick & Ayer Co.

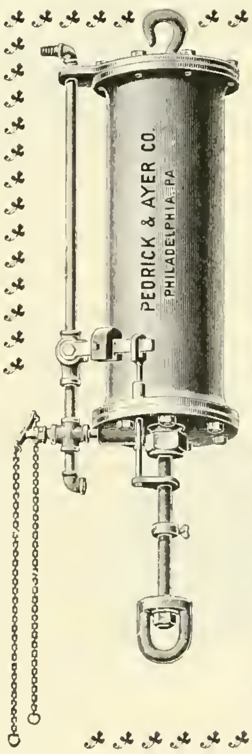
1001 Hamilton Street,
... Philadelphia, Pa.



Air Hose Couplings

Advantages over others. No spanner wrench needed. Three turns of knurled nut opens connection. When open as here shown, check valve is closed. Circular explains many interesting features, sent free.





Compound Automatic Air Compressor

Driven by belt. Regulates automatically, maintaining pressure within 3 pounds at any point. Compounded and water jacketed. Supplies air at one-half cost of fuel of brake pumps. Delivers 44 cubic feet of free air per minute.

Our No. 2 Lift

Is for delicate and exact work, can be made to lift or lower any amount at will, has an automatic stop that will keep load at any point under any conditions and leave operator free to adjust work with both hands. The ideal lift over machine tools.

Eclipses Them All—Thirty-five and a Half Hours, Chicago to Jacksonville, Fla.

The Monon Route, with its customary enterprise, has put on a new fast train that makes the run between Chicago and Jacksonville in 35½ hours.

The train is composed of elegant Pullman Perfected Safety Vestibuled, Open and Compartment Sleepers, including Drawing-room and Buffet Sleepers, as well as comfortable day coaches, with Monon Celebrated High-back Seats.

This train leaves Chicago daily at 8:32 P. M., arriving at Cincinnati next morning, 7:30; Chattanooga, 5:50 P. M.; Atlanta, 10:40 P. M.; reaching Jacksonville at 8:20 the second morning, in ample time to make connection with all lines for points in Central and Southern Florida.

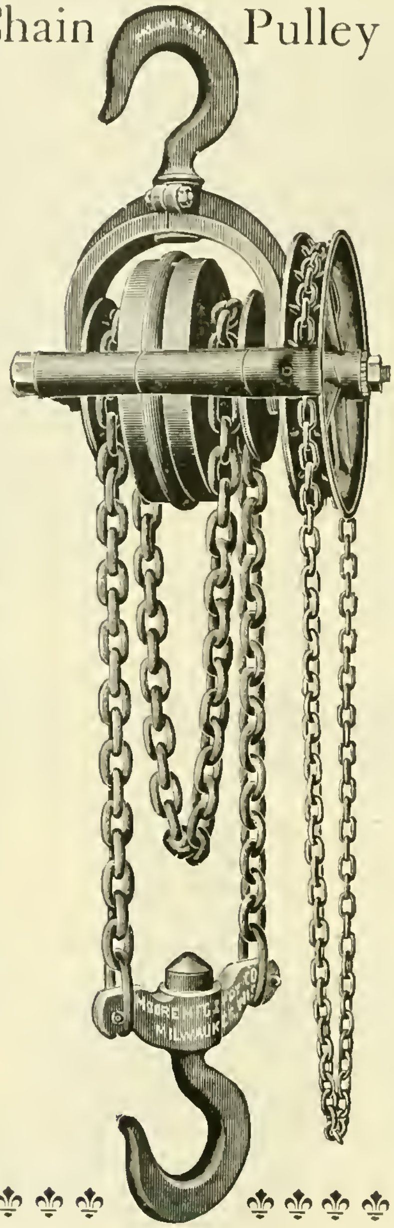
This is the fastest time ever made by any line between Chicago and Florida.

FRANK J. REED,
Genl. Pass. Agt., Chicago.

City Ticket Office, 232 Clark street, Chicago.

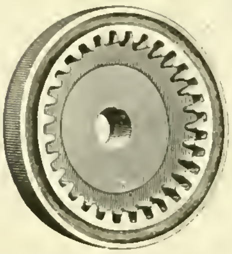
For time-cards, pamphlets and all other information, address L. E. Sessions, N. W. Pass. Agt., Minneapolis, Minn.

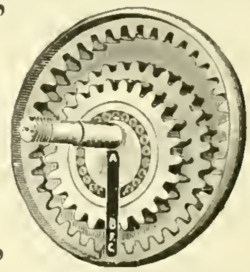
Moore's Anti-Friction Differential Chain Pulley Block.



. The hand and lift chains are separate and independent. The lift chain, therefore, has such a slow movement as to avoid the great wear, both on chains and sprockets, which necessarily follows where one chain serves both as hand and lift chain, and therefore travels under full weight of load from forty to a hundred times as fast in our blocks. . . . . .

. Has these advantages over others: A new movement, a perpetual compound lever, highest efficiency, powerful, simple, durable, light, compact and strong. . One man can lift to the full capacity of the block; self-sustaining at any point, block always hangs plumb. . . Is not the old Egyptian windlass block; is not a screw and worm wheel block; is not a wedging pinion block. . . . .

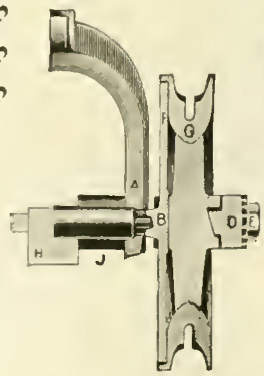




. The leverage is obtained by a gear and pinion movement. . . There is no end thrust of a worm shaft and no wear of worm and worm wheel. . . Anyone who has used worm wheel blocks will appreciate the immense superiority in point of durability of the gear and pinion movement. . . . . . .

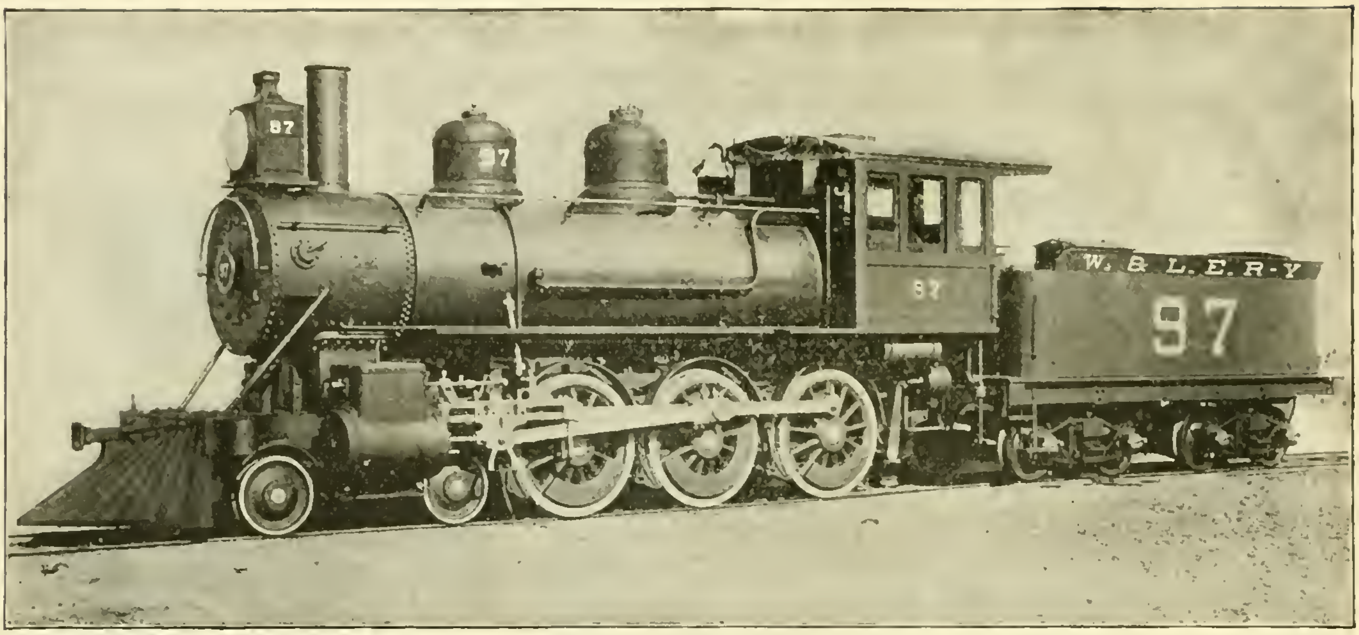
. The teeth in the pinion and annulars are of the same pitch; they fit without grinding or wedging. . . Anti-friction rollers are placed between the eccentric and pinion to reduce friction. By this arrangement the enormous loss by friction in old style blocks is almost entirely overcome. . . . .

Moore Manufacturing and Foundry Co., - Milwaukee, Wis.



. . A very interesting circular illustrating and describing these hoists at length, to be had for the asking. . . . .

Advertising Foundry, L. E., 1896.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W. & L. E. R-Y
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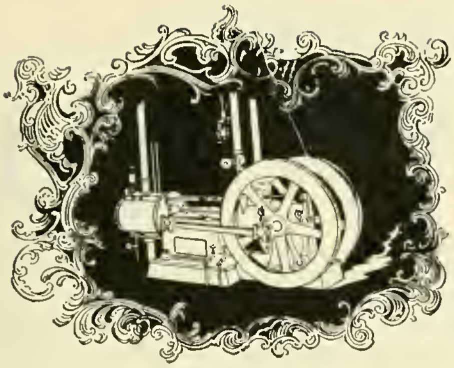


"A STRAIGHT LINE IS THE SHORTEST DISTANCE BETWEEN TWO POINTS."

The "Straight Line," Class "A," Air Compressor,

OF THE INGERSOLL-SERGEANT MAKE, IS THE SHORTEST LINE BETWEEN STEAM AND AIR. CATALOGUE OF AIR COMPRESSORS OF MANY TYPES, FOR USE IN EVERY LINE OF INDUSTRY, SENT ON REQUEST.

HAVEMEYER BUILDING,
NEW YORK.

THE INGERSOLL-SERGEANT DRILL CO.

THE ALEXANDER PRESSED STEEL ENGINE AND CAR REPLACER,

Manufactured by ALEXANDER CAR REPLACER MANUFACTURING COMPANY, Scranton, Pa.

PUT HIGH REPLACER ON OUTSIDE OF RAIL.

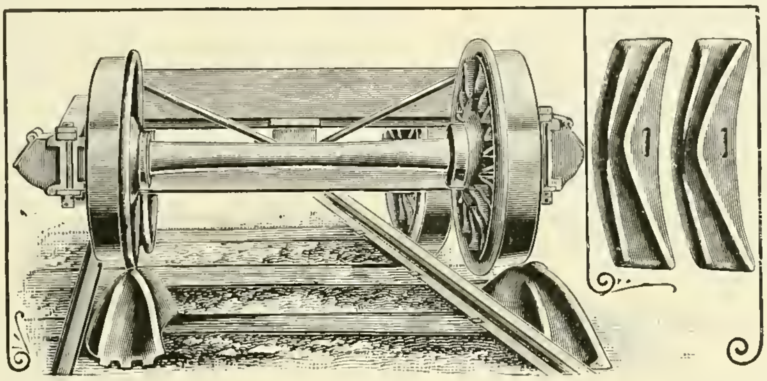
No. 1 Device, 120 lbs. per pair high enough for 6-inch rail.
Per Pair, $15.00.

No. 2 Device, 100 lbs. per pair, high enough for 5 inch rail.
Per Pair, $14.00.

No. 3 Replacer, 50 lbs. per pair, suitable for Traction Companies and mine engines.
Per Pair, $10.00.

...

GUARANTEED TO CARRY 100 TONS.



LIGHTEST AND CHEAPEST WRECKING FROG ON THE MARKET.

THEY CAN BE PURCHASED FROM

Adolph Butze, St. Louis, Mo.
W. & A. C. Semple, Louisville, Ky.
Flint, Eddy & Co.,
68 Broad St., New York.
Manning, Maxwell & Moore,
111 Liberty St., New York.
Sherburne & Co.,
53 Oliver St., Boston, Mass.
Brewer & Rowley,
1030 Monadnock Building, Chicago, Ill.
Strait-Smith Co., St. Paul, Minn.

...

A PAIR SENT SUBJECT TO APPROVAL AT OUR EXPENSE.

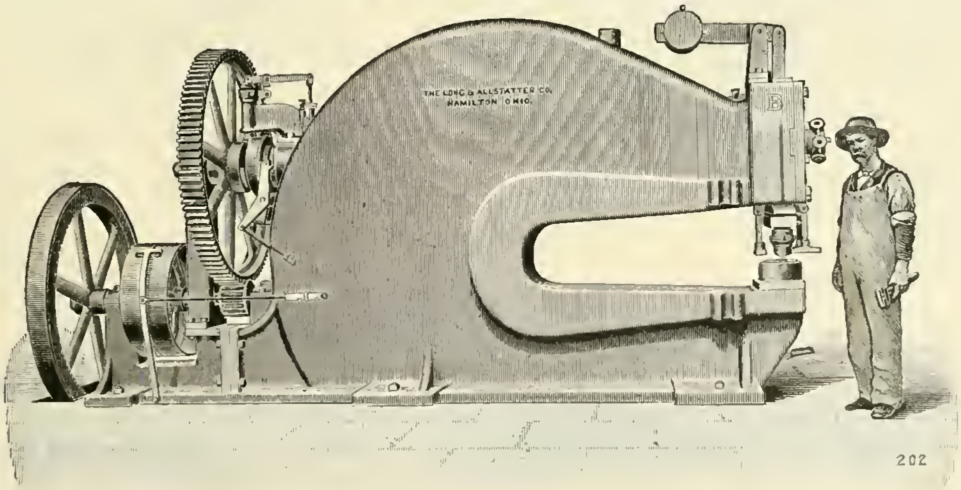
THE LONG & ALLSTATTER COMPANY,

HAMILTON, OHIO, U. S. A.

PUNCHING & SHEARING MACHINERY

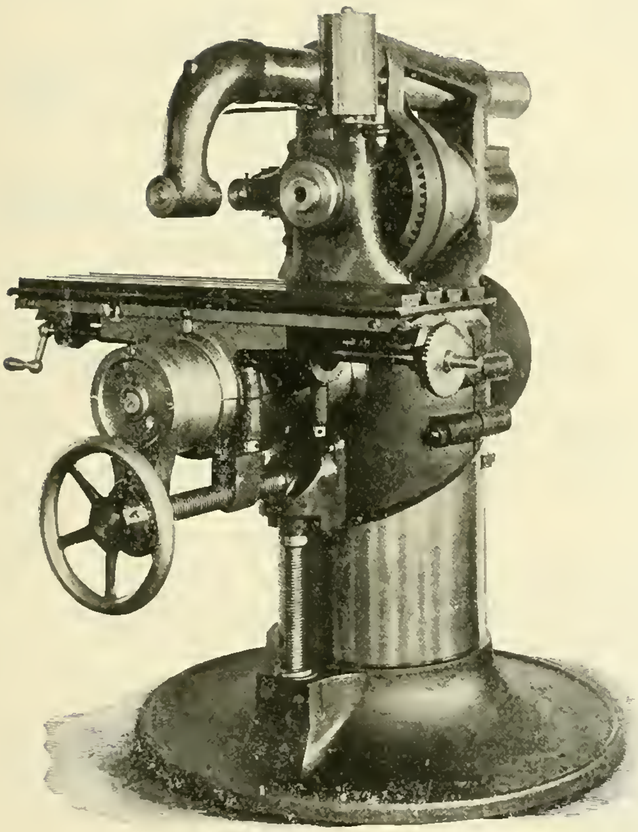
FOR R. R. SHOPS.

Over 350 styles & sizes for all kinds of Punching and Shearing in Metal by Power.

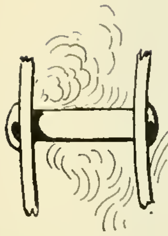


We have A CATALOGUE which will give you an idea of the large variety of Machines we make—write for it.

Single, Double, Twin, Horizontal, Angle-Iron, Hand or Automatic Spacing, Gate or Multiple, Punches or Shears, Belt, Steam or Electrically Driven, for all purposes.

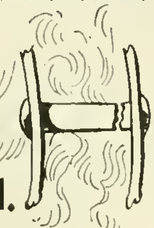


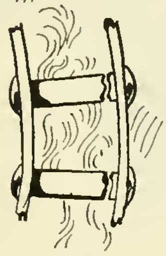
"A Tell-Tale that Tells"



This is the stay-bolt
All forlorn,
That was jammed in the sheet
An' tattered an' torn.

This is the crack
So silent and still,
That got in its work
With a right good will.





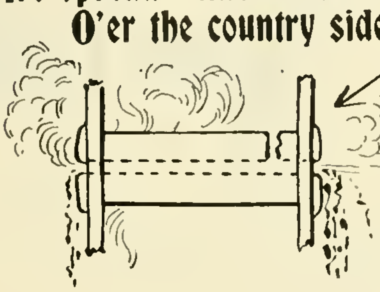
This is a stay-bolt
Jest like t'other,
Who went out on strike
To help his brother.

Falls Hollow Stay-Bolt Co.,
Cuyahoga Falls, O.

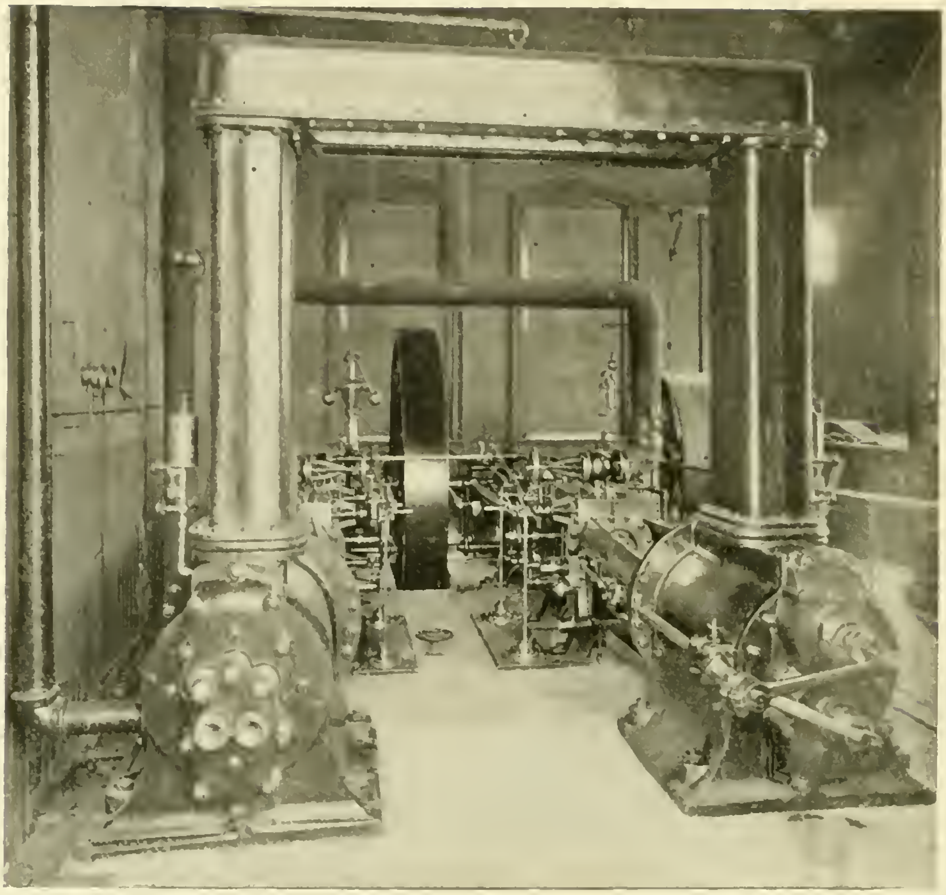
An' this is what happened
One summer day:
The shell hit the ditch,
An' the crown sheet gray
Took a sail in the clouds
T'ward the milky way.
An' the bold engineer
With his eagle eye,
Is part on the earth
And part in the sky,
While the stays, and the flues,
And the grates, in their pride,
Are spread—like manure—
O'er the country side.

This is the stay-bolt—
That stops all this,
For once it is cracked
It will drizzle and hiss,

An' the boiler-make
With his calkin' tool
The Falls Hollow Stay-Bolt
Never can fool;

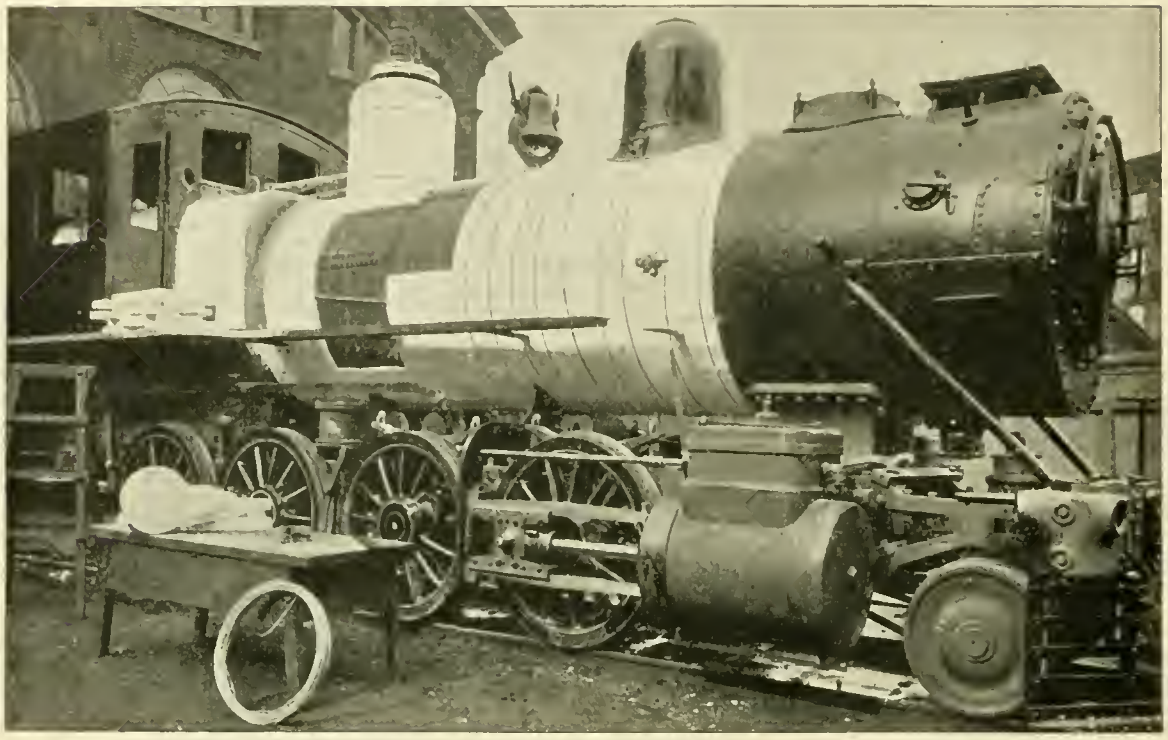


It won't be "doctored"
Up with tricks,
And will never be happy
Until it is fixed.



C. & N. W. RAILROAD.— Compressor having Corliss Engine, Cylinders 10 in. Diam., and Air Cylinders with Rand Mechanical Valves, High Pressure 7½ in., Low Pressure 14 in., Stroke 24 in.

KEASBEY & MATTISON COMPANY'S
Magnesia Locomotive Laggings.



ILLUSTRATING THE APPROVED APPLICATION OF MAGNESIA SECTIONAL LOCOMOTIVE LAGGING TO A LOCOMOTIVE AT THE P. R. R. SHOPS, ALTOONA, PA.

SPECIFIC INSTRUCTIONS

FOR THE APPLICATION OF

MAGNESIA LAGGING TO LOCOMOTIVES.

1st. Draw the wires tightly around the boiler, but not so tightly but that the hooks can be put underneath the wires with ease.

2d. Apply the first block of Magnesia Lagging to the boiler immediately underneath the centre, so that the laggers or other mechanics can work at applying the Magnesia Lagging upon both sides of the locomotive at the same time. Insert the curved ends of the hooks underneath the wires and drive them with the block tightly against the straight edges of the Magnesia Lagging, as then the straight ends of the curved hooks will press firmly upon the top or exterior surface of the Magnesia Lagging, and this will hold the Magnesia Lagging firmly in position.

3d. Next place another block of the Magnesia Lagging tightly against the first one, as this secures the one edge of the second block of Magnesia Lagging firmly against the first one; then insert another curved hook underneath the wire and drive it firmly over the other edge, then another block of the Magnesia Lagging, then another hook, and so on, block after block, until all the blocks are firmly in place and all firmly secured.

4th. In applying the last block of Magnesia Lagging, turn up the straight ends of the hooks, insert the block, and then turn the tips again at right angles and hammer them down carefully and firmly, when the application will be completed.

5th. After all the blocks of Magnesia Lagging are firmly in place, cut the steel tape (which goes over all) into a suitable length for bands, and draw this very tightly around the exterior surface of the Magnesia Lagging and thus make the ends thoroughly secure. This renders the covering firm and prevents any slipping of the Magnesia Lagging, thus making a very firm, secure and strictly first-class job.

Use at least two bands of the steel tape to each length of the Magnesia Lagging. When the lagging is more than 30 inches long, use three bands, that the Magnesia Lagging may be held rigidly in place.

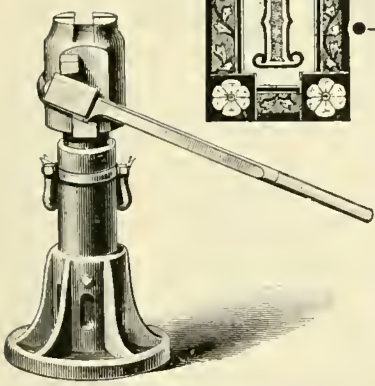
BE CAREFUL to COUNTERSINK for RIVET or BOLT HEADS, as the blocks of Magnesia Lagging will be injured by driving them with a hammer. Wherever driving is necessary, place a piece of board upon the surface or edge of the Magnesia Lagging and tap this gently, but firmly, thus driving it home without injuring the Lagging.

COUNTERSINKING can best be done with the sharp corner of a hatchet.

The blocks may be cut, like wood, to any shape desired, by means of an ordinary saw.

After the application of the Magnesia Lagging is finished, go over all the work with a stiff brush, when the job will be completed and left in good condition for the application of the planished iron jacket.

I originate, others imitate.



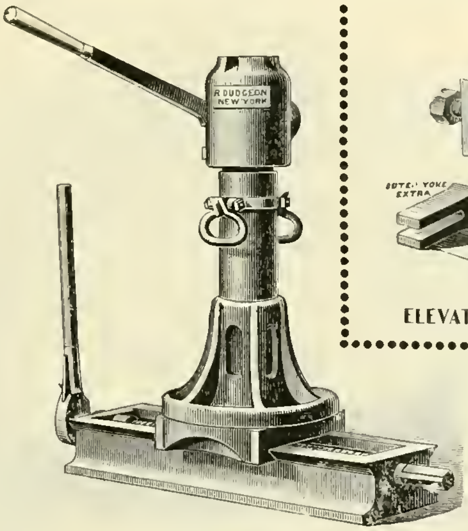
BASE JACK.

When ordering Hydraulic Jacks, Punches, Roller Tube Expanders, specify

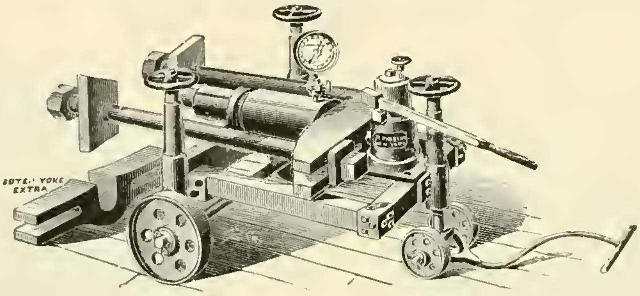
Dudgeon's Latest Improved

Patents on the Hydraulic Jack.

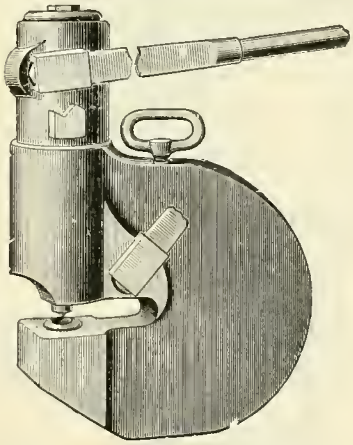
July 8, 1851.
Aug. 1, 1865.
April 15, 1873.
Feb. 2, 1882.
Jan. 23, 1883.
May 6, 1884.
Nov. 17, 1885.
Nov. 17, 1885.
Jan. 12, 1886.
Sept. 13, 1887.
Sept. 13, 1887.
July 5, 1892.



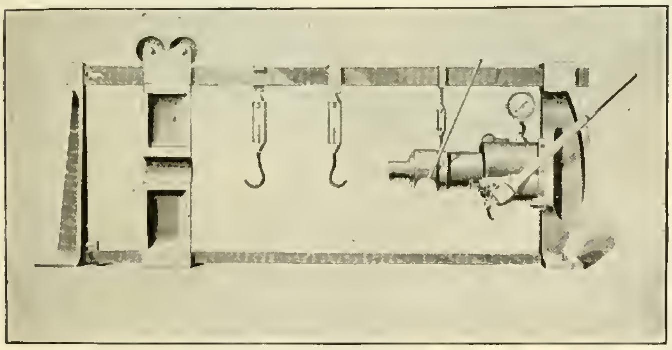
TRAVERSING JACK.



ELEVATING HYDRAULIC CRANK PIN AND SMALL WHEEL PRESS.



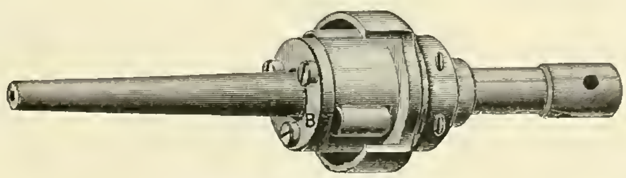
HYDRAULIC HEAD PUNCH.



SMALL WHEEL PRESS.

All correspondence will receive prompt and careful attention.

Original inventor, Patentee and Manufacturer of the Hydraulic Jack, and Controller of all Patents.



IMPROVED TUBE EXPANDER.

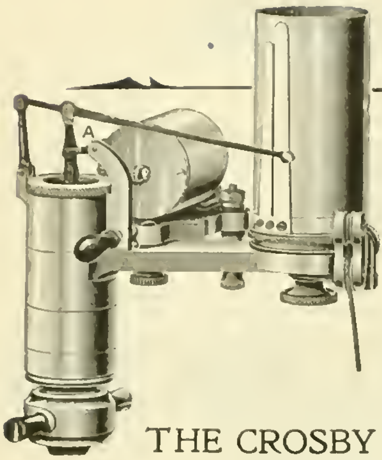
Wheel Presses, and Direct Acting Steam Hammers.

RICHARD DUDGEON,

24-26 COLUMBIA STREET, NEW YORK CITY.

Advertising Foundry, L. E., 1896.

Crosby Steam Gage and Valve Co.,



Boston, Mass., U.S.A.

New York, Chicago. London.

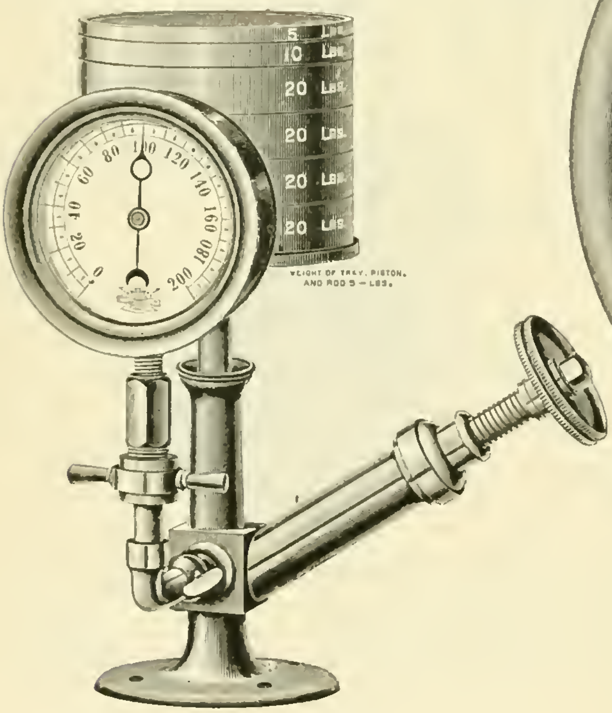
Crosby Pop Safety Valve for all classes of boilers. Muffled Pop Safety Valves. Water Relief Valve for pumps, hydrants, hose, etc. Revolution Counters, Rotary or Reciprocal Motion. Spring, Seat, Globe and Angle Valves. Original Chime Bell Whistles.

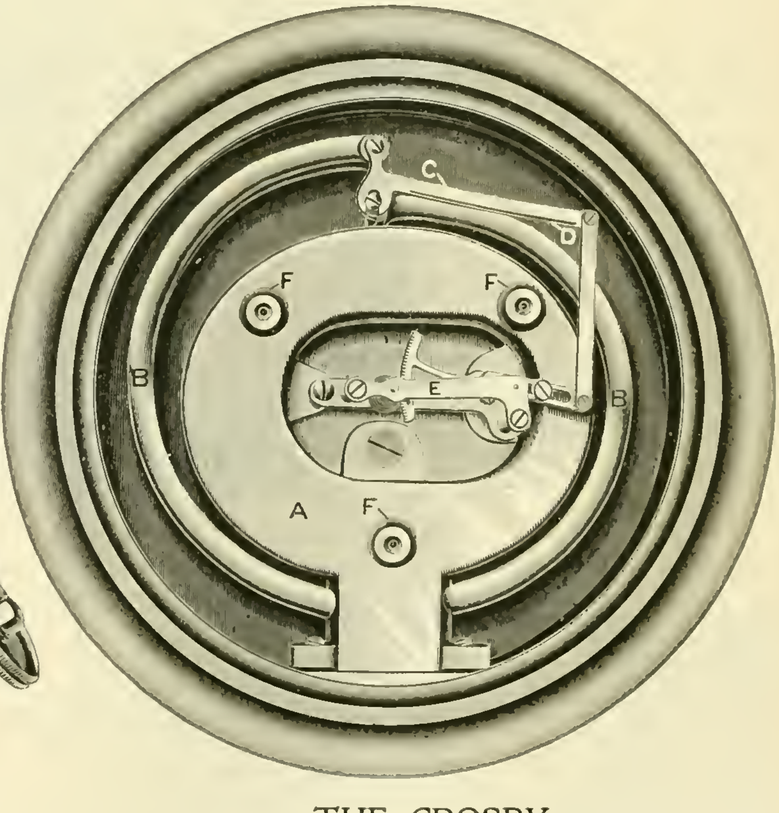
High-Grade Steam Appliances

THE CROSBY STEAM ENGINE INDICATOR.

In no department of science has there been greater progress made during recent years than in that of mechanical and steam engineering.

The Crosby Steam Engine Indicator is an "up-to-date" instrument in every particular, and is recognized as the leading instrument throughout the world. It may be furnished with Sargent's Electrical Attachment, by which any number of diagrams may be taken simultaneously.





THE CROSBY PATENT THERMOSTATIC WATER-BACK PRESSURE GAGE.

Under the extremely high pressures at which steam is now carried, gages often become heated to a high degree and the tube springs become expanded and consequently weakened, so that they offer less resistance, whereby the pointer shows more pressure than actually exists. This has been the cause for much complaint wherever, from the necessary conditions, the **ordinary** steam gage is subjected to extreme heat, as is the case on the boilers of steamships, cruisers, locomotives, and in many other situations. To meet such cases the Crosby Patent Thermostatic Water-Back Gage was invented and is now offered to the public. It is fully guaranteed to register the pressure of steam correctly throughout its working range, at any temperature from 150 to 200 degrees F.

The above illustration shows this device. The thermal bar C, D, is so constructed that when it is subjected to a high temperature its movement exactly counteracts the excessive movement of the tube springs and keeps the pointer true to the actual pressure in the boiler.

Books and catalogues illustrating and describing these appliances, free by mentioning "Locomotive Engineering."

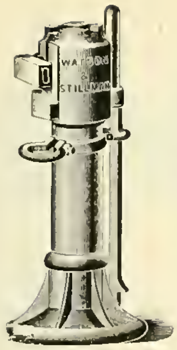
CROSBY PATENT PRESSURE GAGE TESTER.

This machine is designed and constructed on scientific principles and is a standard of mathematical accuracy.

Of it, Mr. John R. Freeman, M. E., Chief Dept. of Inspection, Associated Factory Mutual Insurance Cos., Boston, Mass., in an address before the **Association of Engineering Societies,** said that he believed it to be fully equal to a first-class mercury column in accuracy, and much superior to it in convenience and quickness of manipulation.

Railroads, Mills, Factories, Scientific Schools, Electric Light and Power Plants, and all establishments where any considerable number of pressure gages are used, should be provided with a Crosby Gage Tester. It is capable of testing gages of any pressure up to 1,000 lbs. The price depends upon the number of weights furnished.

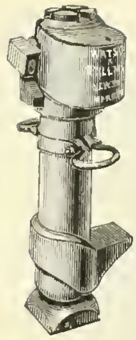
Advertising Foundry, L. E., 1896.



BASE JACK.

Hydraulic Tools for Railroad Work,

the result of many years of careful study and workmanship, come from the establishment of

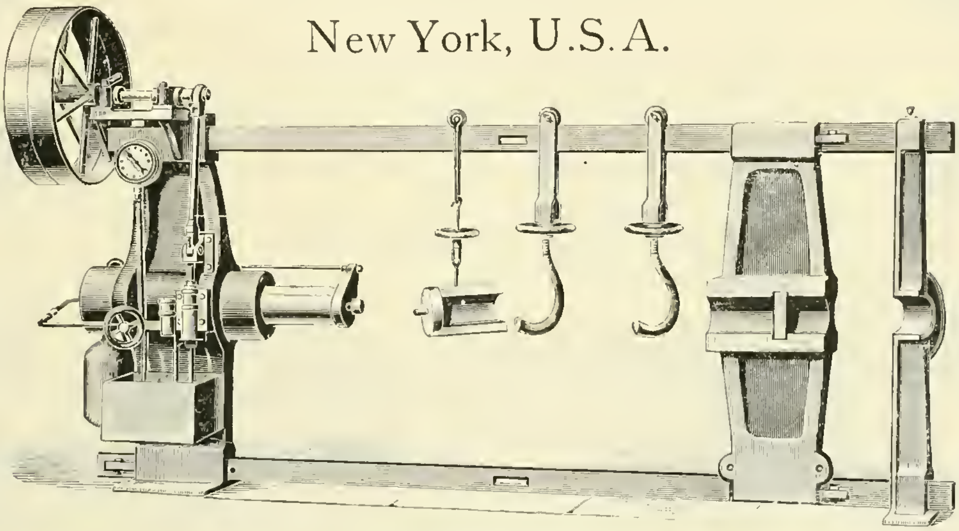


CLAW JACK.

The Watson-Stillman Company,

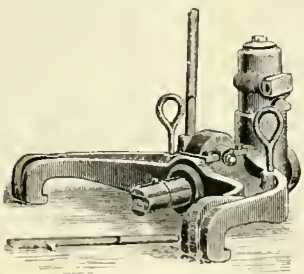
204 to 210 East 43d Street,

New York, U.S.A.

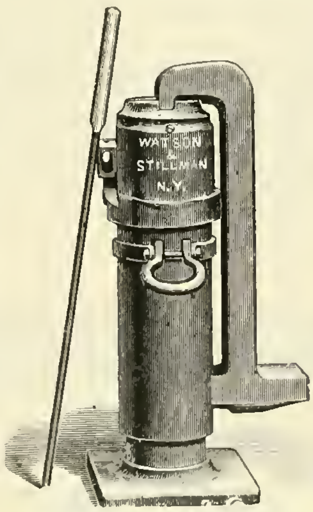


POWER WHEEL PRESS.

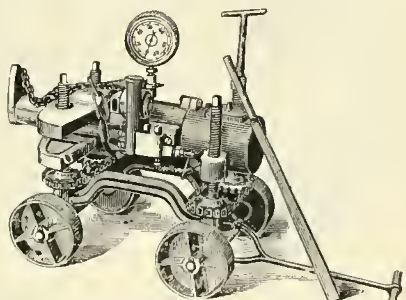
Car Wheel Presses, Crank Pin Presses, Rail Benders, Jacks, etc.



RAIL BENDER.



WRECKING JACK.



CRANK PIN PRESS.

Our new Catalogue W. illustrates and describes these good tools at length. Takes the place of older catalogues, and is to be had for the asking.

Advertising Foundry, L. E., 1896.

Thousands of Dollars

hang on the reliability of

AIR BRAKE HOSE.

The cost of the best is so small that railway officials generally recognize the policy of using nothing else. The making of air brake hose requires brains, experience, the choicest materials, the most improved machinery. Omit any one of these, and the hose is unreliable.

WE USE THEM ALL.

STEAM HOSE.

No hose is so severely tried as steam hose—none requires more skill in its construction. A heavy, seamless tube; tenacious friction; and tough, durable cover are features of our hose.

INTERLOCKING RUBBER TILING.

Artistic in design; more durable than marble; the only tiling perfectly adapted for steamships, cars, public buildings, private residences, etc., etc.

NEW YORK BELTING & PACKING CO. LTD

PIONEERS AND LEADERS, NEW YORK.

LOCOMOTIVE ENGINEERING
A PRACTICAL JOURNAL of RAILWAY MOTIVE POWER AND ROLLING STOCK.
[Trade-Mark Registered.]
Vol. IX. NEW YORK, JULY, 1896. No. 7.

Chesapeake & Ohio Consolidation Compounds.

We present, by means of a half-tone and a line engraving, the new compound consolidation locomotive for the Chesapeake & Ohio, recently designed by Mr. W. S. Morris, superintendent of motive power of the road. Writing about these engines, Mr. Morris says:

"In designing this engine, we have been very careful to keep as much as possible in the lines of our G-4 engines, with the exception of providing a boiler suitable for 200 pounds steam pressure.

"We have now had these engines in service about three months and they are showing remarkable results. We have departed from the 'Belpaire firebox' and use the extension wagon top with radial stays in our new boilers. You will also note the valve seat of the low-pressure steam chest is on an incline; this was necessitated on account of the great diameter of the low-pressure cylinder.

"I have recently conducted a very exhaustive service test of these machines, and I am happy to say we can see a saving of almost 20 per cent. in fuel with these compound engines as compared with our G-4 class of similar dimensions, except that they are simple engines.

"The train load hauled by the new G-5 is also increased, which of course we expected, as the machine weighs a little over 140,000 pounds and carrying 200 pounds of steam, while our G-4 engine weighs 128,300 pounds and carries 160 pounds of steam.

"We certainly feel very proud of this machine, and, as I said before, excepting the two main features, that of compounding the engine and the change in the boilers, our patterns for most every part are applicable both to our G-4 and G-5 consolidation engines."

The following are the principal dimensions of the engine:

Type, consolidation.

Numbers, 351, 352, 353, 354, 355.

Name of builder, Richmond Locomotive & Machine Works.

Kind of fuel to be used, bituminous coal.

Weight on drivers, 121,700 average.

Weight on truck, 18,825 average.

Weight, total, 140,525 average.

Wheelbase, total of engine, 23 feet 5 inches.

Wheel base, driving, 15 feet 8 inches.

Wheel base, total engine and tender, 48 feet 2 inches.

Length over all, engine, 36 feet 7 inches

Length over all, engine and tender, 59 feet.

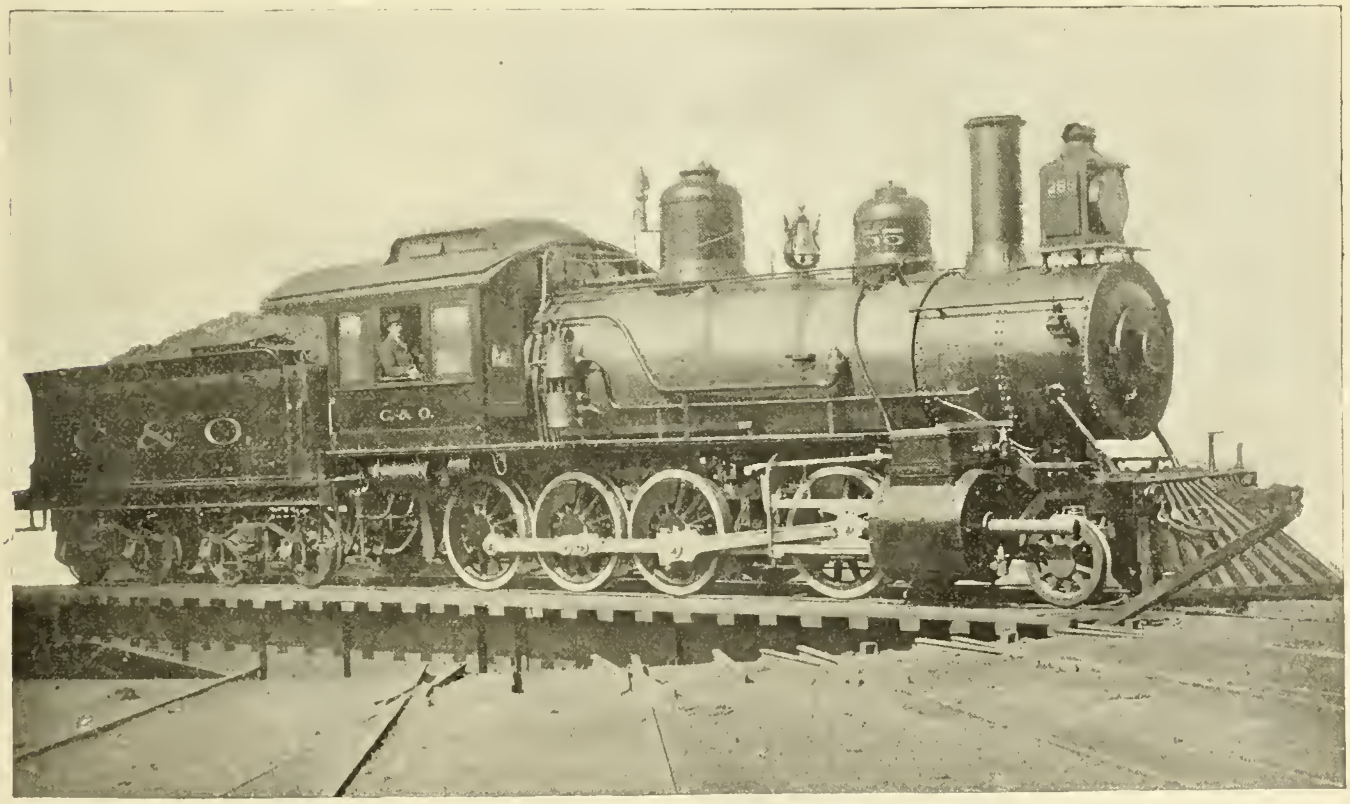
Height center of boiler above rail, 7 feet $3\frac{7}{16}$ inches.

Height of stack, 14 feet $6\frac{7}{8}$ inches.

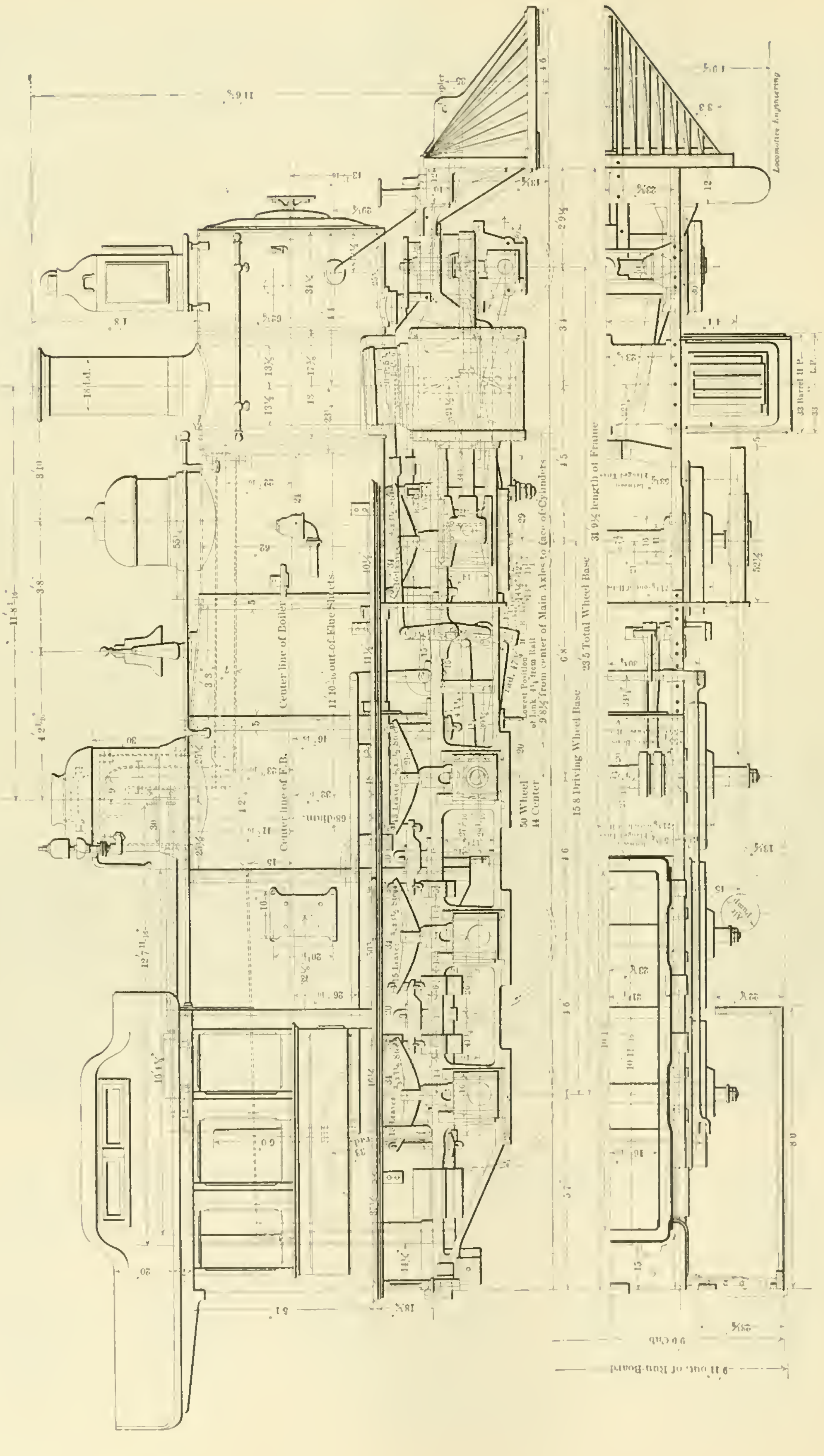
Heating surface, firebox, 228 square feet.

Heating surface, tubes, 1,744 square feet.

Heating surface, total, 2,072 square feet.



RICHMOND COMPOUND FOR CHESAPEAKE & OHIO.



DETAILS OF CHESAPEAKE & OHIO COMPOUND CONSOLIDATIONS

Grate area, 28.18 feet.
Drivers, diameter, 50 inches.
Truck wheels, diameter, 30 inches.
Journals, driving axles, $7\frac{3}{4}$ inches x $8\frac{7}{16}$ inches.
Journals, truck, 5 x $9\frac{7}{8}$ inches.
Main crank pin, $6\frac{1}{2}$ x 6 inches, main rod; $6\frac{1}{2}$ x $5\frac{7}{16}$ inches, side rod.
Parallel rod, pins size, Nos. 1 and 4, $4\frac{1}{2}$ x 4 inches; No. 3, 5 x $5\frac{7}{16}$ inches.
Crosshead pin, $3\frac{1}{2}$ x $3\frac{1}{4}$ inches.
Cylinders, diameter, 21 x 33 inches.
Piston stroke, 24 inches.
Piston rod, diameter, $3\frac{3}{4}$ inches.
Main rod length, C to C, 6 feet $11\frac{1}{2}$ inches.
Steam ports, 23 inches, H. P. and L. P.
Steam ports, width, $1\frac{1}{2}$ inches L. P., $1\frac{1}{4}$ inches H. P.
Exhaust ports, length, 23 inches H. P. and L. P.
Exhaust ports, width, $3\frac{1}{2}$ inches L. P., 3 inches H. P.
Bridge, $1\frac{1}{8}$ inches L. P., $1\frac{1}{4}$ inches H. P.
Valves, kind of, Richardson's balanced.
Valves, greatest travel, L. P. 6 inches, H. P. $5\frac{1}{2}$ inches.
Valves, inside clearance, H. P. $\frac{3}{8}$ inches, L. P. $\frac{5}{16}$ inches.
Boiler, type of, extended wagon top.
Boiler, working pressure, 200 pounds.
Boiler, material in barrel, carbon steel.
Boiler, thickness of material in barrel, $\frac{11}{16}$ and $\frac{3}{4}$ inch.
Boiler, diameter of barrel at front sheet, 62 inches.
Seams, kinds of horizontal, sextuple, riveted butt joint.
Seams, kind of, circumferential, double-riveted.
Thickness of tube sheets, $\frac{1}{2}$ inch.
Thickness of crown sheet, $\frac{3}{8}$ inch.
Crown, stayed with rod stays.
Dome, diameter, 30 inches inside.
Tubes, 281.
Tubes, material, charcoal iron.
Tubes, outside diameter, 2 inches.
Tubes, length over sheets, 11 feet, $10\frac{5}{16}$ inches.
Firebox, length, 10 feet $1\frac{5}{8}$ inches.
Firebox, width, 2 feet $9\frac{3}{8}$ inches.
Firebox, depth, front, $74\frac{3}{4}$ inches.
Firebox, depth, back, $66\frac{1}{4}$ inches.
Firebox, material, carbon steel.
Firebox, thickness of sheets, top sides and back, $\frac{3}{8}$ inches.

Be Satisfied with Less than One Hundred Miles an Hour Speed.

The Annual Report of the Massachusetts Railroad Commission does not give much aid or comfort to the people who are advocating the running of railroad trains at 100 miles an hour speed. In discussing the claims made that electricity renders that speed practical, the report says:

"With respect to speed, extraordinary claims are made by those interested in the development of electric traction; but there is no question that the steam locomotive is fully capable of developing as high a speed as it is desirable or prudent to use. A railroad speed of 100 miles or more an hour is, for the present purpose, a matter of merely curious speculation. It cannot be shown that there is enough traffic demanding this speed to pay the excessive expense of operation, even if, with present methods of construction and equipment, it were otherwise at all practicable. Before any such speed is seriously thought of, there must be radical improvements in safety appliances, as, for example, in brakes and in signals. Whatever the proposed rate of speed, the question of signals becomes at once of importance, since, with the adoption of electricity, all systems of electric signaling which depend on the use of the rail circuit must be modified or abandoned."

EASTERN END OF GREAT SIBERIAN RAILWAY. TO ST. PETERSBURG, 6,547 MILES.

The Eastern End of the Great Siberian Railway.

We have just received the photographs here reproduced from the irrepressible Lodian—he of the pig-tail and the paper-soled shoes. This enterprising traveler has reached Vladivostok, on the Sea of Japan, and started on his long trip across Siberia and Russia. These photographs were made by F. I. Podzorov, of Vladivostok.

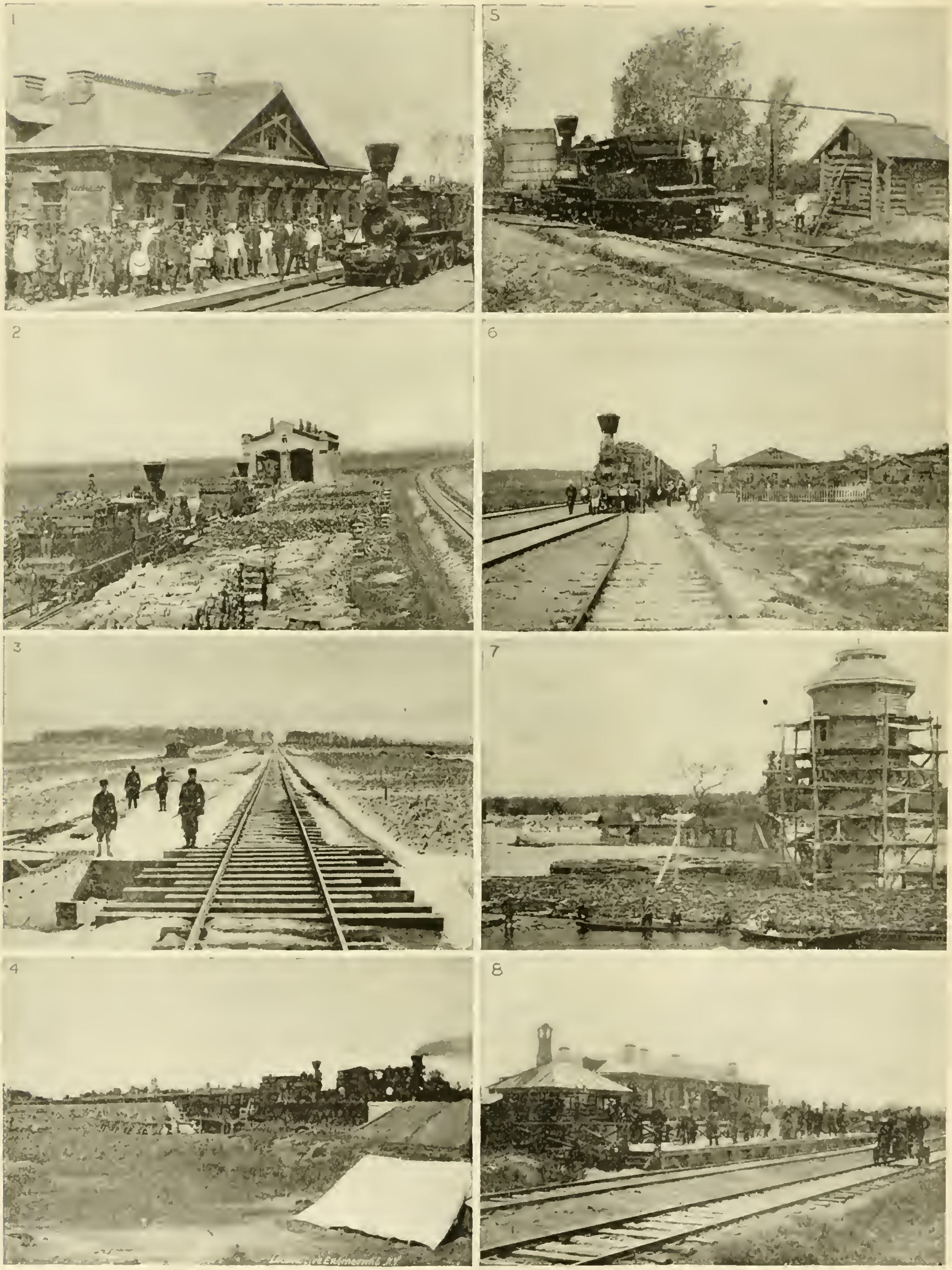
Mr. Lodian writes: "It was a pleasure to clear inland from Vladivostok; it is a town of about 20,000 inhabitants, without a single made road or street; they are either awfully muddy or extremely dusty, and always filthy, fetid and revolting. After nine weeks spent in Japan, Siberia is disappointing at the start. On our steamer coming up were 400 Chinese navvies for the Siberian road, and the stench from them was awful. My next address will be Irkutsk, Central Siberia."

Our readers may not know what a gigantic undertaking the building of the Trans-Siberian Railroad is, nor how much of it is done, and we append here a few facts on the subject:

To begin with, only the military necessities of a great empire could undertake to build such a road across such a country. It is being constructed in sections—from both ends and from points that can be reached by river steamers in the interior. It is now possible to travel direct from St. Petersburg to Omsk, a distance of 2,673 miles. From Omsk to the Ob river—384 miles—the rails are laid the whole distance, but the earthworks are not complete. On the next section, that from the Ob river to Krasnoyarsk, 467 miles, the rails are also laid, and a beginning has been made of the iron bridge, 2,800 feet long, across the Ob, that is to join the two sections. On this section many of the smaller bridges are built, and half the earthworks are completed. The next section is to Irkutsk, a distance of 672 miles, and it presents many difficulties; nearly two-fifths of the earthworks are finished. Beyond Lake Baikal the distance to the head of the Ameer navigation is 701 miles, and in this section work has been begun from the Pacific end; but the difficulties are very great, and much tunneling will have to be done, as the line has to rise to a plateau over 3,500 feet high. The next section presents the greatest difficulties, as the line has to be carried through a marshy region which during the heavy rains is often completely submerged. The line from Vladivostok is completed for 250 miles.

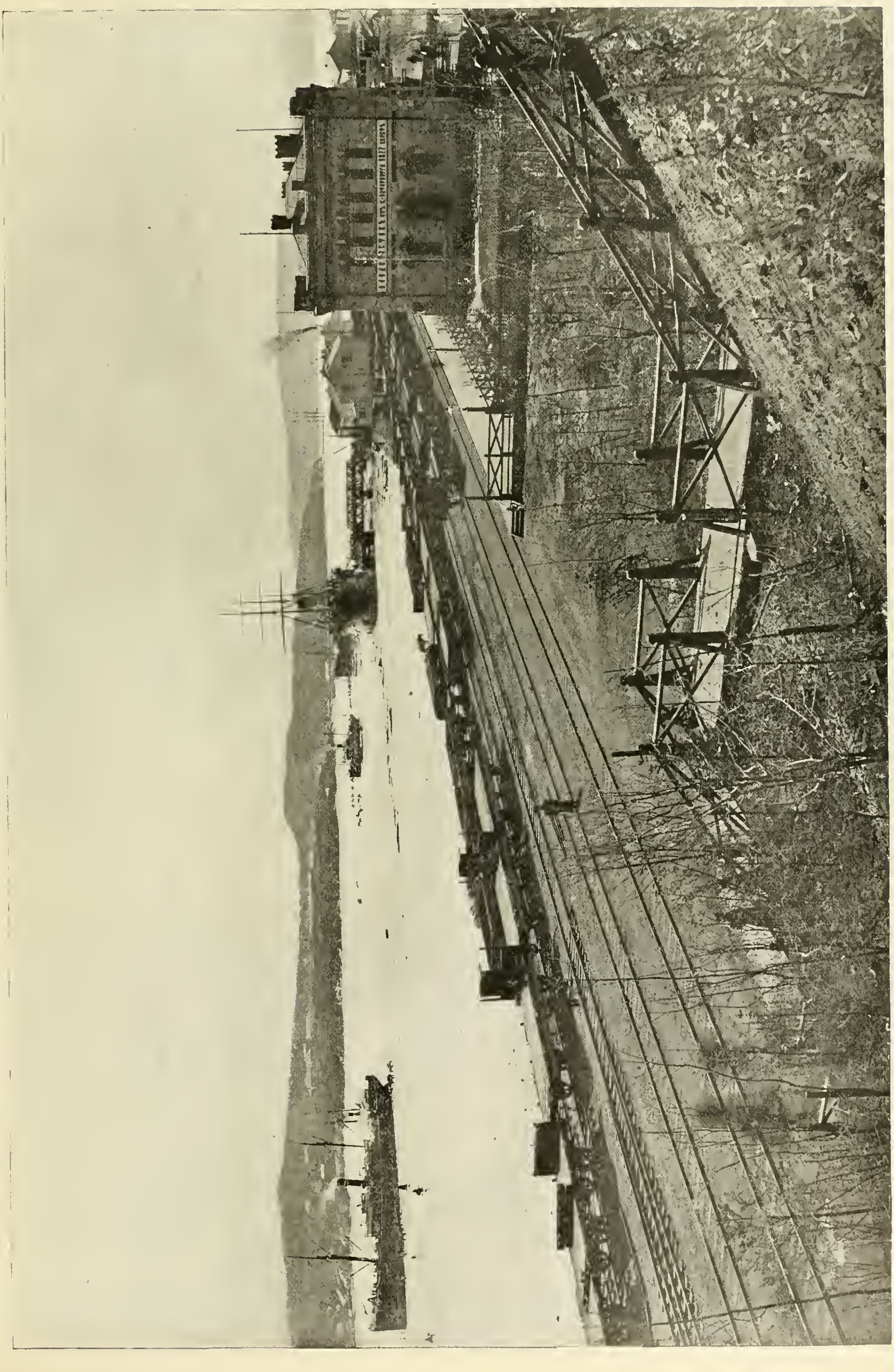
Lodian can have all the fun and glory he can get out of a tramp across Siberia—we had rather be in "God's country."

There is a hospital at Amjeer, India, established for the use of railway men. The money required in erecting the hospital was collected by the Presbyterian Church Mission, and its running expenses are defrayed by the pennies of Sunday-school children.

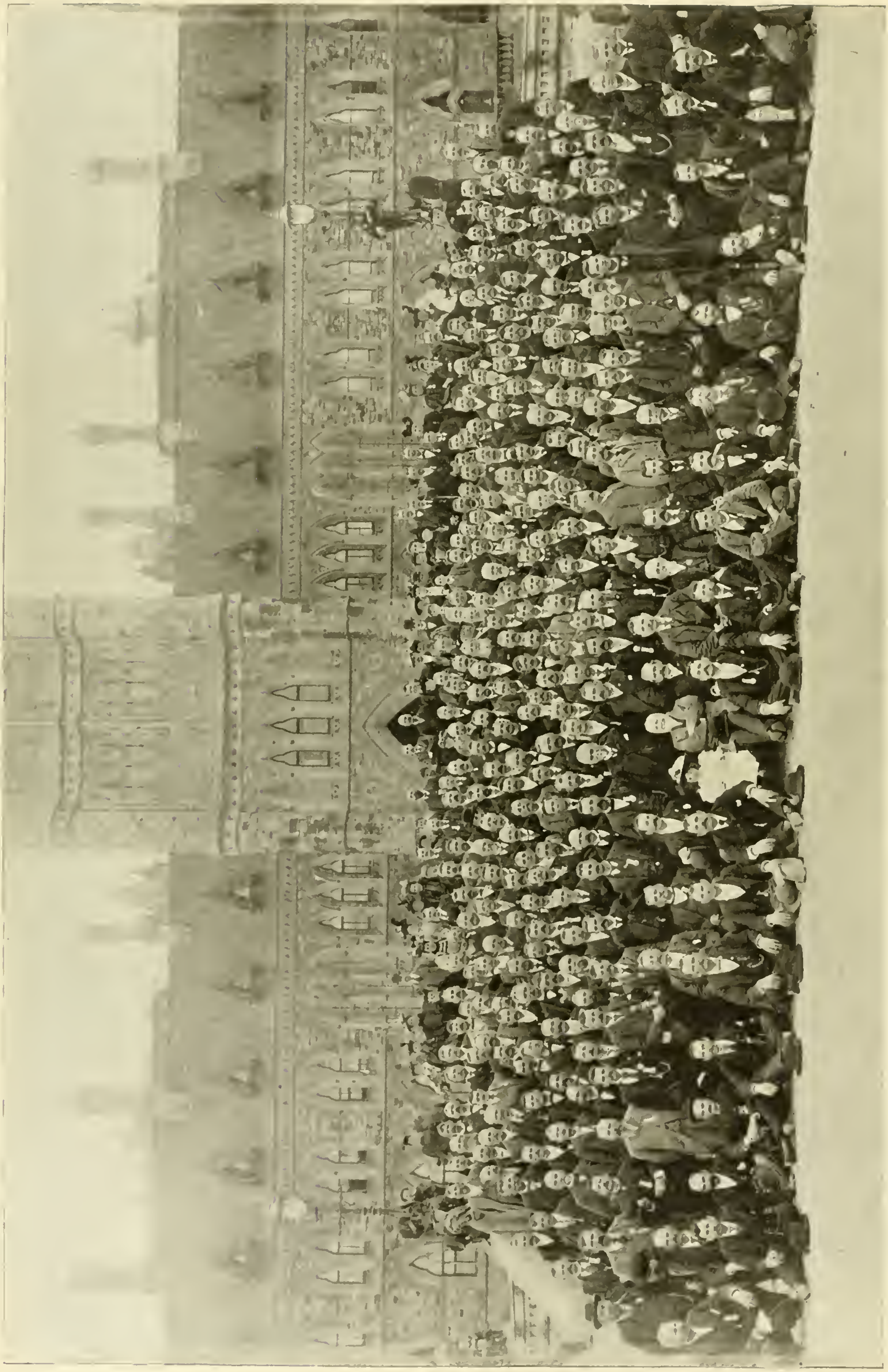


EASTERN END OF THE GREAT SIBERIAN RAILWAY.

1. A Country Station Baldwin Wood Burner. 2. The Usual Solidly Built Engine House on the Usuri Section 3. A Typical Winter Scene. 4 Building the Amoor River End. 5. American Locomotive with Giant Water Tank for Carrying Water to Waterless Regions. Engine Taking Water from Tank Roofed in to Prevent Freezing. 6. Prepared for a Long Run 7. The Siberian Railroad Flooded in the Amoor Valley– Water Tank Inclosed to Prevent Freezing. 8. A Rural Station



VLADIVOSTOK IN WINTER. EASTERN TERMINUS OF THE GREAT SIBERIAN RAILROAD. 9,877 VERSTS (6,547 MILES) TO ST. PETERSBURG.



DELEGATES TO THE BROTHERHOOD OF LOCOMOTIVE ENGINEERS CONVENTION. BEFORE PARLIAMENT HOUSE, OTTAWA, CANADA, MAY 18, 1896.

Shop Heating.

In our May issue we mentioned that Mr. C. M. Higginson, who has lately been appointed assistant to the president of the Atchison, Topeka & Santa Fé, has devoted much attention to matters connected with the economical combustion of fuel. A paper which he read before the Western Railway Club some time ago, contains some points about stationary boilers and shop heating that are well worthy of consideration by those responsible for the heating of railroad shops. Part of the paper reads:

"We find boilers so short that there is not sufficient flameway to finish the combustion of the burning gases, and in all events, not to give sufficient travel to allow the heat evolved from the combustion of the coal to be taken up by the water in the boiler, the consequent result being a very high stack temperature and waste of fuel.

"We also find that the gases are allowed to go from the tubes direct into the stacks, when, by being passed over the top of the boiler again, under the brick work, an additional amount of heat might be absorbed by the water and steam, more work got from the coal, and the stack temperature lowered. It will be noticed that, in the main, these are matters, not of theory, but of everyday mechanical practice; yet upon the slighting of them, much loss of fuel, which is property, rests.

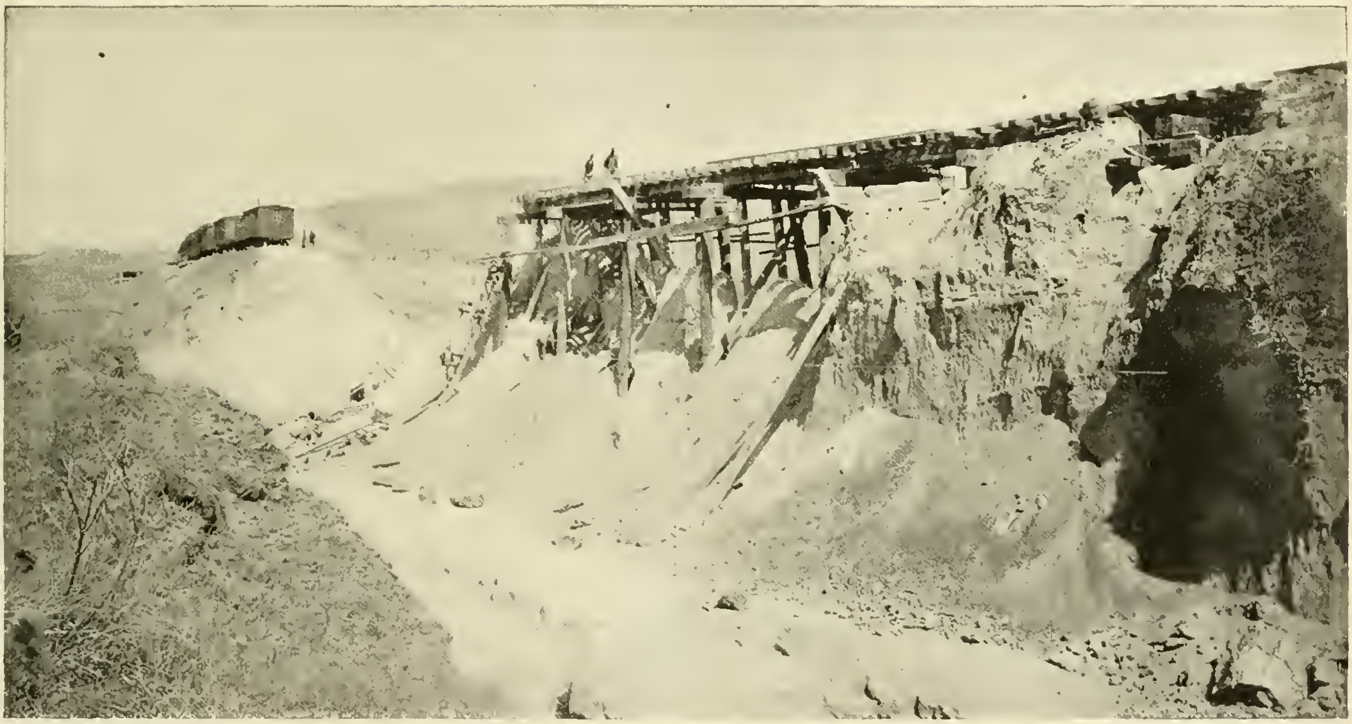
"When we come to consider the matter of heating shops by steam, we find all manner of crude appliances, mainly due to the gradual additions to buildings and plant. Live steam is used from the boiler at a high pressure, through all kinds of illy contrived coils and pipes, the result being much leakage, an occasional bursting of pipes or radiators, and great waste of fuel and unsatisfactory results generally.

"There are a number of excellent methods of using exhaust and low-pressure steam when plants are put in new, and it will not be necessary to dwell upon them here. The great want that I have discovered in our railway buildings, is that of simple adaptations of practice of using exhaust steam to existing plants.

"When the matter of improvement is suggested, an appropriation may be asked for to put in some quite expensive combination, which, though excellent in itself, is out of the question in these times of enforced economy, and it would seem as if some of our best mechanics were sometimes rather too unmindful of the value of what might be called approximate methods. When you cannot get a whole loaf, you should be content with half a one, and if you cannot put in what is considered a desirable steam plant for heating by exhaust steam, it is better even to use the steam from some one engine that, in a corner of the shop, is now exhausting into the open air, for heating the portion of the shop immediately by it. We can, in many cases, cheaply arrange a return system for use at least on a part of our plant, without the expense of exhaust pumps or other complicated devices.

"This whole matter of shop heating, and especially the reorganization of existing plants, is a very fertile one, and one in which much saving in fuel, and in the amount of boiler plant needed, can be made by studying the detailed conditions of each building and each plant separately. To show how local conditions may change a carefully designed plan, I might state that, in our general office building, the plan presented by the architects for the heating system showed a beautiful series of arrows indicating the direction of cool and warm air due to the arrangement of radiators and ventilators. In practical working, however, we found by an exhaustive series of experiments, made with that elaborate apparatus called a tobacco pipe, that the course of the currents was in directly the opposite direction, and it was not until the radiators had been moved to the opposite side of each room that satisfactory and economical results in heating were reached.

"In matters of boiler practice and shop heating, as in nearly everything else on a railway, close attention to details, and the persistent improvement and betterment of little, individual things, is of more vital importance than the discovery of some great system which will revolutionize present practice. This revolution of practice will come in due time, if it is on the books; but before it comes we can save thousands of dollars by close watch and readjustment of matters which are under our eyes every day."



GREAT WASHOUT ON CHEYENNE & HOLDREGE BRANCH OF THE "BURLINGTON" LINE, APRIL 18, 1896, 350 FEET LONG, 65 FEET DEEP.

In the June issue of "Locomotive Engineering" we described an air inlet thimble used on the Columbus, Sandusky & Hocking Railroad, crediting the invention to Mr. Bancroft, the general foreman. This was a mistake; the device is the invention of George C. Sharpe, passenger engineer on the C., A. & C. R. R.

Kinks at the Susquehanna Shops—Erie Railroad.

Among the devices for handling work at these shops we recently saw a machine for testing flues, which, like most tools of the kind, was a home production. The frame, as shown in the illustration, is made of one piece of 6 x 1-inch wrought iron, supported on six ⅝ x 2½-inch wrought-iron legs. The machine does not require much shop room, except lengthwise; its mechanism is simple, consisting only of the hand pump, and piping to the water supply, and the rubber gaskets at the end seats to retain the pressure—the seat at the right hand having a small cock to release the pressure after the required test.

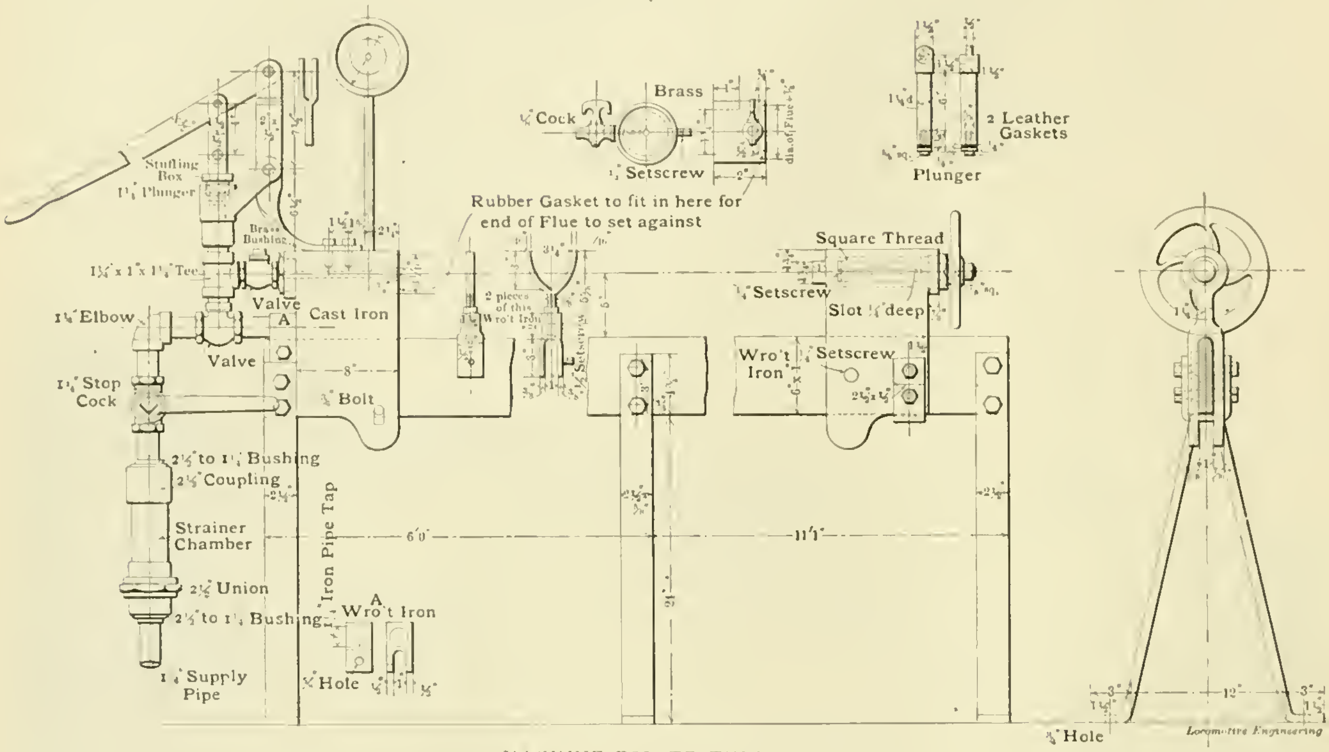
Flues are tested rapidly, because the initial pressure is had at once, equal to that on the city water mains from which the supply is taken, filling the flue without any pumping, leaving that operation for the test pressure alone.

A pump for testing boilers and steam gages is a combination that may have a strange appearance at first glance, when the mind associates the delicate mechanism of a pressure gage with the crude appliances that may be made to pump up pressure on a boiler. Our illustration shows such a pump, that has been found to answer all requirements for both services, and gives equally as good results in its aristocratic tool-room surroundings as in its plebeian quarters in the roundhouse.

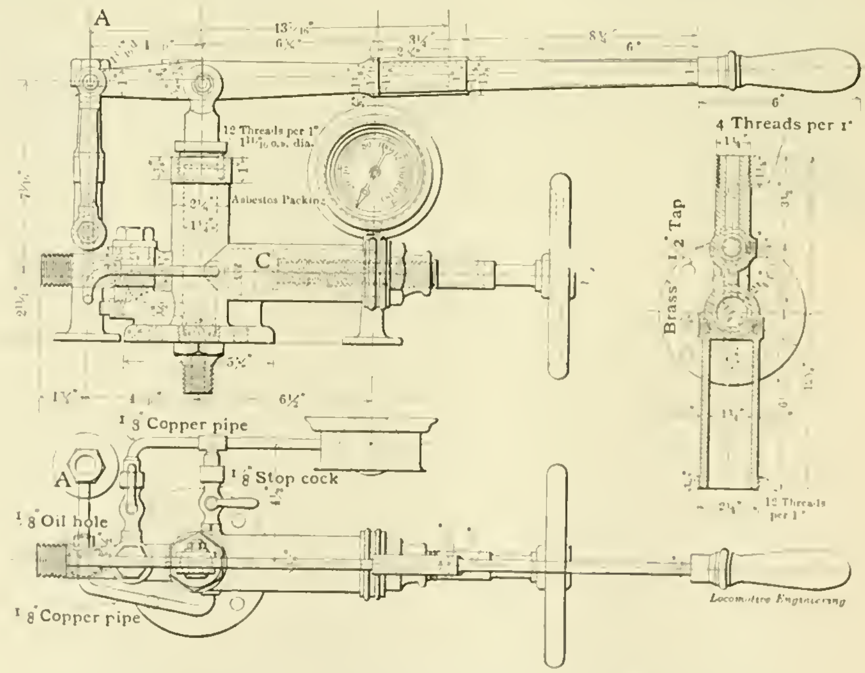
It is shown with its gage as used for testing a boiler, in which the pressure is obtained by means of the lever. When used to test a gage, the latter is secured to the column *A*, and the pressure is had by means of the hand-wheel *B*, which is at the end of the screw piston *C*. The device is small and light, and one of the best of its kind that we have seen.

The engraving of the machine for testing the relative chafing endurance of rubber hose, is given to show how the "Erie" handled the problem. The hose to be tested is clamped in a horizontal position in a wooden frame and with one end capped; the other is in communication with an air reservoir by a length of ¾-inch pipe. A chafing hose of a constant quality is then connected at one end to a crank pin, which travels in a 12-inch circle at the rate of 65 revolutions per minute. The opposite end of the hose being in connection with the air reservoir, air pressure of 75 pounds is turned into both hose. The chafing hose is suspended at a point about midway of its length, by a chain, and guided by a U-strap at its junction with the test hose. The friction between the two sections of hose soon demonstrates the endurance of the tested hose.

A chuck for boring and turning eccentrics is something that is needed in every shop doing locomotive repairs. There are any number of these in commission; some of them designed with the single object in view of boring, and others for



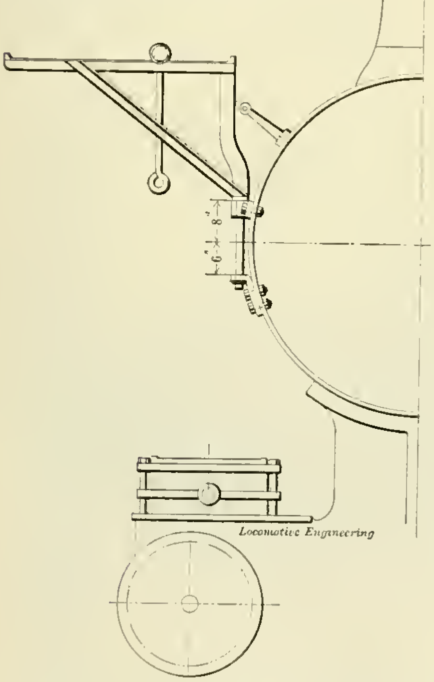
MACHINE FOR TESTING FLUES.



HAND PUMP FOR TESTING BOILERS AND STEAM GAUGES.

turning. The illustration shows a tool designed for both operations. It consists of a rectangular cast-iron plate, having lugs on its inner face to fit the slots in face plate of the lathe, to which it is bolted. On the outer face there is fitted an adjustable chuck, which is movable by a screw to any position in the length of the plate to which it is bolted. The outside plate has two lugs cast on and tapped for bolts, which are used to secure the ecentric centrally in the chuck, by bearing against the bar of the eccentric.

There is a scale attached to the base and a pointer fixed to the chuck by which the latter can be adjusted to its position (while the eccentric is bolted securely to it), either for boring or turning; and it is of no consequence which opera-



CRANE FOR STEAM CHESTS AND CYLINDER HEADS.

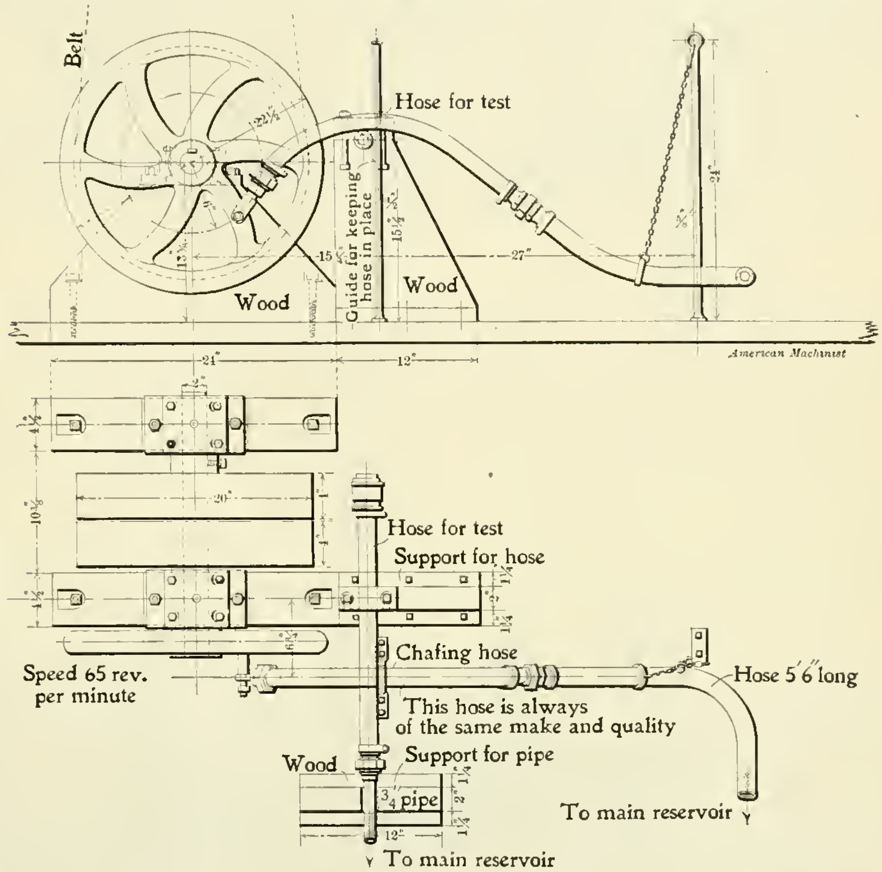
tion is performed first, for the scale attachment makes it possible to give the correct throw to the eccentric in either case.

Our engraving of the small crane swinging from a smoke arch, designed to handle steam chests and steam-chest covers, shows a little affair that is entitled to consideration when looking up the question of these handy devices for roundhouse or machine shops. It is held in tapered sockets, which are bolted to the smoke arch on the vertical center line of stack, and support the step at the top and bottom.

The post is made of one piece of 2 x 2½-inch material, 2 feet 4 inches long over all, with its lower end tapered from 1¼ inches at the bottom to 2 inches at the top, and 16 inches long. The strut is made of two pieces of 1¼-inch angle iron, as is also the jib, which is 3 feet 8 inches long over all, and on which rolls a flanged trolley wheel 3 inches in diameter.

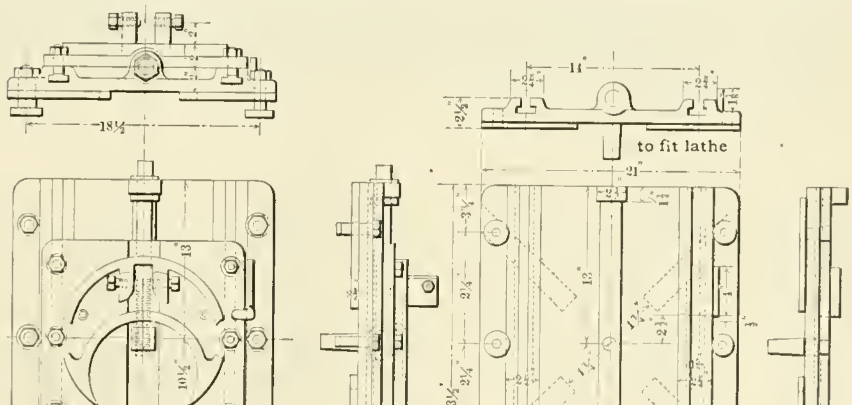
With these brackets a permanent fixture on the smoke arch, these little cranes are pronounced a successful and convenient means of handling a steam chest, a heavy slide valve or a cylinder head.

These devices we are enabled to publish through the courtesy of Mr. Mitchell, the superintendent of motive power of the "Erie," who has contributed many good things in the way of kinks and shop processes that have become standard practice.



METHOD OF TESTING THE RELATIVE CHAFING ENDURANCE OF RUBBER HOSE.

Mr. W. Worsdell, locomotive superintendent of the Northeastern Railway, has made a trial run with his new engines which were built for the East Coast run. They are 20 x 24 eight-wheelers, with drivers, 91¼ inches diameter, and a four-wheeled truck. The boiler is 52 inches diameter, with a firebox 84 inches long. The engine weighs 50 tons and the tender 40 tons of 2,240 pounds, ready for the train. A gait of 70 miles per hour was easily kept up during the experimental trips, which were highly satisfactory to the designers. These engines are over 96 inches from the rail to center of boiler; in respect of loftiness they approach American figures quite closely.



CHUCK FOR BORING AND TURNING ECCENTRICS.

During the first four months of 1896, the Baldwin Locomotive Works turned out 217 locomotives and are now averaging 15 per week—the best in two years.

Mastodon Locomotive for the St. Lawrence and Adirondack.

Our engraving shows a large locomotive just turned out of the Brooks Locomotive Works for the above road.

This engine has cylinders 21 x 26 inches and 55-inch drivers. Her boiler is 68 inches at the smokebox; the firebox is 113 x 37⅞ inches, with 324 2-inch flues 12 feet long. Total length engine and tender, 52 feet 9 inches. Total of engine, 25 feet 5 inches; of drivers, 15 feet 6 inches. Weight of tender, 85,000 pounds; of engine, 174,000, of which 146,000 is on the drivers and 28,000 on the truck.

Automatic Stokers.

There is an impression throughout the country that considerable fuel can be saved by feeding the furnaces of boilers with mechanical stokers, and we have seen suggestions that their use on locomotives would greatly reduce fuel consumption. It is supposed that the regular supply of fuel leads to a more perfect combustion than the irregular firing done with the scoop.

From a paper presented to the American Society of Mechanical Engineers by Mr. J. M. Whitham, and a discussion thereon, it appears that the popular idea about mechanical stokers is not correct. The conclusions arrived at in the paper and in the discussion were, that stokers will not develop as much capacity as hand-firing with stationary grates, having the same draft and coal conditions. Stokers are more constant in the power developed than is a hand-fired grate, and are more responsive to fluctuations in the power demands. The stoker is always in the condition that a hand-worked fire is in just after it is cleaned, i. e., always clean and ready for a pull.

No automatic stoker works well with low-grade coals. It has been practically demonstrated that no one should put in a stoker with the idea of saving money by its use. A fireman with a shovel has been found the best stoker.

Where Motors Are Likely to Supplant Locomotives.

The Massachusetts Railroad Commission has always been noted for its broad and intelligent methods of dealing with railroad problems. The annual reports made by this commission are always interesting, and never fail to discuss railroad problems in a fashion that proves attractive to railroad men. The last report just received is no exception to the rule. The commission discusses the status of electricity on steam railroads in a highly intelligent manner. The points made may be accepted as unbiased conclusions on a subject where there is much conflict of opinion.

The hypothetical question is asked—Is it cheaper to generate at a central station the power for twenty locomotives, and transmit it by means of electricity, than it is to do the work with twenty locomotives, each generating its own power? The answer given to this question is:

"This question does not as yet admit of a categorical and unqualified answer. In the present stage of electrical development, and in the light of such experience as has been had in the actual use of electric power in railway and railroad operation, the most definite answer that can be given, or that has been given by experts and practical railroad men, amounts to this: The more closely a given railroad service resembles in character that of the ordinary street railway, the better the adaptation to that service of electric motive power; and, conversely, the less the resemblance, the poorer the adaptation. In other words, the most efficient and economical use of electric power will be found where there is a considerable and steady volume of local and short-distance travel, which requires or justifies the running of numerous light passenger trains, at short and regular intervals, so that the trains will be constantly and uniformly distributed over the railroad line. The most efficient and economical use of steam power, on the other hand, will be realized where the traffic is concentrated in heavy trains, run at infrequent and irregular intervals, in accordance with the usual method of conducting through or long-distance transportation.

"In passenger traffic, the public demand and the railroad policy have been in the direction of more frequent and quicker trains. In freight service, on the contrary, where there is no such pressure or occasion for frequent trains at high speed, the policy has been in the direction of fewer and heavier trains. The whole tendency of modern railroad development has been to cut down grades and to increase the weight of engines and of tracks, so as to enable a single locomotive to haul a heavier freight train load. It has been estimated by good authority that doubling the number of engines for a given traffic increases the cost of transportation about 50 per cent. The general tendency of passenger traffic may therefore be said to lie in the direction in which electricity is the most serviceable, while the reverse is true as regards freight traffic."

This agrees closely with the position we have always held concerning the place for the electric motor in train operating. It is likely to be more economical than a steam locomotive in handling trains under fifty tons. When that carrying capacity is exceeded, the economy of electricity steadily decreases, until a point is soon reached when the steam locomotive can be most economically employed. We do not doubt that the sixty-car freight trains daily handled by the New York Central Railroad could be hauled by electric motors; but the cost for power would be three or four times greater than that made necessary by the use of steam locomotives.

The University of Pennsylvania has established a distinct department of transportation and commerce, in charge of an assistant professor. It is the intention to instruct the students in the scientific methods connected with the operating of railroads.

MASTODON FOR THE ST. LAWRENCE & ADIRONDACK RAILWAY.

CAR DEPARTMENT.

Conducted by ORVILLE H. REYNOLDS, M. E.

Postal Car--Erie Railroad.

The Erie Railroad has some new postal cars in service, that are models of strength, meeting Government recommendations in that respect; and in attaining this very desirable condition, the element of beauty has not been lost sight of. They are as fine examples of the car-builder's art as can be found in the country; but as it is not our purpose to dwell on this phase of their construction, our attention will be wholly devoted to the practical side of the subject.

With the passing of the platforms comes an increase in strength of the end sills, by sandwiching two plates of 1 x 6½-inch iron between three sections of wood 2 x 8 inches; each section being gained ½ inch deep the full length, to receive the iron plates which are thus boxed in at the back of end sill and the edges exposed at the front, making an end sill 8 x 8 inches.

In the search for a more substantial construction than is afforded in the plain wooden end sill, metal has been largely used in connection with wood in numer-

In place of the usual corner irons at the junction of the end and outside sills, for stiffeners at those points, there is a plate of ¼-inch iron, 25 inches wide, running across the car on the under side of sills, with one edge flush with outside of end sills.

The bridging 1¾ x 8 inches, spaced 16¼ inches, together with the transverse tie-rods, spaced 4 feet 5 inches, rounds out a rigidity to the foundation that is representative of the best practice in body construction.

NEW POST-OFFICE CAR, BUILT BY ERIE RAILROAD.

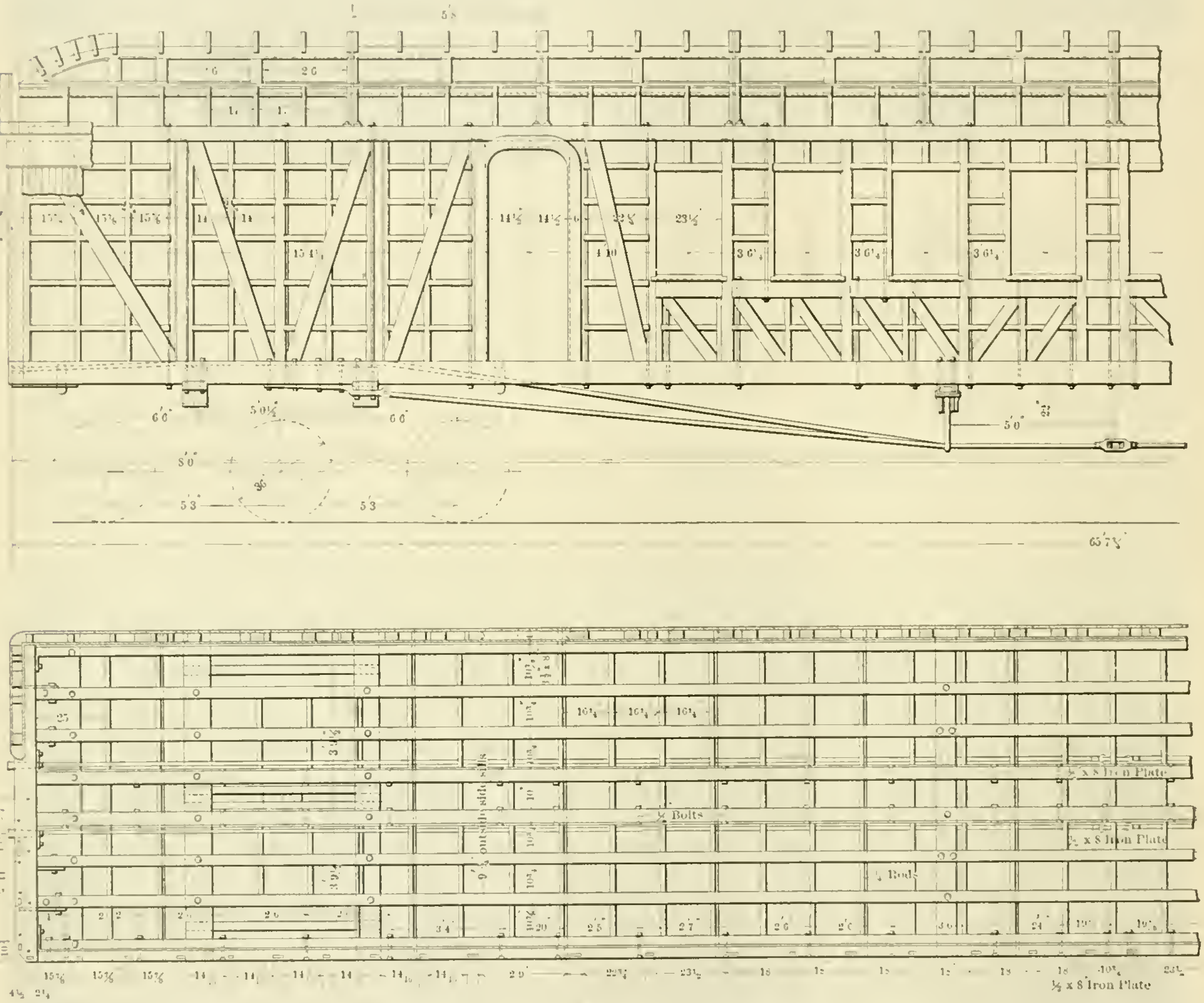
Our illustrations, for which the prints were kindly furnished by Mr. A. E. Mitchell, superintendent of motive power, deal with the framing and construction. These cars are without the platforms and hoods, said by many to be useless and expensive relics handed down from the early builders of railway rolling stock. If any need for these ever existed, it would appear that it has passed into the beyond at this time. They are going the way of some other fads that cannot give convincing reasons for their existence, for in these utilitarian times the demand for a show-down may be relied on to take the curves out of things crooked. The interrogation point is most potent in working reforms.

ous ways, all of which have been an improvement over the old method; and this, one of the latest, is easily one of the best yet devised to resist end shocks, for the reason that the iron plates are placed so as to receive the blow in the direction of their greatest resistance.

There are ten longitudinal sills, all 4 x 8 inches, except those at the center, which are 5 x 8 inches. At these sills is seen evidence of strength equal to that at the end, in the sandwiched ½ x 8-inch iron plate between the two outside sills, and the same size of plate on the outside face of the center sills; the plates extending full length of the sills, and terminating in a foot 8 inches long, which rests against the inside face of end sills.

The superstructure, while not so easily molded to the will of the designer, on account of the side doors, which form unsightly gaps in the framing, partakes of the same general healthy characteristics of the foundation. At the corner posts and the end door posts there are ¾ x 3-inch iron plates running from top of end sills to bottom of end plates, with a 4-inch foot bolting through sills and plates. This idea is followed out at the side posts in the first two panels, by placing ¼ x 3-inch iron plates on the outside of a 3 x 4-inch post, and covering same with a 1½ x 3-inch post which is gained for the furring.

It will be noted that the side plates, 5½ x 3 inches, are placed with their larger dimensions vertically, as though unwilling to allow the strength gained by this position over the regulation that way to escape them. The plates, as shown, have the advantage of being stronger and at the same time furnish a greater resistance to pull

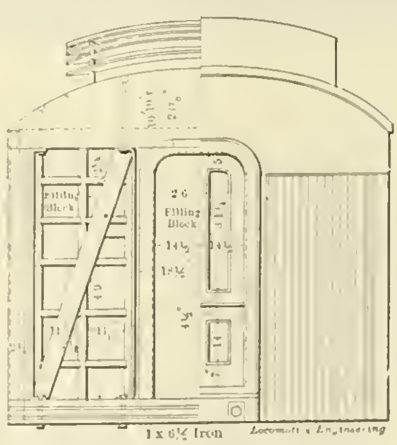


DETAILS OF FRAMING, ERIE POSTAL CAR.

of the framing rods, that are liberally used, some of which pass through the feet of the ⅝ x 2-inch iron carlines, and thus bind the body with continuous iron bands.

While the iron features of the body have been elaborated on, almost to the exclusion of the wooden details, it has been for the purpose of showing what has recently been done in constructive details that are of the liveliest interest to car men: and again, the illustrations show the important points of the wooden parts, so that any extended notice for them is not necessary. This cannot be said of the iron parts, owing to the reduced size of the picture.

Now that decisive and independent action is taken, tearing away from old ivy-covered traditions, and looking to a wider application of metal in car design, we may expect to hear of the further abandonment of wood in the framing of passenger train cars, with a corresponding substitution of metal. Although there are no figures at hand from which to compare the relative cost of maintenance of an all-wood car with that of the composite



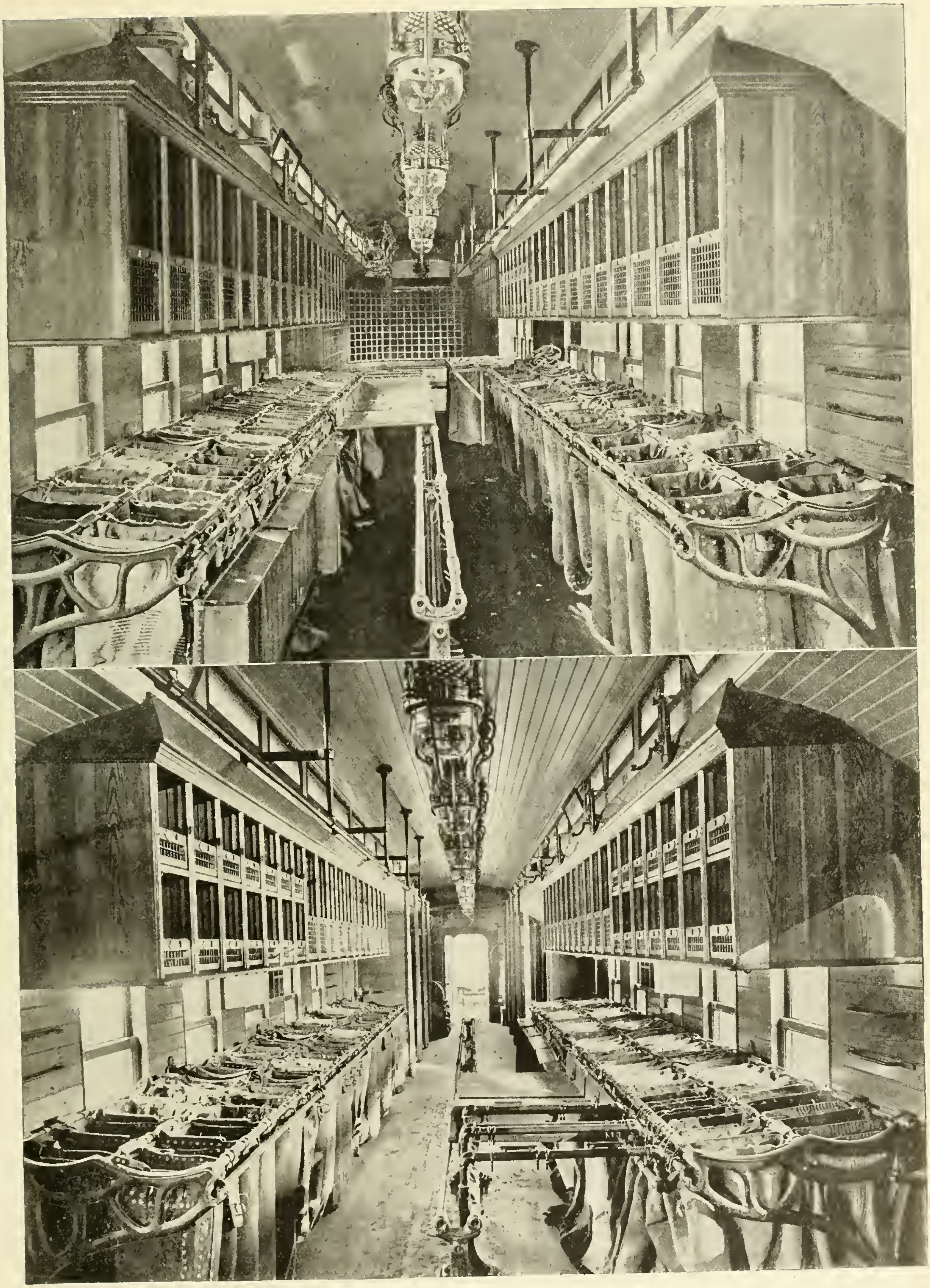
type, there is reason to believe, however, from the meagre data accessible, that the latter is the cheaper car, viewed from any point of the situation. It has surely paved the way for the steel car of the future.

About Hot Boxes.

We draw it mild when we say that there is no more perplexing thing in railway management than the hot box. With all the study into the causes for it, all the intelligent effort to reduce the same, there is so little progress made towards eliminating this pest of the rail that it is sometimes questionable whether it can be done.

The subject forms the basis of discussion, private and in convention. The efforts of the grizzly veteran come to naught just as easily as do those of the fresh young beginner who has never had his internal economy wrung out of shape by repeated failures to reach the seat of trouble.

There is a cause for this tribulation, and that is about the only thing connected with a hot box that can be sworn to. In seeking for this cause, the method of packing the box is usually the first thing to be investigated; if that is found to come up to the inspector's ideas of the fitness of things, then the character of the lubricant is carefully looked into—and this is the period when the matter assumes the



INTERIOR VIEWS OF ERIE POSTAL CAR.

aspect of a puzzle, the stage when all concerned are carrying a burden. Dope seems powerless to ease the load, or avert the inevitable, and so the round goes on, running hot when expected to be cool, and cool when it should by all familiar signs be hot.

A personal knowledge of some of the causes for a hot box has led to the belief that the conditions breeding that state of things were not so greatly different on different roads as to demand special treatment; or, in other words, like causes produce like effects. It was found, among other things, that the scantiest attention was paid to the mechanical side of the case—the poorest of fitting being considered good enough for the boxes and bearings of a truck; and trucks thus fitted up would invariably give the same trouble, no matter how packed or lubricated.

In addition to this, it is well understood that most trucks are not put up square, a rough approximation being thought good enough; and it is this "good enough" verdict that operates to give us the hot box in such cases. The core of a box has been known to shrink and become so distorted as to cause the brass, when in place in the box, to be 1/4 inch away from its correct position, thus taking up all lateral motion. This box ran until lateral motion was given by wear on the end of brass, keeping good and hot the meanwhile. It would be of interest if we knew how much oil had been wasted while wear was freeing the brass laterally. These are some causes for trouble found in actual experience, and not creatures of imagination; and there can be no doubt that more attention should be given to the mechanical side of the matter than is usual at this time.

It is a good sign to see the care bestowed on journals by the best-managed shops; but it seems little short of folly to take such pains with one detail, and leave others, fully as important, to get in their deadly hot work from lack of it.

A freight-car truck is easily the roughest piece of mechanism running on a railroad, and anyone acquainted with the subject knows that it is deserving of the record, which will stick until the advent of better work. Square frames, brasses in the center of the journals, boxes properly packed and oiled, and journals true and smooth, is the ideal condition. How many trucks leave the shop in this shape? Too few. The correct mechanical status of a truck is so closely allied to the decrease of train resistance that it is a matter for comment that so little attention is given it. A study of this phase of the question will make it possible to haul more cars and at the same time use less oil.

Steel in Car Construction.

Since the exhibition of the Harvey steel car at the World's Fair, there has been a gradual awakening to the fact that a steel car had a future when once its favorable points were understood. The car in question was not what its name implied, but was of a composite make-up; the sills were of commercial rolled section, covered with the usual wooden floor, and the posts and braces also of rolled shapes were very light and used as stiffeners between wooden posts.

In this pioneer was seen a compromise between wood and steel, to satisfy, as it were, conflicting conditions; but, unlike most moves of the kind, this one was not a failure simply, because it had a value of the kindergarten kind, in educating people up to the possibilities of steel in an entirely new field, and thus performed a work that might not have been accomplished by any other means.

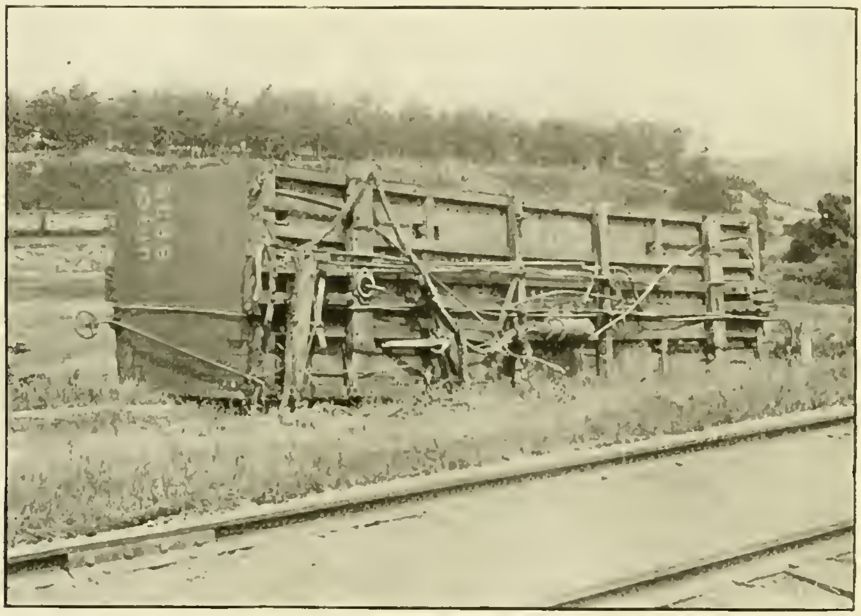
The fruits of this lesson are seen in the free utterances of men who were wedded to the old way, but who, later, were honest in their belief that the time was ripe for a stronger and more lasting material in a car than wood. The endurance shown by the above cars makes it appear that their favorable opinion was not without foundation.

Since that time the development of the steel car has been such as to convince the observer of car matters that the experimental stage was passed, and such a car was a reality. This is brought home to us in tangible form by the steel flat car illustrated in our January issue, a car built of steel throughout, on lines distinctively original, and showing the greatest departure from old traditions yet seen in any car, and which was certainly an important advance in car design, causing renewed interest in the subject.

The fear that a car of this type could not be built light enough to have a paying ratio between its load and dead weight, was seen to be groundless in this case, for with a light weight of 22,600 pounds a load of 118,000 pounds was sustained without serious deflection or a permanent set; this load, however, was greater than the capacity of the trucks, and was used for test purposes only. The reason for this unparalleled performance is, of course, to be found in the shape and dimensions of the material in the body.

Cost of such a car is likely to be the deciding factor, after all other conditions are satisfied, for the metal construction is more expensive, as it must necessarily be; but the matter of maintenance is also a vital question, and will have due weight.

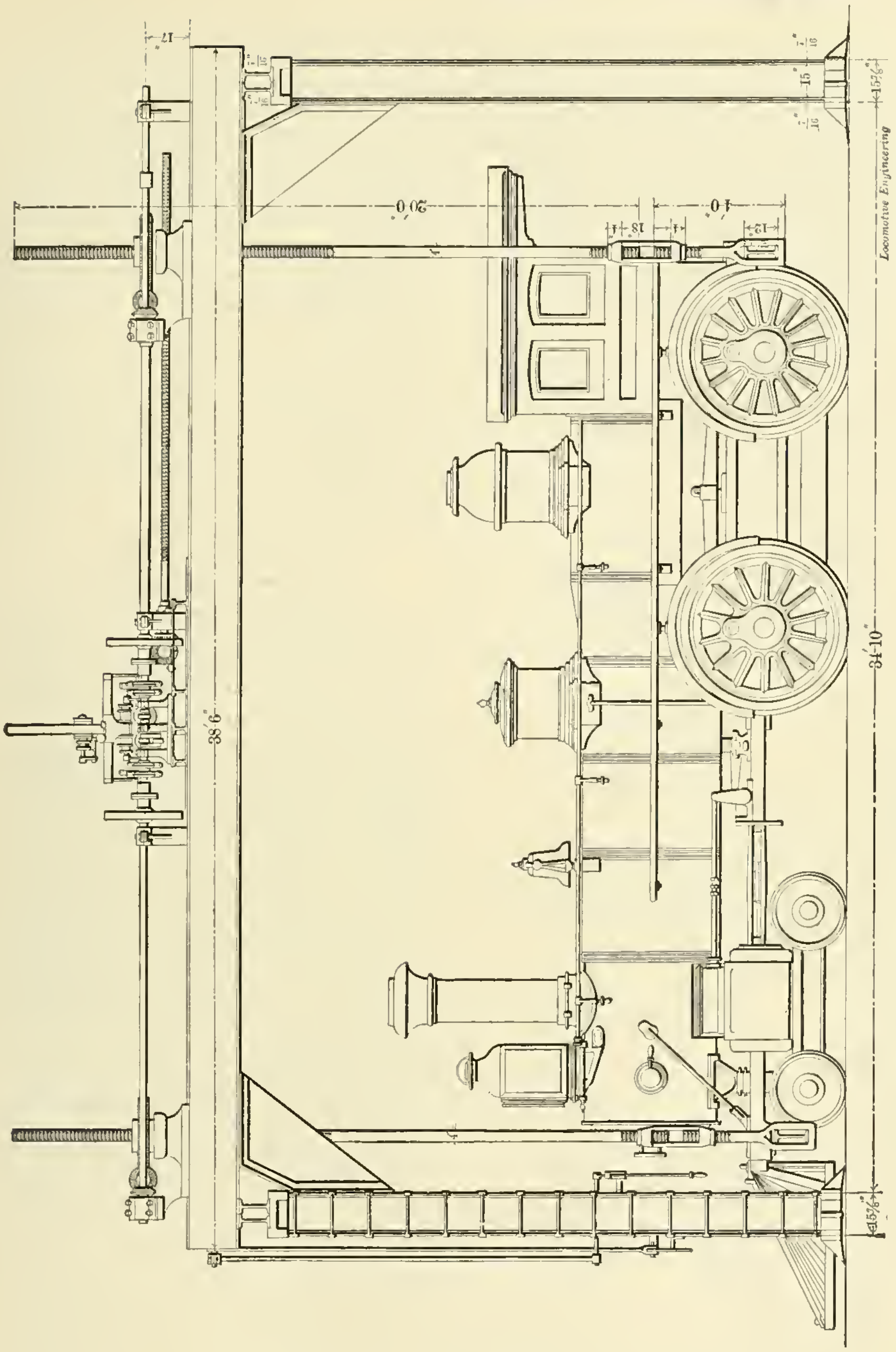
On the established models, a wooden car of large capacity is built of material on more massive lines than one of lesser capacity, in order to have the required strength. It is this fact that is responsible for the hybrid construction; the builder seeking the added strength due to the metal, in parts that have developed a weakness; a strength obtained at a greatly reduced weight over wood.

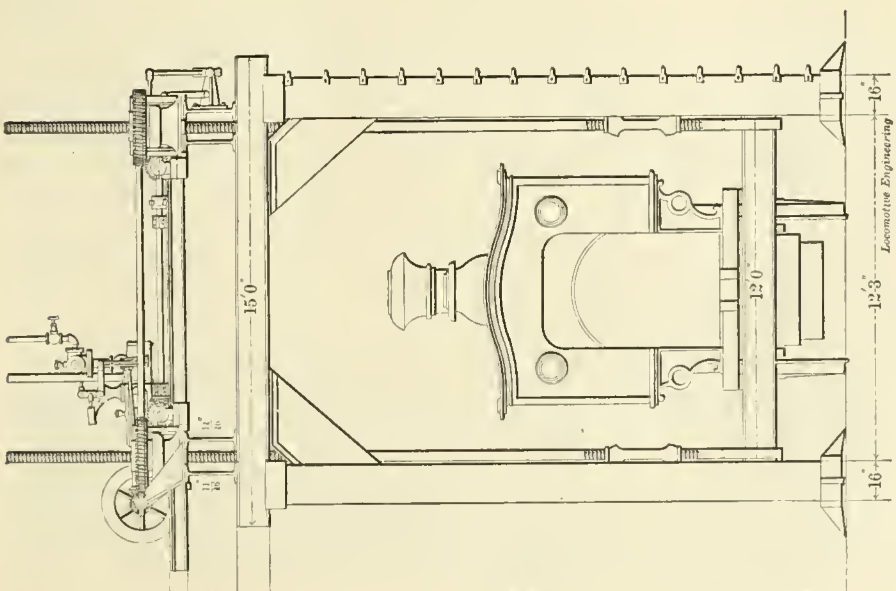


A WAY TO SET OUT BOX CARS WITHOUT A SIDING.

But there is another and fully as important a side to the subject, that may be summed up in the word "depreciation," and this seems not to have had the consideration its bearing in the case deserves. It would appear that any material that would increase the life and earning capacity of a car would be the thing to use in its construction, and it follows, as a natural sequence, that if the depreciation is not as great as in the old case, that repairs would be fewer, and the cost of maintenance therefore less. This view is corroborated by what little is known of the performance of the steel car.

The Gould car coupler, which has been applied to the cars of some luxurious trains for the East Coast route of Great Britain, is described by a correspondent of the "Scotsman" as having the appearance of a huge interrogation mark.





A Screw Locomotive Hoist.

The problem of expeditiously removing wheels from an engine when entering the shops for repairs, has received a great deal of attention from motive power officers—the reason for this being found in the many phases of the situation to be carefully weighed and considered, when covering all the ground from a cheap screw jack, through the diverse jack ramifications, to business-like power cranes and lifts operated by steam, air, electricity or hydrostatics.

Among those in which steam is the motive power, our engraving shows one at the Chicago shops of the Chicago and Northwestern Railway. It is a screw hoist, receiving its power from a pair of small engines located, together with the hoisting gear, on the top of the device. The frame-work is formed of heavy I-beams, placed 34 feet 10 inches apart longitudinally, and resting in castings which are supported on foundations. The top of these beams carry four other I-beams, two at each end; and on these again rest four I-beams, two at each side, which carry the hoisting mechanism.

This latter consists of four screws, 4 inches in diameter and ½ inch pitch; two of these extending from each end of the locomotive frame, up through nuts, which form the centers of the worm wheels from which they are driven. The worms actuating these wheels on the screws are on the main shaft of the engine, and the four nuts are revolved on the screws through the medium of bevel gears, all thus having a positive and simultaneous motion when the engines turn.

At the lower end of each screw is a turnbuckle terminating in a stirrup, which passes over the end of the 12-inch I-beams placed under the locomotive frames at front and back, on which the engine is supported when raised off the wheels. After the engine is raised, and the wheels rolled out, it is lowered on a pair of transfer trucks (made especially for the work in hand, each consisting of four wheels, tied by I-beams), one of which is placed under the firebox and the other under the engine-truck center; on these the engine is taken to any part of the shops.

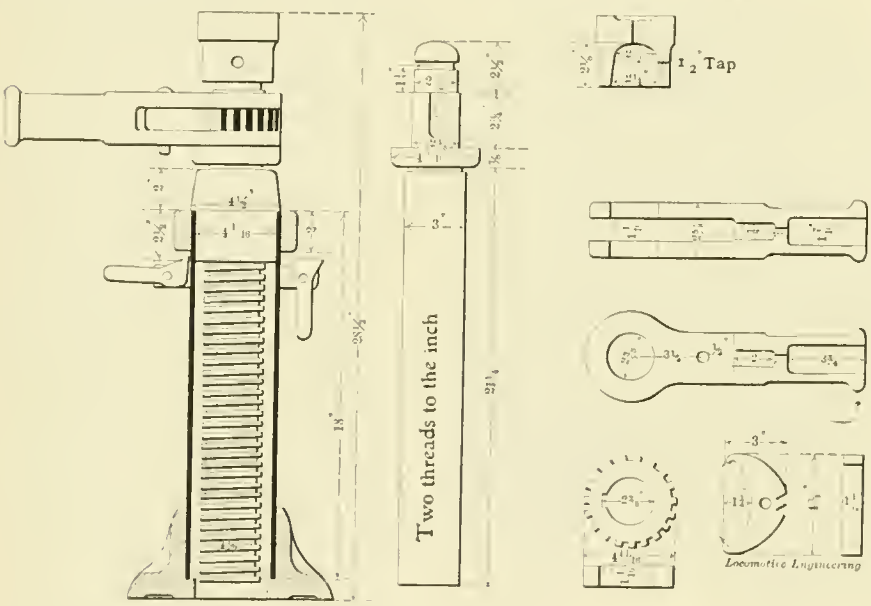
A small engine on the transfer table is used for placing an engine under the hoist, to remove a set of wheels, and also for replacing same—ten minutes usually being sufficient time to remove or replace wheels after the engine is placed under the hoist. The cost for attendance and handling is reduced to the lowest possible limit, as the machine is handled by the stripping gang, and the only cost since its installation is for maintenance, the figures being placed at less than $25 for its five years of service—a very good showing for a device that handles 65-ton engines. Everything about this rig is of a mechanical character and built to last, and it does not therefore call for a periodical appropriation to keep life in it. Mr. Robert Quayle, the superintendent of motive power, has a high opinion of this device, and thinks there is nothing superior to it for use in a shop whose roof has not been designed for a traveling crane.

A Shop Jack.

The average large shop jack is one of the clumsiest articles the machinist has to deal with, more especially when the body is made of cast iron, liberal dimensions, of course, implying weight. Such a jack is portable only by the exercise of muscle.

A jack combining lightness with strength, and one easily handled about the shop, has been designed and built by Master Mechanic Smith at the Oneonta shops. The illustration of it herewith shows a body made of 4-inch pipe, pressed into a cast-iron base. The nut, of brass, is also pressed into the pipe at the top, at which point there is shrunk on the outside a wrought-iron band, making a construction lighter than generally found in a large jack.

The handles being made of wrought iron will withstand any amount of rough usage, and therefore not be conspicuous by their absence, like those of the cast-iron type; nor are they of the jug-handle order, for they are on opposite sides, where they ought to be for quick and convenient handling.



SHOP JACK.

British Express Train With American Attachments.

"The East Coast completely new day trains, 530 feet long, 270 tons in weight, and carrying 300 passengers, will represent," says "Engineering," of London, "the highest attainment in this country. The train belonging to the joint companies, and constructed at Doncaster under the direction of Mr. E. F. Houlden, consists of eight coaches each carried on two six-wheeled bogies, the height of each vehicle being 13 feet 5 inches from the rail level. The four center carriages are of the composite corridor type, now very popular on this route, and they are 66 feet 10 inches long by 8 feet 6 inches wide. At either end of them are third-class carriages, the one on the corridor principle, and 65 feet 10 inches by 8 feet 6 inches, taking 54 passengers, while the other assimilates more to the American type, there being an open passage in the center, only three divisions, holding, respectively, 23, 16 and 15 passengers; but otherwise the carriage is open, with end doors. An ordinary brake van, 62 feet 7 inches long at either end, completes the Edinburgh train.

"The most novel feature, however, is the adoption of Gould's automatic coupling and vestibule, and also the use of the Westinghouse quick-acting brake. The coupling is on the principle adopted in the States and in other countries, and not only obviates the necessity of manual work between the carriages in marshaling trains, but is of great strength, the pull required to break the coupling being 130,000 pounds. Again, the vestibule provides a continuous platform and a central buffer; the ends of the carriages being curved, there is a greater resistance against carriages telescoping or mounting. The central buffer, too, provides greater elasticity in taking curves. The vestibules are 3 feet wide and 6½ feet high, and they are such that passengers will be able to go through without any fear.

"The Westinghouse quick-acting brake has stopped trains greater in length and weight than these new 'Flying Scotchmen,' while going 60 miles an hour, within 500 yards.

"The cars have clerestory roofs, torpedo ventilators, double gas lights, Gold's steam-heating apparatus and electric bells, so that even the third-class passenger may call the attendant to bring tea, coffee and light refreshments en route. The compartments are trimmed with combination velvet in crimson and black, with silk laces to match, and on the walls of the corridor are maps, etc., of the route.

"The cars are as substantial as they are elegant. The bodies are of selected teak, varnished, picked out with gold lines, and the route and the destination are very prominently marked.

"It may be added that all three companies running to the north are fitting on new and exceptionally powerful locomotives, those of the Caledonian, for instance, having 1,403 square feet of heating surface. They have taken trains of nineteen and twenty-two coaches single-handed over the Beattock rise."

The Average Trainman.

"Speaking generally," says Mr. Wm. Gibson, superintendent of the Big Four, "and taking one division with another, or for that matter one system with another, I have about come to the conclusion that 75 per cent. of the men in train and engine and yard service may be classified as first-class men, provided they are handled by efficient officials, and provided also that they are treated fairly and without partiality. Fifteen per cent., which for the sake of distinction I will call the second class, are good, steady, promising men, who are working hard to qualify themselves for the first class. This gives us 90 per cent. who are all right if handled right. The remaining 10 per cent., or third class, are the people on a railroad who keep division officials busy. The chief end of their existence seems to be to get in the miles or the time, regardless of how their work is done; to make as much overtime as possible and to trump up imaginary grievances. The percentage of this last class will rise or fall according to the caliber of the trainmaster and master mechanic, and blessed is the superintendent who has associated with him a trainmaster who can so select and control and educate his men that this percentage will be reduced to an absolute minimum. Past history has demonstrated that this third class (and where it exists it is not by any means confined to young men) cannot be too closely looked after, with a view to educating or clubbing it upwards if possible, or to otherwise wiping it out of existence—for the only way to reform some men is to reform them out of the service."

A railroad company in London has been required to pay $5,750 compensation to the proprietor of a small ice-cream shop which had to be closed up owing to an extension of the railroad company's premises. The evidence in the lawsuit showed that the profit in selling ice cream and cold drinks varied from 67 to 96 per cent.

A Simple Method of Testing Railroad Signal Lamps.

BY T. A. LAWES.*

It is important that signal lamps have lenses with proper curvatures; that they be placed at the proper distance from the flame; that the ventilation is such as to insure their burning during the heaviest gale of wind, and that they will burn when

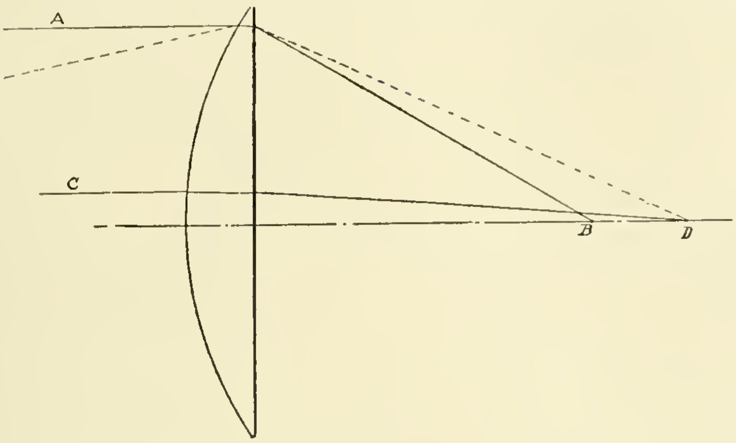


Fig. 1.

subjected to shocks such as a switch lamp must withstand. The following method of testing such lamps has been employed by the writer for some years and always with good results. Hoping that the course pursued may be of interest to others, and to add to the safety of all concerned in railroad traffic, I give the procedure in full.

The forms of lenses in use are shown in Figs. 1, 2, 3, 4 and 5.

Fig. 1 shows the bull's-eye lens which was in common use in the early days of railroads, but is now seldom seen, having been succeeded by others that are more perfect in light-distributing power. Fig. 1 was deficient in this particular: If a ray of light A, Fig. 1, is refracted to the focus

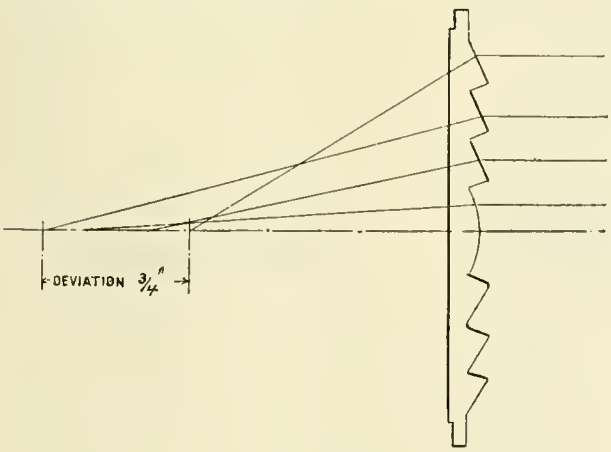


Fig. 4.

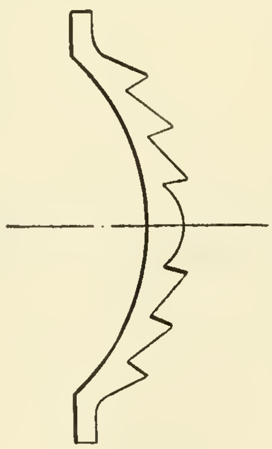


Fig. 5.

B, and a ray C is refracted to a focus D, then the distance BD is the spherical aberration. To produce parallel rays, the flame would have to be located at B and D and in the space between—an impossible condition. If we locate it at D, the central portion of the lens will give parallel rays, and near the edge converging rays, as shown by dotted line, and at a distance this lens would give but a feeble light in comparison with lenses shown in Figs. 2, 3, 4 and 5.

To improve the solid lens, portions are cut out and the curves at A^1 B^1 C^1 and D^1, Fig. 2, are so designed that the foci of each zone coincide as shown at A.

This lens has no spherical aberration, and a flame placed at the focus A will send parallel rays through it. It has been proven that a lens refracting parallel rays of light from the focus will also receive parallel rays and refract them to a focus. This is the law of conjugate foci, as laid down in the works treating on optics. This law enables us to test the lens, as to its freedom from spherical aberration or having the property of refracting the rays of light from the focus in parallel lines.

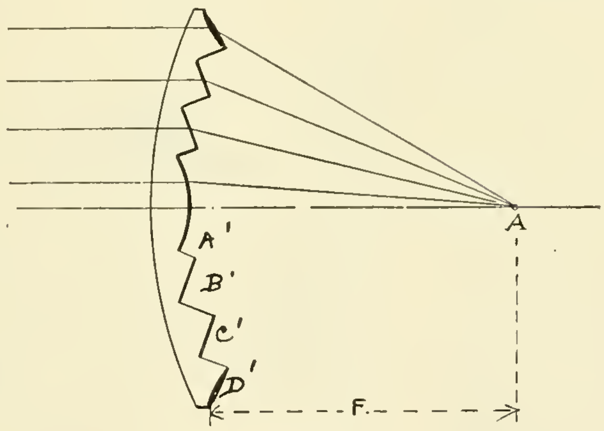


Fig. 2.

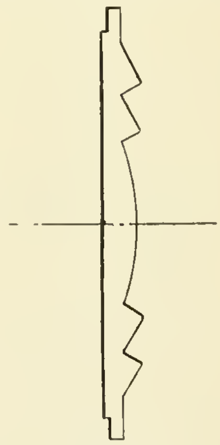


Fig. 3.

Figs. 6, 7, 8, and 9 show a series of opaque diaphragms made of drawing paper. Referring to Fig. 2, the zone A^1 is tested by stopping off all the lens with the exception of the zone A^1, diaphragm No. 6 being used, and so on—the object of using the diaphragm being to cut off all the zones except the one being tested.

Fig. 10 shows the device for testing the lenses for spherical aberration. The lens is held by three wooden clamps, a diaphragm placed on the lens, and the whole turned to the sun. The sliding piece holding the lens is then moved to and fro until a position is found giving the smallest image of the sun; then the distance D is noted. Another diaphragm is then placed on the lens and the focus for that zone determined, and so on, until all the zones have been tested.

Fig. 4 shows the focal distances of the zones of a certain lens. These, as explained before, should have all rays refracted to the same point as in Fig. 2—the least amount of deviation from a common focus showing the superior lens. I have tested lenses that showed over half the light lost by imperfect shape of the zones.

One of the most common defects in lamps is that the lens is not located at exactly the proper distance from the flame. In Fig. 2, the lens should be located at the distance F from the flame. This distance can be found for any lens by the device shown in Fig. 10. Fig. 4 shows a lens having defective zones.

The distance between lens and flame for such a lens is at the focus of the outside zone; but it must be borne in mind that defective zones cannot be compensated for by varying the distance between lens and flame. The distance as given would be the least objectionable for such a defective lens.

The comparative purity of the glass can be determined by observing the appearance of a black line on white paper when the lenses are laid upon it; also by taking blueprints of lenses and comparing them.

The lenses are laid on sensitized blueprint paper and exposed to the sun the same as if they were tracings. After exposure, the lens making the least change

* Supt. M. P. Chicago & E. I.

in color of the blueprint paper is adjudged as being made of the most transparent glass.

The foregoing test will give an idea as

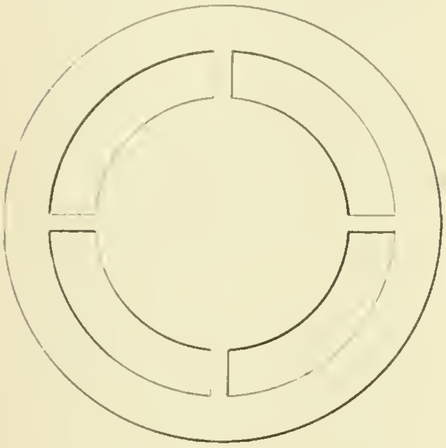


Fig. 9.

Fig. 6.

to the relative value of lenses, so far as their freedom from spherical aberration and purity of the glass are concerned; yet other qualities of lenses, such as the value of short or long foci, have to be determined, and the question of quality of light received from the different kinds of oil is of no little importance. This can be found by using an instrument called a photometer, which is an apparatus for measuring the relative intensity of light. Of several kinds in use, Bunsen's is to be preferred. The photometer must be used in a darkened room—no other lights being used except those undergoing test.

Fig. 11 shows a photometer made of pine wood. The strip *A* is 1 inch thick, 4 inches wide and 10 feet long. *B* is a paper screen on a sliding piece of wood. *C* is a lamp so arranged that a lens can be put in and taken out quickly. *D* is a sperm candle or a gas jet. The paper screen is glued on the sliding piece while wet; when it becomes dry it is tight like a drumhead. The aperture in *E* over which the paper screen is placed is 6

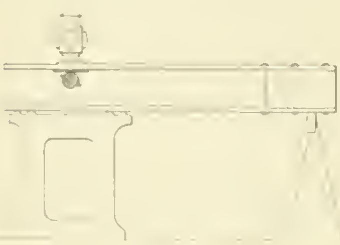


Fig. 13.

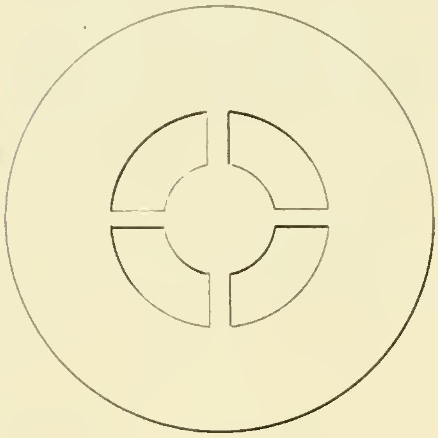


Fig. 7.

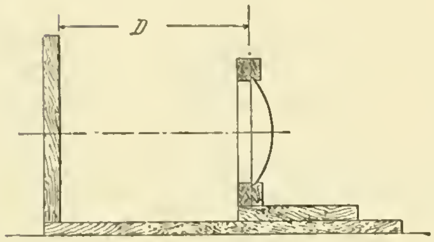


Fig. 10.

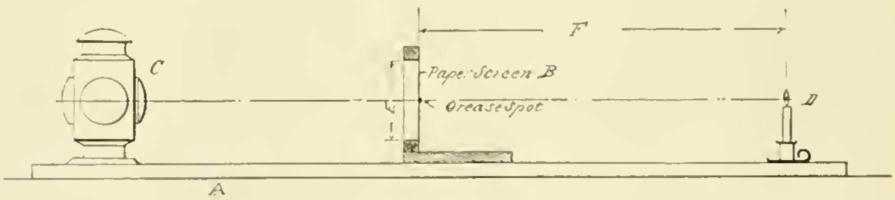


Fig. 11.

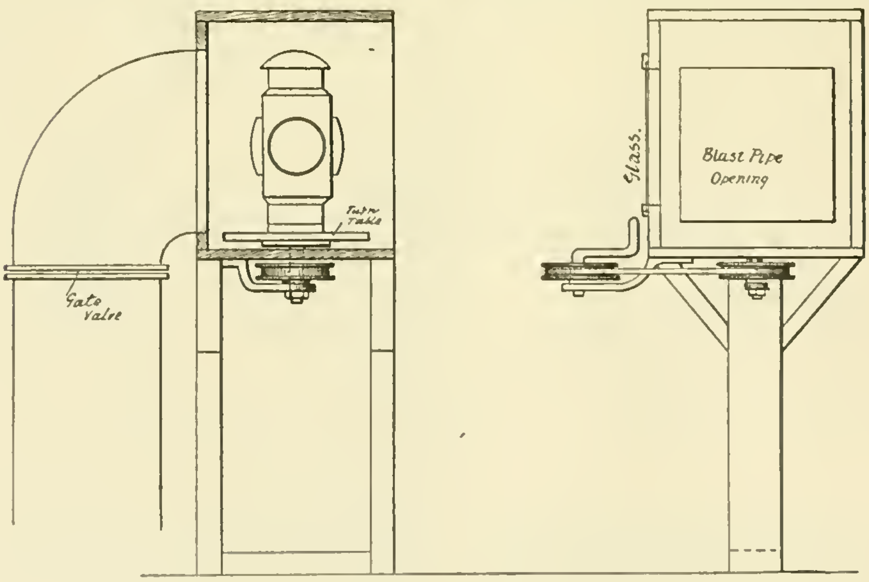


Fig. 12.

inches in diameter. In the center of the paper screen a grease spot ½ inch in diameter is made by means of a solution of spermaceti dissolved in naptha and applied with a clean brush. The theory of the spot is this: When a grease spot is made on bibulous paper it appears translucent; the spot allows more light to pass through it, and reflects less than the unstained part of the paper. If, therefore, the paper be illuminated more strongly from behind, it appears bright on a dark ground. On the contrary, it appears dark

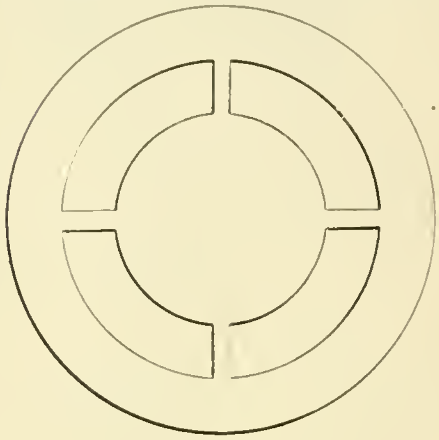


Fig. 8.

on a white ground, if it be more strongly illuminated on the front surface; while with equal illumination the spot will disappear, since it cannot then appear either darker or lighter than the adjoining paper. The lens is tested by moving the candle forward or back until a position is found which will cause the spot to disappear. The distance *F* is noted for each lens or each kind of oil undergoing the test. They are compared with each other inversely as the squares of the distance *F* from paper screen.

The ability of a lamp to withstand wind

is determined by the apparatus shown in Fig. 12. It is a single box connected to a fan. The lamp is placed on a turntable and revolved so that all apertures in it are subjected to the blast of air. The intensity of the blast is regulated by the gate in the pipe. The apparatus was tested in regard to the velocity of the wind, by a United States Signal Service anemometer, and it registered a rate of 70 miles per hour.

The apparatus was designed primarily to enable one to judge of the comparative excellence of the ventilating features of different lamps; but it was also found that the same device could be used for testing the power of burners to remain lighted in a gale of wind. In other words the ability of a lamp to withstand a strong wind depends on the kind of burner used, as well as on the ventilating devices. In a certain experiment with several styles of lamps, one was found that very nearly withstood the entire capacity of the fan. After changing the burner for one of a different design, the whole capacity of the fan could be used without blowing out the light, showing the good qualities of the lamp, combined with the good qualities of the burner—a combination which is seldom met with.

A switch lamp is subjected to severe shocks; and to determine what effect they would have on the lamp, the device shown in Fig. 13 was constructed. Briefly described, it is made of three pieces of wood, the upper piece with iron plate beneath resting on a lathe mandrel, having two projections 1¼ inch long, which, in revolving, cause rapid shocks to the lamp. The speed of the lathe may be so regulated that a lamp attached to the upper piece will be extinguished by the shocks. In making a test of lamps of different designs, the lamp withstanding the highest speed would prove the best for a position requiring a lamp to burn while subjected to severe shocks. If the method of testing as outlined here be followed, anyone can judge of the relative merits of signal lamps.

Leaky Steam-Pipe Joints.

Leaky steam-pipe joints is one of the most troublesome disorders to which a locomotive is subject. The trouble often becomes very serious before it is discovered, and in the meantime it has been wasting no end of fuel by obstructing the free flow of the fire gases through the flues. When a railroad is short of power, the annoyance of leaky steam-pipe joints is doubly serious, for it means taking the engine in for two or three days to have the joints reground.

A committee of the Master Mechanics' Association which investigated the subject of steam-pipe joints reported that, in a large roundhouse turning out 150 engines a day, it was found that between three and four engines per month are held in to have steam-pipe joints reground. This we believe to be a little lower than the average. Of the engines so held in about 40 per cent. had loose cylinder saddles or had been out of the shop after general repairs only two or three months, the inference in the latter case being that the defect was caused by inferior work. The report says that trouble with steam-pipe joints is quite rare except caused by bad workmanship, loose saddles or insecure bolting in high-pressure, heavily-worked engines.

The remedies suggested for leaky steam pipes are:

Steam pipes should be of cast iron of flattened section, as light in the body as consistent with strength and the requirements of foundry practice. The suggestion was made that pipes of malleable iron or cast steel are worthy of trial. Such pipes may be quite thin and still have ample strength, with the resulting advantage of springing instead of working at the joints when expansion strains are brought upon them. This would also tend to decrease the weight in the front end.

The flanges should be arranged, where possible, to take four bolts or studs at both ends on all heavy engines. These bolts should be equally spaced, if possible. The joints should, in all cases, be made up with plano-convex brass joint-rings, the radii of their convex faces to be about equal to the inside diameters of the rings. These rings should be carefully ground upon their corresponding joint surfaces.

The exhaust pipe joints should be made with flat surfaces, carefully scraped and fitted with surface plate, and bolted together without copper or other gaskets. A small amount of red lead, or some kind of heat-hardening cement, may be used if preferred.

The Pitch in Mechanics.

Dr. Coleman Sellers tells an anecdote of a proprietor of a machine shop who called upon him to order a spur gear of a certain size. Dr. Sellers asked him if he had measured the diameter of the gear at the pitch line, and the man wanted to know what the pitch line meant.

We related this story to an experienced and intelligent railroad mechanic, to illustrate the ignorance of some men concerning the details of their business, and to our surprise he exclaimed: "I am in a similar fix, for I don't know what the pitch line of a cog wheel is." Lest others, who ought to be better informed, are ignorant of the meaning of "pitch" as a mechanical expression, we will quote the definition of "pitch" from a favorite reference book:

"Pitch"—(*a*) The distance from center to center of any two adjacent teeth of gearing measured on the pitch line; (*b*) The distance measured on a line parallel to the axis between two threads of a screw; (*c*) The distance between centers of holes, as of rivet holes.

"The pitch line or pitch circle in gearing is a circle concentric with the circumference of the toothed wheel, and cutting its teeth at such a distance from their points as to touch the corresponding circle of the gear working with it and have with that circle a common velocity as in rolling contact; the line or circle on which the pitch of teeth is measured.

"The pitch of a roof is the inclination or slope of the sides.

"The pitch of a saw is the slope of the teeth."

The hot gases generated in a firebox or furnace pass so rapidly through the flues or over the heating surface, that many engineers have believed that material saving of heat could be effected if a practical means of retarding the velocity of the gases could be devised. The best-known work in this direction has been done by the Serve tube, which contains projections designed to retard the movement of the gases. This kind of tube has been largely employed in Europe, and has been tried in this country. The weak point about it is that the projections arrest sparks, and the tube soon becomes filled up. A paper was presented to the last meeting of the Society of Mechanical Engineers, which described tests made with spiral strips of sheet iron placed the whole length of the tubes, twisted to a pitch which made the gases perform two entire convolutions in passing through the tubes. The resulting heat economy varied from 3 to 18 per cent. The economy caused by the spirals was greatest when the boiler was hardest pushed. This seems to be a promising plan for extracting more heat out of the coal used in steam-making.

We have repeatedly called attention to the danger in train operating which results from the practice of underbraking sleeping cars and other cars with six-wheeled trucks. It seems that American railroads are not alone in this line of danger. In the course of an investigation into an accident that happened on the Great Northern of England, of a train running 70 miles an hour, it was found that the engine ran 900 yards before it could be stopped. The investigation brought out the fact that only half the wheels on eight-wheeled cars had brakes applied. The proportion of the total weight of the train braked was less than two-thirds of the whole.

On the Eastern Railway of France, a system of car-heating is employed in which air is mixed with the steam from the locomotive. The claim is made that the air tends to keeps up circulation and overcomes the condensation.

PRACTICAL LETTERS FROM PRACTICAL MEN

Correction.

Editors:

I see in your issue for May, reference to a letter I wrote you some time ago regarding Dixon's graphite. If my letter to you reads 80 or 90 per cent. it is wrong. It should be 8 or 9 (eight or nine) per cent.

Would you kindly correct in your next issue and oblige.

GEO. SMART.

Edgemont, S. D.

Designer of the First Successful Extension Front.

Editors:

In reading your June number, I am somewhat surprised to see the evidence of so hasty reading and jumping at conclusions on the part of one or two of your correspondents, in connection with a published communication from me in your May issue.

I seem to have been understood to make claim to several things which it had never entered my mind to claim. I think that I clearly stated that I was not the designer or originator of the extension front, but was merely an experimenter with it, with a view to developing from it, if possible, a good spark arrester.

My attention was first called to the opportunity for improvement in the design of spark arresters, by observing the enormous quantity of large live sparks thrown from the stacks in extension front engines running on the Hartford division of what is now the New York, New Haven & Hartford Railroad.

The result of our experiments on the Eastern Railroad was the development of a successful spark arrester, which was economical in fuel and unusually free from smoke. The desired ends were brought about by a combination of the long-known extension front (somewhat modified in detail of design) with a brick arch placed in the firebox.

I am sorry that Mr. Kellogg and Mr. Brown should have so misunderstood my communication as to think that I laid claim to credit for inventing the extension front. All that I maintain is that, so far as I am aware, the device described by me was the first extensively used, successful spark arrester devised up to 1882.

Trusting that this will set me right in the eyes of your readers, and that I may not be charged with assuming credit which does not belong to me, I take this liberty of again trespassing on your pages.

A. M. WAITT.

Cleveland, O.

A New Form of Inspection Engine.

Editors:

I send you herewith a photograph of what we think is something new in the line of inspection engines. We have used this engine for about a month and find it very convenient, and it enables us to inspect the track very closely.

It is made of frame-work of angle iron, the engine frame having been lengthened a sufficient distance to accommodate it. We put plate glass in the front, which enables us to get a good view. It does not ride hard, and six men can ride comfortably in it for a day without any bad effects. It is fitted up with steam heat for use in winter and is easily ventilated.

INSPECTION LOCOMOTIVE, C. & W. M. RAILROAD.

B. HASKELL,
Supt. M. P., C. & W. M. Ry.

Grand Rapids, Mich.

Early Extension Fronts.

Editors:

I have been somewhat interested and considerably amused at the controversy going on in the columns of your paper concerning the original extended fronts on locomotives.

I suppose it is generally understood among railroad men that Mr. John Thompson, formerly master mechanic of the Eastern Railroad of Massachusetts, was the first man to apply the extended front. But he did not follow up the matter with the improvements which were made afterwards by the Hartford & New Haven road and others. Consequently, the extended fronts were abandoned on the Eastern road.

As I understand the matter, the Hartford & New Haven road either borrowed or bought the right to use the extended front invented by Mr. Thompson, and by improvements made a success of it. This was nearly twenty years before the extended front was put onto the Eastern Railroad under my supervision.

We did design a front at the time Mr. Waitt was draftsman of the mechanical department, and, although differing somewhat in a few details, the general design was the same as used on the Hartford & New Haven Railroad, and we never claimed anything original in the design.

About the year 1882, the management of the Eastern Railroad requested me to devise some means of preventing fires along the line, and something that would prevent sparks, which were a great annoyance to passengers on trains. Having lived in Hartford, Conn., twenty-five years previous to assuming the office of master of rolling stock on the Eastern Railroad, and being somewhat familiar with the arches in use on the Hartford & New Haven road, I decided that that was the best and only device then known to accomplish these results. In the meantime I had looked over every device I could hear of, and at last visited Hartford and made a thorough inspection of front ends in use at that time, and from which the device used on the Eastern Railroad, with a few minor alterations which we thought were improvements, originated. The first engine to which we applied the extended front was No. 75, if my memory serves me correctly. The experiment was so successful that the management accepted it and ordered it put on as fast as possible.

Mr. George Colby, of the Boston & Albany Railroad at that time, who had been watching the experiment with much interest, borrowed our drawings and applied it to one of the engines on the Boston & Albany Railroad, and the result was that that company adopted it, and, I think, are using it to-day, with perhaps slight changes to accommodate different styles of engines.

I should not take any notice of the controversy if my name had not been mentioned in connection therewith.

Amos Pilsbury,
Supt. Motive Power.
Portland, Me.

Something New in Time-Cards.

Editors:

Between this city and Brightwood, Ind. (four miles distant), the City Street-Car Company have electric cars leaving either place every eighteen minutes, requiring a time-table to show this of not less than seventy readings. Below you will see a table I got up, which gives the time of any car leaving, and our men have adopted it, "pasting it in their hat."

Believing it might be of interest to anyone getting up time-cards, I will submit it to you for publication. To read it—example—it's now ten o'clock and ten minutes. Under the head of "Hours" find "10" o'clock; read horizontally, and under the head of "Minutes" you will find "25;" therefore, next car leaves at 10:25 at Brightwood, or from Indianapolis one minute sooner:

Electric Car Time-Table.
Leaving Brightwood, Ind.
Leaving Indianapolis 1 min. sooner.

Hours.	Minutes.
6— 9—12—3	13—31—49—
7—10— 1—4	07—25—43—
8—11— 2—5	01—19—37—55

W. J. Hartman,
Air-Brake Ins., Big Four Ry.
Indianapolis, Ind.

A Novel Air Compressor.

Editors:

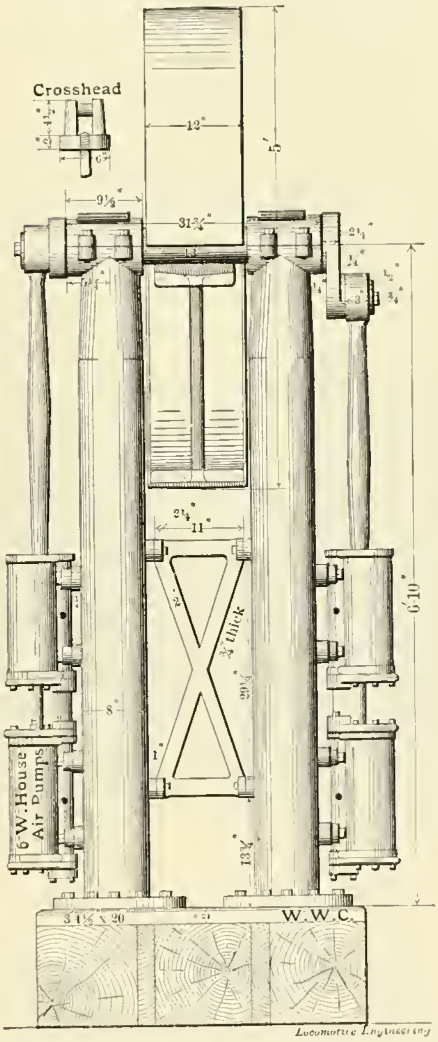
Inclosed please find blueprint of air compressor recently built in the shops of the Fall Brook road. I used in the construction of this compressor, two 6-inch Westinghouse pumps, using the steam cylinders as crosshead guides. The connecting rods are made of cast iron, also the crank shaft and cranks, cast in one piece.

Wm. A. Foster,
Supt. Machinery.
Corning, N. Y.

Views on Valve Motion.

Editors:

It is not necessary to have lead to start trains, or to have engine work smoothly at or near full gear. By increasing the outside lap to 1-inch and giving the required clearance, an engine will run smoothly at a shorter cut-off than with a valve that has ¾-inch outside lap and no clearance, if the same amount of lead is used with both valves. Consequently, the lead at 6-inch cut-off can be increased to advantage in proportion to the outside lap.



FOSTER'S AIR COMPRESSOR.

I consider the greatest disadvantage in too much lead is that it causes too much pre-admission when engine is worked near mid-gear. Where pre-admission is too great with the required lead, the best way to reduce it is to use valves with more outside lap. Valves with 1-inch outside lap will reduce the pre-admission one-third over valves with ¾-inch outside lap, when engine is worked at 6-inch cut-off. Valves with 1-inch outside lap with ¼-inch clearance will stand ¼-inch lead at 6-inch cut-off, and with ¾-inch outside lap with no clearance should have only $\frac{7}{32}$-inch lead at 6-inch cut-off.

I consider inside clearance an advantage to fast-running engines, or engines with small wheels at a moderate rate of speed. Negative lead allows steam to work longer in cylinder before being exhausted at full stroke. Advancing back-up eccentrics to produce a required lead, will give a longer cut-off near mid-gear in forward motion. With a 4-foot radius there will be no lead required in forward or back gear to produce the best results. A 6-foot radius would require a $\frac{1}{16}$-inch lead in forward and back motion to give ¼-inch lead at 6-inch cut-off. An 8-foot radius would require ⅛-inch lead in forward and back motion to give ¼-inch lead at 6-inch cut-off.

With the same travel of valves, viz., 5-inch, and with the different radii of links ranging from 4 feet to 8 feet, I would recommend eccentrics set as follows:

4-foot radius—Valves set negative lead in forward motion full gear, and, if necessary to produce the required lead, advance the back-up eccentrics.

6-foot radius—Valves set line and line forward motion, and back-up eccentrics advanced to give the required lead at 6-inch cut-off.

8-foot radius—Valves set with ⅛-inch positive lead, in forward and back motion.

C. B. Peck,
Foreman.
Tracy, Minn.

Nozzles Too Small.

Editors:

About what size single exhaust nozzle should a standard eight-wheel engine, 17 x 24, diamond stack, have for ordinary service, where the water is bad and a set of tubes only last, on an average, about nine months? The fuel used is native lignite coal—a very good coal when fresh mined, but when exposed to the air for a short time becomes slacked and loses at least a third of its heating qualities, when it requires a sharp blast to burn it.

In order that you may clearly understand the circumstances of the case, I will try and explain more fully. There are some here who claim that the larger the exhaust nozzle, the better results an engine will give. The amount of coal she burns, or how she burns it, is not considered at all, or whether she steams free or hard, as long as she gets over the road. When an engine comes out with a new set of tubes, we can get along nicely with a 4-inch nozzle for the class of engine mentioned; but after, say, six months, when the boiler begins to scale and tubes leaking very often, we find it very difficult to get along at all. Still is it claimed that those conditions should make no difference to the engine steaming. I think that when a fire has to be forced all the time to keep up steam that it is more wasteful of fuel than if a nice clear fire could be kept and engine steaming freely. I believe in having as large a nozzle as an engine will steam free with. The reason that the coal is so old when we get it is on account of having to keep a large surplus on hand in case of emergency. It is piled up on the open prairie, exposed to the weather at all times, and we use off one side of the pile while fresh mined coal is being piled on the other. The poorest quality of Pittsburgh coal is much superior to it. The average firemen here have fired from four to nine years, and try to perform their duties in the best possible manner for the interests of the company that employs them.

Please give us your views on this question, for we are confident that it will be of much benefit to us.

JOHN SMITH.

Napinka, Manitoba, Can.

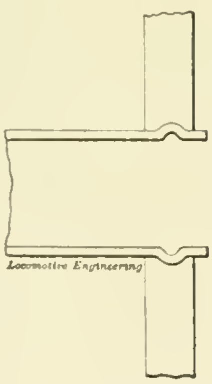
[We think that much fuel is sometimes wasted by attempts to use nozzles so large that the draft does not stimulate the fire properly. In a general way, it is wise to use nozzles as large as practicable, but it is also possible to have them too large for economical working. We cannot tell whether or not the nozzles of the engines written about are too small, but the indications are that they might be contracted to advantage when the engines cease to be free steamers.—Eds.]

Recess in Sheet for Holding Tubes.

Editors:

In May "Locomotive Engineering" is shown a cut of an improved method of securing tubes in sheet.

About twenty-five years ago, the writer rebuilt a locomotive in which the



tubes gave a great deal of trouble. As an experiment, I made a chisel and chipped a groove in one of the tube holes (back sheet), and expanded the tube into the groove, as shown in cut. It gave no trouble whatever, and I believe it to be a good way to put in tubes, not only to prevent leaks, but to brace the two sheets. A great many tubes are kept leaking by striking the sheet with a stick of wood in firing up.

I have the model of device; also drawing of grooving tool to be used in drill press. No; I never applied for a patent.

W. DE SANNO,
Pan Handle Shops.

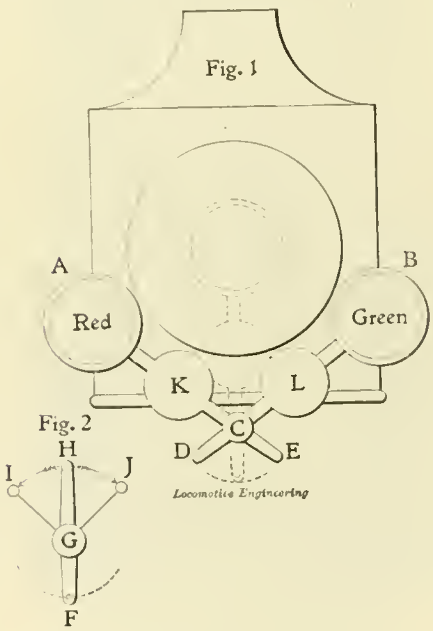
Indianapolis, Ind.

Headlight Signals.

Editors:

My experience on the road has been at times to want to put out a signal instantly. To dig a colored or white light out of the tender-box takes time. To meet these conditions, I designed the headlight semaphore signals as shown in cut.

The arms *A* and *B*, Fig. 1 (which are pivoted under the headlight), each carry a colored lens. On the arms are also the disks, *K* and *L*, painted to suit color of glass. The short arms *D* and *E* are con-



nected to the arm *F*, Fig. 2, which arm is on end of hand-rail or other rod running back into cab. On cab end of rod or hand-rail is the crank or handle *H*, Fig. 2. To put the green signal into position in center of headlight, as shown by dotted lines, the cab crank is thrown over to the position of *I*, and vice versa for the red. When cab crank is in vertical position *H*, both signals are in the position shown in cut. The rods connecting the arm *F*, Fig. 2, to the arms *D* and *E*, Fig. 1, are slotted on one end; otherwise the two signals could not be operated by the one arm *F*. I do not believe in shrouding headlights at meeting-points, at night.

This device gives us an instantaneous signal, day or night, at meeting-points, or when flagging in, and can be operated by engineer without leaving his seat.

W. DE SANNO,
Pan Handle Shops.

Indianapolis, Ind.

Old Philadelphia & Reading Locomotives.

Editors:

I find in your May copy of "Locomotive Engineering," an article on "Old Philadelphia & Reading Locomotives," which needs a few words of correction.

The engines referred to were built in London, England, by the firm of Braithwait & Ericsson, and were received at Philadelphia, for the Philadelphia & Reading Railway Co., by me, during the month of June, 1838. Their names were "Rocket," "Spitfire," "Dragon," "Firefly," "Comet," "Hecla," "Gem," and "Planet." The "Planet" was the last of the lot to reach Reading, as it was dropped into the river by the slings breaking while being swung from the ship to the wharf. On being raised, it was sent to the Baldwin shops for repairs, thus causing delay. They were four-wheeled coupled engines; straight boilers; cylinders inside, about 10½ x 16 inches; no cabs. The "Catawissa" must have been of more recent date, built by some American firm, as the dome boiler indicates. The old-time Baldwins are very familiar features of the early railway movements in the coal regions.

JOHN DODSWORTH.

Farnham, P. Q.

Beading Flues in Sheet.

Editors:

In your article on "Beading flues in the Flue Sheet," which appears in your June issue, you seem to have arrived at a too hasty conclusion. There is no doubt but Mr. Prosser patented the tool you describe. You say it was intended to perform the "identical operation" for which I was granted a patent. Now, this is where you make the mistake. The word "similar" not "identical" might have been proper.

My claim for a patent consists in providing a cavity to receive the surplus metal, which in all other methods of setting flues is, during the process of repeated rolling, pressed to either side of the sheet, thereby thinning the metal in the joint—which is impossible with my method. The Patent Office records show nothing patented by Mr. Prosser in conflict with my idea. So, gentlemen, there is no harm done; just a simple, unintentional mistake, and one readily understood by mechanics who have made a particular study of the art of setting flues.

What puzzles me the most is why Mr. Noah should go to the trouble of setting the flues in the boilers of the Ark in this secure manner, when he had such an abundance of good, pure water at his command, unless he expected to land in one of our Western alkali deserts, and in that case it would simply bear out his reputation for good judgment.

JOHN R. LOWREY.

Omaha, Neb.

New Express Engine on the Great Western Railway, England.

Editors:

Mr. W. Dean, the locomotive superintendent of the Great Western Railway, England, has lately turned out of the company's works at Swindon some new engines for working the fast passenger traffic on the hilly roads in Devonshire and Cornwall. This design of locomotive has attracted much attention over in England, as in it are found several distinct departures from what is generally accepted as English practice.

The general appearance of the engines can be clearly seen by referring to the illustration, and the principal dimensions are as follows:

Diameter of cylinders, 18 inches.

Stroke, 26 inches.

Length of barrel of boiler, 11 feet.

Outside diameter of boiler, 4 ft. 5 in.

Number of tubes in boiler, 249.

Diameter of tubes, 1¾ inches.

Heating surface of tubes, 1,285.58 square feet.

Heating surface of firebox, 115.67 square feet.

Total heating surface, 1,400.85 square feet.

Area of grate, 19.1 square feet.

Working pressure, 160 pounds per square inch.

Diameter of driving wheels, 5 feet 7½ inches.

Diameter of trailing wheels, 5 feet 7½ inches.

Diameter of bogie wheels, 3 feet, 7½ inches.

Weight on bogie frame, 17 tons 10 cwts.

Weight on driving wheels, 15 tons 7 cwts.

Weight on trailing wheels, 13 tons 3 cwts.

Total weight of engine, 46 tons.

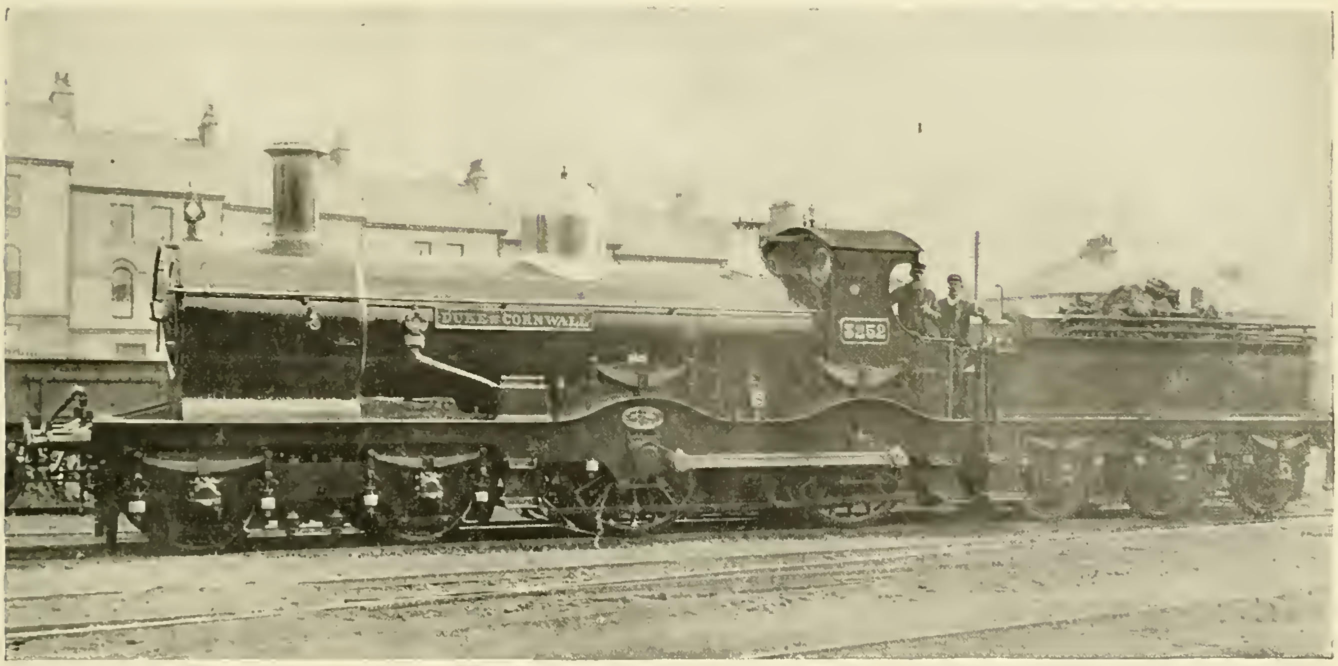
Total weight of engine and tender, 70 tons.

Length over buffers, 51 feet 7¾ inches.

Mr. Dean has not adopted the raised firebox shell in this design of engine, as in the case of his single and four-coupled engines, illustrated in the April number of "Locomotive Engineering." The crown sheet of the firebox of this engine is carried partly by longitudinal girder stays and partly by transverse slings. One of the most conspicuous points about the engine is the extended smokebox, which is something quite new in England. The top of the blast pipe protrudes through the netting in the smokebox, and the stack has a short inside extension piece, thus allowing the blast pipe to be cut somewhat shorter than usual. The cylinders are given an inclination of 1 in 10, and the valves are placed below them. The bogie frame is similar to those fitted to the large single and four-coupled types; the bogie wheels, however, in this class are of the wooden disk pattern. From the illustration, it will be clearly seen that the engine is built with double frames. With this arrangement the driving axle has four journals, one inside and one outside each wheel. The trailing axle, however, is only given two outside bearings; outside cranks are used for coupling the two pairs of wheels together, the coupling rods being of the usual H-section. Some very good work is always done by these engines, when they handle the trains which meet the Hamburgh-American mail steamers at Plymouth. They work up as far as Exeter, and often, over a very hilly section of the line, attain an average speed of 47 miles per hour with a train load of 115 tons, their coal consumption averaging just over 31 pounds per mile. These engines also work the train known on the line as the "Cornishman," which is one of the company's best trains from London to Penzance. Engines of this type are still being built at the Great Western Railway Works at Swindon.

P. J. COWAN.

London, Eng.



GREAT WESTERN, OF ENGLAND, EXPRESS ENGINE.

Those Harlem Extension Front Locomotives.

Editors:

The extension front has given rise to considerable argument, and I am pleased to see it go on.

Mr. A. D. Brown, whom I am unable to place, although he may remember me, says, on page 498 of "Locomotive Engineering," that the engines Nos. 29, 34, 39, 40, 41 and 42 came on the New York, New Haven & Harlem Railroad, 1863 to 1865, with extension fronts, which statement is very near correct. The "29" and "34" came in the fall of 1863, and Nos. 39, 40, 41 and 42 in 1864. These engines all had extension fronts and Hunter stacks; their exhaust was level with top row of flues; they had no "petticoat" or deflection plate, and the netting was in the stack. They would fill up with sparks, and we used to take them out of the front and stack, both. They did not run this way long. Their exhaust pipe was cut down and a "petticoat" put in, and diamond stacks put on to them, and they ran this way until they were scrapped, with one exception.

Along in the '70's, Ed. Humphry prevailed upon Mr. Wm. M. Strong who was the master mechanic at that time, to cut off the front of No. 40; but as no great benefit was derived from this action, the others were not disturbed.

I was firing when these engines came on the road, and I remember well some reminiscences regarding them that I see no harm in relating. The first trip the "29" made, Ed., or "Mick" Humphry, as we used to call him, took her out on the mail train to Chatham, and Mr. Leach, who came with her from the Taunton shops, accompanied him. The next A. M., Wm. Marsh, with Engine No. 11, and James Barnum, with No. 28, were sent North from New York, with a double-head train of empty stock cars—and I was fireman for Barnum that day.

Well, we got started and went along all right up to Brewsters Station, and were obliged to stand on main line and put the mail train in siding, to pass. Our conductor went up to the station, and, when the train arrived, explained to Humphry and his conductor the situation. When Humphry got the signal to go he seemed to have forgotten us, and he came right down into No. 11. Marsh and Barnum endeavored to get back and give him room to stop, but were unable to do so, and the No. 29 was derailed, and her little "Yankee pilot," as we called it, was smashed.

Well, we all took hold and put the "29" on the track, and cleared up the debris so that we could pass, and the "29" went on to New York with her train.

Only a short time after this occurrence, I was firing Engine No. 31 for Jim Culvert, on the regular freight. We were bound North, and while standing at Brewsters Station, unloading freight, up came James, or "Cockey" Beard, with the No. 29 and mail train, and ran into our rear. Her front end was knocked in, and the extension arch was somewhat damaged. She was derailed, and the draw timbers of the caboose punched a hole in her flue sheet. The hot water and steam cleaned out the caboose in great shape.

Well, the "29" was taken to the New York shops and put in order again, and Humphry started out with her. But it was not long before he struck No. 15 on the frog at the Ice Pond, and knocked off one of the "29's" cylinders, and tipped her over on her side.

About this time Nos. 39 and 40 came. Charley Barton took No. 39 and the day express. Humphry thought he had had enough of the "29," so he took the No. 40 and the other day express. John Hollenbeck was running No. 10 on the night express, and when the "29" came out he took her and ran her a long time with no mishaps.

The first trip the "34" made over the road, Alonzo Swing, or "Fat Jack," ran her on the milk train from New York to Millerton and return one Sunday—and I was his fireman. Albert Patterage then took her on one of the night expresses.

Then the "41" and "42" came. They had 5-foot driving wheels and were considered freight engines. John Dolan took the "41," and Sam. Mattison the "42," and ran them on stock trains for some time.

The brick arch was used in all these engines, and they were all fair steamers.

C. J. McMaster.

Providence, R. I.

"Who Can Tell Which Side of a Balance Valve Is Blowing?"

Editors:

Noticing in the June number of "Locomotive Engineering" where Mr. S. D. Hutchins raised a question about detecting valve strips blowing, will say that during my experience with the balance valve, I find by placing the valve in a central position, thereby getting the relief hole in top of valve directly over exhaust port of cylinder, it don't matter how slight the leak may be, it can be detected by the vibration caused by the rush of steam over strips through relief port in valve and out exhaust port. In all cases where an engineer reports "valves blowing" we first examine to find out which side is blowing, and have never failed in a single instance to locate the leak where there was but one side blowing.

Hoping this will throw some light on the subject, I remain

T. L. Stevens,
R. H. F'man, G. C. & S. F. Ry.

Temple, Tex.

Editors:

I see a question in your June number, that Mr. S. D. Hutchins, president of the Air-Brake Association, asked, which was not answered.

I would like to say to Mr. Hutchins that the engine I am running has two holes tapped into base of exhausts under saddle for condensed water. If valve is blowing, block driving wheels and have fireman give engine steam, and you can see from which exhaust steam is escaping. If there are no holes under saddle, open the front end and see which exhaust steam is blowing out of. If there is any easier way I would like to hear from someone else.

S. E. Norman.

Somersworth, N. H.

Editors:

In reply to the question raised by Mr. S. D. Hutchins, about valve strips leaking, will say the tremendous friction he speaks of makes it an easy matter for the engineer to locate the defective side. Step out on the running board while ascending a heavy grade or pulling out of a station, and put your foot on the valve stem and you will feel the jar from the one that is moving the valve with the leaky strip. Be sure that the lubricator is working freely before you make this investigation; for in case the valves are not well lubricated, you will find the jar in both valve stems.

I adopted the above plan several years since, and have my first mistake to make in locating the valve with the leaky strip.

C. T. Allis.

Nona, Tex.

Editors:

Seeing the question "Who Can Tell Which Side of a Balance Valve Is Blowing?" in your June edition, and Mr. Hutchin's remarks thereon, will say if the engine is put on the quarter each side alternately, and throttle opened a trifle, and reverse lever moved, it can be ascertained which valve is blowing; or, in other words, which valve has the friction caused by the strip being down.

For illustration, suppose we put the crank pin on the quarter on right side: Open the throttle slightly, then move reverse lever back and forth a few times—we can tell whether or not there is any unnecessary friction on the right valve. Then move the engine, and put the left crank pin on the quarter and go through the same operation. By this time we will have ascertained which valve had the friction, as only one valve is being moved at each operation, the other crank being on the center.

D. Brown,
M. M.

Scranton, Pa.

Editors:

"Who Can Tell Which Side of a Balance Valve Is Blowing?" With straight stack and single exhaust nozzle, the following method is practiced here with much success.

Apply the driver brake; put a shovel of coal in the firebox, to make a little smoke; then shut off air pump. When the throttle is open, the smoke will stand up straight out of one side of the stack; the broken spring will be found on the opposite side. In case of a long valve rod, the increased friction will cause excessive vibration of the rod.

If at night, stand on boiler behind the stack, and hold a lighted torch in front; or by putting both hands over the stack, any one can easily tell from which side the most steam is coming.

In case of a broken balance spring, with valve in certain positions, would cylinder take steam in both ends?

W. E. Fowler.

Charlottesville, Va.

[We would answer no to the question asked.—Eds.]

Editors:

I notice in June "Locomotive Engineering" an article headed—"Who Can Tell Which Side of a Balance Valve Is Blowing?" I have tried a way which never has failed, which I will explain for the benefit of the readers of your valuable paper.

When valve strips and springs are in

proper condition, and cylinder cocks are open, the latter show steam alternately. When the spring is broken or weak, move the engine with a light throttle, so that the blowing valve can be heard in the stack; and then, by watching the cylinder cocks, it will be seen that steam will flow continually therefrom on the side having the broken strip or weak spring.

MAURICE LEAHY.

Dubuque, Ia.

Editors:

I see an inquiry in your paper for some method of finding out which valve blows on engines equipped with balanced valves.

When one of the springs is broken, it allows the steam to get on top of valve and will cause the valve to handle hard; then, by placing engine on center and working reverse lever with throttle open, it is an easy matter to find which valve is blowing through by way reverse lever handles. If, by placing engine on center on right side, the lever handles hard, it will show that the left valve blows; then, by placing the engine on center on left side, and right valve is not blowing through balance strips, lever will handle easy with throttle open.

H. MONTGOMERY,
Foreman C. & N. Ry.

Waseca, Minn.

Editors:

In your June number, on page 471, I noticed an article headed—"Who Can Tell Which Side of a Balance Valve is Blowing?" After reading the article, I inferred that the question meant how to tell which valve to report strips down on.

If that was the question, I wish to say that I have always been able to locate the side that blows by the difference in the strain on the two valve rods.

To do this, go out on the running board and put your foot on one rod, and then on the other, when the engine is working steam. The rod on the side where the strips are down will buckle and strain, while the other side will move with its usual smooth action.

GEO. R. PRICE.

Rochester, N. Y.

Editors:

I notice in your June issue the question raised by Mr. S. D. Hutchins, president of the Air-Brake Association, in regard to valve strips blowing on one side of the engine. I have located trouble of this kind in the following manner:

While running at a speed of 10 or 15 miles per hour, work steam with throttle open just so the reverse lever can be held by hands with the latch lifted out of the notches. Hook lever down to cut-off at about 15 inches of stroke. If valves are tight, the lever can be held quite still. If valve strips on one side blow, there will be two perceptible jerks or pulls on lever in one revolution of driving wheel—the pull takes place as the valve stops, or rather starts, at each end of its travel. By watching the valve rod or rocker arm, this can often be located. If valves blow on both sides, there will be four jerks of lever per revolution, the same as if the valves were dry. On engines with double exhaust nozzle, open front end, place the lever on center and open throttle; the blow will show at nozzle on the side that is blowing.

S. C. WHEELER.

Havelock, Neb.

Editors:

I noticed in June "Locomotive Engineering," page 471, that Mr. S. D. Hutchins had asked the question, at the New England Railway Club, if anyone could tell which side the blow came from when the balance strips were leaking.

I have had some experience with leaking strips, or, more especially, broken springs, and have always been successful in locating the right side since I have adopted this plan: When a spring is broken or strips leak badly it allows the pressure to come on top of valve, causing valve to move harder and reverse lever to handle harder. I go out on running board and put my hand on each valve rod, and ascertain in that way which one it takes the greatest effort to move, as there will be more of a jerk at the end of stroke. I have always been able to tell ever since I thought of this plan, and have never been mistaken.

J. C. HAVER,
Eng. Ala. Gt. So. Ry.

Birmingham, Ala.

Editors:

In answer to Mr. S. D. Hutchins' question, put before the New England Railroad Club, I should like to state what I consider an accurate way to tell when balance strips in Richardson balance valves are broken or blowing.

In backing out of train shed or roundhouse, where you are under cover, use light throttle and watch crosshead closely, and the side that has strips blowing will cause exhaust on that side to be muffled just the instant the exhaust steam fills the cavity of valve. By giving careful test you will find it an easy matter to tell.

T. J. MENDENHALL,
Eng. P. R. R.

Jersey City, N. J.

Traction of Locomotives.

Editors:

In an article under the heading "Traction of Locomotives," which appeared in the June number of "Locomotive Engineering," it was stated that the formula commonly used for finding tractive power had been tested at the Purdue plant and found to be correct. The formula as stated was slightly in error, boiler pressure being used instead of mean effective pressure. The formula is derived from the equation of two well-known expressions, one representing the indicated power and the other the tractive power, with the assumption that all the power generated in the cylinder appears at the drawbar, or in other words, that the friction of the engine is zero. The formula, stated mathematically, is as follows:

$$I.\,H.\,P. = T.\,H.\,P. \text{ or } \frac{4\,P\,L\,A\,N}{33000} = \frac{T\,C\,N}{33000}$$

where P = means effective pressure (average of four ends);
L = stroke in feet;
A = area of cylinder in inches = $\frac{1}{4}\,\pi\,d^2$;
N = revolutions per minute;
C = circumference of drivers in feet = $\pi\,D$;
T = drawbar stress.

By reduction this becomes:

$$T = \frac{P\,L\,d^2}{D}$$

The items L and D are here given in feet, but may be taken in either feet or inches as desired, provided that they are both in the same units.

It is apparent that by reason of the assumption of no engine friction—a condition not found in practice—it is impossible to verify the formula experimentally.

R. A. SMART,
Purdue University.

Lafayette, Ind.

Give the Front End More Attention.

Editors:

One of the most interesting as well as the most important subjects for consideration in the locomotive department is the front end, and when railway companies are doing all in their power to reduce expenses generally, it behooves us in the mechanical department to use the best judgment conducive to that end. We have read a great deal during the last year or two on economy of engines, and at times the discussion has been very interesting, but in my opinion very one-sided.

I want to draw the attention of locomotive men to the fact that we have been giving our valves and cylinders, our grate and heating surface, a great deal of attention—also regarding steam admission and distribution; the least clearance and space possible in passages and cylinders; cylinder packing that will fill cylinder with the least friction, especially when shut off; the amount of expansion conducive to economy, etc. This attention has been well bestowed; but let us give a little more attention to the smokebox end, and strive to abstract a few more of the large percentage of heat units that pass to the atmosphere. Mutual effort and the interchange of observation and experience, with a little discussion, will be conducive to that end. I feel sure a page in your valuable paper on the smokebox, and the economy of fuel from the standpoint of making engines steam, would give us all information and be conducive to a greater economy of fuel than we can ever expect in the future from the present mechanism of the locomotive.

When we look at the tremendous waste there is in fuel from many locomotives, owing to the mechanism of the front end not being exactly in position or properly proportioned, it is appalling, not only in engines perhaps that are hard steamers, but in many that are comparatively free steamers and the less noticeable.

What a furore there would be in the locomotive engineering world if a mechanism were invented that would economize from 15 to 20 per cent. of the fuel now used! Even if its cost was great, the inventor's name would be handed down from generation to generation as one of the great benefactors of our race; and yet now and then we manage to do the same thing by merely the moving of a part. But then, with all our experience, it is mere guesswork—we have no definite plan, no regular rule; we are working under a cloud—a cloud that by co-operation can be dispelled.

Now, I am in the dark as much as many; am doing the best I can, and want to know what others are doing in this direction:

First, then, for a start: Engine No. 258, 19 x 24, would not steam. She was just from shops—new flues, steam pipes tight and engine in good shape, diameter of smokebox 62 inches, single nozzle, height 34 inches, adjustable diaphragm plate, size of nozzle $4\frac{1}{2}$; netting horizontal, 2 inches below center line of arch. Funnel entered stack a tight fit, and stood 9 inches above nozzle and 2 inches in stack. Diameter stack in choke $13\frac{3}{4}$; at top 18 inches. Height top stack from arch 4 feet $7\frac{1}{2}$ inches. Diaphragm plate $4\frac{1}{2}$ inches from flue sheet at top, and $11\frac{3}{4}$ inches at bottom. Bottom of diaphragm plate, center of sixth row of flues from bottom, cuts fire even. This engine, when exhausting at 12-inch cut-off, would actually draw a piece of waste down one side of stack unless held moderately tight. Our master mechanic, when telling him of the occurrence, said in one instance he found the stack out of plumb; and as we had tried the funnel in various positions, and had boiler-maker square it up and he reported it "O. K.," we tried the stack for plumb and found it out $\frac{3}{8}$ of an inch. We then tried a different funnel, but to no purpose; tried the nozzle and found it out about 3-16. This we squared up; made a lift pipe $11\frac{1}{2}$ at the upper end; flare 9 inches deep and 24 inches wide. It was set $13\frac{3}{4}$ inches from top of nozzle and 7 inches from top of smoke arch. The engine now burns two tons less on her trip of 100 miles and steams good.

GEO. SMART.

Edgemont, S. D.

Experience with the Straight Piston Fit.

Editors:

I noticed in your June number, page 493, an article from F. A. Halsey, on "Fastening Piston Rods," and wanting to know if anyone has any objection to the straight fit in crossheads.

About four and a half years ago there were two Richmond engines sent to the Alabama Great Southern, which belonged to the Louisville Southern, to be used in passenger service, which had straight fits to their pistons. They were 18 x 24 cylinders, eight-wheeled engines, and I can truthfully say that not a month passed that either one or the other did not break a piston in the keyway or lose a key out. It went on in this way until the master mechanic tapered the crossheads and put in new pistons, and we had no more trouble with them. The straight fit became worn, which allowed the pistons to bend, and by constant bending and working would break off at weakest place, which was in keyway. Then it was impossible to keep the key tight, as you could not draw the piston any tighter, as it bottomed in crosshead; and as I ran one of these engines, I had frequently to stop between stations and drive in key, and had to have a hole drilled in key, close up to hub, to hold key in. These engines almost ruined their cylinders by having them broken in front, caused by the piston coming out front head, taking part of cylinder with it; and one of them had to have one new cylinder. The trouble all disappeared when the taper fit was applied.

J. C. HAVER,
Eng. A. G. S. R. R.

Birmingham, Ala.

Hub Liners.

A committee of the Master Mechanics' Association made a very succinct report on the use of hub liners for locomotive driving wheels. Hub liners are coming very largely into use, and where steel driving boxes or steel wheel centers are employed they are an absolute necessity. The most common form of hub liner in use is a plain disk secured by patch bolts or brass plugs. Most of the liners are made of cast iron, but brass and bronze are used to some extent. A few roads use no liners on hubs of wheels, but line the wearing faces of driving boxes and truck boxes; while another group of roads combine these two practices and use, to some extent, liners on the hubs of wheels and liners on the wearing faces of the boxes. The practice is becoming popular of making hub liners to template, so that they may be uniform and interchangeable for engines of the same class of wheels having the same diameter of hub.

A curious fact is mentioned in the report in connection with locomotives running on the London & Northwestern. Engines that have been in service for nearly forty years have never had any liners applied to their hubs and are still in good condition. The committee does not mention the fact, but we are aware that the engines referred to have wrought-iron wheel centers and brass driving boxes.

The conclusions of the committee are, that if a good system of interchange hub liners is in use it is unnecessary to make use of box liners; that cast iron is sufficiently good material for hub liners, and that the use of brass or bronze is unnecessary; that the application of hub liners to all the wheels of new engines, and to all wheels introduced under old engines, is good practice; that the use of loose liners, riding on axle between wheel hub and box, is not good practice.

Relative Dead Weight of Bicycles and Cars.

A bicycle can carry a passenger safely over roads where shocks are severe, with a dead weight of less than one-eighth the weight of the passenger. A palace car, on the other hand, requires ten times the weight of the load in passengers as dead weight. A bicycle is made of steel put in the strongest shapes; a palace car is principally made of wood, in a form that calls for ponderous sizes to provide the necessary strength. It seems that a study of the bicycle might be a profitable pastime for the designers of railroad rolling stock. The prevailing tendency of bicycle designers is towards less dead weight; the trend of car designers is to increase the proportion of dead weight to paying load.

The first cost is decidedly in favor of the car; but it might pay to increase first cost for the sake of reducing the expense of haulage. A bicycle costs about $4 a pound, although a living profit might be made if the price were half that sum. A car is expensive if it costs more than 10 cents a pound.

Joy's valve gear was so popular in England for a short time after it was first introduced that it looked as if it were going to push the link motion out of use. On the smooth roadbeds that English railways have, the irregularities caused to the travel of the valve by the up-and-down motion of the axle boxes was not so conspicuous as it was on American locomotives equipped with Joy's motion. But of late years Joy's gear seems to be falling into disrepute even in England. Mr. Clement E. Stretton, writing to the "Railway Herald," says: "The latest express engines upon the Northwestern, Northeastern and Midland railways all have 'link motion,' although those companies had tried the Joy gear. Either with valves 'above,' 'below,' or 'between' the cylinders, the 'link motion' is the best valve gear in use in this country."

AIR BRAKE DEPARTMENT

Conducted by F. M. NELLIS.

Field Notes.

Editors:

There is a class of refrigerator cars in service that were equipped with automatic brakes before the quick-action triples were perfected, as they have the plain freight triple valve, plate B-25, which can be set for either automatic, straight air, or, when cut out, opens a bleed port in the plug cock in triple. Their general appearance and manner of operating go to show that the air brake does not get all the care that it should have, while some of the repairs made on them from time to time show a sorry lack of intelligence on the part of the repair-man.

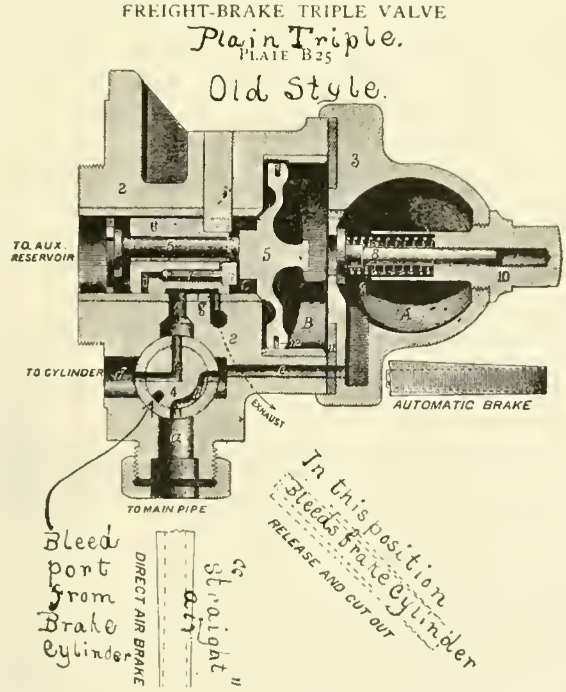
The other day, while holding an air-brake school, we used a long string of "freezers" for what "Skeevers" would call an "object lesson," and took the class out to unravel the many puzzles found among these cars. Of course, some of them were all right and in working order. Of those that were not we will now speak.

The first one had lost the original handle for turning the cut-out plug cock in the triple; another handle had been put on; this handle was not made for that place, and was put on wrong, so that it pointed towards the ground when the triple was working automatic. To see whether this brake would work, it was necessary to crawl under the car and inspect the port marks on the end of cut-out plug, which show which way the ports are open. When this triple was cut out for any defect, it opened the bleed port to the train pipe, which would make it necessary to have this car behind all other air-brake cars and cock at front end of car closed.

Another triple had the handle also put on wrong; and while it could be set for either automatic or straight air, yet the plug was half a-turn out of the way, so that when cut out it would bleed the bottom case of the triple instead of the brake cylinder. There is no bleeder on the auxiliary with this pattern of triple; if the bleed port in plug cock does not operate right, and brake stuck on you, it would be necessary to turn this cock for straight air, let all the air out of the train pipe—which would let air out of brake cylinder—and then cut it out.

Another triple had lost the original handle, and one of the handles which belong on the train pipe cocks at the end of the car had been put on. This style of handles is much larger than the proper ones, so it caught on the side of the triple; this particular one had a wire nail in the rivet hole through handle and plug, which struck the pipe from exhaust port to pressure retainer, so ports could not be opened

FREIGHT-BRAKE TRIPLE VALVE



FIELD NOTES.

wide enough to get a good action of the automatic in setting or releasing the brake. When turned the other way it would not go far enough to open the ports for straight-air operating, which made the brake on that car only a trap to catch the man who was unfortunate enough to try to work it in a train; the bleed hole was turned away from cylinder.

While we unravel these puzzles at the time we tell of their existence, yet the strongest point is, that it is a fact—and a disagreeable one, too—that men are allowed to do repair work on air brakes who do more damage to the equipment, by their ignorance or careless disregard of instructions issued for their guidance, than any amount of neglect can cause. All air-brake repairs should be made by intelligent and careful men, or else not made at all.

C. B. CONGER.

Grand Rapids, Mich.

A Queer-Acting Brake.

Editors:

I have noticed several good problems appear in "Locomotive Engineering" of late, which cause one to think a few moments before solving. In addition to those which were puzzling, I will add this one, which may be interesting to some of your readers.

Some time ago a train left a terminal, made up as follows: 21 air and 24 non-air cars, respectively. The 21 air cars had two kind of couplers, the majority of them being Janney's, which were next to the engine; the remaining ones between the Janney and non-air cars. The train had journeyed for 100 miles, with everything working apparently nicely, the engineer only drawing off 12 to 15 pounds of air in making the stops. The triples were responding nicely to the light applications being made.

At a certain point we received an order to pick up a car which was equipped with air brakes and the old link and pin coupler, so we placed it in the rear of the cars equipped with Janney couplers. We coupled up, released brakes and started out. After we had passed through the switch the engineer started to check the train up so the brakeman could get aboard, and in so doing, the train went into quick action and both gage hands dropped back. At once the engineer placed the valve on lap and said to the brakeman: "See where that burst hose is." The brakeman immediately obeyed, but returned fruitless; so the air was again turned in to the train pipe, but the brakes only released to again apply. All of the air passed out of the main reservoir, and the gage hands dropped back to the pin; then the pump again accumulated its pressure and the brakes released. The same action took place each time a stop was attempted, and all the air in the main reservoir was lost before pressure could be again restored each time.

These cars were all equipped with Westinghouse air brakes. After cutting the defective car out, the remaining cars worked to perfection. I will add, too, that the quick-acting valves were in good condition in all triples, the train pipe being as free from leaks as ordinary freight trains are.

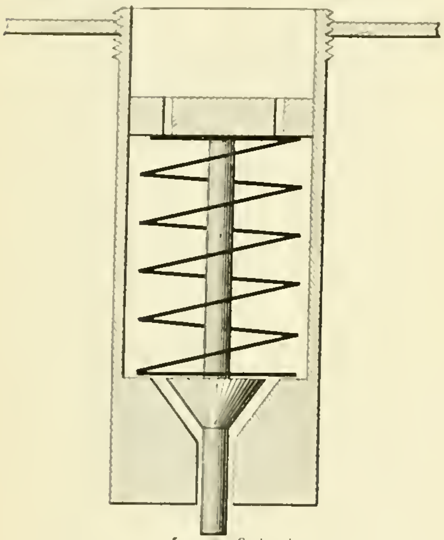
P. P. Haller,
A. B. Insp., C. & O. Ry.
Covington, Ky.

Automatic Drainage Valve for Main Reservoirs.

Editors:

I am sending you a sketch of valve for drawing water from main reservoirs automatically. This, you will find, will open when pressure gets down to 10 pounds in main drum, when engine is put in shop, and the remaining pressure will drive out what water has accumulated in it; also will remain open until pump has again been started, and overcome resistance of spring. Thus, a clean drum is had to start out with.

I submit this to you for your consideration and opinion. The sketch will give



Locomotive Engineering

AUTOMATIC DRAINAGE VALVE FOR MAIN RESERVOIRS.

you an idea of valve: First, part that screws in drum will be slightly taper to insure being kept tight; second, the spring adjusted to about 10 pounds compression; third, piston rod and valve all one; spring resting on shoulders by valve seat, and under piston head; two holes in piston head large enough to let grit and water through, which will be driven out past valve seat and piston rod below, which is left long enough to raise valve with, should dirt get on its seat.

George R. Young,
Can. Pac. Ry.
Moose Jaw, N. W. T., Canada.

QUESTIONS AND ANSWERS

On Air-Brake Subjects.

(44) T. J. M., Jersey City, N. J., writes:

I should like to ask why some 8-inch air pumps condense so much water. I have noticed some 8-inch pumps where the steam end would condense so much water that there was a constant dripping down the piston rod at all times while pump was working. A.—The absence or loose fit in the boiler nipple of the dry pipe to the pump, and a long steam pipe from the throttle in cab to the pump, will cause it. Poor piston rod packing makes it more noticeable.

(45) R. L. F., Albany, N. Y., writes:

1. Can piston travel be correctly adjusted by taking up slack so that the brake shoes clear the wheels just so much? I have seen car inspectors and train crews taking up slack this way. 2. Why is it that, on the same truck, one brake beam will hold the shoes away from the wheels, while the shoes on the opposite beam will drag? If you try to take up slack so the distant shoe will become closer, the close shoe will rub. 3. What is to be done in this case? A.—1 No; the only proper and reliable way to take up slack by hand is to apply the brake and regulate it by the distance the piston travels. Shoes will clear differently on cars with different total leverage. Low leverage clears the most. It is a mistake and makeshift to attempt to follow out the method used by the parties mentioned. 2. The brake-beam springs are of different tension. 3. Adjust the springs. Never try to remedy this unequal clearance by taking up slack. It makes the train hard to pull, and may crack wheels from heating. Get at the root of the trouble—the beam springs.

(46) F. A. M., Jersey City, N. J., writes:

1. Is there any harm in leaving the steam-chamber cylinder cock partly open all the time on the 8-inch pump? 2. How should the handle of the cocks on the 9½-inch pump be while running? Would it be harmful to leave one or both of them open all the time to carry off condensation? 3. Why is it that the piston travel is longer on a car while running than when standing? A.—1. No. 2. They should be kept closed after condensation has been worked off in starting up the pump. The cock on the 8-inch pump opens out of the exhaust passage; while on the 9½-inch pump, one cock opens from the steam supply pipe, and the other one opens from the steam passage to under side of main piston; hence, live steam would be lost. Should the pump, when running, throw out much water for any reason, a small drainage cock could be advantageously used in exhaust pipe to pump near the smokebox, and left open all the time. 3. When a car is running, the jolting will allow the lost motion in the running gear to be drawn up together more closely by the brakes. The tilting of the trucks has also something to do with it. See Card No. 3 on page 403 in May issue of "Locomotive Engineering." Note that the travel was increased nearly ¾-inch by engine bumping against it after the brakes had been applied standing still. The loop in the line in the upper right-hand corner shown in Card No. 16 on page 405, shows the effect of the truck tilting.

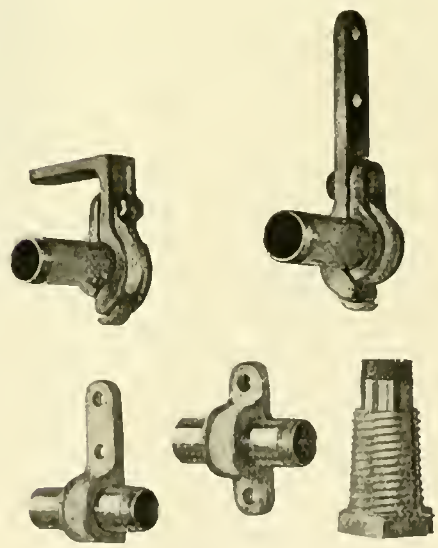
(47) E. L., Amboy, N. J., writes:

1. What is the hole in the flange of the new brake valve, where the handle works, just beyond the service stop for? 2. On brake valves where the feed valve attachment is used, why is the pump governor connected to the main-reservoir pressure instead of the train pipe? 3. Is it proper to carry 80 pounds train-pipe pressure if train is composed of heavy cars, such as Pullman sleepers, instead of 70 pounds, as is carried with a train of ordinary coaches? A.—1. On a certain road where much rough braking was done it was found that the emergency position of the brake valve was being promiscuously used, and, as it seemed impossible to stop it, the scheme of drilling a hole between the service and emergency positions and placing a lead plug therein which would be broken off in an emergency application, was struck upon. For a while one man was kept busy making plugs, and much of the master mechanic's time was spent listening to explanations of how the plug became broken; but gradually the effectiveness of the scheme began to tell, and rough handling disappeared. The plugs were then taken out. So successful was the plug in producing smooth braking that a hole is now drilled in all valves. 2. When handle is in running position, the feed-valve attachment automatically supplies and regulates the pressure in the train pipe only. In order to keep the main-reservoir pressure from getting too high, the pump governor is connected to that pressure. 3. No; all passenger cars, regardless of their weight, should be braked to 90 per cent. The brake force is always based on a 70-pound train-pipe pressure and 60-pound (emergency) brake-cylinder pressure.

Expensive Repair Men.

One of the foremost and progressive master mechanics in the country recently remarked: "Some time ago we used our shop machinists promiscuously on air-brake work, and the job changed hands so often that the equipment got into bad shape. Recently, however, I gave the work to a practical machinist, who is thoroughly acquainted with overhauling air pumps, triples, brake valves, etc., and we are getting our air brakes back into their former good condition."

Doubtless there are many similar cases like this one. The air-brake work is



THE "ACME" PIPE CLAMP.

given to the machinist who happens to finish his work first. Every Tom, Dick and Harry has a trial at it, and as many different kinds of work are had. There is no doubt that this policy is expensive. No "Jack-of-all-trades" ever made a pronounced success of any particular thing.

Looking Out for the Pressure Recorder.

"Shall I test the brake?" said Fireman Blake.

"Yes," replied Engineer Lee. "But remember the mission of the service position, and beware of the 'emergency.'"

Items.

It pays to keep a good man regularly on air-brake work.

Advanced air-brake study seems to be running to car equipment.

A form of pipe clamp which does not prevent longitudinal play of the train pipe fails in its object.

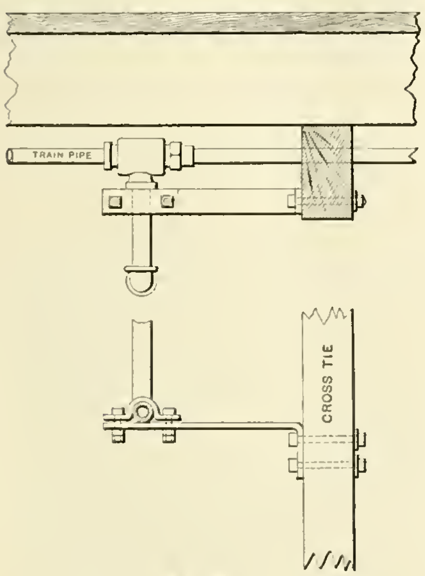
A piston-rod swab and an oil cup will lengthen the life of any packing, but they are especially valuable on pumps equipped with metallic rod packing.

Total leverage, shoe clearance, running and standing travel, will prove interesting and instructive to those who have heretofore confined their researches to air-brake equipment on locomotives.

"The Air-Brake Men's Proceedings," fresh from the press of "Locomotive Engineering," is, without exception, the most refreshing and instructive air-brake book ever published. It teems with valuable information for all classes of students. The progressive form of questions and answers contains information for all grades, while the advanced student will find much to study and learn in the indicator cards in the paper on "Piston Travel."

A system for recording the repairs on locomotive air-brake equipment, worthy of attention by others, has been adopted by the New York, New Haven & Hartford Railroad at New Haven, Conn. A book is kept by the repairman, in which an accurate record is kept of each piece that is supplied. By referring to his book, he can tell the age of each piece and the exact condition of the equipment.

Guatemala is going to have an international exhibition next year. We understand that several American firms handling railroad material will have exhibits. The exhibition is expected to open in May or June. We learn that among the goods for which there is at present a good demand in Guatemala are railway material, electrical light and power plants, bicycles, hardware, etc. Some of our business houses are already selling considerable material to Guatemala, and it is expected that the exhibition will be the means of extending the trade.



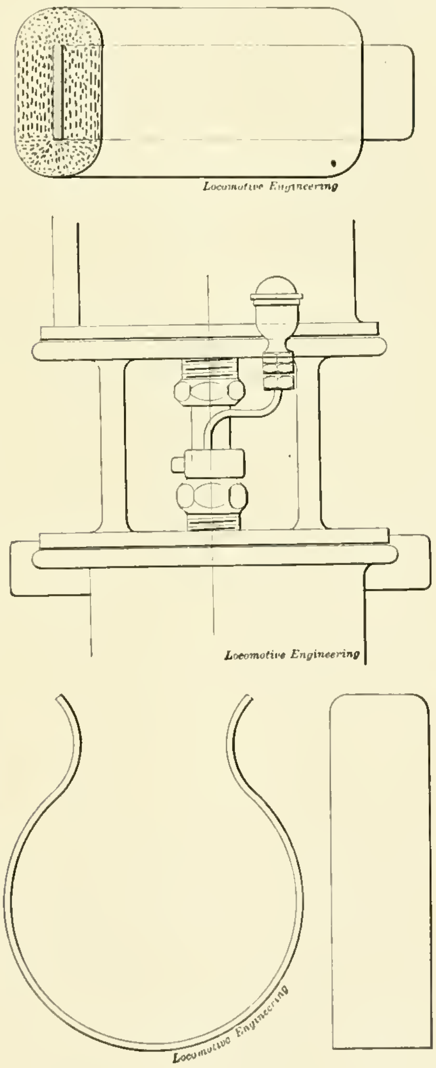
PIPE CLAMP—M., K. & T. RY.

Secretary Sinclair Resigns.

In his annual report to the Master Mechanics' Association, Secretary Sinclair said:

"In submitting what will be his last report to this association, your secretary will ask your indulgence while he makes a brief retrospective review of his stewardship. In 1887 when the present secretary was elected, the total membership was 277, and the income was too small to defray the expense of printing the annual report; so your secretary commenced systematically to solicit subscriptions from railroad companies that held aloof from the association. He found at first that many railroad managers believed that the conventions were merely pleasure meetings, and they were very reluctant to subscribe. Persistent work was done in the course of many personal interviews to convince railroad managers that the American Railway Master Mechanics' Association was worthy of support as an educational organization which would return manifold savings for the contributions given to its support. They were also urged to send their master mechanics to the conventions, and arguments sufficient were advanced to convert many railroad officers to the belief that it would pay to have their master mechanics attend the conventions.

"We now have a membership approaching 800; the finances are in a flourishing condition; and now your secretary feels that he can step out with entire credit."


PISTON SWAB AND OIL CUP—SOUTHERN RAILWAY.

Origin of Malleable Iron Steam Pipes.

The malleable iron steam pipe, which was highly commended by a committee of the Master Mechanics' Association, originated with Mr. J. H. McConnell, of the Union Pacific. Mr. McConnell has long been dissatisfied with the ordinary steam pipe, owing to its weight and rigidity. He made a set of pipes from large wrought-iron pipe and found them quite satisfactory, but an objection to them was that the flange had to be screwed on and they were expensive to make. He then thought of cast steel, and corresponded with steel makers to see if they could make steam pipes $\frac{7}{8}$ inch thick, capable of standing a test of 300 pounds to the square inch. None of the steel makers would undertake to meet these requirements. Then he thought of malleable iron, and on making a proposition of a similar nature to the National Malleable Iron Co., they undertook to do the work and guarantee the pipes. Mr. McConnell at once began to put in malleable iron pipes, and expects to keep on till the whole of his engines are equipped. The malleable iron pipe is nearly 100 pounds lighter than those made of gray iron; it takes care of expansion and contraction by springing at the curve, and no undue strain is put upon the joints.

The Nickel Plate people run their own eating cars, and they have adopted a rather unique manner of keeping the men in charge of the cars up to the mark. There is a Grievance Committee, consisting of two superintendents, the superintendent of motive power, the traveling engineer and the general car inspector, who have authority to take a meal in the cars at any time and report on anything they find wrong. These fellows make life a burden to the superintendent of the dining cars. There is a good deal of pleasantry about the criticisms, but those patronizing these cars find that they never have reason to complain of the victuals being cold or out of season.

LOCOMOTIVE ENGINEERING

A Practical Journal of Railway Motive Power and Rolling Stock.

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Action of the Exhaust Jet.

There are few if any subjects connected with the operating of railroad machinery which have received so much study and attention from practical men and theorists as the draft appliances of locomotives. It has been found in practice, that very small changes in the dimensions and setting of the parts that regulate the draft through the tubes exercise a material difference on the steam-making qualities of boilers, and there has naturally been a desire to devise the very best arrangement for maintaining a good draft with the largest possible exhaust nozzles. With American locomotives there have always been conflicting elements present in the efforts to provide the best arrangement of draft appliances for steam-making, because the preventing of spark-throwing called for the placing of obstructions between the firebox and the atmosphere. The history of the development of the American locomotive has woven into its inmost recesses a persistent struggle on the part of inventors to stifle the draft on one hand to prevent spark-throwing, and on the other hand to stimulate it by all kinds of artificial means, so that the fire gases might be permitted to flow freely enough through the tubes to generate the steam required.

A combination of parts which would admit of the use of a large nozzle, which relieves undue back pressure in the cylinders, with the employment of devices which would arrest sparks, was very much to be desired, and inventors and those responsible for the economical operating of locomotives have labored for years to produce something that would harmonize the two conflicting elements. A vast amount of experimenting has been done to find out what draft appliances would produce the best results. By the tentative process of trying various designs and proportions and noting the results, very successful draft appliances have been brought into use, and a code of draft appliance philosophy has grown up which has been accepted as sound gospel by most of the men interested in the subject.

The two principal tenets of draft appliance philosophy have been: First, that the rarefication or vacuum in the smokebox is principally due to the exhaust steam filling the smokestack, producing an action similar to the plunger in a pump cylinder. To make this pumping action reach its maximum efficiency, it was considered essential that nozzle and stack should be so set, designed and proportioned that the steam would fill the stack at its base. Second, that part of the rarefication in the smokebox is due to the induced action and friction of the current of exhaust steam upon the fuel gases and air in the smokebox. It was reluctantly admitted that the necessary draft might be caused by a combination of the pumping and induced current action, but the inclination of wise engineers was to advise the nursing and conserving of the pumping principle.

Religious enthusiasts are not the only people who have occasionally to deplore the loss of broken idols. The engineering world have their heart burnings through idols turning out to be made of mud. The pumping action in the smokestack has turned out to be a myth when all the railroad mechanical world was just about convinced that it was something worthy of being regarded with unmixed belief and undoubting devotion.

The iconoclasts who have ruthlessly torn down and shattered in pieces this latest of latter-day idols, are Robert Quayle, of the Chicago & Northwestern; Professor Goss, of Purdue University, and J. F. Deems, of the Chicago, Burlington & Quincy. These persons, not satisfied with the accepted tenets of the draft appliance creed, proceeded to prove the faith for themselves, and the whole fabric erected on the foundation of so much thought tumbled in a heap.

For several years, committees of the Railway Master Mechanics' Association have been investigating draft appliances, and they have done valuable work in finding out the best combinations of exhaust nozzles, smokestacks and other parts for producing the maximum draft with minimum back cylinder pressure. This year the committee enjoyed peculiarly good facilities for making scientific experiments with the exhaust jet. Mr. Quayle, the chairman, had beside him, in the West Chicago shops, an apparatus on which he could run any kind of a locomotive at any speed required, and he had a full equipment of apparatus for testing purposes. Professor Goss, another member of the committee, made very exhaustive tests on the locomotive at Purdue University. To ascertain the behavior of the exhaust steam with different forms and positions of exhaust pipes and nozzles, he drilled holes through the smokestack at different heights, and inserted movable tubes which were connected with very sensitive gages. Experiments with this apparatus showed that, instead of expanding in fan-like shape after leaving the nozzle, the column of steam shoots upward in a compact mass with so little expansive action that it does not touch the sides of the stack until the top is almost reached. It was found in some instances that the column of exhaust steam sometimes became of smaller diameter after it entered the smokestack. The fuel gases do not mingle with the exhaust steam until they get more than half way up the smokestack. They ascend most of the way, clinging to the exhaust jet. The action of the exhaust jet in creating a vacuum is almost entirely inductive, of the same character as that of an injector lifting water.

While Professor Goss was engaged in this interesting work, Mr. J. F. Deems, of the Chicago, Burlington & Quincy, made similar experiments with a locomotive in train service. His discoveries were precisely the same as those made by Professor Goss. Commenting in a paper, read before the Western Railway Club, on what he had found out, Mr. Deems said: "From what experiments we made, it seems certain that with every change of exhaust opening, every change of distance between the exhaust tip and stack, whether by altering exhaust pipe or stack, or with every change in the diameter of the stack, comes a change in the form of the exhaust jet. It seems possible that if proper relations are once established, one part should not be altered without some change in the others in order to obtain the best results."

We predict that the discoveries made concerning the action of the exhaust jet will lead to radical changes in the front end, and that the changes will prevent much waste of fuel.

How to Tell on Which Side Balance Valve Packing Strips Leak.

Last month, Mr. S. D. Hutchins asked a question before the New England Railroad Club, concerning the difficulty of telling exactly on which side the packing strips of the Richardson balance valve were leaking.

The publication of this question in "Locomotive Engineering" has called out a great many answers—many more in fact than we are publishing in "Letters from Practical Men," as many of them are duplicates.

In this connection it seems to us that the experience of Mr. C. F. Thomas, master mechanic of the Southern Railway at Alexandria, Va., goes a long way toward pointing out a sure method of telling on which side the strips leak, and also preventing heavy losses from constantly leaking strips. Mr. Thomas plugs up the hole in the back of the valve and makes a straight opening through from the balance plate to the outside of the chest, and puts a ½-inch pipe in this with elbow on top of it. If the strips leak on either side, it will show outside of the chest, and is such an annoyance that these strips will be kept perfectly tight—something that is not regularly done in service. There is no doubt but that packing strips are allowed to become very leaky before complaint is made of them. Mr. Thomas has several engines fitted up in this way that have been in the service for from two to three years and have given entire satisfaction.

It should be stated in this connection, however, that when this plan is followed it is better to reduce the amount of balance, for the simple reason that the back of the valve is minus the load of the exhaust pressure, which it has with the ordinary balance with a hole in the back.

It seems to us that this little tell tale outside does away with all patented plans of finding out which side is leaking, and will keep the roundhouse repair force up to their work. Another important advantage is that when the strips or springs break on the road, a plug in the elbow gives a plain unbalanced valve, and ought never to delay a train for more than a minute.

Forming and Enforcing Rules.

The adoption by several railroad companies of the "Brown System of Discipline Without Suspension" appears to have excited an unusual degree of interest in the subject of discipline of railroad men. The fact is becoming more generally recognized that the savage methods of punishment that have prevailed in the past are not fair when looked at from a sentimental standpoint, and that they are not good for the interests of railroad companies when looked at from a business standpoint. It is promising for the harmony and good-will of the future that so many railroad officers are talking of more just methods of dealing with those who have violated rules. There is no kind of service that we know of where strict rules are more necessary than on railroads to prevent accidents. It is necessary that these rules should be strictly followed, and when there is a disposition manifested by individuals to violate rules of safety it is necessary that they should be punished in some way.

Colonel Haines, the celebrated past president of the American Railway Association, was given to quoting what became with him an aphorism in relation to accidents, which says: "The lack of unquestioned obedience to authority, and of prompt compliance with established rules, is at the bottom of more railway accidents than all other causes put together." Very few people familiar with the causes of railway accidents will question the opinion of Colonel Haines, but we are inclined to think that his aphorism does not cover half the question. It has been a practice with many railroad companies to establish a great mass of rules, many of which could not be strictly adhered to without causing delays and inconveniences to train service. In such cases, the practice of ignoring the rule becomes the rule. When employés feel at liberty to violate one rule it is a very easy step towards violating others, and the sense of obligation to obey rules strictly becomes vitiated. By degrees, rules become looked upon as merely a justification for inflicting punishement in cases of accident. Superintendents and others are perfectly aware that important rules are daily violated, and yet they exercise no discipline until an accident happens, when the unfortunate who has been violating some rule is savagely punished for doing what has been habit and repute with others for years.

When accidents happen under circumstances of this kind, we hold it is not the individual, who violated the particular rule intended to guard against the accident, who was to blame, but his superior, who permitted the violation of rules to go on without check. There ought to be no rule established which cannot be enforced without inconvenience to the business of the road, and when once a rule is established it ought to be rigidly adhered to. Much of the savage punishment inflicted on account of rules violated would not be necessary if better management were displayed in the forming and enforcing of rules.

How the American Nation Treats Its Engineers.

The American Navy is the most snobbish and exclusive navy in the world. The line officers, who are all-powerful and run the service for the benefit and glory of their own class, have displayed unceasing animosity to the engineering and other scientific men, who are now the backbone of naval service.

It is a disgrace to the nation that Congress permits the injustice notoriously practiced for the benefit of a branch of the service which has been waning in importance since the day that a steam engine was first employed on shipboard. The position of an engineer in the Navy is made so disagreeable by the line snobs that there is great difficulty in maintaining the supply of engineers from the Naval Academy, and it is proposed to admit engineers who are graduates of other colleges, but we do not think there would be much of a rush to join the Navy while the existing disgraceful condition of affairs exists. The increase of mechanical appliances, which have made a man-of-war a fighting machine, has led the engineering department to be greater than the line in the navies of other countries, but in the American Navy the line is treated as the most important.

At the close of the War the Navy had no vessel capable of developing more than 1,000 horse-power, and the "Minnesota," with a horse-power represented by those figures, had nine engineers, while the cruiser "New York," with her engines of 17,000 horse-power, has only five engineers, and the "Columbia," with 18,500 horse-power, has only four members of the engineer corps on board, or one less than the old monitors of the "Lehigh" and "Nantucket" type carried, with engines developing 340 horse-power. Another fact which properly finds a place in the comparison is that in 1864 there were 268 steamers in commission and 77 sailing vessels; yet, with 20 per cent. of the vessels without engines, there were only 1.64 line officers to each engineer, while today, without a sailing ship in commission, and with many ships unable to spread a shred of canvas, there are 4.13 line officers to each engineer. In 1864 few ships had any engines other than the main propelling engines and a couple of donkey pumps—the monitors, in addition, having engines for working the turrets and providing ventilation—but not over a half-dozen in all. The "Columbia" has no less than ninety separate engines, having a total of 172 steam cylinders, and the other vessels are equipped in proportion.

The condition of the Navy is the same as what railroad service would be if conductors were given entire charge of enginemen and had the whole direction of what should be done with engines and men. Eighty-four line officers are kept on duty in Washington, many of them being advisers to the Secretary of the Navy. An analogous practice would be for a General Manager of a railroad to keep a Corps of Conductors in the general office to advise him on matters relating to the mechanical and engineering departments.

Put on Safe Steps and Handholds.

It is earnestly to be hoped that master mechanics and other designers of locomotives will take to heart and put into practice the recommendations made at last convention by a Committee on Steps and Handholds for Locomotives. Many a man has lost life or limb by the inconvenient and inferior steps and handholds provided on locomotives, and it is high time that substantial and convenient means of mounting to the deck of a locomotive should be provided. The difference between the cost of putting up good steps and handholds, and those that are small, unhandy and dangerous, is so trifling that no master mechanic would consider it as a drawback. That inconvenient steps and handholds are left on locomotives is due, to a great extent, to indifference. Accidents are not common; and when there is no personal injury to stimulate a change, the bad appliances are left to do duty.

The committee, of which Mr. John Medway was chairman, recommended a wide double step secured to the tender frame, similar to the design of steps on the Erie locomotive illustrated in the first page of "Locomotive Engineering" for June. A long, vertical grab iron, conveniently situated at the front corner of tank, was recommended.

The report concluded with an expression of the opinion that, to insure comparative safety, the form and location of locomotive steps and handholds should be so nearly uniform that, in mounting or alighting, one could, even in the dark, readily locate with his feet and hands all the steps and handholds of any locomotive.

Education of Mechanics.

The report submitted to the Master Mechanics' Convention on "The Apprentice Boy" is a slight manifestation of a growing desire among railroad officers to give a helping hand in educating the young men under their charge to fit them for the higher positions in the service. The committee merely echoed a widespread sentiment in saying that it is desirable for railroad companies to treat the boys in their service in a manner to develop principles of fidelity and loyalty. It is true, as the report says, that where this policy is wisely and consistently followed, the loyalty of the employés to their employers becomes second only to their loyalty to State and Church.

Social economists and labor agitators have had a great deal to say of late years about the decay of the apprentice system, but we think that the system is not nearly so moribund as has been represented. At least there is nothing in the report under consideration which would lead us to believe that the apprentice system is not as healthy and vigorous as it ever was. The committee did not find it necessary to urge members to do more to encourage the employment of apprentices; their whole effort seemed to be directed to giving the numerous apprentices in railroad shops the opportunity to educate themselves in the principles of their business. To further this desirable end, the committee had been in correspondence with several educational institutions, and they received the assurance that more than one educational institution was ready to undertake the supervision of evening schools for mechanics if the necessary support was forthcoming. The authorities of Purdue University displayed great willingness to undertake this work. It is to be hoped that those in charge of railroad shops within a night's ride of Purdue University will give aid in the organizing of night schools for apprentices, and have them supervised by the University named.

The committee failed to mention a great educational system which is already in full, active and successful operation, which offers the apprentice, and even grown workmen, the benefit of a good scientific education. This is the correspondence school, of which the International Correspondence School, of Scranton, Pa., and the Scientific Machinist School, of Cleveland, O., are best known. These institutions are, by means of admirably conducted correspondence, educating hundreds of young men in the science of the business they are engaged in. It is wonderful the extent to which these schools lead students into the higher ranges of science, mathematics and applied mechanics. While we have no inclination to underrate the value of technical colleges conducted on the lecture plan, we believe that the hope of the ambitious mechanic who has commenced work before receiving a scientific education lies in connecting himself with a correspondence school.

Growth of the Interchangeable System.

The agitation, kept up principally by college professors and other theorists, in favor of our adopting the metric system of weights and measures, ebbs and flows continually, but never is still. Persistence nearly always brings success, and this movement is likely to win in the end; but its triumph will involve more sacrifices than most people are aware of.

Dr. Coleman Sellers, who is one of the best authorities on the good and bad features of the metric system, read a paper at the Railway Master Mechanics' Convention twenty-three years ago, in which he said:

"Eli Whitney, whose name has always been associated with the invention of the cotton gin, founded, in 1798, an establishment for the manufacture of small arms on the principle known as the interchangeable system, carried out by the use of hardened jigs or forms of the same shape as the parts to be produced, thereby making all parts of guns alike and interchangeable one with another. He introduced the use of milling, by means of revolving cutters, those intricate shapes needed in gun work. When he proposed to Thomas Jefferson, then Secretary of State in Washington's Cabinet, to make an arm modeled after the approved French Charville flint lock, in which all parts of all guns should be interchangeable, he was ridiculed by both French and English ordnance officers. The Government aided Mr. Whitney, and in 1800 the present Springfield Armory was established, and Mr. Whitney's inventions and system put in force there. It was not until 1855 that the English War Department was forced to adopt the same system, importing a large amount of machinery from America for that purpose.

"This was not the only branch of the mechanic arts that was benefited by this interchangeable system. America, contending with high-priced labor, has been forced to exercise ingenuity, and make labor-saving machines produce cheaper work. This could only be done by carrying the interchangeable system into other processes of manufacture; and American clocks, watches, sewing machines, and all the countless small articles of hardware, are made by machinery, each piece like the others. Recognizing the absolute need of this interchangeable quality in everything manufactured, but few trades exist in this country that do not avail themselves of its advantages. Gradually separate and distinct manufacturing establishments have come to use the same standards and to make their production interchange one part with another. Witness the various devices making up what is known as 'line shafting,' as also all the screws and fittings for steam, gas and water pipes, and now the so complete recognition of the American system of screw threads for bolts and nuts. The primary object of this association may almost be said to be to introduce uniformity in all parts of the great railroad system of the United States. There is no country in the world where the value of uniformity in the devices used in common by all mechanics, is so fully recognized as in this land of ours. What has been done in this direction, and what is being done now, is founded on the inch as the unit of measurement in the machine shops."

A rather striking object lesson was given by Mr. G. W. Rhodes at the Master Car-Builders' Convention, about how damaged air-brake hose may be made to perform good work instead of going to the scrap heap. Mr. Rhodes rides a bicycle, and his familiarity with the repairing of wheel tires suggested the repairing of damaged air hose in the same way. He had with him a bundle of hose which had been repaired in different ways. Some had holes plugged, others were spliced, and all were good for many miles' service at an expense that ranged from 7 cents to 25 cents. The ordinary plan is to throw away a hose that gets punctured, and put on another one which costs 70 cents at the very least.

A new pamphlet on Mannocitin has just been issued by Otto Goetze, 114 Broad street, New York. Besides descriptions of the article handled by Mr. Goetze, extracts from letters of leading firms are given, which all express their entire satisfaction with the compound as a rust-preventive.

PERSONAL.

Mr. D. P. Kellogg has been appointed roundhouse foreman of the Duluth & Iron Range, at Two Harbors, Minn.

Mr. Sidney Emerson has been appointed chief engineer of the Wabash, with headquarters at St. Louis, Mo.

Mr. Isaac Brereton has been appointed land commissioner of the Florida Central & Peninsular, with headquarters at Jacksonville, Fla.

Mr. J. W. Coneys has been appointed trainmaster of the Richmond division of the Pennsylvania lines. He was formerly general yardmaster.

Mr. George M. Burns, for some time fuel agent of the Wabash, has been appointed secretary to General Manager Ramsey of that road.

Mr. A. McLean has been appointed superintendent of motive power and equipment of the Georgia Northern, with headquarters at Pidcock, Ga.

Mr. J. D. Brennan has been appointed trainmaster of the Chicago division of the Lake Shore & Michigan Southern, with headquarters at Chicago.

Mr. A. G. Wright has been appointed division master mechanic of the Chicago, St. Paul, Minneapolis & Omaha Railroad, with headquarters at Altoona, Wis.

Mr. C. Sullivan has been appointed acting superintendent of the Oregon Central & Eastern, in place of Mr. Charles Clark, superintendent. Office, Corvallis, Ore.

Mr. W. Cotter has been appointed division superintendent of the Grand Trunk, with headquarters at Brockville, Ont. He was formerly trainmaster on the Wabash.

Mr. R. S. Logan has been appointed secretary to General Manager Hays of the Grand Trunk Railway. Mr. Logan was secretary for Mr. Hays while he was on the Wabash.

Mr. N. D. Miller, formerly chief engineer of the Great Northern, has been appointed general superintendent in charge of the construction of the Yankton, Norfolk & Southwestern.

Mr. H. F. Garrett, formerly general foreman of the Richmond & Danville shops at Atlanta, Ga., has been appointed foreman of the machine shops of the Southern Railway at Birmingham, Ala.

Our friend Shandy McGuire, the railroad poet, has a rival in the track department. Owen McSweeney, of Indianapolis, is noted both as an excellent track foreman and for his happy faculty of recording in rhyme his experiences.

Mr. R. H. Aishton has been promoted from assistant to be superintendent of the Northern Iowa division of the Chicago & Northwestern, with headquarters at Eagle Grove, Ia. Mr. W. H. Graves has been appointed assistant superintendent.

Mr. W. E. Amann, for a number of years division master mechanic of the Chicago, St. Paul, Minneapolis & Omaha Railroad at Altoona, Wis., has resigned his position to accept that of mechanical expert for the Galena Oil Co., on the Southern Pacific system.

Mr. O. O. Winter has been appointed general manager of the Brainerd & Northern Minnesota Railway, with headquarters at Brainerd. He has been with the Great Northern for the last four years, and was formerly general superintendent of the Fort Worth & Denver City.

The latest talk among enthusiasts is that the New York Central Railroad is preparing to abolish its locomotives for all kinds of service, and introduce electrical or compressed-air equipment, the power to be obtained from water in the streams along the route followed by the railroad.

Mr. Austin Corbin, president of the Long Island Railroad, was fatally injured by a runaway team last month. Mr. Corbin had been a very successful railroad manager, and his control of the Long Island Railroad conferred great benefits on the property along the road traversed.

The Rutland Railroad having been severed from the Central Vermont, and Mr. P. W. Clement elected president, he has issued a circular intimating the appointment of Mr. Jesse Burdett as general superintendent, and Mr. George W. Kenny as superintendent of motive power; headquarters of both at Rutland, Vt.

Mr. J. H. Barrett, formerly general superintendent of the Cleveland, Akron & Columbus, has been appointed superintendent of the Fifth division of the Southern Railway, with headquarters at Atlanta, Ga., in place of Mr. W. R. Beauprie, who has been appointed superintendent of the Eighth division, just created.

Mr. M. J. Comar, Vicksburg, Miss., writes us, saying that he wishes us to make a notice of the death of his wife, Susie M. Comar. She had friends and acquaintances in the railroad service all over the world, and her husband believes that "Locomotive Engineering" can spread the news of her death better than any other medium.

A large circle of railroad men have lost a friend through the death of Gen. John Burritt Gray, who died at Asheville, N. C., last month. General Gray was vice-president of the American Brake Co. for many years, and represented the company's interest in New York. He was a very genial gentleman, and made many friends among those who visited him on business.

The American Boiler Manufacturers' Association, in session in Cleveland last week, adjourned Thursday morning. The following were elected officers for the coming year: H. S. Robinson, Boston, President; James Lappan, of Pittsburgh, First Vice-President; H. J. Hartley, of Philadelphia, Second Vice-President; H. W. Fletcher, Third Vice-President; Richard Hammond, of Buffalo, Treasurer; Col. E. D. Meier, of St. Louis, Secretary.

Mr. W. G. Pearce, assistant general manager of the Northern Pacific, has ridden many thousands of miles in all kinds of trains and all kinds of railroad vehicles, and never received a scratch of injury. He has lately taken to riding on a more dangerous vehicle than anything found on railroads, and while coasting down hill on a bicycle, received a fall which broke his collar-bone and left arm, and left him otherwise in a sadly mutilated condition.

Mr. F. L. Sheppard, general superintendent of the Pennsylvania Railroad at Altoona, Pa., has been in very precarious health for several months, and has received indefinite leave of absence until he recovers. His malady was finally diagnosed to be abscess of the liver, and a very painful operation was performed in a hospital in Philadelphia, whereby the abscess was removed. Mr. Sheppard is now doing well, and the doctors believe that he will soon be restored to good health.

At the last convention of the Master Mechanics' Association, R. H. Soule, Norfolk & Western, was elected president; Pulaski Leeds, Louisville & Nashville, first vice-president; Robert Quayle, Chicago & Northwestern, second vice-president; and O. Stewart, Bangor & Aroostook, treasurer. After the convention adjourned, the Executive Committee met and unanimously elected Angus Sinclair secretary. Mr. Sinclair refused to accept the position, and Mr. John W. Cloud, of Chicago, was elected.

Mr. Arthur B. Underhill, for many years superintendent of motive power of the Boston & Albany, died at Springfield, Mass., last month. He began his railway career in 1860 as foreman of repair shops of the Boston & Worcester. He was subsequently, until 1864, master mechanic of the Atlantic & Great Western, and from 1864 to 1880 was master mechanic of the Boston & Worcester. He was appointed superintendent of motive power of the Boston & Albany, September 1, 1880, which position he resigned in December, 1893, on account of ill-health.

The new official roster of the Master Car Builders' Association for 1897 reads as follows: President, S. A. Crone, master car-builder, New York Central; First Vice-President, E. D. Bronner, assistant superintendent motive power, Michigan

Central; Second Vice-President, C. A. Schroyer, master car-builder, Chicago & Northwestern Railway; Third Vice-President, J. T. Chamberlain, master car-builder, Boston & Maine Railway; Treasurer, G. W. Demarest, master car-builder, Northern Central Railway; Secretary, J. W. Cloud, Chicago.

Mr. H. A. Worcester, of the Lansing division of the Lake Shore & Michigan Southern, has been appointed superintendent of the Detroit division, with headquarters in Detroit.. Mr. Worcester is the son of Mr. E. D. Worcester, secretary and treasurer of the Vanderbilt roads, and vice-president of the Lake Shore & Michigan Southern. Although having this favorable backing to push him forward, Mr. Worcester was content to begin at the foot of the ladder and work his way laboriously upwards. He has been a very successful superintendent, and is highly popular with the men under his charge.

Mr. F. D. Casanave, general superintendent of motive power of the Pennsylvania lines at Altoona, had several surgical operations performed, one of which left an open wound that withstood all efforts of the surgeons to make it heal up. They cut it open several times, expecting to produce conditions which would make it heal, but without success. One day Mr. Casanave was visiting the car shops at Altoona, and he there saw a salve, the recipe for which one of the workmen brought from England years ago. That salve had been used very successfully among workmen who received wounds or bruises while at work. Mr. Casanave thought he would try the salve on his wound, and took a portion of it home. It acted so well that the wound healed up in a few weeks. That salve is now greatly in demand.

We wish to direct the attention of our readers to an article on another page, on "A Simple Method of Testing Railroad Signal Lamps," by Mr. T. A. Lawes, superintendent of motive power of the Chicago & East Illinois Railroad. There are a great many signal lamps in use that give very defective light, due to various defects of the lenses. Mr. Lawes has devoted great attention to the subject, and has devised several methods of testing lamps, which are very simple and inexpensive. It is a well-known fact that lenses rejected by railroad companies that systematically test their light-throwing properties, are sent to other companies that do not pay any attention to what kind of lenses they receive. As the safety of train-operating depends very materially on having good lamps, it seems to us that this subject ought to receive greater attention than it appears to get. We consider that Mr. Lawes has done good service to railroads generally in showing so graphically a satisfactory method of testing lamps.

EQUIPMENT NOTES.

The Georgia Railroad are about to order 325 cars.

The Florida East Coast line are getting 350 freight cars built.

The Southern Railway have ordered six engines from Brooks.

Rogers are building three engines for the Keokuk & Western.

The Cincinnati, Hamilton & Dayton have ordered three passenger cars.

The Venice Transportation Company are getting 100 cars built at Madison.

The Grand Rapids & Indiana have placed an order for six consolidations.

Barney & Smith are building two passenger cars for the Detroit & Mackinac.

The Illinois Central have given an order to the United States Car Co. for 300 cars.

The Chinese Government are advertising for four passenger and four freight locomotives.

Schenectady people are building two engines for the Fitchburg, and four for the Texas Midland.

The Southern Railway have placed an order with Richmond for four locomotives, and with Brooks for six engines.

The Richmond Locomotive Works have received an order from the C., C., C. & St. L. to convert sixty simple engines into compounds.

The Baltimore & Ohio have ordered thirty consolidation locomotives, with cylinders 22 x 28, from the Pittsburgh Locomotive Works.

The Pittsburgh Locomotive Works have received an order from the Baltimore & Ohio for 20 consolidation locomotives, with cylinders 20 x 28 inches.

The Lehigh Valley people have placed an order with Baldwins for twenty-five locomotives. Five of them are passenger engines and the remainder heavy freight.

The Baldwin people are building one engine for the Carnegie Steel Works, one for Mr. E. F. Melhoramentos, twenty-five for the Lehigh Valley, and two more for the Philadelphia & Reading.

The Georgia & Alabama Railroad are in the market for cars and locomotives. The business on the road is better than it has ever been, and the company are urgently in need of more rolling stock.

A circular recently issued by Vice-President Voorhees, of the Philadelphia & Reading, intimates that the general road foreman of engines will have charge of the distribution of locomotives, under direction of the assistant superintendent of motive power.

There has been for years some uncertainty about how thin flanges of engine-wheel trucks should safely be run. The subject was brought up a year ago to the Master Mechanics' Association at the request of the Railroad Commissioner of the State of Michigan, and a committee was appointed to investigate the subject. The report which was prepared by this committee recommended that tires should not be run with flanges thinner than one inch.

There was a vigorous fight in the Master Mechanics' Convention, on the proposal to change the constitution so that the secretary should be chosen by the Executive Committee, instead of being elected by the members direct. There was some rather strong "spread eagle" talk in favor of the old plan, but the good sense of the convention finally decided that the Executive Committee should have the privilege of selecting the secretary, who really is their clerk. This puts the Master Mechanics' Association in line with nearly all other societies, in the way of choosing their officers.

Master Mechanics' Convention.

The address of President R. C. Blackall was full of suggestions looking to the best points of advanced practice for master mechanics—hints that were of the greatest value in assisting the younger members of the association to reach the high standard aimed at by the best minds of a representative body of men. The live issues and important questions of motive power management were ably handled and brought before the convention in the earnest and convincing style for which the president is noted.

There was an earnest discussion of the metric system, in which many of the difficulties of its application to railway practice were ably presented; the sentiment of the meeting, however, seemed to be about equally divided, until a resolution was presented by Mr. Higgins of the Lehigh Valley Railway, asking the aid of Congress against the proposed new system. The resolution was endorsed unanimously.

The report on exhaust pipes and steam passages was one of the best presented, and was favorably received by the members. Owing to its voluminous and exhaustive character, and lack of time to properly discuss it, the committee was continued for one year, and a motion made and carried that experiments should be made under its provisions by the superintendents of motive power to determine the value of its recommendations under road conditions.

The motion that the Secretary be no longer an elective office, but appointive by the Executive Committee, raised the temperature of the hall several degrees, and brought out the forensic abilities of the old oratorical standby's for the admiration of the wall flowers. A standing vote was necessary to settle the matter, when the motion went through almost unanimously.

Rod Packing.

At a recent meeting of the New England Railroad Club, Mr. T. B. Purves, Jr., superintendent of rolling stock of the Boston & Albany, opened a discussion on "Packing for Piston Rods and Valve Stems," as follows:

"Numerous and varied are the different forms of metallic rod packing now in use, but from the information I have at hand there seem to be but two styles that are used to any great extent at the present time, i. e., the 'United States' and the 'Jerome.' By referring to the subject, you will understand that it is not within our province to say which of these two forms gives the best results—by this we mean which can be maintained at the smaller cost; also, which will cause the least trouble to keep tight. I am not in a position to give any information regarding the cost or durability of any form of packing except the 'United States,' as every locomotive on the Boston & Albany is equipped with this packing. We adopted it in 1881, and equipped every engine as soon thereafter as possible, and it has given the best of satisfaction. Metallic packing, like all other parts of the locomotive, must receive attention in order to get the proper results; and if the different parts are carefully examined, and put in good condition when engines are in shop for general repairs, little difficulty will be experienced in maintaining it at a comparatively small cost until the engine is again taken to the shop.

"We have found it more of a problem to maintain valve-rod packing than piston-rod packing. This may be attributed to several causes: The valve rod receives a motion from the rocker arm that causes the ball joints to wear more rapidly in the former than the latter; the changing of the path of wear, caused by the variation of the travel of valve, and one of the greatest annoyances is caused by the valve rod getting sufficiently low to allow it to come in contact with the cast-iron packing case, thereby wearing the rod directly in the path of the packing rings. Provision is made to overcome this difficulty by inserting a bushing in the stuffing box or back end of packing case. This method will answer the purpose for a while; but the weight of rod and yoke being constant, renewals of these bushings are frequently necessary. Another important objection to sustaining the weight in this manner is that the rod also wears very rapidly at this point, and the life of the rod will be determined by this wear rather than by the wear of the packing. In our experience we found it preferable to put all the weight of yoke and rod on the valve. To do this we place a wrought-iron band around the body of the valve, the bottom of this band bearing on the wings of the valve, and being of sufficient height or thickness that, when the yoke rests upon it, it will maintain the center line of rod above the center line of steam chest. This same difficulty will sometimes occur with the piston-rod packing where solid piston heads are used, and the bottom of head and bottom of cylinder become sufficiently worn to allow the piston rod to drop below the center line of stuffing box, thereby throwing all the weight of these parts directly on the packing rings. I understand that the Old Colony Railroad is using a device to obviate this difficulty with valve-rod packing. The diameter of the rod at yoke, and extending about six inches toward the end of rod, is one-fourth inch larger than original diameter, with a thread cut on to receive a composition sleeve. This sleeve wears on the stuffing-box bushing, and is easily renewed when necessary.

"We have also found it an advantage to cut the packing rings in two parts, which admits renewals without disconnecting the valve rod at union nut or knuckle joint, or removing the piston rod from crosshead. By avoiding the latter we eliminate in a measure the danger of fracturing the rod at this point, and which frequent driving of the crosshead key invites. Another factor—and a very important one too—in obtaining good results from metallic packing is to make it from just the proper kind of material. The best is none too good for this purpose. The following formula we have found very satisfactory: Copper, one part; antimony, two parts; Malacca tin, six parts; to each one and one-quarter pounds of this mixture add two pounds of tin. The quality of this babbitt metal depends upon the quality of tin used. Good bread cannot be made from an inferior brand of flour; neither can good babbitt metal be made by using an inferior brand of tin. If too hard, it will cause no end of trouble by frequent breakages; if too soft, it will wear rapidly, both on the rod and in the cone, and the smaller or inside ring will soon be forced through the packing cup. Lubrication also plays an important part in the efficiency of the packing rings, and we find some engineers do not give it the attention they should. Oil cups designed for this purpose should be kept in working order, and never allowed to run without covers; otherwise they will soon become inoperative by reason of sparks and dirt that accumulate in them.

"The cost of maintaining metallic packing varies with the service of the locomotive. We find that in heavy freight service the cost is fully one hundred per cent. more than in switching service. The comparison is as follows, viz.:

Cost per 1,000 miles, switching engines, 15 cents.
" " passenger " 21 "
" " freight " 36 "

which gives an average cost per 1,000 miles of 25 cents.

"This includes the material and labor required to manufacture the rings; also the time of the man who makes the application."

Mr. Henry Bartlett, superintendent of motive power of the Boston & Maine, said: "From what few figures I have on the matter, it seems to me there is a saving of about five dollars per engine per year on metallic valve-stem packing, and about ten dollars per year on metallic piston-rod packing. Those are general figures—about fifteen dollars per year an engine over hemp packing. Metallic packing has been known with us to run as high as twenty-seven months without any repairs. On an average, it only runs twelve months; but often from fifteen to eighteen months with good care. Hemp packing, as a rule, takes repairs every two weeks, perhaps, or something of that sort. We manufacture our own metallic packing. The company bought the right to do this some years ago. As to the cost of equipping an engine with metallic packing above hemp packing, I am not able to say just what that is. I presume it costs something in the neighborhood of five dollars more to equip an engine with metallic packing than with hemp packing."

President Butler said: "I would say that we use 'United States' metallic packing on about half of our engines. It is undoubtedly the cheapest packing used, because the various kinds of fibrous packing are not very good packing; they do not last well."

Diversity of Rolling-Stock Details.

For nearly thirty years the various mechanical and engineering societies in this country have been advocating the use of interchangeable parts in all kinds of machines likely to be reproduced without much change of general dimensions. Railroad mechanical men were quick to perceive the advantages that would result from the use of interchangeable parts in railroad rolling stock, and the railroad mechanical associations became enthusiastic advocates of the reform. The first important detail taken up was the movement to induce railroad companies to adopt the Sellers screw threads. The carrying out of this reform was a great triumph for railroad men, since their influence had great weight in making the Sellers screw threads the standard adopted by the whole country.

That important reform was no sooner consummated than others were undertaken, and investigations and discussions took place that led to the adopting of standard parts for cars and locomotives. These reforms have constituted the most important work done by the Master Car-Builders' and Master Mechanics' Associations. Much good work has been done in this line, but many radical reforms might still be carried out with advantage to railroad companies. Some railroad companies which have been ready to adopt standards recommended by the mechanical associations, have been remarkably slow to standardize the details that make up the greater part of locomotives and cars yet are not made standard by the associations. The extent to which confusion in these details exists on one great railroad system has been strongly emphasized lately by a paper read at the Northwestern Railroad Club, on "Uniformity in Storehouse Stock," by Mr. S. F. Forbes, general storekeeper of the Great Northern Railway.

A general storekeeper is likely to be particularly well informed about the diversity of parts that make the carrying of extra stock necessary, with the entailed labor and trouble of classification where the difference is trifling. Mr. Forbes is evidently a master of detail, and has prepared a paper which deserves to be carefully studied by all men interested in simplifying the repairs of railroad rolling stock. He makes the statement that the largest general stock of material required to be kept on hand is that for locomotive repairs. There are certain parts about locomotives which are common to all. These parts should be of the same design and material, so that they would fit any engine. The assertion is made that, so far from this being the case, the same parts of different classes of locomotives are as varied on most roads as the variation in the classes.

There is certainly still too much want of uniformity in parts that ought to be made interchangeable; but we think that the state of affairs described by the paper does not correctly apply to "most roads." Complaint is made that the parts of different headlights are not interchangeable with others:

"The injector throttle on some engines has a connection threaded 10 threads to one inch, others 12 threads, and others again 14 threads, requiring that one of each of these be kept in stock where the engines are located. They also are different in their shape and design. Injector checks also vary in the boiler fit. Whistles have a variety of ways of being connected. Cylinder cocks are made to fit into their places in the cylinder, which may be threaded 6, 8 or 10 threads to one inch. Pilot castings and tender-draft castings on different classes of engines are often of different design, or are cored so that the bolt holes on one engine do not coincide with bolt holes on another.

"The rocker grates of one class of locomotives seldom work in the grate bar of another of almost similar design, sometimes only an excess of half an inch in length preventing a fit.

"Cylinder heads and castings are necessary for each individual class of engine, and usually different in each, even though the cylinders may be of equal diameter; and sometimes even engines of the same class and make have more studs in the cylinders of one engine than in those of another. Set screws are a varied product. Eccentric straps of the same throw are generally as different in pattern as the classes of engines. Firebox doors differ on different engines, as also do the door liners."

The condition of affairs described in the foregoing paragraphs makes repairs expensive, and requires the maintaining a stock of parts beyond all reason. Our experience and observation inclines us, however, to the belief that there are now very few first-class roads which fail to make nearly all the parts mentioned of one pattern each. There are unquestionably a great many roads that order locomotives and cars from different builders without specifying standard parts. The consequence is that they have as many different kinds of details as they have different makes of locomotives and cars. A second order to the same builder frequently brings forth a set of parts of different pattern from those used on the preceding order.

The combined efforts of the mechanical associations may succeed in restraining the tendency of rolling-stock builders to diversity of patterns. But the real remedy lies with the heads of mechanical departments. Every locomotive and car ought to belong to a standard, and the detailed parts ought to be the same for all the standards, so far as circumstances will permit. When the determination to have rolling stock put in this shape becomes general, a great deal of useless expense and inconvenience will be prevented.

Discipline with Common Punishment.

A paper was contributed to the Western Railroad Club by Mr. H. D. Judson, on Railroad Ethics, which brings to our mind the torturings of the blind giant who pulled down the temple upon his tormentors. The paper is a plan for more humane and merciful methods of disciplining railroad employés. The author has evidently little acquaintance with the Brown system of "discipline without suspension." We wish respectfully to direct his attention—and we would include all others who believe that punishment is frequently inflicted savagely and injudiciously—to the admirable system devised by Mr. Brown, of the Fall Brook Railroad, and introduced upon several railroad systems.

The following are a few of the remarks made by Mr. Judson:

"Some of the foremost schools and colleges of the country have adopted what is known as a self-government system of discipline; a system which appeals to the intelligence and sense of honor of the pupil. Our transportation lines, in whose employ are hundreds of thousands of 'children of a larger growth,' still cling to a system which savors too much of the master and man idea, and has nothing to recommend it but its age.

"We have made more progress in our methods of dealing with things than with men. We have improved our tracks till we have a roadbed and rail section capable of sustaining the heaviest and fastest traffic; we equip our lines with the latest improved and most powerful locomotives; we furnish the public with the most luxurious of coaches for their personal use and with cars adapted to all classes and kinds of freight; we transport passengers and freight at a cost below that of any other country and at a speed of which the earlier builders of railroads never dreamed. But what are we doing for the improvement of the employé, on whom the integrity of our service depends?

"We spend considerable sums for laboratories in which to test the materials which are to be used in construction and repairs; we know the history of every bit of wood, the wearing qualities of our paints and oils, the tensile strength of each piece of iron or steel; we keep careful watch of the working of every new device, noting its performance with the utmost anxiety. But what do we know of the men we employ? How do we satisfy ourselves of their fitness for the work, and, once in the service and charged with responsibility, what do we know of their habits and their tendencies? Employés are too often selected in a haphazard way by the head of a department who has need of their services at once, with no reference to a higher purpose than present needs.

"More thought should be given to the capacity of the man to fulfill higher duties when called. However good a fireman you may think a man will make, if you are satisfied he has not the capacity to become a competent engineer, don't employ him. A man may be strong and nimble enough to do duty as a brakeman; but if he has not the making of a good conductor in him, don't engage him.

"Being once in your employ, see that opportunity is given him to fit himself for advancement. What is our practice? Do we keep in touch with our men? Do we counsel and advise? Do we aid and encourage? Do we acknowledge and approve everything meritorious, or do we simply discipline them for their shortcomings, and leave them to be taken care of by other and different influences? And speaking of discipline—how is it administered? Do we inquire carefully into each offense? Do we consider the record of the offender, giving him credit for the good service he has performed? Do we intelligently weigh the effect of the discipline on the service and on the individual, or is the discipline prescribed by a subordinate who is sometimes arbitrary and tyrannical, and who, rejoicing in his power, uses it to wound and humiliate?

"Do we not, all of us, know of good and true men who have been well nigh ruined by unnecessarily harsh treatment at the hands of some bumptious official? Do we not know of others who were going wrong in a way that would lead to their dismissal and perhaps their ruin, who have been reclaimed and set aright by the kindly considerate interest shown them by a superior?

"What is the object of discipline? Clearly to improve the service. The only way to improve the service is to improve the men. Are they being made better by the system which obtains? Obviously, we have a higher grade of men than we had twenty years ago; but is the improvement not rather in spite of our discipline than by reason of it? The man who early learns that harshness is less powerful than kindness, in commanding the services of another, will have best success with his men. Chastisement is too often regarded as proper discipline. Too many men in charge of others seem of the opinion that the only way a man can be taught is to be made to suffer. 'Touch his pocketbook,' says one, 'and he will not repeat the offense.' Rather, it seems to me, should discipline be educative. And if this is true, is not our system wrong? Not that our discipline is too strict or too lax—it is both—but the system, it seems to me, is defective.

"A man, or a boy, enters the shops of a great railroad, and becomes at once a part of a great machine. Nobody notes his coming or his going. Nobody notes that his work is good; that he is sober and industrious, though quiet and retiring. Some day he ventures to suggest to his foreman an idea which he thinks is good. He is told to attend to his work and not concern himself with something beyond his province. Naturally diffident, he is easily crowded into a corner, where he remains. He becomes indifferent and mechanical, takes no thought to surrounding conditions, but plods on because he must, working for the whistle and the paycar.

"He might have been encouraged to make suggestions and have become a more valuable man; but his foreman, from ignorance, jealousy it may be, or a desire to show his authority, or possibly, simply from a lack of knowledge of human nature, holds him down. Of course there are 'some men, like some trees, who agree with any soil, who grow and thrive in spite of blight or neglect and under all treatments;' but unless he have unusual pluck and courage, and the skin of a pachyderm, he will lose heart and receive a serious set-back.'

"He grows old in the service. He becomes unable to perform as much as he once did. He is discharged to make room for a younger man. What with buying a home and raising a family, he has been able to save but little. He is now old, without work and without means. What an inducement for good men to engage in railroad work.

"Perhaps he goes into train or engine service, and in course of time comes to take charge of a locomotive or a train. He runs for years without trouble or expense to the company, when one day he is involved in an accident which costs considerable money. He is called before the superintendent or master mechanic, or both. The master mechanic is very busy and anxious to get back to his shops. The superintendent's liver is working badly. They are both irascible, and the man is summarily disposed of by being sentenced to thirty days—not hard labor; better in many cases if it were—but thirty days' enforced idleness. For, with all our progression, we have not progressed beyond the old-fashioned way of punishing for accidents. Thirty days in which to go and come at will, degraded before his family and his fellows. Thirty days for the street, perhaps the saloon and the gaming-table. The thirty days has cost him one hundred dollars, more or less, though profiting the company nothing; and he returns to work with a feeling that he has been unjustly treated, and nursing his wrath against the day when trouble comes to the hated corporation. Nothing can be worse for company or for men than unrestrained power in the hands of a passionate or narrow-minded man. One subordinate with a quick temper and a sharp tongue, who thinks more of showing his authority than of keeping good men satisfied, can sow more discord in a minute than the most diplomatic manager can eradicate in a year.

"I venture nothing in saying that half the strikes which railroads have suffered might have been averted by more considerate and intelligent treatment of employés by those in immediate control over them. I go farther and say that, in my opinion, if heads of departments were more broad-minded and level-headed, used more moderation, appealed more to reason and less to force, the older and more conservative labor organizations would exhibit a more tolerant spirit, and the younger and more pernicious ones would die of atrophy."

Many Kinds of Engineers.

Mr. Walter Katte, chief engineer of the New York Central, contributed to "New York Railroad Men," a paper on the "Organization of the Chief Engineer's Department," in which he said:

"'Engine' is derived from the Latin word *ingenium*, defined first as innate natural quality or ability to do something, and from which our common words 'genius' and 'ingenious' are derived; and second, as an artful device or skillfully devised contrivance, plan or method. An engine means a very great deal more than simply a mechanical device or machine; it also means a mental device or contrivance, or, as stated, a 'plan' or 'method,' as well as a mechanical machine like the locomotive engine you are all so familiar with; and, used in the verb sense, 'to engineer' means to promulgate and conduct a project, scheme or movement, and that is just what it is the business of the civil engineer to do, namely, to skillfully or ingeniously devise methods and plans for applying the materials and forces of Nature to the uses, convenience and comfort of mankind in the civil relations. 'Civil' is derived from the Latin '*civilis*,' or relating to a citizen, or pertaining to the state of organized society as represented by civil government for purposes of peace, as differentiated from military, naval, or ecclesiastical government. Thus, captains, majors, colonels, generals, commanders and admirals; and deacons, priests, bishops, cardinals and popes, are, after all, simply 'engineers' of various grades in their several vocations—military, naval and ecclesiastical—the same as we are in the 'civil' vocation.

"You now see how closely allied are the two grand divisions of the work of making the railroad into which it is necessarily divided, namely, the civil and mechanical engineering, which are really the right and left legs supporting the whole body of the railroad; neither one of much use without the other.

"The chief officers in these departments in the organization of our company are entitled the 'Chief Engineer,' and the 'Superintendent of Motive Power and Rolling Stock,' and are necessarily 'civil' and 'mechanical' engineers in their respective departments, although it is by no means uncommon, and the history of railroad development contains many brilliant examples of both functions being most skillfully performed by the same man. This is very common in the English system of railway organization, where the general manager is often a technical expert in both civil and mechanical engineering. The two Stephensons and the well-known Mr. Webb, of the London & Northwestern Railway, are notable examples of this in the last and present generations. The harmony and interdependence of these two grand divisions of engineering science were so thoroughly recognized by Robert Stephenson that he took occasion to record his views in the following words:

"'Having been brought up originally as a mechanical engineer, and seen perhaps as much as anyone of the other branches of the profession, I feel justified in insisting that the civil engineering department is best founded upon the mechanical knowledge obtained in the workshop; and the further my experience has advanced, the more have I been convinced that it is necessary to educate an engineer in the workshop—that is, the education emphatically which is calculated to render the engineer most intelligent, most useful and the fullest of resources in times of difficulty.'"

Stephenson's experience agrees with that of nearly all eminent engineers, and the impression is now general that shop experience is the most valuable.

Happenings at the Master Car-Builders' Convention,

At Saratoga, June 17, 18, 19, 1896.

The address of Mr. H. S. Haynes, President of the American Railway Association, before the members of the Master Car-Builders' Association, was a masterly talk, replete with bright things, while dealing with the serious aspects of everyday needs in the maintenance of the immense rolling equipment of our railroads. Particular reference was made to the heavy cars that have made their appearance as the result of a demand for an increased hauling capacity, and great stress laid on the necessity of reducing their weight to a paying basis. While giving his attention to cars, the motive power department was not forgotten. Recommendations for the improvement of power were freely made, that showed a familiarity with rolling-stock technics, which betokened a more than thorough study of the subject. It was one of the most interesting addresses ever listened to by the association.

Mr. Adams' reminiscences of the birth of the Master Car-Builders' Association were full of interest to the members. Mr. John Mulligan, a gentlemen who was present at the organization and first meeting of the association, was presented to the assembly by Mr. Adams, and made a neat little speech that took his hearers back over thirty years, and covered the time from that date to the present, with some car-builders' lore that the listeners recognized the value of.

President J. S. Lentz, in his opening address, made some wise suggestions for the preservation of the Master Car-Builders' Association, interesting alike to the members and all who were within reach of his voice. It was a valuable effort, and one calculated to awaken a renewed interest in car-building and maintenance.

The question of uncoupling of cars, among the topical subjects for discussion at the noon hour, was of such interest that the ten-minute limit was extended three times in order to give the members full swing at it. It was plainly apparent that manufacturers should make an effort to build their couplers so as to remedy some very serious defects, or the link and pin were likely to become the preferable device.

The report of the Committee on Metal Underframing for Freight Cars was read by the chairman, R. P. C. Sanderson, who prefaced the reading by a few remarks in happy reference to one of "Jim Skeevers' " object lessons, as furnished by a pile-up of wooden cars. The comparative strength of wood and iron was well exemplified in the case of a collision, where the iron tender frame of one of the engines was a perfect buffer, coming out of the wreck with no damage except a slight bending down at the rear end, while the wooden tender-frame was pulverized, and allowed the engine's fire to reach the train behind it, destroying nine cars. The report was an admirable one, covering the situation clearly. Mr. J. R. Joughins followed with some information on metal in car construction, which was of the most interesting character, reciting his experience in constructing a flat car of steel, together with the observed favorable points as were developed by about four years of service of the same car. This experience of one of the pioneers in the move towards a metal car gave an additional interest to the subject, and threw a strong light on the advantages of metal in car-framing.

Mr. Stirling, the President of the Universal Construction Co., of Chicago, also made some remarks on the needs of the manufacturer in keeping stock on hand to meet the requirements of railroads in furnishing material for steel cars, or, as he put it, the "indestructible cars." With these remarks, the discussion of what is one of the most important issues before the car man, was closed. A Committee of Five was then appointed by the Executive Committee, to furnish individual designs for a steel car, to be presented at the ensuing meeting.

This report is of special interest to us, for the reason that there is such a close similarity, in its recommendations, to our own propositions as outlined in these columns, particularly that section of it referring to a reduced ratio of dead weight to paying load.

On the tracks not far from the convention hall are several steel cars on exhibition. One of these is a hopper bottom car of 100,000 pounds' capacity, weighing 39,950 pounds, made by the Carnegie Steel Company, and loaded with 97,000 pounds of ore, just to show how it looks in service. This car is a product of the bridge engineers, put together to see what the outcome would be if they turned their attention to car-building. No claim is made that the car is perfect as an engineering feat; in fact, they want it understood that they are fully alive to the fact that the car can be materially reduced in dead weight, and they also would like to remind the mechanical world that they know what a steel car should be, and are certain that they can build satisfactorily to any lines—so say the exhibitors, who are all practical men.

There are also two steel flats built by the same company as above; one of these is loaded to its capacity of 80,000 pounds, with steel rails. We noted that the side bearings were down solid on this car.

The Pennock Brothers have in this exhibition two 80,000-pound steel cars, one a flat like that we illustrated and described a short time since, and one hopper bottom for ore or coal. The flat car, as seen in its working clothes, is sure to impress the observer as the product of a practical man that knows his business. It is a beautiful example of original thought worked out in steel.

One other flat car, the Harvey, an old veteran that has braved the hard knocks of four years' service, stands there, not as a prize beauty, but a sure money-winner for the transportation department. It was claimed that not one dollar has ever been spent on the body for maintenance. There is a record of what the steel car will do, in this battered old flat. This car and also the Pennock cars were exhibited by the Universal Construction Company, of Chicago.

During the tail-bolt discussion, it was moved and carried that it be the sense of the meeting that in future construction the tail-bolt be discarded.

When the subject of standardizing the parts in car construction was up for discussion, the size of arch bars was merely mentioned, and that in the most perfunctory manner, by one member. A singular apathy was apparent, and the discussion was closed without any action whatever. The subject was up as a noon-hour topic, a time when a gnawing at the vitals precludes all chance of fair treatment for any subject. It would not be a bad idea to go into convention with a full stomach sometime and make this subject the first order of business.

In the matter of modification of handholds and grab-iron location, it was voted to submit the question to letter ballot as recommended practice. The proposed changes are rather late in the day, it seems to us, since most roads have already fitted out most of their equipment.

The Committee on Uncoupling Arrangements has been continued for one year, in order to get one uniform standard of uncoupling parts on the drawbars. One of the fathers of the association, sitting near, asked the scribe why it was not possible to force the coupler builders to make uniform uncoupling arrangements, just as they are made to give a standard contour on the knuckle. There is more in this suggestion than appears on the surface.

The report on Stenciling of Cars was voted to be submitted to letter ballot as presented, on account of its general excellence. There are few committees that receive this compliment.

Report of the Committee on Loading Long Timbers was voted to be submitted to letter ballot as recommended practice, and the secretary to have copies of same printed and kept for sale.

The discussion of the "Proposed Modification of Rules of Inspection" proved to be a hot topic for the members. It was proposed to read the revised rules by sections and discuss any objectionable passages or portions of same, when the suggestion caused a jangle that would make a Babel a scene of graveyard quietude in comparison. These modifications, it will be remembered, were recommended by a committee composed of twenty-one bright minds—the flower of the association—and if adopted as printed would no doubt have been as fair a compilation of rules for all concerned as any that could be framed; but, like all great measures of the kind, they were supposed to be defective in certain sections, and this caused a locking of horns between the pro's and anti's. A motion was made to accept the unread sections without further discussion, but it was not seconded, and the Kilkenny exhibition went on. After more wrangling, the rules were accepted as printed, with a few minor changes.

Great convenience has resulted to railroad companies from the rule established by the Master Car-Builders' Association several years ago, making it legal to repair cars with any Master Car-Builders' type of car coupler. The Master Car-Builders' Association is now working to make it legal to introduce other standard parts in making repairs. This is a good line to follow up.

The C., B. & Q. have inherited a legacy from the 1,500 New York air brakes which they put on their freight cars five or six years ago. Mr. Rhodes, superintendent of motive power, talking at last Master Car-Builders' Convention, said that other roads seemed to think they liked New York triple valves, for cars that had the Westinghouse triple often came home with New York triples substituted. The convention voted that making repairs with a strange triple was not proper practice.

A rather forcible illustration of how a short test may fail to reveal the shortcomings of an invention was given at the Master Car-Builders' Convention by Mr. S. Higgins, of the Lehigh Valley Railroad. The Lehigh Valley uses shell brass bearings very largely, the body of the bearing being filled with soft metal. Before the practice was introduced, tests were made to find out how the bearings behaved under a few cars. They did very well, and the bearing was adopted. More experience showed that the bearing was good unless something unusual happened to cause heating, such as sand or a damaged journal. When that happened the shell bearing went to pieces.

In a paper on "Retarders in Fire Tubes of Steam Boilers," contributed by Mr. Jay M. Whitham to the American Society of Engineers, tests were described which indicated that there is practically no change in the economical working of the boiler when run at from 50 per cent. below to 70 per cent. above its rating. There was no material difference in the evaporative efficiency of the boiler between the ranges of 6.7 and 27.7 square feet of grate area.

Fire-Kindling.

The conservative habits of the ordinary railroad official are very well illustrated in connection with the small progress made by devices for kindling fires of locomotives by oil or methods superior to the use of wood. The efficiency, economy and decrease of fire risks resulting from the use of oil for kindling locomotive fires have been demonstrated beyond question. The subject of improved fire kindlers has been reported on and discussed twice at Master Mechanics' Conventions, and it has also been investigated by committees of various railroad clubs. All the experiments and investigations have gone to show that fires can be kindled with oil at about half the expense of wood, and yet we find that very few railroad companies have adopted improved fire-kindling methods. Most of them continue to patronize the dangerous wood pile, and replenish it from worn-out car timbers and decayed track ties.

It has been proven that the labor of collecting and cutting up old car timbers and ties, to make them suitable for firewood, is greater than the cost incurred in using oil. This is a case where a greater evil than first cost is involved. Car timbers and ties are not suitable material to convert into fire-kindling wood, because they are never free from spikes and bolts which frequently get stuck in the grates so that they cannot be shaken. Burnt grates and delays from having to stop and clean the fire are common penalties paid for using car timber and ties as kindling wood. When the lower cost of oil is considered, its convenience and cleanliness compared to wood, it appears strange that so little progress has been made towards the adoption of the better methods.

The subject of fire-kindling was recently presented to the Southwestern Railway Club by Mr. R. P. C. Sanderson, of the Norfolk & Western. He said that they had been quite successful in using cheap black oil for fire-kindling. By exciting rivalry among different shops they had got the cost of fire-kindling reduced to one and one-fifth cents per engine. Then some one had done better than that and kindled the fires with greasy waste which had been used in wiping. Engines with fire-boxes ten feet long are successfully fired up in this way. The author of the paper acknowledged that cutting up car timbers and ties to make firewood was more costly than using oil. The Norfolk & Western have adopted the practice of selling old timbers or burning them up in heaps instead of converting them into firewood.

We learn from the Gould Coupler Co. that there is a misapprehension as to the scope of the opinion of the Circuit Court of Appeals, in the suit of that company against the Trojan Car Coupler Co. The decision merely dissolved the preliminary injunction. The Gould Coupler Co. are now proceeding to take testimony, and will proceed with the case as though no preliminary injunction had been granted.

The Baldwin Locomotive Works have issued a new illustrated catalogue, showing the various forms of Vauclain compound locomotives built by the firm, and the various parts of the same. It is a very handsome catalogue and contains a great many half-tone illustrations. The pamphlet will be sent to applicants who are interested in the purchase of locomotives.

The New York Belting & Packing Company, Limited, has removed from No. 15 Park row to No. 25 Park place and No. 22 Murray street, New York City. The new store is located only two blocks away from the old building, extending entirely through from Park place to Murray street. The entrance is on Park place, the Murray street side being reserved entirely for shipping purposes.

The Union Pacific is gradually getting rid of leaky steam pipes, and they expect to see an end to that source of annoyance when all the engines are equipped with malleable iron steam pipes. Those who are laboring to reduce the dead weight of locomotives would find the use of malleable iron steam and exhaust pipes worthy of attention.

There is talk in Cleveland, O., that Mr. Rockefeller, of the Standard Oil Company, is going to build an immense steel plant in that city, which will be the largest in the world. There are more steel plants already in use than what are needed, and we doubt that the great oil magnate is going to spend a fortune in overdoing the business.

Some time ago the Fitchburg Railroad brought out an air-brake instruction car. This car is marked "A. B. C.," which was interpreted to mean "Air Brake Car." Shortly after this the road department got out a big pile-driver, and someone proposed marking it "P. D. Q.," which he said meant "Piles Driven Quickly."

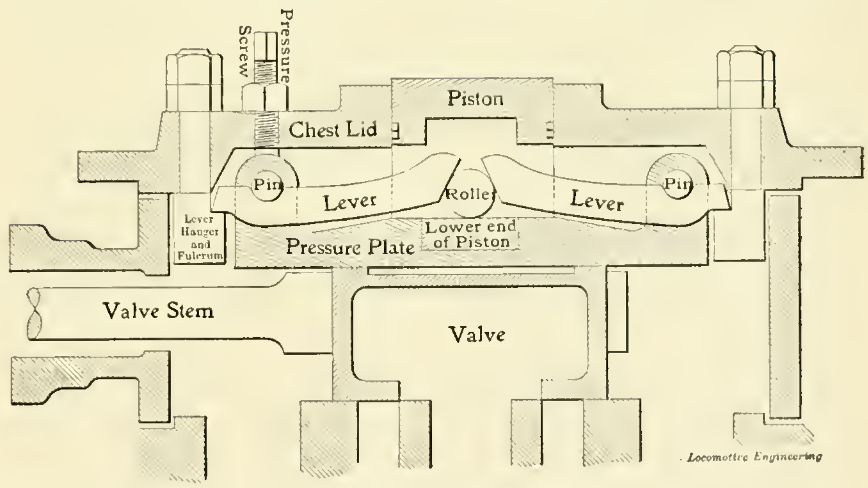
The Q. & C. Co. are pushing the Hoyt flush car door, which, they say, has several new features which are worthy of careful investigation. It is claimed to be the cheapest in first cost of any flush door used, has the least number of parts, is easy to apply, and the expense of maintenance little if anything.

We are informed by the Chicago Pneumatic Tool Co. that they have just received a cable order from London for ten more of their B-size hammers.

Alexander's Balanced Valve.

Mr. S. A. Alexander's balanced slide valve, here illustrated, is thus described by the inventor:

"When pressure enters the chest, it acts on the piston; a slot in the piston receives a loose roller, on which the levers rest and press; the other ends of the levers rest on hangers, which are also fulcrums. Each end of the pressure plate is provided with suitable lever pins, through which pressure on top of the plate is sustained by the piston. The angular end of the levers, pressing against the roller, provides for the automatic adjustment of the levers in case of unequal wear on their bearings; it also, in conjunction with the piston, takes care of all variations of pressure on the plate that constantly occur by the changes of the position of the valve. The piston, with its levers, is arranged to relieve the valve of nearly all pressure, set screws being applied on top of the plate with sufficient force to prevent leakage between the valve and its seat and the plate. It will be noticed that a recess in the plate receives the lower end of the piston; thus



each is a support to the other. The valve has no end flanges; thus a much larger exhaust cavity is obtained. The whole design is easily fitted; no springs or packing strips are needed or used. The piston packing is the same as that usually in common use in the cylinders."

Mr. Alexander further informs us that balanced valves of that kind have been in use on a large consolidation engine, and are giving good service.

We do not know of any embarrassing situation which ought to excite the sympathy of benignant persons more than to see a corpulent man squeezing himself into the deepest recesses of a Wagner berth, looking for his collar button. It is not creditable to the average trainman to be compelled to relate that sympathy is not much in evidence on occasions of that kind. What is there to laugh about? thought the scribe, as he wildly raked under cushions and mattresses on a recent journey. The historical flea is nothing to a missing collar button.

Tools Needed in Small Railroad Repair Shops.

BY JOHN D. CAMPBELL.

When I last saw you I promised to give you my views of what tools would be required in a shop of a road with twenty engines. I intended to have done so at once. When I have not been fully occupied attending to business the mountain malaria has kept me attending to it, and now that I have commenced to try and fulfill my promise I hardly know how to do so.

There are conditions that may influence the number and kind of tools that would be required—one is the amount of the power to be maintained; again, the amount of work it may have to do and the resulting effect upon it. With these factors known, the amount of work required to be done in a given time must be considered, just the same as in a manufacturing concern that has a certain amount of work to do in a given time, and make a calculation of the number of tools required, of each kind and capacity; and the same rule applies to locomotive repairs.

Let us consider how often an engine will be in the shops for general repairs, and the percentage of the power that must be in, and also what work will have to be done; then upon this basis, the amount and kind of tools required. Assuming a road with twenty engines, and that each engine will have to go into the shop for general repairs once in eighteen months; that it is an average road engine, of average age, and requiring the average general repairs: Under these conditions each engine would have 22.5 days shop time in each eighteen months; this time would be more than required for a lathe to do all the bolt and small turning work, and a lathe of 10-inch swing and 6-foot bed would answer the purpose. Taking up the other turning work to be done, we find it to be cylinder packing, rocker arms, crank pins, pistons, etc., and this work must be done in the same number of days; but the parts mentioned do not have to be renewed—in fact, many of them are not touched—and considering what will have to be done, we will find that it can be done in one lathe, say with 30-inch swing and 14-foot bed. The two lathes mentioned would be all that would be required for repairs on engines, or work to be done for other machinery on the road; and while it may not be strictly employed, it is well to have a third lathe and one that will do the work of and relieve either of the two mentioned if required to do so.

Again, we will assume that the road has its proportion of cars, and the shop must do the axle work: There will not be enough work for an axle lathe, so we must make provision to do it; and for this and the other reason mentioned, we will add a third lathe, one having 22-inch swing and 12-foot bed.

The next most common work in locomotive repairs is that done on a planer. This flat-faced work must be done in a planer, shaper or slotter. There will not be enough to keep each constantly employed, yet the economy of each and its adaptability to different classes of work is such that each is required, and it remains to see what will best answer the purpose. First, I would say that a planer 36 inches by 15 feet, a shaper of 18-inch stroke, and a slotter of 18-inch stroke, would fill all requirements.

A question that is sometimes perplexing is—Is a vertical boring mill a necessity in a shop of the size under consideration? It is not; but it is a tool that should be placed in it. With one a little larger than those mentioned it is not required. Without it is again supposed that car-wheel work has to be done, there will not be enough work for a wheel borer, and the vertical mill can be used for the purpose; and it is surprising what a good wheel borer it will make, and will also relieve the lathes when crowded.

What its dimensions should be is a question to be decided by the work it may be required to do, or what may possibly be required of it in the future. It will be a good rule to have the machine larger than the immediate requirements call for. It seems hardly necessary to say that a wheel lathe and wheel press are essential, or what size is needed; but as we are making the list, let us add them and say the wheel lathe should have a quartering attachment, and that neither should be stinted in size—bearing in mind not the present limit of work they will have to do, but what they may have to do in the future, and that an 80-inch lathe and press would do anything below that size, and also that a 60-inch cannot go above 60 inches.

A tool that is as necessary to a shop as the shafting is the bolt cutter, and the best is none too good. It occupies a humble but important place in the work and its economy. It should be a double-head machine and capable of cutting the largest bolts that may be required for any purpose on the road. The question of the drill press is one that may not seem important, yet a good drill press is a most useful tool in a shop. It is the most necessary one, and about the first tool that will be found in a shop doing general work. A country blacksmith shop may not have another machine, but it will have a drill press of some kind. A modern tool can be made to do much work besides its regulation duty as a drill, when in a shop like the one under consideration. One would be sufficient, but it would be well to have two—a large one with a 40-inch table, and a smaller one with an 18-inch table. The small work can be done more quickly in the small machine; and as much of the drill-press work is always in a hurry, this small drill would obviate moving any work that may be set up in the larger machine.

Passing from the machine to the boiler and blacksmith shop, we will find that the two are combined in most small shops. We will first consider what tools are required in the blacksmith shop. The first and most important is the steam hammer. There seems to be an impression in many minds that because a shop is small the hammer should be also, and no greater mistake can be made. A small shop on a road that has but one must be prepared to take and do any kind of repairs, from welding a frame to a spring hanger. A small road cannot afford to buy material or forging of parts of a locomotive, that may some time in the far future be required, and lay an engine in a long time until it can be provided; and therefore the hammer in a small shop should be of such a size that it can be called upon in any emergency to produce quickly any forging that may be required in locomotive repairs.

Another tool that is necessary, and that will answer the purpose of both the smith and boiler shops, is a power punch and shear; and it is just as necessary as in a larger shop, and indispensable wherever work is done.

In the boiler shop proper but few tools are required. The punch and shear are common to both, and a set of hand rolls and a flange clamp will answer all purposes for a small road.

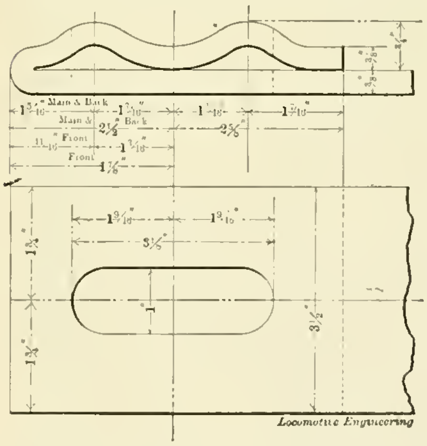
How far special tools shall be employed is a question that requires careful consideration. Where a particular kind of work is in sufficient quantity to keep a machine constantly employed, then a machine especially adapted to it and labor also trained to it, and the machine fitted with tools to produce any particular part of the work, there is no question of its economy. For that reason it is better economy to go to an establishment that has work for such a machine and buy from them, than to have a machine to produce it which may not be employed but a few hours per week.

No one will question the economy of a milling machine on new work, and where there is enough of it to keep a machine employed, and there are proper cutters to do the work; but it is a poor tool on repair work in a small repair shop. It is out of its place there, and the same statement applies to other special tools.

There is one class of tools that is just at home in a small shop; and that is, the power lifts at the machines and around the shop. A large shop will have help that is employed in lifting, which thus may not really interfere with the other operations; but in the small shop there are few men employed, and when they are helping others the loss is felt more than in the large shop, where laborers can be employed. But in the small shop there will be but few of these, and the machine men must do their helping; and this makes the small shop a peculiarly good place for power lifts.

Strengthened Bearing for Spring Hanger.

The annexed engraving illustrates a form of spring-hanger support used very successfully by the Pennsylvania lines west of Pittsburgh, for driving springs of locomotives. It is said to be a great help in preventing broken hangers and springs.



It will be seen that the invention consists in turning the end of the top leaf of the spring back to form the bearing for the spring-hanger gib.

We are indebted to Mr. G. L. Potter, superintendent of motive power, for the blueprint from which the engraving was made.

Introduction to America of Steel Tires.

An interesting industrial, historical incident is told in our correspondence columns by Mr. E. J. Rauch, road foreman of engines of the New York Elevated Railways, in his letter on "The First Steel Tires Used on American Locomotives." Mr. Rauch was in the employ of the Philadelphia & Reading Railroad at the time he states the first steel tires were made, and the facts he gives may be readily accepted as correct, for he has a remarkably good memory. According to his statement, steel tires were used on the Reading locomotives as early as 1851. There were very few steel tires tried anywhere in this country until fifteen years later, although they began to be applied to locomotives in Europe about 1850. Krupp was the pioneer in the making of steel tires, and he held a patent on the process of rolling a weldless tire, which gave him great advantages over other tire makers as long as the patent lasted.

The Krupp Steel Co. exhibited a fine display of steel tires in the exhibition of London in 1851, and one of these, eight feet in diameter, is still to be seen secured on the outside of Thomas Prosser & Son's office at the corner of Gold and Platt streets, New York City.

About 1854, when General McClellan was superintendent of the Illinois Central Railroad, he purchased a set of Krupp tires and had them applied to a passenger engine. There was then a fierce prejudice among American railroad men against steel for tires, and it was freely predicted that General McClellan's enterprise would lead to trouble. It did so to some extent, for in applying them the same shrinkage was allowed as for iron, and one of the tires broke. A great deal of "I told you so" talk followed, but the tires wore so well that they convinced those familiar with the service secured that steel might yet prove itself the best material for tires.

But the change came very slowly. It was not till after the War that steel tires began to push iron out of the field. As late as 1869, at the second convention of the American Railway Master Mechanics' Association, a committee reported on steel tires, which seems to be very exhaustive for the information then procurable. It was reported that there were in the country then about 10,000 locomotives, with 41,800 wheels, of which about 3,900 had cast-iron tires, 9,620 wrought-iron tires, and 28,280, or nearly 68 per cent. of the whole, cast-steel tires. Up to the time that the report was prepared, the committee had learned that Krupp's agents had supplied 16,273 tires, and four other steel makers had supplied an aggregate of 14,461 steel tires. The committee say that, although the general judgment as to the actual superiority of the steel tire is shown by the rapidity to which they have, to so great an extent, superseded all others, yet a definite conclusion as to their comparative wearing merits was not then practicable. It appeared that none of the steel tires applied to American locomotives had yet been worn out, as far as the committee had learned, and they were unwilling to make recommendations until they found how thin a steel tire could be run.

Some of the figures presented indicate that the first tires introduced gave extraordinary mileage. By correspondence with members, the committee found out a good many facts about tires which were new to the association, and which, no doubt, still further helped to bring steel tires into popularity. Among the facts presented they say: "Engine 37, on the Ohio & Mississippi Railroad, commenced running with a set of Krupp's tires, September, 1861, and had run, up to July, 1869, 179.594 miles. Original thickness 'in the rough,' $2\frac{1}{2}$ inches; present thickness, $1\frac{1}{8}$ inches. Work, allowing nothing for turning when fitted, 13.815 miles to $\frac{1}{16}$ inch wear. Engine 'Gazelle,' Lake Shore Railroad, commenced running with a set of Krupp's tires, January 4, 1864, and had run, up to July, 1869, 237,550 miles. Original thickness of tire, $2\frac{1}{4}$ inches; present thickness, $1\frac{7}{16}$ inches. Work, 13,975 miles to $\frac{1}{16}$ inch wear. Engine 34 (freight, weight 35 tons), on the Chicago, Burlington & Quincy Railroad, commenced running with a set of Krupp's tires, October, 1863, and had run, up to second turning, 147,999 miles. Original thickness not given. Amount turned off, $\frac{7}{32}$ and $\frac{1}{4}$ to $\frac{15}{32}$. Work, 19,733 miles to $\frac{1}{16}$ inch wear."

There had been considerable breakage among steel tires, which, no doubt, resulted from being shrunk on too tight. Those who wrote to the committee, concerning the shrinkage they thought sufficient, differed greatly in their opinions, the recommendations being from $\frac{1}{16}$ to $\frac{1}{64}$ of an inch for a 60-inch wheel. The methods of fastening the tires also received considerable attention, there having been five methods more or less in use. The first of these, which seemed to be most popular, was shrinkage alone; then shrinkage, with set screws or bolts; taper, with set bolts, with gib-headed bolts between wheel and tire, secured by nuts on the inside; and lastly, wooden blocks between wheel and tire, without shrinkage.

In spite of the conservative spirit displayed by American railroad men in regard to the introduction of steel tires, the change was very rapid when once the persons most interested were convinced that the material was safe. The most surprising thing connected with the first application of steel tires to American locomotives was, that a clear-headed official like James Millholland went back to cast iron after having used steel.

Russian-American Locomotive Works.

About six months ago Mr. Walter F. Dixon, who was chief draftsman of the Rogers Locomotive Works, made an engagement with the Russian-American Manufacturing Company as general manager. The company was formed for the purpose of building large locomotive works at Nijni-Novgorod, Russia. Mr. Dixon immediately went to Russia to examine the ground where the locomotive works are to be built. After examining the ground, he returned to Philadelphia, where the American headquarters of the company are, and prepared plans for works having a capacity of about 200 locomotives a year. These plans, when finished, were taken to St. Petersburg, and examined by a committee of Russian and American engineers, with headquarters in St. Petersburg. The plans were accepted substantially as prepared by Mr. Dixon, and he is now back in this country, purchasing machinery for the plant. The works are going to be equipped with the most modern style of machinery for turning out work promptly, and it will nearly all be of American manufacture. We understand that contracts for machinery amounting to $500,000 have been awarded, and there are still more contracts to fill.

The locomotive works in Russia are to be built in connection with the Sermoya Works, an extensive establishment in Nijni-Novgorod, manufacturing cars, steamboats, steam boilers, etc., and employing about 5,000 men. Mr. Dixon will have entire charge of the locomotive works, in which he expects to employ about 1,000 men. It is his intention to take foremen and some leading men out from this country.

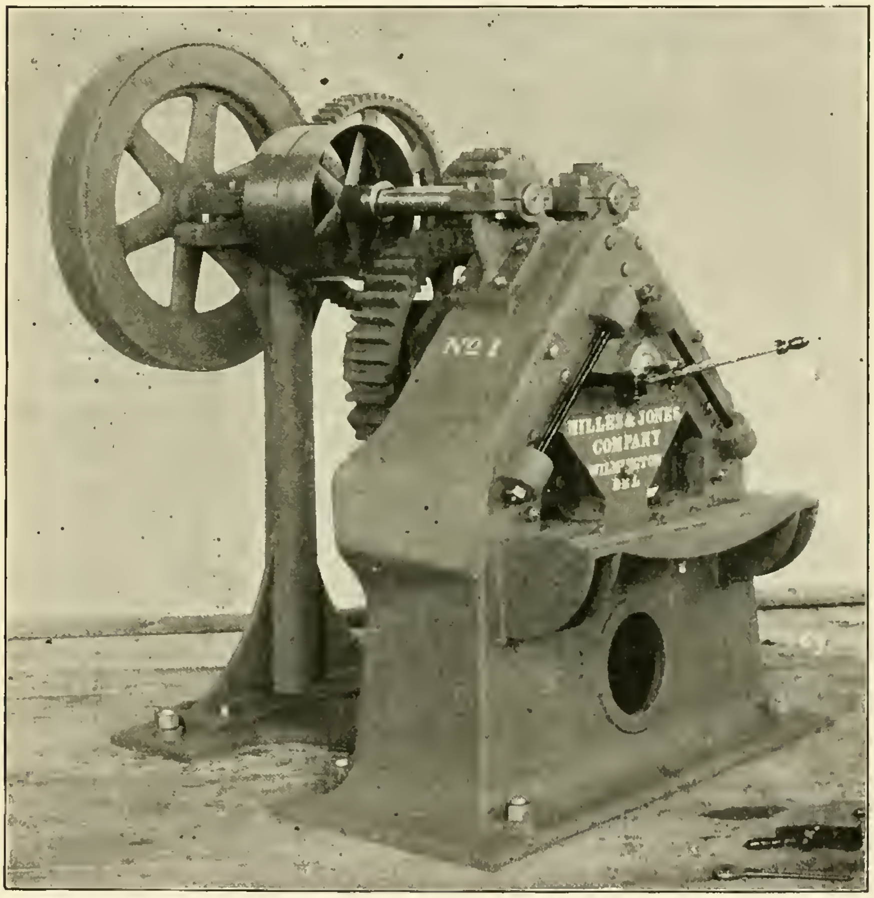
Peter Weber, of Pittsburgh, Pa., has patented a form of roll intended to make the manufacture of car axles more systematic than anything hitherto tried. The rolls conform to the shape of the finished axle, and have flanges at the sides to prevent the elongation of the metal from which the axle is made. It looks as if a billet could be put into the rolls and after a few turns emerge as a finished axle. The principal objection that we see to the device is, that it will decrease the working which metal received in being converted from a billet to an axle. That amount of working is too limited already for the production of a durable article.

The amount of extra coal used by a locomotive when the train speed is very high, has never been clearly ascertained; but it must be considerable, as every fireman knows who has kept up steam for high-speed engines. The cost of high speed for steamers is known accurately. A case, recently made public, gives a striking idea of the cost of high speed. The French torpedo boat "Forban," upon her official trial made an average speed of 35.7 miles an hour three times over one measured mile, and used 5,940 pounds of coal. The same boat steamed eight hours at a speed of 16.1 miles per hour, on a total fuel consumption of 423 pounds of coal.

The Railway Master Mechanics' Association have adopted standard specifications for locomotive iron boiler tubes, based upon the new decimal gage as a means of measurement.

Heavy Angle Shear.

Our engraving shows the latest form of angle shear, as built by Hilles & Jones for the Baldwin Locomotive Works. This tool will cut angles up to 5 x 5 inches. The sliding heads work at an angle of 45 degrees, and the piece sheared can therefore be mitred or cut to a bevel. This is necessary on a great deal of work, and such a machine saves much time in fitting up. A sliding head worked vertically or horizontally will not do this shearing to advantage. There is a clamping table in front of the knives for convenience in holding pieces to be sheared.



A Recent Example of Self-Help.

We frequently hear complaints made, that nowadays a mechanic has little opportunity of rising above the position of mere workman unless he has some influential friends to push him along. It may be that influential friends are more useful in pushing mechanics upwards than they once were, but we believe that the principal force to effect this species of elevation will always remain in the mechanic himself. The principle of self-help is as active to-day as it ever was; and it is those who are determined to do the best for themselves who are likely to ascend most rapidly towards the top of the ladder. These thoughts have recurred to us recently on learning details of the professional experience of Mr. John R. Wagner, recently appointed superintendent of motive power of the Delaware, Susquehanna & Schuylkill Railroad. Here is a brief outline of how he gradually worked his way upwards:

"Born May 12, 1861, in Northampton County, Pa. Served a four-year apprenticeship at the machinist trade, from the age of fourteen to eighteen. Engaged as a machinist one year with Bement, Miles & Co., Philadelphia, and one year with Wm. Sellers & Co., Philadelphia; also several months in steam engine work. During these two years in Philadelphia, he attended the Broad and Spring Garden Institute (night-school) two evenings per week; and the Artisan School, Broad and Green streets, three evenings per week. Left Wm. Sellers & Co. in May, 1881, to take course in mechanical engineering at Lehigh University, and in the interval, while he was preparing, between this and the opening of the fall term in September, he had charge of the Shive Steam Engine Governor Works at Bethlehem, Pa. Graduated at "Lehigh" in 1885, having spent his vacation in the shops of the Bethlehem Iron Co. Engaged with Coxe Bros. & Co. at Drifton, Pa., for the past eleven years, entering the machine shop for a few weeks, then transferred to drawing room, and shortly after devoting his whole time to making steam boiler tests and indicating the many steam engines and mine pumps operated by the company at their various collieries. In 1886, he became general scientific assistant to the late Hon. Eckley B. Coxe, which position he held up to the time of Mr. Coxe's death, in May, 1895. In this capacity he was in charge of Mr. Coxe's celebrated scientific library, and also superintendent of testing and experimental laboratories of Coxe Bros. & Co. In 1889 and 1890, he took special course in mining engineering at Lehigh University, at the same time attending to his regular duties under the company, and taught night-school besides four nights per week at Drifton. In April, 1896, was appointed acting superintendent of motive power of the Delaware, Susquehanna & Schuylkill Railroad, and since June 1st, appointed to full title of superintendent of motive power. He is still superintendent of testing bureau of the Coxe Iron Mfg. Co., the latter company being organized January, 1895. Mr. Wagner is also principal of the Mining and Mechanical Institute of the anthracite coal regions of Pennsylvania. Is member of the following engineering societies: American Society of Mechanical Engineers, American Institute of Mining Engineers, American Society Chemical Industry, American Railway Master Mechanics' Association and the Society for the Promotion of Engineering Education."

Superheated Steam.

"Opinion seems substantially unanimous, and all testimony confirms the conclusion," says Professor Thurston, in a paper contributed to the American Society of Mechanical Engineers, "that superheat may effect large net economies. Collating the results of about fifty authentic and well-conducted experiments, it is found that the gain in fuel, by the introduction of superheating, ranges from 10 to 50 per cent. of the fuel used with wet steam; that about 100 degrees superheat, on the Fahrenheit scale, gives usually complete extinction of initial condensation; that even 15 or 20 degrees will make an important gain in reduction of internal wastes; that every application of this system, discreetly effected, returns several times—actually from two to ten times—its cost in heat expended; that the largest returns are secured by the smallest quantities of superheat; and that the indications are, so far as we can to-day judge from earlier and contemporary practice, good engineering in this direction pays, and pays well; the limit being found at that point, continually becoming more remote and at a higher and higher temperature, at which excess of temperature begins to cause rapid destruction of superheating apparatus, and consequent expense and danger in such degree as to become a large and more than counterbalancing element. The average of fifty-two cases observed by the writer gives a gain of 26 per cent., with a superheat of 105 degrees Fahr. The average gain with compound engines examined is 20 per cent., with a lower but uncertain amount of superheating, in a majority of the cases reported the superheat not having been measured. In cases averaging about 50 degrees of superheat, the gain was 20 per cent., and this is probably not far from the average for all."

Bushing Cylinders.

The practice of bushing locomotive cylinders receives decided support from a committee which investigated the subject for last convention. They say that by the use of an independent bushing a perfectly clean casting of uniform density throughout, and of such a hardness as will give the best results as to wear, can be obtained without in any manner influencing the quality of the material in the body of the cylinder. Frictional resistance between the cylinder and the piston consumes a large amount of power, and any means which will reduce this resistance is likely to produce a freer-working engine and one more economical in the consumption of fuel and oil. Members of the committee were decidedly of the opinion that the advantages gained by using a bushing harder than it is possible to obtain in the ordinary cylinder casting, effect a decided economy.

The conclusions of the committee are, that cylinder bushings ½ inch to ¾ inch in thickness will meet all requirements; that the bushings should be turned to the same diameter as the cylinder fit; bushings fitted without any fastening, except the pressure of the heads, will give perfectly satisfactory results; the use of bushings is a practical method of reducing the bore of cylinders, of repairing cracked and worn cylinders, and avoiding the difficulty of cylinders which are too soft; the question of fuel and oil economy, which may be obtained by the use of hard, homogeneous bushings, is one which should receive careful attention.

A good many railroad companies report compound locomotives effecting a saving of fuel of from 15 to 30 per cent., but very few of them have displayed an inclination to secure the saving in operating expenses that results from such a proportion of fuel-saving. Year after year master mechanics have stood up in the convention and told about the amount of fuel saved by the compound locomotives they had in use, but still there was no increase in the number of this kind of engines employed. It appears to us that the Cleveland, Cincinnati, Chicago & St. Louis Railroad people have been the first to act courageously on their convictions concerning the economy of compound engines. The Richmond Locomotive Works has just received an order from that company to convert sixty of their locomotives from simple to compound engines as fast as they can be put through the shops. This is the greatest revolution in locomotive construction that has been announced in recent years.

WHAT YOU WANT TO KNOW.

Questions and Answers.

(55) W. D. S., Indianapolis, Ind., writes: Will you kindly explain the smoke jet used on the New York Central Railroad, quoted in Hill's Examinations? A.—The above probably refers to the steam jet used through openings at the front and rear of firebox, to induce air currents to enter over the grate for the purpose of aiding combustion.

(56) C. J. C., Dunkirk, N. Y., writes: Will you please state in your valuable paper what the sizes of steam and exhaust ports, and the lap and travel of valve, should be for a 3¼ x 3¼ cylinder stationary engine, to run 300 revolutions, with 50 pounds boiler pressure? A.—The steam ports may be $\frac{3}{16}$ x 1¼ inches; the exhaust ports ⅜ x 1¼ inches; the lap $\frac{5}{16}$ inch, and the travel 1 inch. The above lap will give a cut-off at about five-eighths of the stroke.

(57) H. W. S., Cape Breton, N. S., asks: What should be the outside and inside lap of valve on a locomotive having eccentrics with 5-inch throw? A.—The distribution of steam required will determine the amount of lap in this case; and since the throw is dependent on the lap of valve and width of steam ports, a decisive answer cannot be given to the question. Outside lap for freight engines is made from ⅝ to ¾ inch, and inside lap from $\frac{1}{16}$ to $\frac{3}{16}$ inch. On passenger engines the outside lap will range from $\frac{13}{16}$ to 1¼ inches and inside lap from $\frac{1}{32}$ to zero. In many cases the valve is cut out so as to leave ⅛ inch or more of clearance on passenger engines.

(58) J. J. H., Montgomery, Ala., writes: As I am a subscriber to your paper, and interested in the working of locomotives, I would like to ask a few questions: 1. Will you please tell me whether, when water gets low in tender, it will have anything to do with the check valve sticking? A.—We know of no reason why the check should stick under the condition named. 2. I have some arguments about throttling engines. Which is right, to run with wide open throttle, or open it according to grade and train? A.—Some of the best engineers have always taken the latter course. 3. Does slipping the water out of an engine injure the valves or packing after working water out of cylinder slowly? A.—No. 4. Does opening the fire-door to keep engine from popping, when working steam with a good fire, injure the flues enough to make them leak? A.—Leaving the fire-door open will cause flues to leak. 5. Can an engineman tell when a staybolt breaks, when out on the road, unless it is a hollow staybolt? If so, how? A.—There is no infallible rule by which to tell when a staybolt breaks on the road. They sometimes let go with a report that is easily understood when heard, but more usually their giving way is never known. 6. The engine I have makes a cracking noise when fired up, after being cold; can you tell what causes this noise? A.—We cannot positively say, but suppose it to be the result of expansion, which takes place as the engine warms up.

(59) J. H. P., Rockwood, Tenn., writes: Will you kindly give your formula for deriving the tractive power and gross hauling capacity of a locomotive, and illustrate it by showing how many tons a locomotive of the following dimensions will haul on a 4½ per cent. grade: Cylinders, 14 x 18 inches; drivers, 36 inches diameter; steam pressure, 135 pounds; weight on drivers, 44,000 pounds? A.—The tractive power of a locomotive is found by the formula $T = (d^2 \times P \times S) \div D$, in which the symbols represent the following values: D = diameter of drivers in inches, S = stroke in inches, P = mean effective pressure on the piston in pounds, d^2 = diameter of the cylinder in inches, squared, and T = tractive power. The mean effective pressure can be determined accurately only by the indicator; and without that is known, there is more or less uncertainty in the results obtained by calculation. Theoretically, the maximum effort of the engine is had at a cut-off of .875 of the stroke, and with a boiler pressure of 135 pounds; the calculated mean pressure is equal to 123.8 pounds after making deductions for back pressure, but this is seldom realized in practice, and we will therefore make a further reduction to allow for restricted steam passages, which always cause a loss of initial pressure, and take the mean effective pressure at 120 pounds. This is a reasonable figure, amounting to 89 per cent. of the boiler pressure, nearly, and not likely to be exceeded when the indicator is applied. Placing these values in the formula, we have: $T = (14^2 \times 120 \times 18) \div 36 = (196 \times 120 \times 18) \div 36 = 423{,}360 \div 36 = 11{,}760$ pounds' pull on the drawbar. The 4.5 per cent. grade is equal to a rise of 237.6 feet per mile, and the resistance equals $(237.6 \times 2{,}000) \div 5{,}280 = 90$ pounds per ton, due to gravity alone, to which must be added the resistance due to velocity, which on above grade will be taken at 5 miles per hour. The resistance for that speed is another uncertain factor, variable by many causes, such as wind resistance, rolling friction, etc.; but we take it at 6 pounds per ton, as a fair average on a straight, level track. The total resistance then becomes $90 + 6 = 96$ pounds per ton; and dividing the tractive power in pounds by the resistance in pounds per ton, we have $11{,}760 \div 96 = 122.5$ gross tons' capacity for above engine. The condition of the rail, whether wet or dry, also has a certain bearing on the power exerted by the engine. If the rail is wet, the wheels may slip, and the engine will not then be able to exert the calculated pull on the drawbar; and the same statement holds if there is not weight enough on the drivers to hold the engine down on a dry rail. The ratio between tractive power and weight on drivers for this engine is $44{,}000 \div 11{,}760 = 3.74$, and is somewhat lower than usual practice. From this it is seen that the rail must be in a good condition, or the engine cannot haul the tonnage calculated.

The American Steamship Line have had extraordinarily bad luck in trying to steam their vessels over dry ground, but otherwise the company is a petted child of good fortune. The name "American Line" is a charm that brings the company loads of treasure. They fly the American flag, and that is the only thing that distinguishes the line from any of the others trading across the Atlantic. They hire no American help, they purchase nothing here that can be bought at less cost abroad, and they favor no American interest—but they fly the Stars and Stripes. For that they obtain an enormous subsidy from the American Government, and numerous other favors. The postal authorities have lately issued orders that all newspapers for Europe shall be carried by the American Line unless specifically addressed to go by some other line.

A Useful Hand-Book.

The Pennsylvania Railroad Department of the Y. M. C. A. of Pittsburgh, Pa., has gotten out a neat little hand-book that is being gratuitously distributed. The only consideration asked is that the recipient shall appreciate the source through which he becomes the possessor of it.

The book shows, in a general way, the work being done by the Y. M. C. A., and contains, besides the photo-engravings and short biographical sketches of the officers of the Pittsburgh division and the eight "Veterans," much valuable information, among which is a condensed Catechism on Air Brakes, by John R. Alexander, general air-brake inspector of the Pennsylvania Railroad system.

Expert Train Running.

For the month of May the record of train movement on the Baltimore & Ohio Railroad eclipsed the record-breaking record for April, when the passenger trains arrived at their destinations as per schedule ninety-five times out of a possible hundred. The Baltimore & Ohio fast freight trains between New York, Philadelphia and Baltimore on the east, and Cincinnati, St. Louis and Chicago on the west, are being moved with an equal degree of precision.

The Q. & C. Co. have issued an illustrated pamphlet as a means of making announcement that their New York offices have been moved to the American Surety Building, which is the highest building in the city. They say: "Our offices are centrally located, in one of the highest buildings in New York City, convenient to prominent hotels, depots and public buildings, and we extend a cordial invitation to our customers and friends to call upon us and enjoy the splendid scenery afforded by our altitude and location." The pamphlet contains very handsome illustrations of the American Surety Building, and gives a variety of most striking bird's-eye views seen from the building. It is the most striking series of views of New York that we have ever examined. We understand that the pamphlet will be given away to the friends of the company, and we should advise those who are fond of fine views to send for it. Send a two-cent stamp to pay the postage.

The J. A. Fay & Egan Co., the manufacturers of woodworking machinery, of Cincinnati, O., have received, in the face of the strongest European and American competition, a large order for locomotive and railway car shop tools for Russia. This order, amounting to over $10,000, is especially gratifying, inasmuch as it is the second received during the course of a few years.

This is one of our busiest days, and visitors are looked upon askance; but we have lost nearly two valuable hours by rashly looking inside the lurid cover of a book called "Wonderland," published by the passenger department of the Northern Pacific Railroad, for the double purpose of describing the beautiful and interesting places to be reached by the railroad named, and to allure people away from their homes to witness some of the wonders portrayed in the book. It is beautifully illustrated by numerous half-tone engravings. Send six cents in stamps to Charles S. Fee, St. Paul, and you will receive "Wonderland," which you will consider the most wonderful bargain you have ever made.

The Standard Paint Co., of New York, are meeting with much success with their Ruberoid roofing. This material makes a light and extremely elastic roofing. The base of the material is cow-hair felt, which renders it very strong and pliable. It is absolutely free from tar or any deteriorating elements, and is guaranteed for ten years. Mr. J. A. Millholland, president of the George's Creek & Cumberland Railroad, used 24,000 square feet of three-ply Ruberoid roofing on one of his roundhouses some years ago, and he considers it the best roundhouse roofing ever applied.

During the past ten days the New York Belting & Packing Co. have taken orders for installing their interlocking rubber tiling on four steamers and one entire train of cars. The interlocking feature, making it absolutely impossible to displace the tiling, peculiarly adapts this material for use in all places where there is vibration, such as on steamers and railroad trains. Its noiselessness recommends it for vestibules, aisles, corridors, hospitals and court rooms.

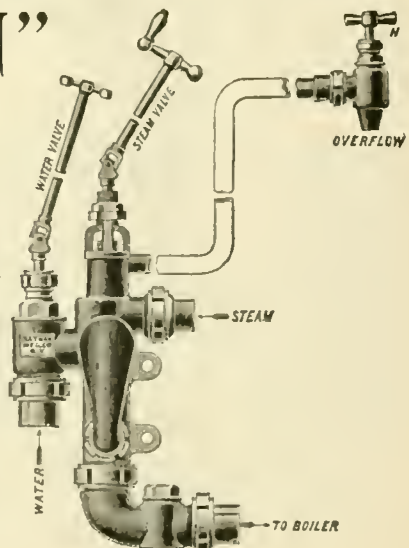
A statement has been issued to the effect that the Otis Steel Co., which has been in the hands of receivers for over a year, has been reorganized under the name of the Otis Steel Co., Limited. Mr. P. J. Benbow, who has been one of the receivers, takes the position as general manager of the reorganized company.

The A. H. Zenner Co., Detroit, Mich., has been reorganized and comes out as the Zenner-Raymond Disinfectant Co. Several strong men are members of the directory, among them being James H. McMillan, of the Peninsular Car Works.

Two patents for improvements in car couplers have been granted to Mr. Chas. H. Taylor, South Orange, N. J. Mr. Taylor is general manager of the Smillie Car Coupler Co. His invention relates to means of opening the knuckle.

INDEX TO ADVERTISEMENTS.

Continued on page 645.



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Daily at 9.00 p. m. from Chicago. New and elegant equipment, built expressly for this service. Train lighted throughout by gas. Tickets and further information of your local ticket agent, or by addressing A. H. HANSON, G. P. A. Ill. Cent. R. R. Chicago, Ill.

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THE BEST IS THE CHEAPEST.

The Star Engine.

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Write for Prices and Circulars.

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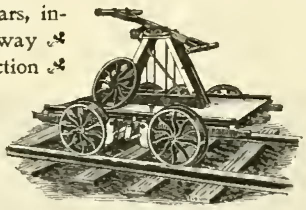
RAILWAY "SAFETY." WEIGHS ONLY 55 POUNDS. BALL BEARINGS AND MADE THROUGHOUT SIMILAR TO ROAD BICYCLE. FURNISHED WITH RUBBER CUSHIONED TIRES.

50 Different Styles of Light Railway Cars, including Steel Velocipedes, New Railway "Safety" Section Hand Cars, Inspection Hand Cars, Steam Inspection Cars, Gasoline Motor Inspection Cars, Rail or Construction Cars, Push Cars, Cane Cars, Steel Sugar Wagons, Metal Surface Cattle Guards, etc.

SEND FOR RED CATALOGUE No. 10. 56 PAGES, 51 ILLUSTRATIONS OF BEST RAILWAY CARS MADE.



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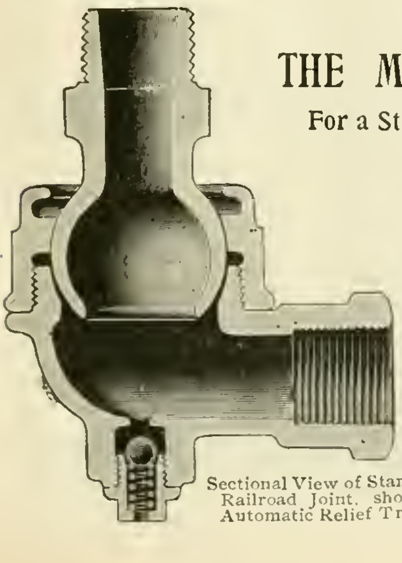

Sectional View of Standard Railroad Joint, showing Automatic Relief Trap.

INDEX TO ADVERTISEMENTS—*Continued.*

Buyers' Finding List.

Air Brake Fittings.
Crane Co., Chicago, Ill.

Air Brake Hose.
Boston Belting Co., Boston, Mass.
N. Y. Belting & Packing Co., New York.

Air Brakes.
Westinghouse Air Brake Co., Pittsburg, Pa.

Air Brake Gage.
Utica Steam Gage Co., Utica, N. Y.

Air-Brake Pump Governors.
Foster Engineering Co., Newark, N. J.

Air Compressors.
Clayton Air Compressor Works, New York.
Ingersoll-Sergeant Drill Co., N. Y. City.
Norwalk Iron Works Co., South Norwalk, Ct.
Pedrick & Ayer Co., Philadelphia, Pa.
Rand Drill Co., New York.
St. Louis Steam Engine Co., St. Louis, Mo.

Air Drilling Machine.
C. H. Haeseler & Co., Philadelphia, Pa.

Air Hoists.
Pedrick & Ayer Co., Philadelphia, Pa.
Whiting Foundry Equipment Co., Chicago, Ill.

Arch Bars.
Cambria Iron Co., Philadelphia, Pa.

Asbestos.
H. W. Johns Mfg. Co., New York.

Axles.
Cambria Iron Co., Philadelphia, Pa.
Gould Coupler Co., Buffalo, N. Y.
B. M. Jones & Co., Boston, Mass.
Krupp (T. Prosser & Son, New York).

Balanced Slide Valves.
Am. Bal. Slide Valve Co., San Francisco, Cal.
M. C. Hammett, Troy, N. Y.

Bearing Metal.
Ajax Metal Co., Philadelphia, Pa.
Paul S. Reeves, Philadelphia, Pa.
U. S. Metallic Pkg. Co., Philadelphia, Pa.

Bell Ringer.
Trumbull Mfg. Co., Warren, O.
U. S. Metallic Packing Co., Philadelphia, Pa.

Belting.
Boston Belting Co., Boston, Mass.
N. Y. Belting & Packing Co., New York.
Shultz Belting Co., St. Louis, Mo.

(*Continued on page 646.*)

BUYERS' FINDING LIST—*Continued.*

Boiler and Firebox Steel.
Shoenberger Steel Co., Pittsburg, Pa.
Boiler Checks—Inside.
Foster Engineering Co., Newark, N. J.
Boilers.
Pittsburg Locomotive Works, Pittsburg, Pa.
Boiler Iron.
Ewald Iron Co., St. Louis, Mo.
Boiler Testers.
Rue Mfg. Co., Philadelphia, Pa.
Boiler Tools.
Richard Dudgeon, New York.
Hilles & Jones Co., Wilmington, Del.
Long & Allstatter Co., Hamilton, O.
Boiler Washers.
Nathan Mfg. Co., New York.
Rue Mfg. Co., Philadelphia, Pa.
Bolt Machinery.
Acme Machinery Co., Cleveland, O.
Bolt Threading Machinery.
Detrick & Harvey Machine Co., Baltimore, Md.
Books.
H. C. Baird & Co., Philadelphia, Pa.
Open Court Pub. Co., Chicago, Ill.
Philadelphia Book Co., Philadelphia, Pa.
D. Van Nostrand Co., New York City.
Brake Adjusters.
Q. & C. Co., Chicago, Ill.
Brake Shoes.
Ramapo Iron Works, Hillburn, N. Y.
Ramapo Wheel & Foundry Co., Ramapo, N.Y.
Brass Castings.
Ajax Metal Co., Inc., Philadelphia, Pa.
Paul S. Reeves, Philadelphia, Pa.
Buffers.
Gould Coupler Co., Buffalo, N. Y.
Bulldozers.
Williams, White & Co., Moline, Ill.
Cab Seats
Stannard & White, Appleton, Wis.
Cars.
Allison Mfg. Co., Philadelphia, Pa.
Lima Locomotive & Machine Co., Lima, O.
Ramapo Iron Works, Hillburn, N. Y.
Car Couplers.
Gould Coupler Co., Buffalo, N. Y.
McConway & Torley Co., Pittsburg, Pa.
National Malleable Castings Co., Chicago, Ill.
St. Louis Car Coupler Co., St. Louis, Mo.
Sams Automatic Coupler Co., Denver, Col.
Smillie Coupler & Mfg. Co., Newark, N. J.
Standard Coupler Co., New York.
Trojan Car Coupler Co., Troy, N. Y.
Car Heating.
William C. Baker, New York.
Gold Car Heating Co., New York.
Safety Car Heating & Lighting Co., New York.
Car Lighting.
Safety Car Heating & Lighting Co., New York.
Car Paints.
Detroit White Lead Works, Detroit, Mich.
Car Roofing.
P. H. Murphy Mfg. Co., E. St. Louis, Ill.
Standard Paint Co., New York.
Warren Chemical & Mfg. Co., New York.
Car Seats.
Hale & Kilburn Mfg. Co., Philadelphia, Pa.
Car Ventilators.
M. C. Hammett, Troy, N. Y.
Car Wheels.
Kalamazoo R. R. Velocipede & Car Co., Kalamazoo, Mich.
Krupp (T. Prosser & Son, New York).
Lima Locomotive & Machine Co., Lima, O.
Ramapo Wheel & Foundry Co., Ramapo, N.Y.
Standard Steel Works, Philadelphia, Pa.
Washburn Car Wheel Co., Hartford, Conn.
Cattle Guards.
Q. & C. Co., Chicago, Ill.
Chain Pulley Blocks.
Moore Mfg. & Fdy. Co., Milwaukee, Wis.
Chime Whistles.
Crosby Steam Gage & Valve Co., Boston, Mass.
Star Brass Mfg. Co., Boston, Mass.
Clocks.
John J. McGrane, New York.
Coal Handling Machinery.
Link Belt Engineering Co., Philadelphia, Pa.
Coal Chutes.
Williams, White & Co., Moline, Ill.
Correspondence Schools.
Internat'l Corres. Schools Scranton, Pa.
The Scientific Machinist Co., Cleveland, O.
Corundum Wheels.
Sterling Emery Wheel Mfg. Co., Tiffin, O.
Cranes.
Manning, Maxwell & Moore, New York.
Maris Bros., Philadelphia, Pa.
William Sellers & Co., Philadelphia, Pa.
Whiting Foundry Equipment Co., Chicago, Ill.
R. D. Wood & Co., Philadelphia, Pa.

(*Continued on page 647.*)

BUYERS' FINDING LIST—*Continued.*

Crank Pin Gages.
M. C. Hammett, Troy, N. Y.

Crank Pins.
Cambria Iron Co., Philadelphia, Pa.
B. M. Jones & Co., Boston, Mass.
Krupp (T. Prosser & Son, New York).

Drills.
Cleveland Twist Drill Co., Cleveland, O.
Standard Tool Co., Cleveland, O.

Drilling Machines.
J. T. Connelly, Milton, Pa.
Gould & Eberhardt, Newark, N. J.

Electric Lighting and Power Apparatus.
Westinghouse Elec. & Mfg. Co., Pittsburgh, Pa.

Emery Wheels.
Sterling Emery Wheel Mfg. Co, Tiffin, O.

Enamel.
Detroit White Lead Works, Detroit, Mich.

Engines.
St. Louis Steam Engine Co., St. Louis, Mo.

Engravings.
Bradley & Poates, New York.
Standard Engraving Co., New York.

Exhaust Pipe.
The General Agency Co., New York.

Expanding Mandrel.
Geo. L. Weiss, Cleveland, O.

Files and Rasps.
Arcade File Works, Anderson, Ind.
Nicholson File Co., Providence, R. I.

Filters.
A. Major, New York.

Fire Kindlers.
J. S. Leslie, Paterson, N. J.

Flexible Shaft.
Stow Flexible Shaft Co., Philadelphia, Pa.

Flexible Steam Joint.
Moran Flexible Steam Joint Co., Louisville, Ky.

Flues and Tubes.
Allison Mfg. Co., Philadelphia, Pa.
Tyler Tube & Pipe Co., Washington, Pa.

Forges.
Buffalo Forge Co., Buffalo, N. Y.

Forging Machinery.
Williams, White & Co., Moline, Ill.

Foundry Equipment.
Whiting Foundry Equipment Co., Chicago, Ill.

Frogs and Crossings.
Ramapo Iron Works, Hillburn, N. Y.

Graphite.
Jos. Dixon Crucible Co., Jersey City, N. J.

Heating System for Shops.
Buffalo Forge Co.
B. F. Sturtevant Co., Boston, Mass.

Hoisting Engines.
Earle C. Bacon, New York.

Hollow Staybolts.
Falls Hollow Staybolt Co., Cuyahoga Falls, O.

Hydraulic Tools.
Richard Dudgeon, New York.
Watson & Stillman, New York.
R. D. Wood & Co., Philadelphia, Pa.

Indicators.
Crosby Steam Gage and Valve Co., Boston.

Injectors.
Automatic Injector Co., Cincinnati, O.
Hancock Inspirator Co., Boston, Mass.
Hayden & Derby Mfg. Co., New York.
Nathan Mfg. Co., New York.
Ohio Injector Co., Chicago, Ill.
Rue Mfg. Co., Philadelphia, Pa.
William Sellers & Co., Philadelphia, Pa.

Jacks
E C. Boyer, Dayton, O.
Richard Dudgeon, New York.
A L. Henderer, Wilmington, Del.
A. O. Norton, Boston, Mass.
Watson & Stillman, New York.

Laggings for Locomotives.
H. W. Johns Mfg. Co., New York
Keasbey & Mattison Co., Ambler, Pa.

Locomotives.
Baldwin Locomotive Works, Philadelphia, Pa.
Brooks Locomotive Works, Dunkirk, N. Y.
Cooke Loco. & Machine Co., Paterson, N. J.
Dickson Mfg. Co., Scranton, Pa.
Lima Locomotive & Machine Co., Lima, O.
Pittsburg Locomotive Works, Pittsburg, Pa.
H. K. Porter & Co., Pittsburg, Pa.
R. I. Locomotive Works, Providence, R. I.
Richmond Loco. & Mch. Wks., Richmond, Va.
Rogers Locomotive Works, Paterson, N. J.
Schenectady Loco. Wks., Schenectady, N. Y.

Lubricators
Detroit Lubricator Co., Detroit, Mich.
M. C. Hammett, Troy, N. Y.
Nathan Mfg. Co., New York.

Lubricating Oils.
Galena Oil Works Ltd., Franklin, Pa.
Leonard & Ellis, New York.
Signal Oil Works, Franklin, Pa.

(*Continued on page 648*).

BUYERS' FINDING LIST—*Continued.*

Machine Tools.
Bement, Miles & Co., Philadelphia, Pa.
Detrick & Harvey Mach. Co., Baltimore, Md.
W. D. Forbes & Co., Hoboken, N. J.
Gould & Eberhardt, Newark, N. J.
Hilles & Jones Co., Wilmington, Del.
Jones & Lamson Machine Co., Springfield, Vt.
Manning, Maxwell & Moore, New York.
National Machinery Co., Tiffin, O.
Newton Machine Tool Wks., Philadelphia, Pa.
Niles Tool Works Co., Hamilton, O.
Geo. Place, New York.
Pratt & Whitney Co., Hartford, Conn.
Prentiss Tool and Supply Co., New York.
William Sellers & Co., Inc., Philadelphia, Pa.

Mechanics' Tools.
Armstrong Bros. Tool Co., Chicago, Ill.
Keystone Mfg. Co., Buffalo, N. Y.
Chas. A. Strelinger & Co., Detroit, Mich.

Metal Polish.
G. W. Hoffman, Indianapolis, Ind.

Metal Sawing Machines.
Pratt & Whitney Co., Hartford, Conn.
Q. & C. Co., Chicago, Ill.

Milling Machines.
Cincinnati Milling Machine Co., Cincinnati, O.
Pratt & Whitney Co., Hartford, Conn.

Mining Machinery.
Earle C. Bacon, New York.

Molding Machines.
Tabor Mfg. Co., New York City.

Over Clothes.
H. S. Peters, Dover, N. J.

Packing.
Boston Belting Co., Boston, Mass.
Gould Packing Co., East Cambridge, Mass.
H. W. Johns Mfg. Co., New York.
Jenkins Bros., New York.
N. Y. Belting & Packing Co., New York.
U. S. Metallic Packing Co., Philadelphia, Pa.

Paints.
Standard Paint Co., New York.
Detroit White Lead Works, Detroit, Mich.
Detroit Graphite Mfg. Co., Detroit, Mich.
H. W. Johns Mfg. Co., New York.

Patents.
John Wedderburn & Co., Washington, D. C.
George P. Whittlesey, Washington, D. C.

Perforated Metal.
Aitchison Perforated Metal Co., Chicago, Ill
A. J. Beckley & Co., Meriden, Conn.
The Hendrick Mfg. Co., Ltd., Carbondale, Pa.

Photographs.
F. Moore, London, Eng.

Pipe Threading and Cutting Machinery.
Bignall & Keeler Mfg. Co., Edwardsville, Ill.
Armstrong Mfg. Co., Bridgeport, Conn.
D. Saunders' Sons, Yonkers, N. Y.

Piston Rods.
Cambria Iron Co., Philadelphia, Pa.
B. M. Jones & Co., Boston, Mass.
Thomas Prosser & Son, New York.

Pneumatic Tools.
Chicago Pneumatic Tool Co., Chicago, Ill.
C. H. Haeseler & Co., Philadelphia, Pa.

Pressed Steel Materials
Schoen Mfg. Co., Pittsburg, Pa.

Pressure Regulators.
Foster Engineering Co., Newark, N. J.
Newark Regulator Co., Newark, O.

Pump Valves.
Boston Belting Co., Boston, Mass.
N. Y. Belting & Packing Co., New York.

Punching and Shearing Machinery.
Hilles & Jones Co., Wilmington, Del.
Long & Allstatter Co., Hamilton, O.
Williams, White & Co., Moline, Ill.
R. D. Wood & Co., Philadelphia, Pa.

Railway Fences.
Page Woven Wire Fence Co., Adrian, Mich.

Railway Gates.
Standard Ry. Gate Co., Saginaw, Mich.

Regulators.
Mason Regulator Co., Boston, Mass.

Retaining Rings
Ramapo Wheel & Foundry Co., Ramapo, N. Y

Rubber.
Boston Belting Co., Boston, Mass.
N. Y. Belting & Packing Co., New York.

Rust Preventing Compound.
Otto Goetze, New York.

Safety Valves.
Ashton Valve Co., Boston, Mass.
Coale Muffler and Safety Valve Co., Baltimore, Md.
Consolidated Valve Co., Bridgeport, Conn.
Crosby Steam Gage & Valve Co., Boston, Mass.
Star Brass Mfg. Co., Boston, Mass.

Sending Apparatus.
Henry L. Leach, North Cambridge, Mass.
Sherburne & Co., Boston, Mass.

Shafting.
William Sellers & Co., Philadelphia, Pa.

(Continued on page 649).

BUYERS' FINDING LIST—*Continued.*

Smoke Jack.
Bruyn's Auto. Smoke Jack Co., Waverly, O.

Spark Arrester Plate.
A. J. Beckley & Co., Meriden, Conn.
Hendrick Mfg. Co., Carbondale, Pa.

Springs.
A. French Spring Co., Pittsburg, Pa.

Spring Steel.
Thomas Prosser & Son, New York.

Stay-Bolts.
Ewald Iron Co., St. Louis, Mo.
Falls Hollow Stay-Bolt Co., Cuyahoga Falls, O
B. M. Jones & Co., Boston, Mass.

Steam Gages.
Crosby Steam Gage & Valve Co., Boston.
Star Brass Mfg. Co., Boston, Mass.
Utica Steam Gage Co., Utica, N. Y.

Steam Hammers.
Bement, Miles & Co., Philadelphia, Pa.

Steam Hose.
Boston Belting Co., Boston, Mass.
N. Y. Belting & Packing Co., New York.

Steam Pumps.
A. S. Cameron Steam Pump Works, New York.

Steel.
Cambria Iron Co., Philadelphia, Pa.
Carbon Steel Co., Pittsburgh, Pa.
Ewald Iron Co., St. Louis, Mo.
B. M. Jones & Co., Boston, Mass.
Krupp (T. Prosser & Son, New York).
Latrobe Steel Co., Latrobe, Pa.
Schoen Mfg. Co., Pittsburg, Pa.
Shoenberger Steel Co., Pittsburg, Pa.

Steel Tired Wheels.
Krupp (T. Prosser & Son, New York).
Ramapo Wheel & Foundry Co., Ramapo, N. Y
Standard Steel Works, Philadelphia, Pa.
Washburn Car Wheel Co., Hartford, Conn.

Steel Tires.
Latrobe Steel Works, Latrobe, Pa.
Krupp (T. Prosser & Son, New York).
Standard Steel Works, Philadelphia, Pa

Steel Truck Frames.
Fox Solid Pressed Steel Co., Chicago, Ill.

Stocks and Dies.
Armstrong Mfg. Co., Bridgeport, Conn.

Switches.
Ramapo Iron Works, Hillburn, N. Y.

Tie Plates.
Q. & C. Co., Chicago, Ill.

Tires.
Krupp (T. Prosser & Son, New York).
Latrobe Steel Co., Philadelphia, Pa.

Tool Holders.
Armstrong Bros. Tool Co., Chicago, Ill.
Gould & Eberhardt, Newark, N. J.

Tool Steel.
B. M. Jones & Co., Boston, Mass.

Tube Expanders.
A. L. Henderer, Wilmington, Del.

Turnbuckles.
Cleveland City Forge & Iron Co., Cleveland O.

Turret Machines.
Jones & Lamson, Springfield, Vt.

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Cleveland Twist Drill Co., Cleveland, O.
Standard Tool Co., Cleveland, O.

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Ashton Valve Co., Boston, Mass.
Coale Muffler and Safety Valve Co., Baltimore, Md.
Jenkins Bros., New York.
Ross Valve Co., Troy, N. Y.
Star Brass Mfg. Co., Boston, Mass.

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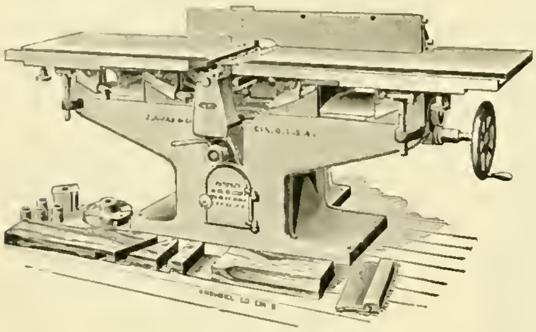

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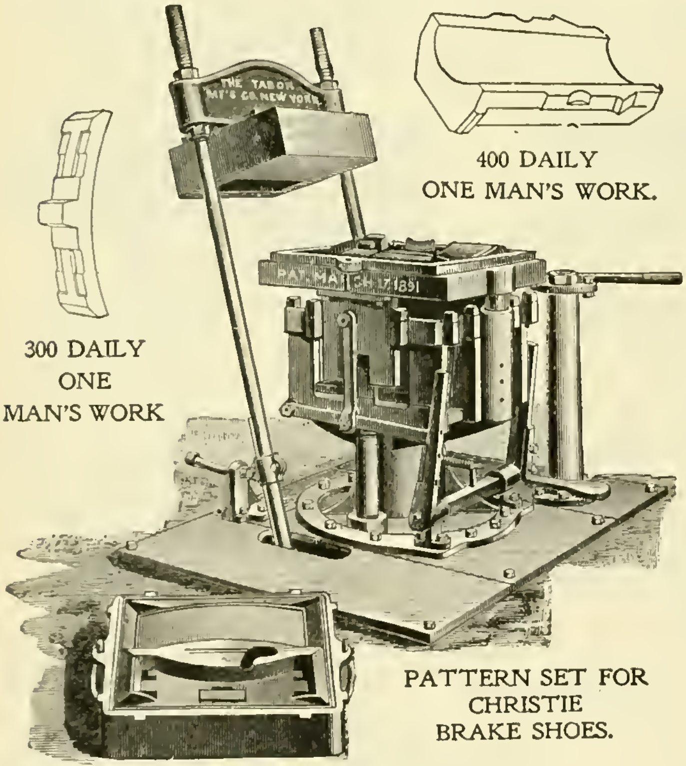

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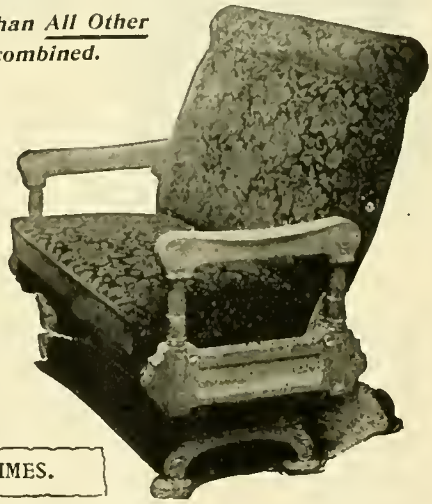

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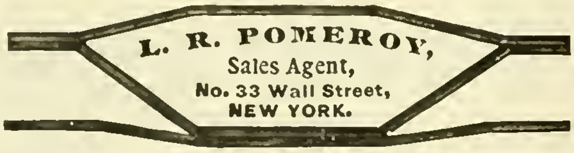

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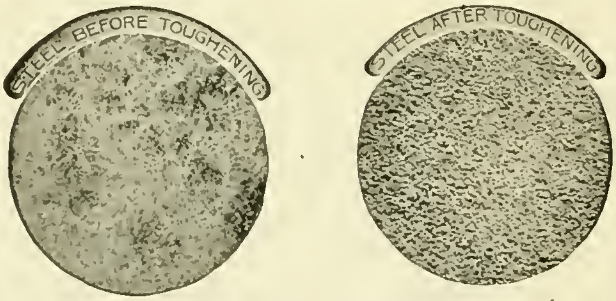

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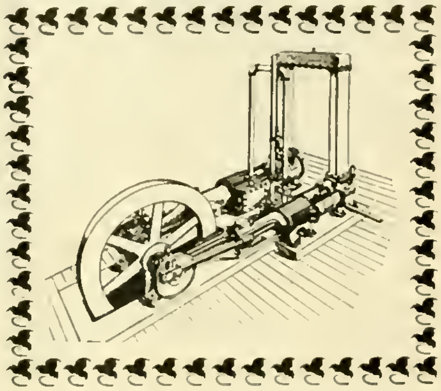

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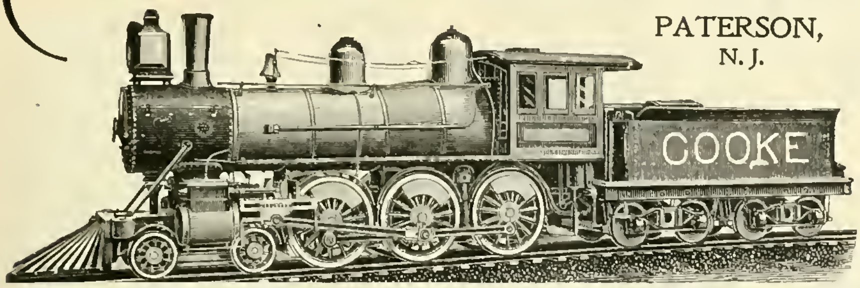

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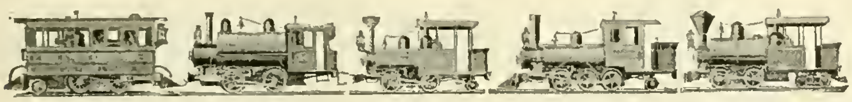

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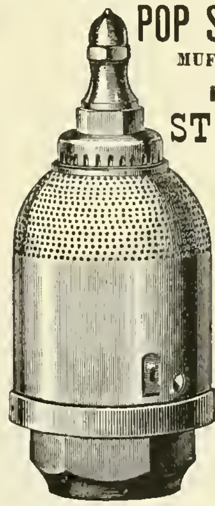

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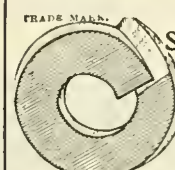

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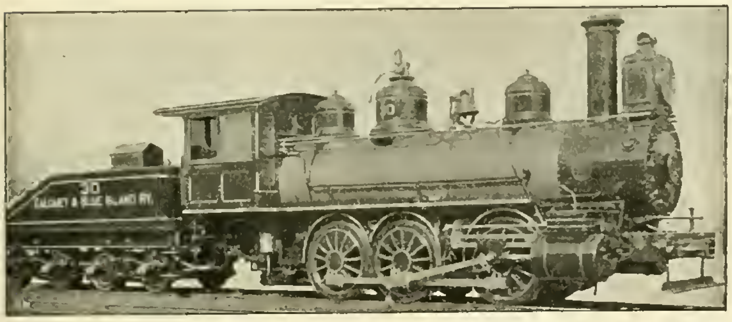

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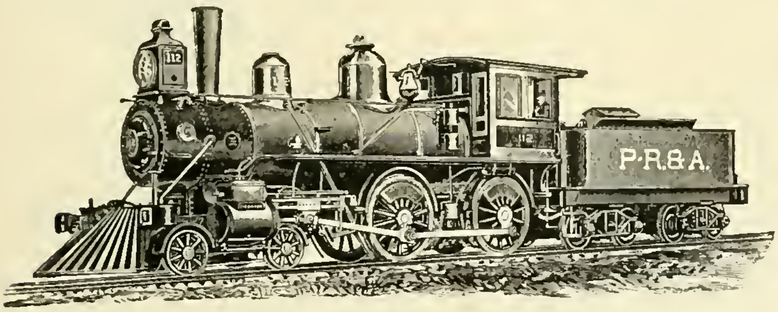

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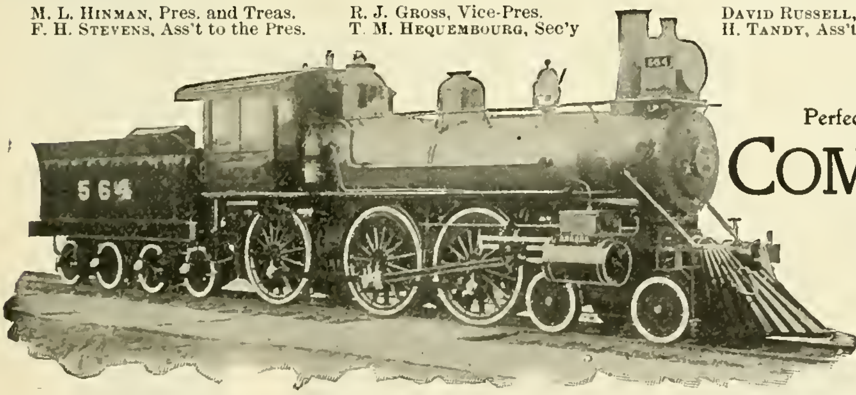

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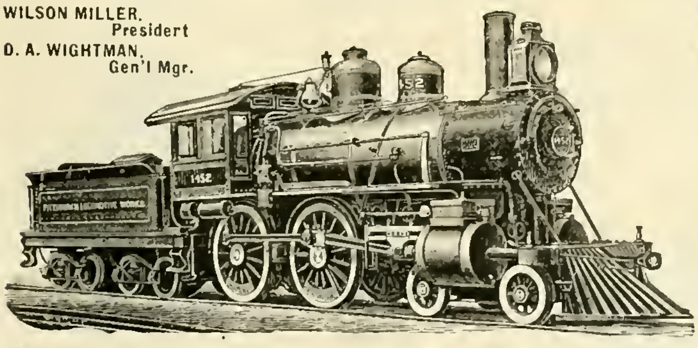

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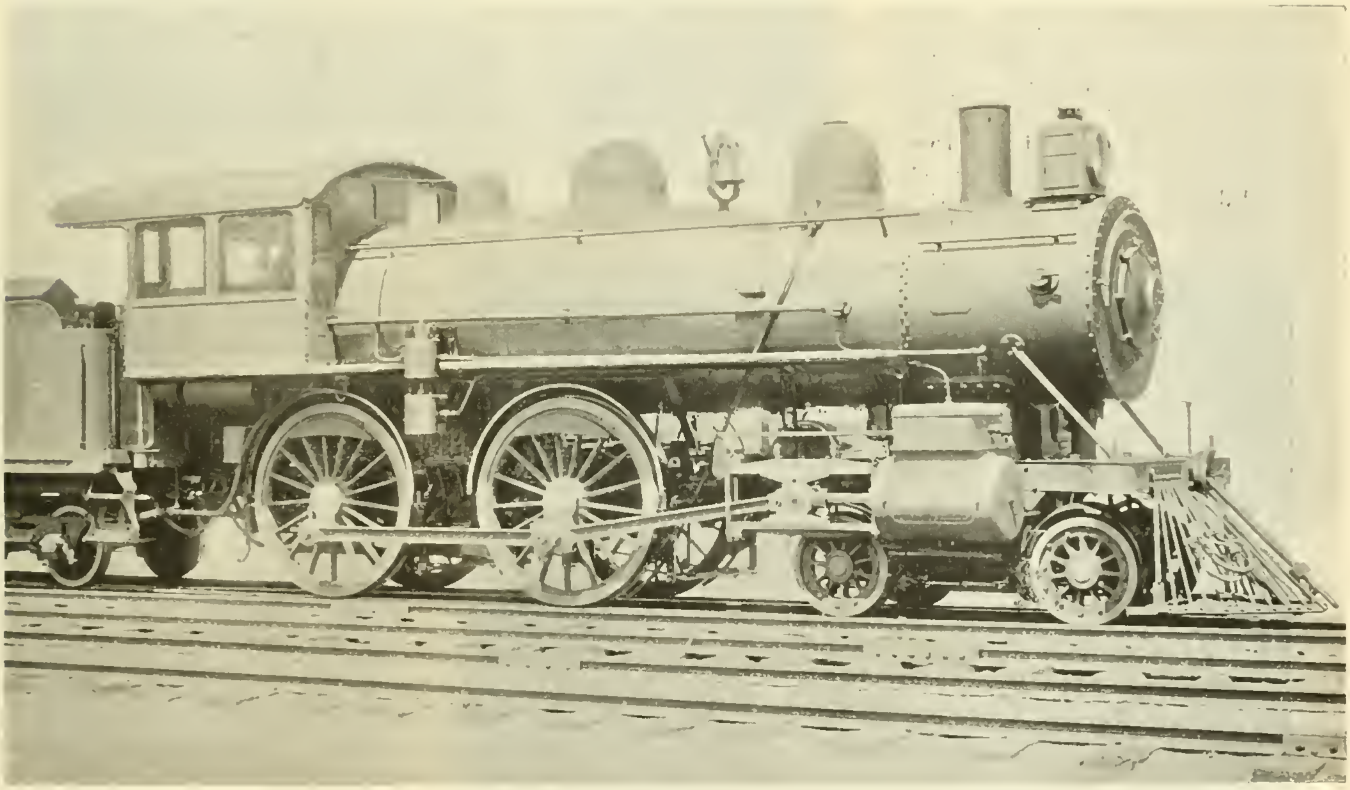
[Trade-Mark Registered.]
Vol. IX. NEW YORK, AUGUST, 1896. No. 8.

New York, New Haven & Hartford Passenger Engines.

The annexed engraving illustrates a splendid passenger engine, one of eight recently built by the Schenectady Locomotive Works for the New York, New Haven & Hartford Railroad Co.



NEW EXPRESS LOCOMOTIVE FOR N. Y., N. H. & H. RAILROAD.

The engines were built to specifications furnished by Mr. John Henny, Jr., superintendent of motive power, and are for service on the heavy fast express trains between New York and Boston. Several of the engines are already in service and are doing splendid work, and are attracting a great deal of attention by their handsome appearance and persistence in keeping trains on time.

The engines have cylinders 20 x 24 inches, driving wheels 73 inches inside diameter, and carry boiler pressure of 190 pounds per square inch. A little calculation will show that these dimensions produce a remarkably powerful engine, which is as efficient in starting a heavy train as it is likely to be in keeping it going at high speed under the most adverse circumstances of severe weather and hard-pulling trains. The cylinder capacity, with size of driving wheels, make the engine capable of exerting 170 pounds tractive force for every pound of mean effective steam pressure in the cylinders. This gives about 30,000 pounds of tractive force in starting. The bearings and rubbing parts of the engines have been designed to make cool running a certainty, and the best of material has been specified throughout. The driving axles of Taylor iron have bearings 9 x 12 inches; the crank pins, which are of Krupp crucible steel, have journals 6 x 6 inches in diameter, and the side-rod pins of the same material have journals 5 x 4½ inches. The engine-truck axles have journals 6 x 12 inches. The pistons are of cast steel, and the rods of Taylor iron 3¼ inches in diameter.

The driving-wheel centers are of cast steel of a very neat pattern. Richardson's balanced valves are employed on valve seats, with steam ports 20 x 1⅜ inches and exhaust port 20 x 3 inches. The greatest valve travel is 6 inches; outside lap, 1⅛ inches. A peculiarity about the valve motion is that it is set with $\frac{1}{16}$-inch lead in full gear, forward, and ¼-inch lap, full gear, back motion. As most people know, this tends to hasten port opening at the beginning of the stroke, in forward motion.

Great care has been exercised to provide all the best-known appliances for economy and convenience in handling of the engines, and everything in the cab is arranged very conveniently for the men operating the engines—and these appear to appreciate the conveniences supplied.

The Westinghouse-American brake is applied to all drivers, and also to engine-truck wheels. Two 3-inch consolidated safety valves relieve the boiler—one mufiled and one cased. The boiler is covered with magnesia sectional covering.

The Leach sanding device and consolidated car-heating apparatus are on all the engines. The tender is equipped with a water scoop for picking up water while the train is in motion. Two Metropolitan injectors, Model "E," are used.

The boiler, as will be noticed from the engraving, is of the extended wagon-top style, and is $62\frac{3}{8}$ inches diameter at the first ring. Carbon firebox steel is used—not only for the inside of the firebox, but for the whole of the boiler. The shell is made of $\frac{11}{16}$-inch plate, the waist and throat are of $\frac{11}{16}$-inch plate, and the balance $\frac{1}{2}$ inch. The horizontal seams are butt joints sextuple-riveted, with welt strip inside and outside. The circumferential seams are double-riveted. The length of the firebox is $108\frac{8}{16}$ inches, width $40\frac{1}{4}$ inches, depth 73 inches forward and $59\frac{1}{2}$ inches at the back. The side sheets are $3\frac{1}{2}$ inches, back sheet $\frac{5}{16}$ inch, crown sheet $\frac{3}{8}$-inch, and tube sheet $\frac{1}{2}$-inch thick. The crown is secured by radial stays 1-inch in diameter, of Taylor iron, and all the other staybolts are of the same material and the same thickness. There are 312 two-inch tubes 12 feet long. These give a heating surface of 1,946.72 square feet and the firebox 167.52 square feet of heating surface, making a total of 2,114.24 square feet. The grate area is 30.22 square feet. The tender carries 4,500 gallons of water and $8\frac{1}{2}$ tons of coal.

Both designer and builders deserve credit for the production of these highly efficient locomotives.

The Eastern Railway of France is experimenting with acetylene gas for lighting cars. So far as they have gone, they do not find acetylene to be very economical.

Staybolt Seating Machine.

BY JOHN RANDOL.

This machine, designed by Mr. R. Wells, superintendent of the Rogers Locomotive Works, Paterson, N. J., and in constant use at those shops, is not only unique, but meets an extremely exacting set of conditions in a very satisfactory manner, and is well worthy of careful consideration by machine designers as well as by firebox boiler makers.

Mr. Wells could not give exact figures as to the saving effected by the use of his machine, but I should say that it reduced the cost of seating the crown staybolts of a locomotive boiler at least one-half, while doing even better work than is commonly done by hand.

Unfortunately for photographic purposes, the Rogers boiler shops are lighted from overhead in every direction, so as to make it impossible to obtain a really good picture of the staybolt seating machine from any point of view. Figs. 1, 2 and 3 are reproductions of the best of some six or eight pictures taken, though they leave much to be desired.

The frame of the machine is made of two beams of] shape, about 12 inches deep by $\frac{3}{4}$ inch thick, with $3\frac{1}{2}$-inch flanges; these frame beams are bolted one

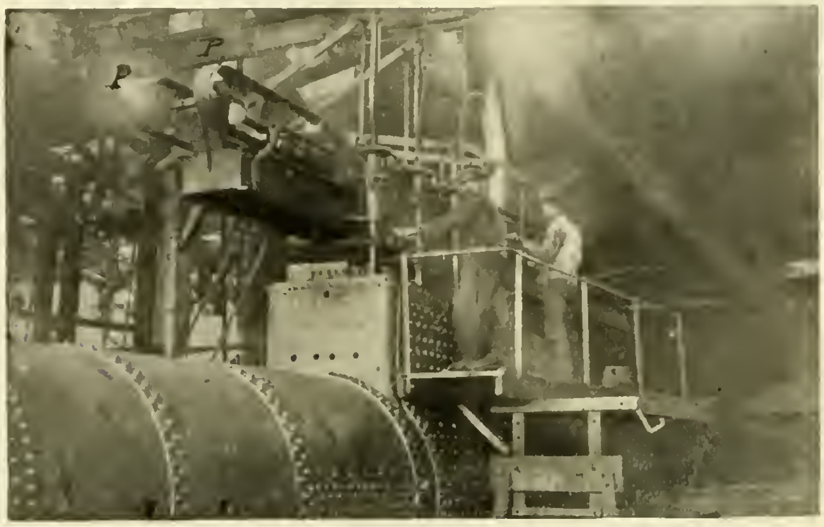


Fig. 1. WELLS STAYBOLT-SEATING MACHINE.

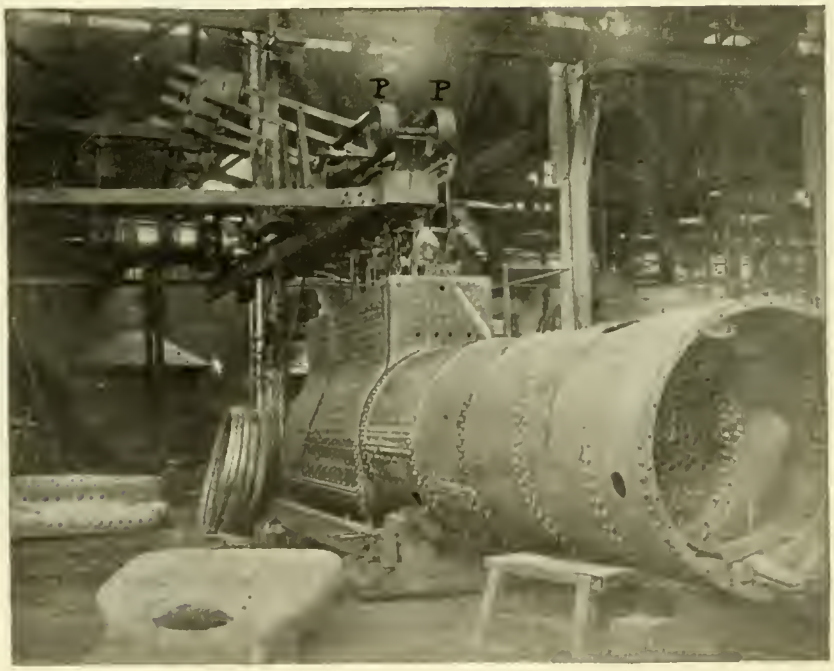


Fig. 2. WELLS STAYBOLT-SEATING MACHINE.

on each side of one of the iron traveling-crane-way supports of the shop, about 10 feet clear of the floor, so that they project 16 feet clear of the iron pillar over the working space covered by the crane; they also project eight or ten feet on the other side of the pillar, to which they are braced in front as shown in Fig. 3.

On these wrought beams, as a sole plate, four exactly similar spindle-carrying saddles are placed; these saddles can be adjusted to and secured in any desired position on the beams. The spindles are about 3-inch diameter, and long enough to have 42-inch vertical travel; they are almost exactly balanced by weighted levers; the weights have a small automatic travel on the balancing levers, as will be afterward explained, so that in working positions the weights just balance the spindles, while in extreme up idle position the spindles are a little overbalanced, which retains them at the high point so long as they are not touched.

The drive is had through two horizontal belts from the countershaft carried on the sole beams at the left hand of Fig. 3, one belt being crossed over the idle pulley at *I*, on the pillar, Fig. 3, and running at twice the speed of the other horizontal belt, which does not show in Fig. 3, and is straight, so that the two horizontal belts run in contrary directions. These driving belts are looped under idlers around loose clutch pulleys on short horizontal shafts carried on each spindle saddle, as partly shown in Fig. 3, and these horizontal shafts have each a hand-lever-operated clutch on a feather between the two belt-driven pulleys; all so arranged that by

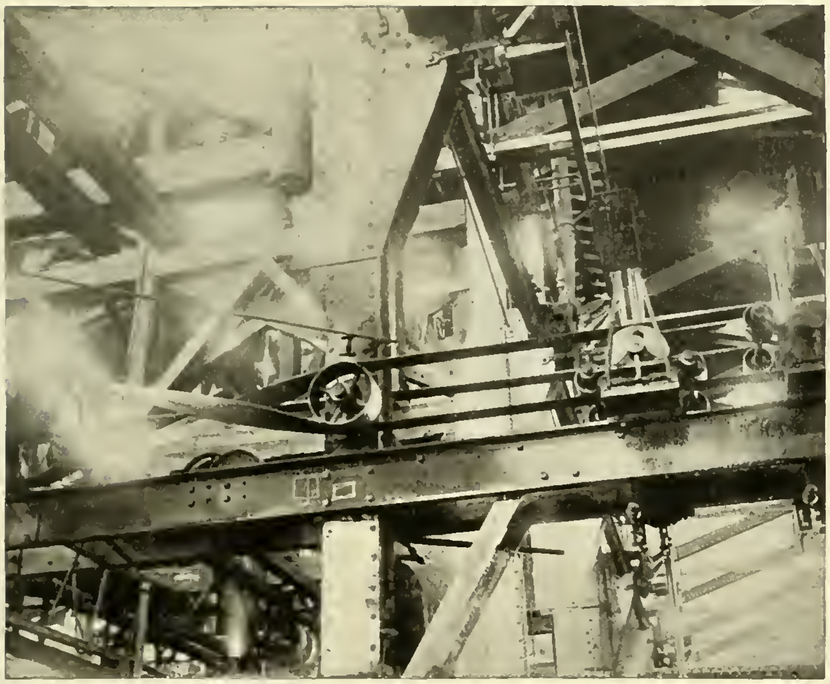
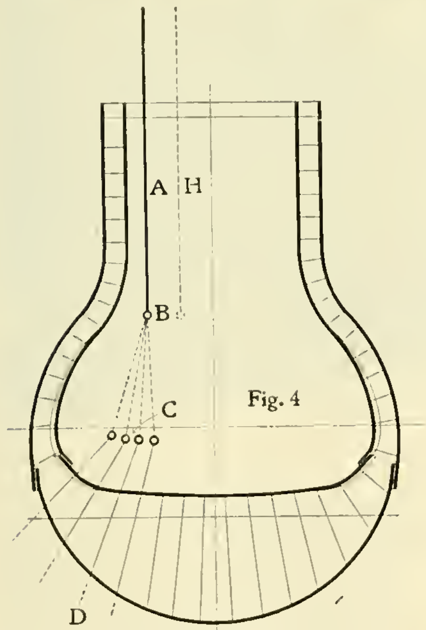


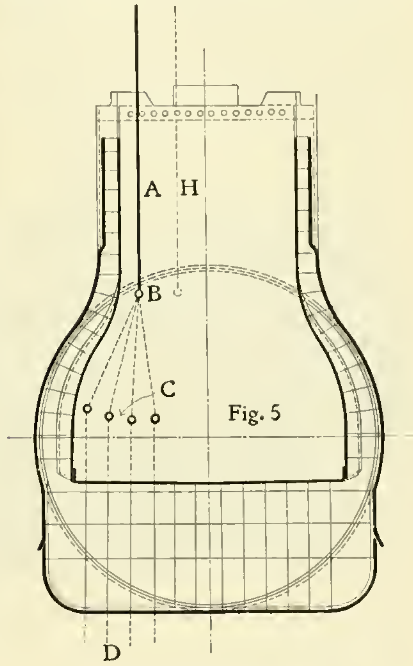
Fig. 3. WELLS STAYBOLT-SEATING MACHINE.



RADIAL STAY FIREBOX.

throwing the clutch levers one way the horizontal shafts are driven forward, and by throwing it the other way they are driven backward at double the forward speed. The clutch-shifting hand lever, shown in Fig. 1, is notched on the under side, and slides in a slotted guide having a projection to fit the hand-lever notches so that the hand levers stay where they are left until lifted and moved. The horizontal driving belts are carried over supporting idle pulleys *P P*, Figs 1 and 2, at the inner end of the sole beams, the effect of the whole arrangement being to drive the short horizontal shaft of each of the four spindle-carrying saddles in either direction at will, in any position on the sole beams, or to cause it to stand still by placing the feathered clutch sleeve in middle position between the belted clutch pulleys. Each of the two horizontal belts thus drives four clutch pulleys, two in the top stretch of each belt and two in the bottom stretch, which brings the belt-looping idle pulleys (see Fig. 3) alternately top and bottom, and so permits the spindle centers to be adjusted closer to each other than if the pulleys were all four of them driven from either the single top or bottom stretch of the horizontal driving belt. Each of the horizontal shafts carries a bevel pinion which meshes with a large bevel driving gear splined on the top end of a quill supported in vertical journals on the saddle, through which the vertical working spindles slide drill-spindle fashion, each spindle being universal-jointed at its top to its balance weight lever, Figs. 1 and 2. Each balance lever is prolonged in front of the spindle joint, and has pivoted to its front end, next the operator, a suspended hand rod with a hand loop at the lower end, by which the spindle can be rapidly raised or lowered; the spindle quills are fitted with racks and pinions, the latter being driven from a worm and worm gear driven feed shaft, which gives an independent feed motion to each of the spindles.

The lower end of each spindle has universally jointed to it a downward telescoping extension, which can be placed at



BELPAIRE FIREBOX.

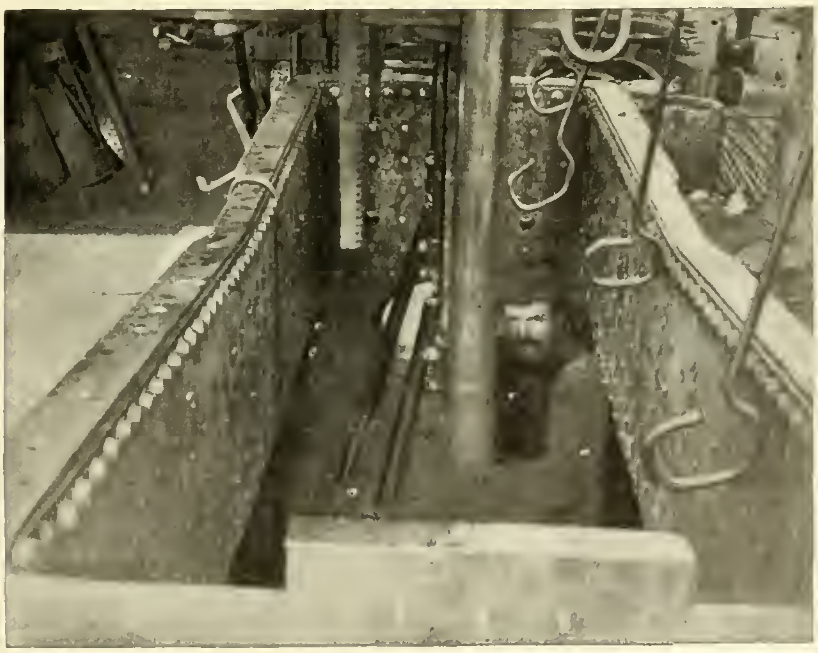


Fig. 6. LOOKING INTO FIREBOX.

any angle up to about 60 degrees from the vertical line of the spindle, and has a telescopic adjustment of 18 inches in its length. The drive is strong enough for tapping and reaming up to 1½-inch diameter, and the spindle feed may be either by hand or automatic.

The stage on which the workmen stand in Fig. 1 is pivoted to a sliding saddle on the jib of a small crane, near one end, and supported at the free end by a horse having a pin-and-hole adjusted false beam, quite clearly shown in Fig. 1. Two men stand on this stage, and two more work inside of the firebox of the boiler under treatment, as shown in Fig. 6, where the hand of the workman is seen grasping a telescopic spindle extension which stands off at an angle to the left. It is much to be regretted that better photographs could not be obtained, and that no drawings of this unique machine were ever made. Like almost all special tools made for use in the shop where they are built, no drawings of this staybolt-seating machine exist, nor could the cost of the machine be given. I should say that a cash outlay of about $500 would duplicate it in the Rogers shops, where the patterns are ready for use.

Mr. Wells very kindly had the drawings reproduced in Figs. 4 and 5 made to show the drive of the taps and reamers at various angles as required for seating staybolts in the Belpaire and wagon-top styles of boilers, and also furnished the following particulars of construction, arrangement and operation, which will greatly aid in a full understanding of this remarkable and extremely useful new tool.

A shows the position of one of the four spindles from an end view of the firebox, when in position for reaming, tapping and screwing in the crown stays. *B* is a universal joint at the lower end of the spindle. *C* is another universal joint at the lower end of a telescopic connection piece between *B* and *C*. This connection is adjustable in its length from 24 to 40 inches, in case the vertical motion of 42 inches of the spindle *A* is not sufficient to bring the reamers and taps to the required position for work. The joint at *C* has a socket in its lower part, with a square hole to receive the square of the reamers, taps, facing tool and the heads of the crown stays to be screwed in.

The reamers and taps are made of a length *C* to *D* to operate on both sheets at the same time, and the stem of the rose-reamer, for facing the crown sheet around the hole so as to give the stays which have heads on them a perfect bearing between head and sheet, also extends through both sheets to *D*, insuring a good fit of the head and sheet around the hole.

The universal joints at *B* and *C* allow the taps and reamers and stays to assume any angular position that may be necessary to enable them to pass through the holes in the two sheets, as shown in the sketches. As the boiler is bottom side up on a low-wheeled truck, it is easily moved in a lateral direction; for instance, to the left, which would then bring the spindle *A* to the dotted line *H*, and so on until all the holes to be operated on come within the range of the machine, requiring perhaps three small movements of the boiler in that direction. The spindles and their carriages are movable at will, independently of each other, in the direction of the length of the firebox, on the 16-foot overhang of the ways of the machine, as may be needed. The spindles will work as close together as 12 inches between centers, and as far apart as the total length of the ways will admit.

The spindles and their attachments are balanced by movable weights on levers, as shown in Figs. 1 and 2. The weights rest on rollers and have a limited travel on the lever, so that when the spindle is down far enough for the tap to begin cutting, the balance weights will run inward (down grade) towards the fulcrum about 1 inch, leaving the spindles then in perfect balance, so as to follow the tap free from any pull up or down. When the spindle is raised up to the top limit of its motion, the part of the lever where the balance weight is located is inclined in the opposite direction, and the weight runs outward the limit of its 1 inch of travel, increasing its leverage, and the spindle then remains in that up position until pulled down again by the operator, when the weight again automatically adjusts itself to the requirements of the operation. Each spindle is fitted with an independent rack and pinion feed and friction clutch, for feeding when reaming or facing the sheet for the head of the stays. When the reamer or the facing tool is at the point where it begins to cut, this feed clutch is thrown in by the operator; and when the reaming is completed, it is thrown out and the spindle raised up for the next hole, and so on.

For convenience in operating, a platform about 2 x 10 feet, secured on a low crane jib, is swung around against one side of the firebox, on which the operators stand, usually two, when operating the four spindles at a time.

The spindles are reversible in their motion, each independently of the other, and are driven by friction clutches; the backing speed for running taps out is double the working speed. The countershaft for driving the machine has two different speeds to suit the diameters of taps or reamers used.

Endless belts are used for both the cutting and backing motions; the backing motion, however, is only required for backing out the taps. In screwing in the crown stays, which are made of a diameter at their upper end small enough to pass through the hole in the crown sheet, and of such a length that the thread on the upper end engages before that at the crown sheet, they are put in place and screwed in about one thread by hand; then the socket of the universal joint at *C* is put on the projecting square on the head of the stay, and the stay screwed in by the spindle to within about one turn of being up, where it is left to have the final turn "home" given by hand with a suitable wrench, so that it is known by feeling how hard the bolt is screwed to its final position.

As the friction clutch is adjusted by pressure of a coiled spring to give only the required torsion to turn the stay at a proper degree of tightness, the clutch will slip whenever the resistance is unnecessarily great, so that no damage to the thread will result in case of an improper fit, and the final screwing up of the stay by hand, as mentioned, will detect any want of sufficient tightness.

The various operations of this machine are such that the work is more perfectly done, and done in very much less time and at less cost than this class of boiler work can be done by any other of the various plans now practiced.

A Moment of Peril.

There is a tendency among trainmen to charge trackmen with habitual carelessness in putting the track in a dangerous condition without sending out signals. The charge is not entirely without foundation; but trackmen, on the other hand, have sometimes reason to complain about the recklessness of trainmen in running past signals sent back to prevent accidents.

A trackman, talking on this subject, said: "I have seen a good many close calls arising from the carelessness of section foremen and of engineers; but one that happened at the foot of Morgan's grade, eight or ten years ago, was the closest escape from disaster I have ever seen. At the foot of the grade there is a deep gully, spanned by a bridge about 150 feet high. One day we were working on the track at that point, and a flag had been sent back to stop any "extra" that might come along. Just as we had removed a rail, an "extra" with a Sunday-school excursion came dashing down the grade, and we did not see them until they were around the curve, about 500 feet distance. They were so close that most of the men in the gang ran in terror from the spot where the opening in the track was; but two of the men, Jim Cary and Pat Sullivan, kept their heads, grasped the rail between them, and carried it quickly to the opening and threw it in. They had scarcely got cleared when the engine truck struck the rail. It held and the train passed over in safety. The engineer had failed to see our signal, and his carelessness very nearly resulted in running a train, loaded with four or five hundred children, into a pit of destruction."

More Kinks from the Fitchburg Railroad.

Some labor-saving appliances for getting work out easily and rapidly at the Fitchburg Railroad engine house, Fitchburg, Mass., are presented herewith.

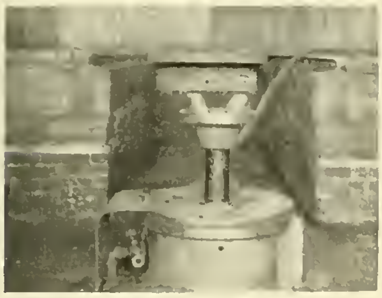


Fig. 1.

Fig. 1 shows a large drop pit for lowering driving wheels. It is worked with water at a pressure of 80 pounds per square inch, and will easily raise 12 tons. On this pit, drivers of the heaviest mogul engines have been dropped for new driving boxes and two hours from the time engine was put over the pit. A standard 18 x 24 engine has been placed over this drop at 9 A. M., and two men let down the main wheels, fitted a new main driving box, and replacing the wheels, connected everything up, having the engine ready for service at 5 P. M. the same day.

The illustration shows the simplicity of the whole arrangement. The timbers at the sides of the pit are on slides of wrought iron, and are moved back in the pit as soon as the water is applied to the cylinder through the hose connection, when raising the wheels clear of the rails, after blocking the engine up; this does away with all lifting of timbers or rails. The forked head at the upper end of piston is fitted loosely, so that, if it should be required, the wheels can be easily swung around for change of flanges, or any other purpose. The total cost of this pit was less than $100, and it was built by the regular men employed at the engine house, excepting two days of mason work, which was hired outside. The pit has been in service about five months.

Fig. 2 illustrates a drop pit on the same general lines as the above, only smaller. This little fellow will raise 3,800 pounds with a pressure of 80 pounds per square inch; it was designed and arranged for engine-truck wheels from 33 inches diameter down. A pair of 33-inch truck wheels have been taken out of a consolidation engine, and a new pair put in, inside of 60 minutes. No jacks or blocking were used; nothing except a clamp to hold the truck frame up. This same feat was performed with the rear wheels of a four-wheel truck in exactly the same time. The fork on this piston is also loose, so that wheels can be swung for flange wear. This pit has been in service about one year; its cost was less than $30.

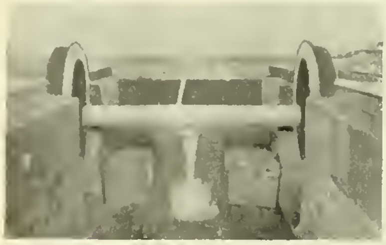


Fig. 2.

Fig. 3 is a machine for applying and removing the fittings for steam and air hose. Like the other devices, this works by water pressure, having all suitable appliances for rapidly and conveniently performing all the operations required.

The valve motion model shown in Fig. 4 is a useful adjunct to the educational features of the engine house, and highly prized by the men. It is made quarter size, from the standard 18 x 24 engine of the road. All the parts are adjustable.

These machines are all home-made—built in the machine shop. Comparing the expense of building and putting in these devices with the large amount of work that has been and can be done on them, it is seen that it is a good investment to have good tools to do work with. These tools were designed, made and put in operation by Mr. Geo. M. Tower, foreman of the locomotive department, Tunnel Division.

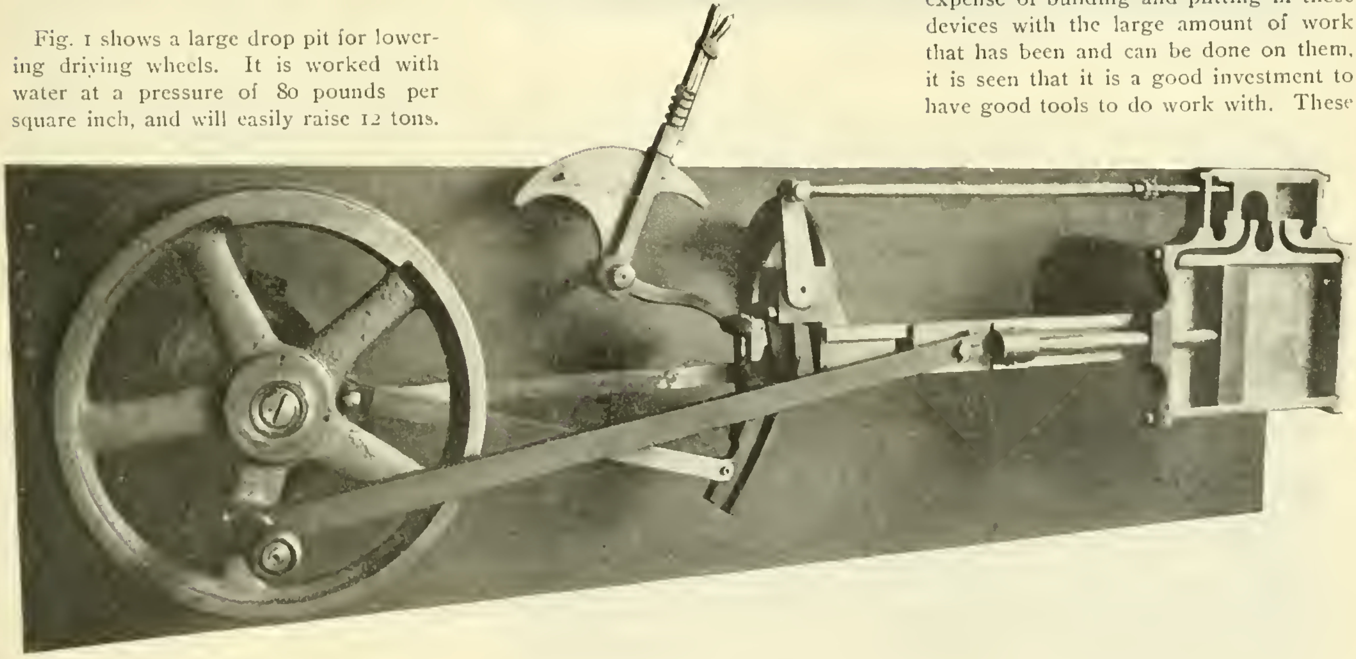


Fig. 4.

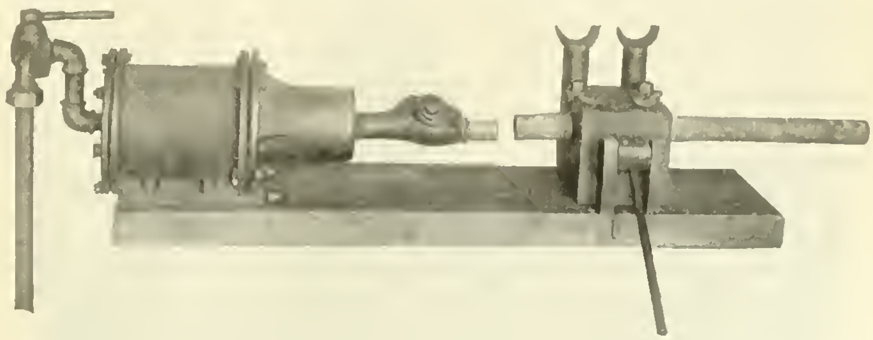


Fig. 3.

The Great Northern Railway of England has adopted as standard the Westinghouse quick-acting brake. That is the first railway in the British Isles to adopt this powerful means of preventing collisions.

AS THEY STRIKE.

ONE SECOND LATER.

TWO MINUTES LATER.

A Piece of Iron Two Thousand Years Old.

S. T. Wellman, the well known metallurgist, of the Wellman-Seaver Engineering Co., Cleveland, has a portion of a round bar of iron—and a few like pieces are held in the United States—that antedates the Christian era by two or three centuries. The iron, which had been originally hammered into plates, and was deeply rusted from age, was found a few years ago by Dr. Karl Humann, in the ruins of the Temple of Artemis Leucophryne at Magnesia, Asia Minor. Dr. Humann sent it to Hallbauer in Germany and the latter made from a portion of it a memorial tablet. This was presented to Bismarck in April, 1894. It bore this inscription, in German: "For you, Prince Bismarck, the iron chancellor, Hermogenes forged this iron at Magnesia, 200 B. C. Humann found it in the Temple of Artemis after 2,000 years and sent it to Hallbauer, who gave it the form in which it shall bear witness that your deeds shall outlive millenia."

At the time of the presentation to Bismarck "Stahl und Eisen" gave a photographic reproduction of the plate and an account of the discovery of the iron. The Temple of Artemis, one of the most magnificent of ancient monuments, was rebuilt about 300 B. C., though by some the date is put at 200 B. C.

The metal is described as approximating steel in its composition, though closely akin to malleable iron. It was made at a low temperature and great care was necessary in the forging. It was found rather difficult to roll the pieces that were preserved as relics, these having a diameter of about ½ inch. One analysis showed carbon 0.20 per cent.; phosphorus, 0.016 per cent.; iron, 92.71 per cent. Another gave carbon 0.23 per cent.; phosphorus, 0.0223 per cent.; sulphur, a trace, with no distinguishable amount of manganese or silicon. An analysis in the laboratory of Prof. Ledebur showed 1.01 per cent. of slag, 0.025 per cent. of phosphorus, and 0.061 per cent. of carbon.—"Iron Trade Review."

A "Made-a-Purpose" Collision.

On May 30th, at Buckeye Park, about twenty-five miles below Columbus, on the C. H. V. & T. Ry., there was a prearranged collision between two engines owned by the above company.

The engines were old eight-wheeled Hinckley engines, with two domes, straight stacks and short front end; cylinders about 16 x 24. They were started two miles apart, and came together on a side track about thirty car-lengths long, built for the purpose. Each one had a train consisting of three empty gondolas and caboose. They reached a speed of about 35 or 40 miles per hour, and came together within 50 feet from a stake driven in center of track, where it was intended they should hit.

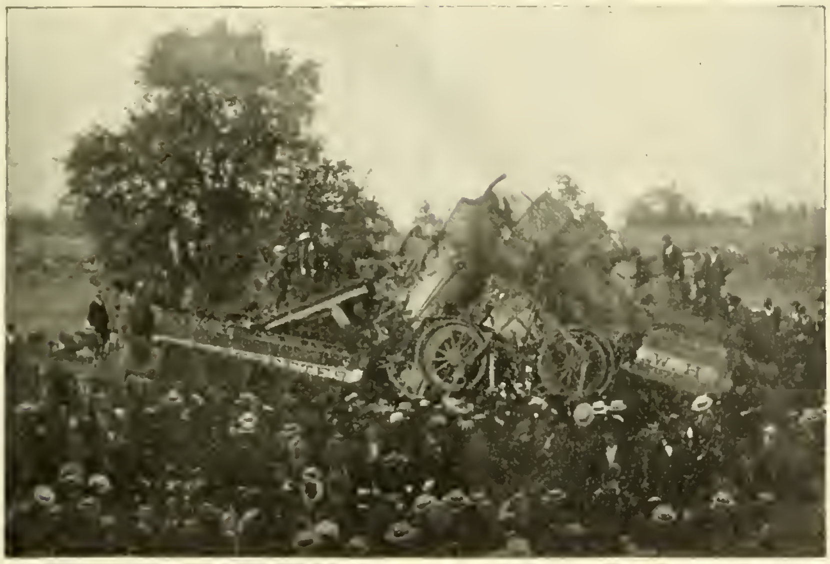
The track was built at the foot of a high hill, forming a natural grand stand, and there was about 20,000 spectators. The engines were badly smashed; the boilers were driven into each other nearly to the sandboxes, cabs and cylinders smashed, and both broken up about as you would expect under the circumstances.

The photographer took four pictures in five minutes, as shown below. The light was not good, but there was enough to show what happened.

This may be a new way to get rid of old rolling stock at a profit.

The Pennsylvania Compounds.

The Pennsylvania Railroad Company are running the four mogul compounds and the simple engine of the same class in the same kind of service, and the officials are slowly collecting data concerning the relative economical performance of the various engines. The figures are not nearly complete, but the indications are that the performance of the compounds will not be materially different. They all appear to do their work with about 15 per cent. less fuel than that used by the simple engine of the same general dimensions. The "Von Borries" is the favorite with the officials, and it is likely that an improved form of that type of compound will be made the standard engine for heavy freight service. The fuel economy of the compound, as compared with the simple engine, does not amount to much in dollars and cents with the cheap fuel used by the company. The margin of saving is so small that it still remains an open question whether it will pay to build and maintain compounds. The final decision on this question will not be made until more data are collected about the cost of repairs for the different kinds of engines.



FIVE MINUTES LATER.

In one respect these new compounds have made a record which is likely to produce important results. They pull about 15 per cent. more tonnage than the Class P consolidations, and do the work on less than half the fuel. The consolidation engines are fairly representative of the heavy freight engines of this country. The cylinders are 20 x 24 inches, the driving wheels are 50 inches in diameter, and the boiler provides 1,258 square feet. According to modern ideas, these engines are overcylindered and the driving wheels are too small. The fact that very small driving wheels make a locomotive very expensive to keep in running order has been forcing itself upon railroad men for years is indisputable; but few have recognized that an engine of that kind consumes much more coal than one with larger wheels and the same power, has not been generally appreciated, unless by observing men whose duties were to operate locomotives.

The discoveries made by the Pennsylvania Railroad people, concerning the superior economy and efficiency of the new moguls, is likely to have far-reaching effects. The mechanical departments of many railroads act on the assumption that anything which is good enough for the Pennsylvania Railroad is good enough for them, and imitations are likely to be very fashionable directly.

In view of the success which these engines are achieving, we think it would not be amiss to quote some paragraphs written, in describing the engines, about the time the first one was ready to leave the shop. Among other things we said:

"Officials of the Pennsylvania Railroad have experimented with compounds long enough to be convinced that there is something in the system, and that the two-cylinder style of compound is most likely to fulfill their requirements.

"In the second place, they have had courage enough to put a big boiler over the axle of a big wheel. It is believed by some of the ablest mechanics in the business that heavy freight engines having much larger wheels and longer stroke would be more efficient and more economical for freight service, as they would ride better, have better steam distribution, wear out their machinery slower, and be capable of higher speed without uncomfortable consequences.

* * * * * * * *

"We are inclined to think that the 62-inch wheel and the 28-inch stroke will be found to be a first-class combination, and that this mogul will be found as efficient as the average consolidation engine, much better proportioned, easier repaired, inspected and cleaned.

"Railroad men far and near will be interested in this trial of the various two-cylinder systems of compounding, and the results will be worth something to the railroad world. We have our doubts if any one of the compounds will be adopted by the Pennsylvania Railroad. They are not much given to handling anything but goods of their own brand, and it is likely in the end that they will adopt a compound of their own. It is almost the only road in America where the motive power is almost entirely of their own design and build, and there are some mighty fine-looking and fine-working engines on the road—power that any road might well be proud of."

Best Way of Annealing Hard Steel.

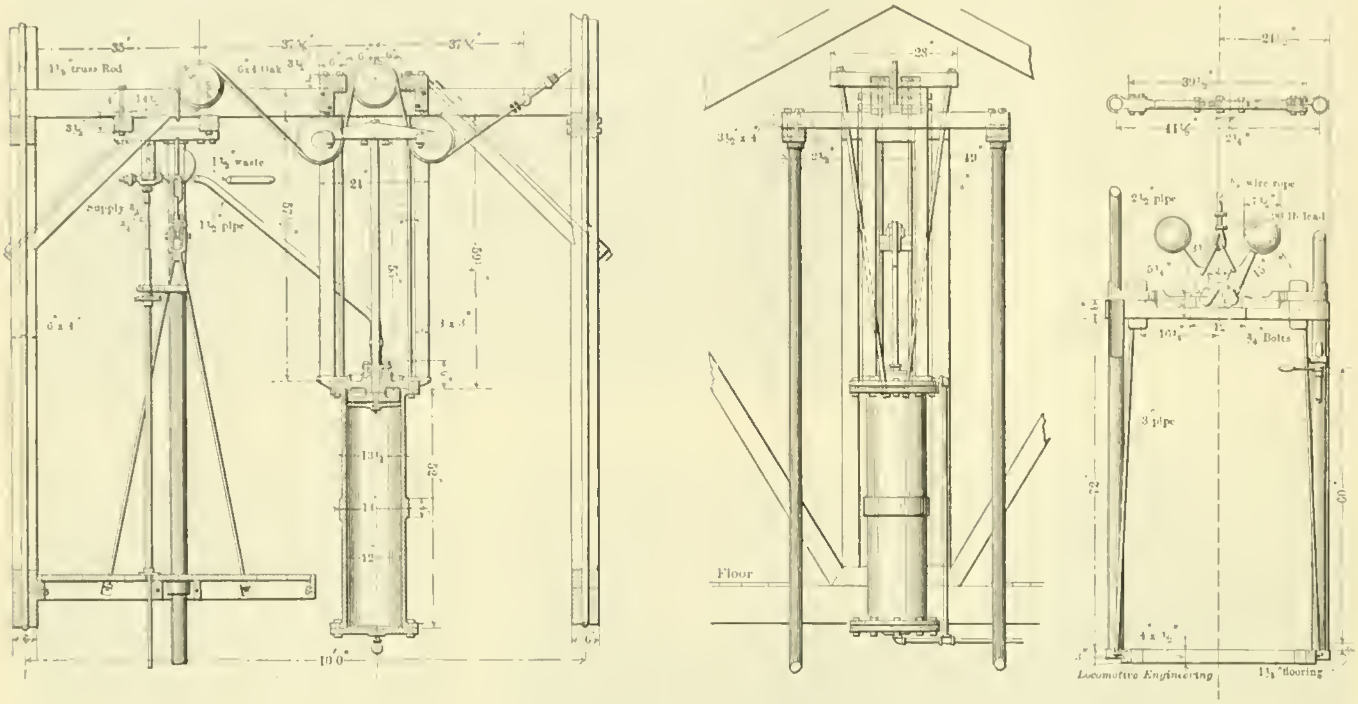
"In 1865 we sold a quantity—forty tons—of decarbonized gun-steel to a Rhode Island firm, for making rifle barrels. This steel was all cut to short lengths, and was useless for any other purpose. It was annealed by the buyers, and, when they came to drill it, it was found impossible to touch it with a tool. The steel was rejected, and held subject to our order. This was a serious matter, for at that time steel was worth something like ten cents gold. We were sent to investigate the method of annealing, and found that it had been annealled in charcoal. This seemed to us the cause of the trouble, for, as we argued, annealing decarbonized steel in charcoal for a matter of three days (heating and cooling) turned it into cemented steel, and it had the appearance of it when broken; a bar of it, struck across an anvil smartly, broke like glass, with a crystalline fracture. We ordered all the steel reannealed in spent gas-house lime, used in the purifiers, we believe, of which large quantities can be had for nothing. This proved entirely satisfactory, and the steel worked perfectly under every tool. Spent gas-house lime is the best vehicle for annealing steel we ever found or heard of: the steel is more like lead than steel, and its hardening qualities and durability are unimpaired. Twenty-four hours—even twelve hours—are sufficient to anneal the steel in lime."—"Engineer."

Hydraulic Appliances at Oneonta Shops.

The Oneonta shops of the Delaware & Hudson Canal Co. have long enjoyed the reputation of having one of the best equipments in the way of lifts, cranes, etc., to be seen in any shop; and to the observer interested in labor-saving methods of handling work they are of peculiar interest, from the fact that water furnishes the motive power, and also further, that many of the earliest efforts in the design of lifts were made here.

A more complete and satisfactory installation of these tools is not easily conceived, filling, as they do, all requirements at machines and other places about the shops, thus saving time and muscle, which can certainly be put to better uses as earning factors in other directions.

Engines are raised from their wheels and returned to same by a hydraulic lift, which is unique and as efficient for the purpose as any device of the kind ever made. Four cylinders 18 inches diameter, having rams with a lift of 30 inches, are built so as to project above the floor about 36 inches, and are placed to clear the driving wheels at the rear, and the cylinders at the front, two at each end of the engine—the forward pair having an adjustment longitudinally, so as to take the longest and shortest engines.



HYDRAULIC ELEVATOR.

WHEEL PRESS.

When raising an engine from the wheels, an I-beam is placed on the rams at the rear, and under the tail girder of the engine frame; a like beam is placed at the front, under the frame forward of the cylinders, and the water is turned on. The valves are so arranged that all four cylinders can be operated at one time, or separately, as desired—a good thing in leveling the engine, and also a safety measure.

A pressure of 75 pounds per square inch is on the water-service pipes at all times; but this is increased to 120 pounds in the pipe system controlling the heavy lifts by an auxiliary pump, ingeniously arranged in the system at a point that will cut out the lighter devices.

With this pressure on the four 18-inch rams, calculation shows a lifting effort of over 120,000 pounds, and this is more than ample to raise their heaviest power. It is a matter for regret that there are no drawings of this device, so that we could show how really simple and cheap it is. Master Mechanic Smith gives his assurance that they have never spent one dollar for repairs since this lift was put in—many years since.

The driving-wheel lathes have a 12-inch lift running on a trolley which extends across the tracks in the machine shops, making it convenient to pick up a pair of wheels from either track and place them at once on the lathe centers. Five-inch lifts are used at the car-wheel lathes and wheel borers, and entirely dispense with laborers' service at those tools.

The elevator shown is a home-made one, built substantially, and with no frills whatever. The piston has a diameter of 12 inches and a travel of 48 inches; the movement of the platform is multiplied by the arrangement of sheaves as shown.

The safety device to arrest a fall in case of a broken cable, is seen to be one not likely to fail when needed. It is connected directly to the cable, and consists of a pair of levers having counterweights at their upper ends, which are inoperative while the cable holds together; but in case the latter parts, the weighted levers are free to move, and the clamps tightly bind on the guide posts, which are made of iron pipe.

On the wheel presses they have a novel method of forcing the ram out to the work, quite independently of the pump, which is only called upon to perform after everything is in readiness. This is accomplished by means of a valve of peculiar construction, bolted to the end of the cylinder. To this valve case is attached the pump and pressure gage, as the only entrance to the cylinder is through the case. The combination valve shown in the sectional views, embraces, first, an ordinary plug valve which is cored to receive the water under a pressure of 120 pounds per square inch, and second, a wing valve with a small poppet valve through its center, which controls the entrance of water to the ram from the service pipes. These supply and discharge pipes are shown on the end view of pump.

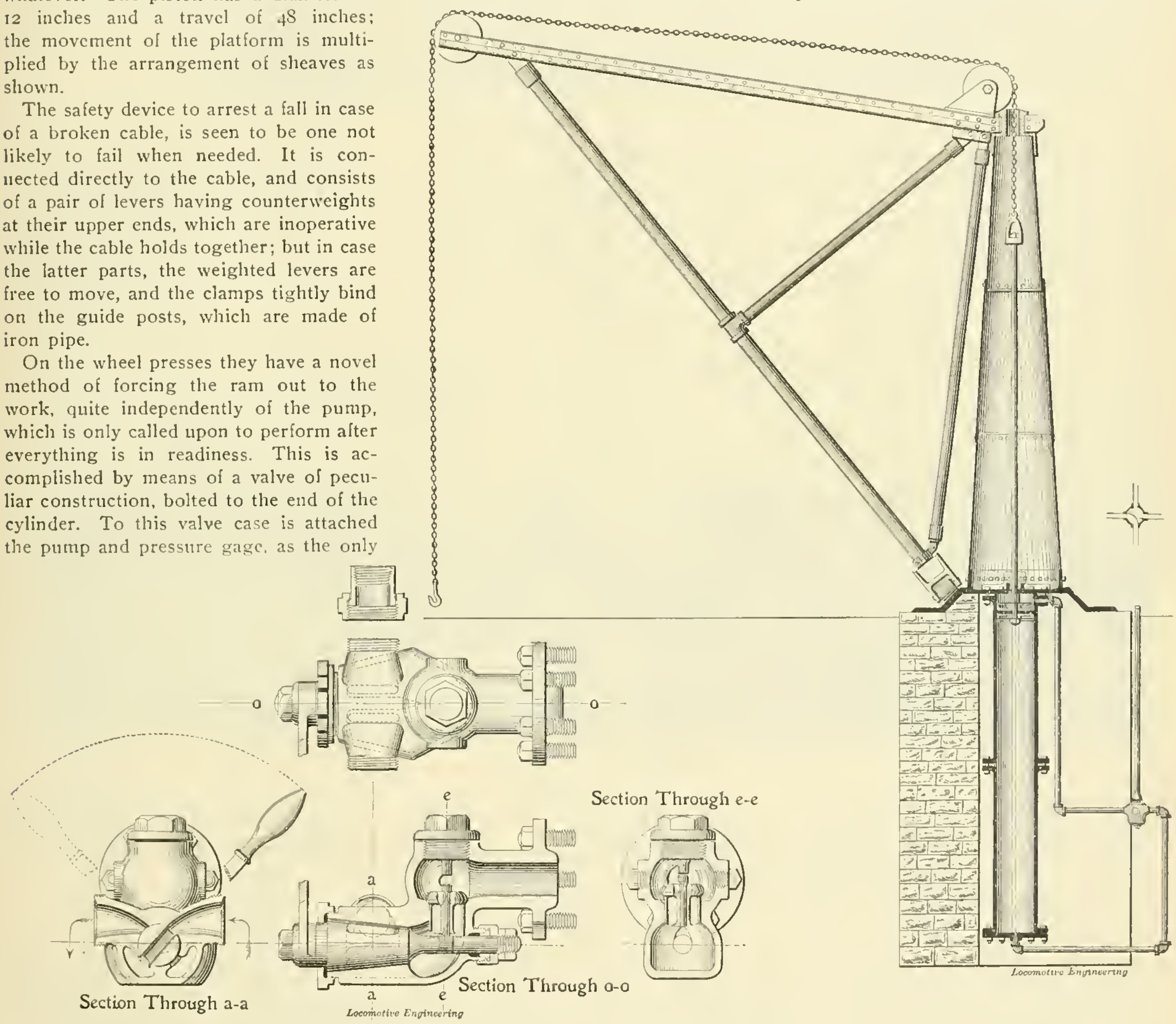
The end of the plug within the valve case terminates in a stem, on which is a cam, the function of the cam being to raise the small poppet valve, and thus release the top of the wing valve from the pump pressure, after which the wing valve is easily raised by the cam—something that would be impossible to do without the small poppet valve. It is apparent that any movement of the plug valve by means of the lever will perform two operations, namely, admit water from the supply pipe to the valve case, and at the same time raise the poppet and wing valves to admit water to the ram. A movement of the lever in the opposite direction cuts off the water supply, thus allowing the wing valve to seat itself again, and diverts the water to the discharge pipe through a T which enters the reservoir supplying the pump; the former always catching enough water from overflow to maintain practically a constant supply.

Hydraulic presses are in use here to the exclusion of the old screw-and-lever variety, for straightening work, forcing bushings in and out, and also for putting in or removing driving-box brasses.

The steel cranes about the yards, for handling wheels and other materials, are fitted with cylinders and also utilize the water system to their loads. The illustration shows the arrangement of one of these cranes at the wheel platform, in which a 12-inch cylinder is seen in a pit immediately under the mast.

The piston has a travel of 8 feet and has a connection to the hoisting chain which passes over sheaves to the load. Some misgivings were felt at the time this experiment was made, as to the liability of the water freezing in the cylinder, and a steam pipe was carried into the pit to meet such a contingency and be on the safe side; but the cylinders were found to work well in all ordinary winter weather without the aid of the steam pipes.

This plant stands alone as a purely hydraulic adaptation of labor-saving devices usually handled by air; but it must not be understood that this principle was adopted after compressed air had been found to be a success for such purposes. Experiments were conducted on these lines probably as early as were those with air; at all events, the water method is fully as successful in this place as air could possibly be.



HYDRAULIC APPLIANCES AT ONEONTA SHOPS.

The Metric System in England.

There has been very vigorous opposition manifested in Great Britain to a bill before Parliament, making the use of the metric system of weights and measures compulsory after a certain time. The existing weights and measures in Great Britain are a little more confusing than they are in the United States, and the reform is very much needed: but the great mass of the people are very conservative, and hate to make any changes calling for new lines of thought and extra calculations.

If it was merely home practices that were in consideration, England would never agree to reform their weights and measures; but the tyranny of trade is likely to make them agree to submit to very inconvenient changes. Britain is practically the workshop of the world, and all countries, except the English-speaking races, have adopted the French system of weights and measures.

When England sends machinery to South America, to Japan, to China, or to any other country, except Rnssia, where English is not spoken, the mechanics find the dimensions given in machinery based on the inch, which they are not familiar with. Belgian and German manufacturers have been taking advantage of this inconvenience of English metrology, and claim an advantage for their product on the ground that the measurements used are on the metric basis. This appears to appeal to the purchasers, and the consequence is that England is losing business as a result of it.

Anything that interferes with success of business hits a very tender spot in British hearts; on that account we should not be at all surprised to see the metric system pushed into practice within a very few years. If Great Britain adopts the metric system, there is no question but that the United States will do likewise, in spite of the numerous inconveniences that would result for a time.

A very important question to be settled by industrial nations using the metric system of measurements, is establishing standard screw threads. At present there is diversity of screw threads in Europe. The Whitworth threads, used generally in England, and to a great extent in all European countries, are not divisible by the metric unit. The French Admiralty have recently adopted a system of standard screw threads based on the metric unit. These threads closely approach in form and dimensions our Sellers threads, and there is good reason for believing that the French naval standard threads will become the standard of the world.

A New Phase of the Silver Question.

A Canadian paper of recent date says:

"There are probably but few of our merchants who have not noticed and commented on the manner in which American silver is replacing the Canadian coinage in all our leading cities. It is hardly possible in any of our business centers to secure a dollar's worth of change without finding among it a number of American coins—usually well worn, and often defaced—and, as it is an open secret that these "plugged" coins are deliberately imported by railway conductors, baggage men and other employés, who purchase them at rates varying from 65 cents to 80 cents in the dollar in the United States, and then put them into circulation in this country at par, the loss to Canada can readily be imagined. Plugged coins are resolutely refused in every city in the United States. In fact, in some States it is an offence against the law to even attempt to pass them. Yet they are imported in quantities into this Dominion, and although the larger corporations refuse to receive them in settlement of accounts, they seem to have no hesitation in passing them out to the public."

Relative Merits of Iron and Steel.

Ever since steel began to come into use for boiler-making, there has been more or less conflict of opinion among boiler-users as to the relative merits of iron and steel for boiler-making. In fact there appears to be no department of industry in which steel has taken the place of iron, where there are not disputes about the merits of steel.

This has been found in bridge-building and railroad rolling stock, and now we find that a dispute is going on in England on the merits of steel for ship-building. In some instances steel has corroded so rapidly that ship-builders are now specifying a large portion of the work to be done in iron, such as the upper decks, floors, tank tops, etc.

Some steel-makers have been experimenting to determine whether it is really the case that steel corrodes more quickly than iron. Experiments were carried out by immersing steel and iron plates in salt water, and watching the degree of corosion which resulted. At first it seemed that steel corroded faster than iron, but as the experiments were continued, steel proved to have the advantage.

In spite of all the experiments that have been made with iron and steel, there is still a good deal to be learned about the relative merits of the two metals.

THEY MET BY CHANCE(?)

Straw Fuel.

Straw is used to a considerable extent for fuel in the cold regions of the Northwest, and they are now using it for steam-making purposes. Among those who have begun to use straw for fuel in a large way are the Electric Plant Co., at Watertown, S. D. Coal costs about $4 a ton at that place, and good flax straw $1 a ton.

They find, by experience, that two tons of straw is equal in heating capacity to one ton of the best coal. They are burning the straw in the ordinary furnaces without any other change than the putting of sheet-iron flaring chutes in front of the furnace doors. These chutes are kept constantly full of solid straw, which is pushed forward as it burns. No fire-door is required.

Those having straw to sell are already recommending it for locomotives, but we are afraid the drafts would be too great for light material like straw.

CAR DEPARTMENT

Conducted by ORVILLE H. REYNOLDS, M. E.

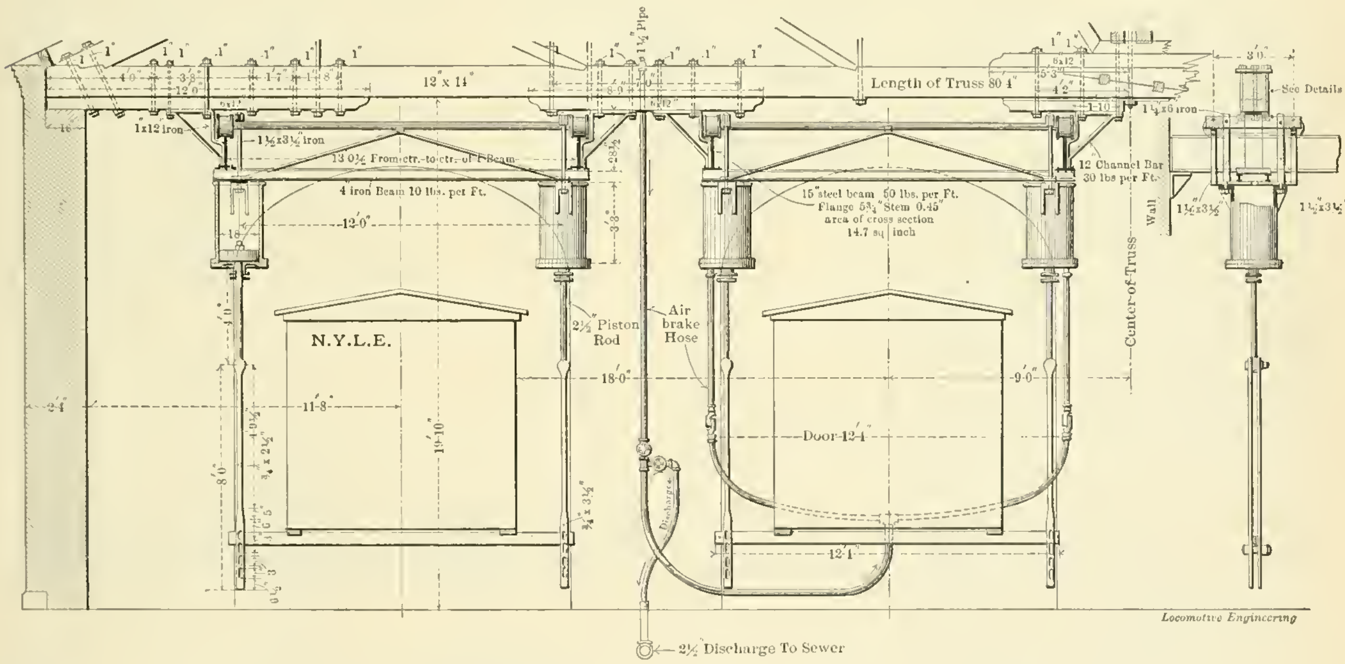
Hydraulic Car Lift at Oneonta Shops.

In the car department of the Delaware & Hudson shops at Oneonta, they have a system of hydraulic lifts that is carried to a point as near perfection as can be imagined, and must be seen in operation to be fully understood and appreciated. Running the full length of the car repair shops, over two tracks, as shown in the engraving, is a pair of trolleys, each one of which carries a pair of 18-inch cylinders, having a lifting stroke of 36 inches.

These trolleys roll on 15-inch I-beams which are suspended from the underside of the roof truss, and are moved to all points in the length of the shop by a rope transmission that is thrown in and out of gear by means of a friction clutch; this part of the device, however, is not shown.

By means of flexible connections, the water is admitted to both cylinders at the same time, and the lift is exerted through two 1¼ x 6-inch iron bars passing under the sills of car. In operation, a car body is lifted from its trucks, one end at a time, and dropped on trestles; how this is done is told by the picture plainer than words.

Besides these lifts, there are small portable affairs that can be placed under the carry-irons, and will send a car up in the air with the same ease shown by the larger ones. These are operated by water, precisely the same as the larger ones, making the lifting facilities second to none.



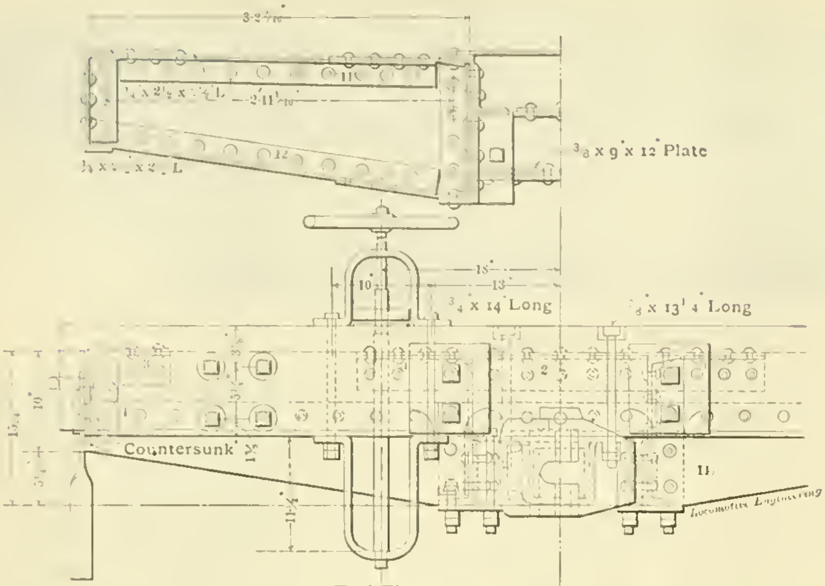
Steel Cars—Norfolk & Western Railway.

A report on "Metal Underframing for Freight Cars" was submitted at the last Master Car-Builders' Convention by Mr. R. P. C. Sanderson, division superintendent of motive power of the Norfolk & Western Railway, which was an admirable paper, and the recommendations therein for future practice in a field yet pracitcally virgin, evinces thought on original lines that will no doubt leave its impress on those who come to attack the problem later.

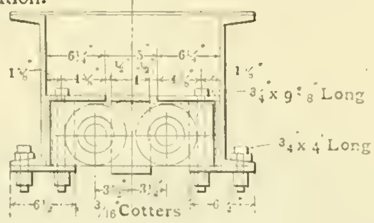
Our illustration of the framing of a flat car in accordance with the suggestions made in the report referred to, is evidence that the courage of his convictions animated the designer. While it is unique in many particulars, and a wide departure from old methods in constructive details, it takes its place among the tangible things accomplished by the best mechanical minds in improvement of our rolling stock.

This car has only four longitudinal sills, two center and two outside, made of channels. Those at the center are 15 inches deep, and covered at both top and bottom by plates that are riveted to the channel flanges. These plates do not extend the whole length of car, but are placed at the central portion, between the body bolsters, of such a length as shown by calculation will aid to resist the bending moment due to the load and vertical shocks of service, thus forming a box girder at the weakest portion of the car.

The two outside sills are made of 10-inch channels, which with the center sills abut against, and are tied at the ends by, a plate ⅜ inch thick; secured to these plates, at the bottom, is an 8-inch channel with its flanges extending upward to receive an end sill of oak, 8 inches wide and 10 inches deep. The frame is further secured laterally by two transverse girders spaced equi-distant between the body bolsters. The body bolsters, made of two 6-inch I-beams, also materially assist these girders in preventing distortion of the frame, by aid of the gusset plates on each, at their junction with the sills. To give an additional stiffness to the frame with a very slight amount of material, there are also gusset plates at the inside face of end sills, and extending over center sills, Half Section at Transverse Girders.



End Elevation.



Center Sills and Draft Rig.

from which there are diagonal braces reaching back to the gussets at the bolsters—a construction that will tend to preserve the car from the racking effects of the severest buffing shocks. These are well shown on the plan view.

The center sills are spaced sufficiently far apart to take a twin-spring draft rig, thus doubling the capacity of the spring to reduce the above shocks to a minimum. This is a scheme that is coming to be well known where new construction makes it possible to get the proper space between the sills. With a 15-inch center sill, that terror of the repair track, the draft timber, is no longer necessary; the longitudinal section shows an infinitely better construction than could ever be worked out by the draft-timber cobbler, even in his happiest mood. A central draft is correct, and looks mechanical when it is right.

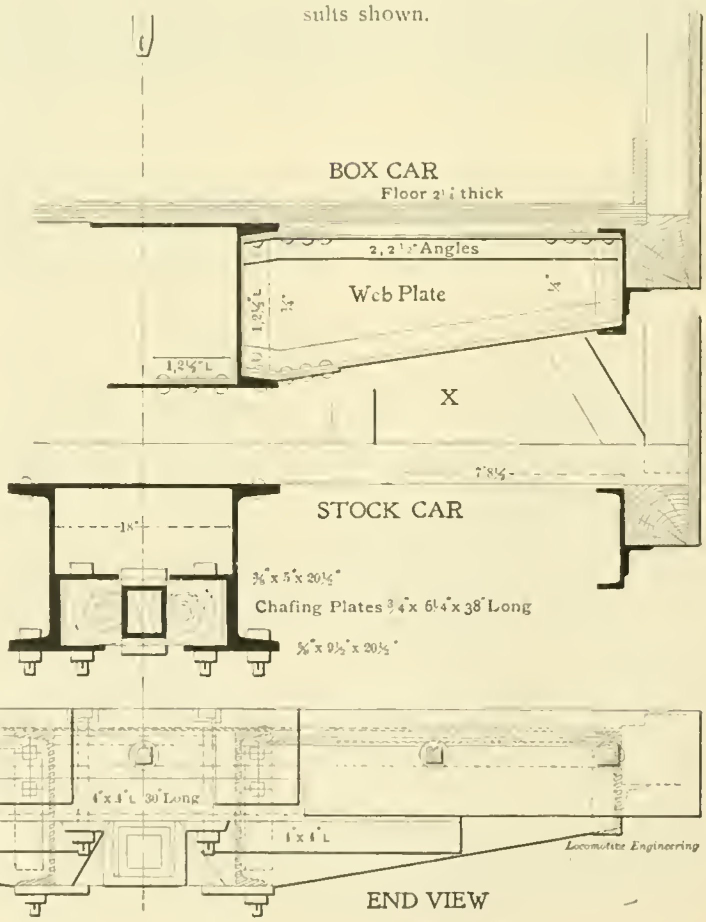
A novel arrangement of the flooring is had by laying it in sections which comprise the space between each transverse girder. The planks at each section are held in position by wooden battens on the under side, placed centrally between the sills, and also by angle irons on the inside face of sills. Bolting to these angle irons and battens by coach bolts with heads let in, each piece of flooring is firmly held. Making it in sections as described, it has been found to possess advantages in inspection and repairs. This idea was first worked out by Mr. Joughins, superintendent of motive power of the Norfolk & Southern Railway, to whom due credit it given.

A test of this car was made with a distributed load of 100,000 pounds. After a short run in the yard to get all the kinks out, the amount of deflection under the load was noted. The measurements were taken with a surveyor's level, and it was found that the box-girder center sills showed a maximum deflection of a scant 9-16 inch at the center, and the side sills were down a scant $\frac{5}{8}$ inch at the same point. There was no permanent set whatever.

The method of building the superstructure of a box or stock car on the underframing as shown for a flat car, is illustrated in the details marked *X*, which show an angle iron secured to the outer face of outside channels, this angle supporting a wooden sill, or, more properly, a furring piece which receives the posts and braces, and to which the outside sheathing is nailed. A comparison of weight of this framing with the wooden type is given below:

The underframing complete, except drawheads and gear, dead blocks, center plates and pins, will weigh 9,509 pounds. The steel alone will weigh 8,519 pounds. The actual weight of the corresponding parts of a 60,000-pound, 8-sill, underframe car having same general dimensions and a light weight of 30,000 pounds, is 9,620 pounds, showing that the steel frame car is lighter than the wooden frame, and has a carrying capacity of 72,000 pounds distributed load when fibre stress was 15,000 pounds per square inch.

It is seen that there are no new or special shapes involved in the details of these cars; all parts are of standard commercial section, obtainable at any time and at the shortest notice. Every attention has been given these designs to make them easily accessible for riveting—all complications of a mechanical nature having been carefully avoided in reaching the results shown.



STEEL CARS—NORFOLK & WESTERN RAILWAY.

Disputes in Car Interchange.

The Pennsylvania Company rendered a bill against the Chicago & West Michigan Railway, on July 2d, for work done at Chicago, which consisted of raising two drawbars, amount of bill, $1. The Chicago & West Michigan Company returned the bill, stating that the car in question was on the owner's track on July 22d, and in order to bring the drawbars to the proper height it was necessary to put a 2½-inch plank on top of the truck bolsters, and that, as the car was not raised to 34½ inches by the Pennsylvania Company, and the Chicago & West Michigan Company had to raise the car afterwards, it declined to pay the Pennsylvania Company's bill.

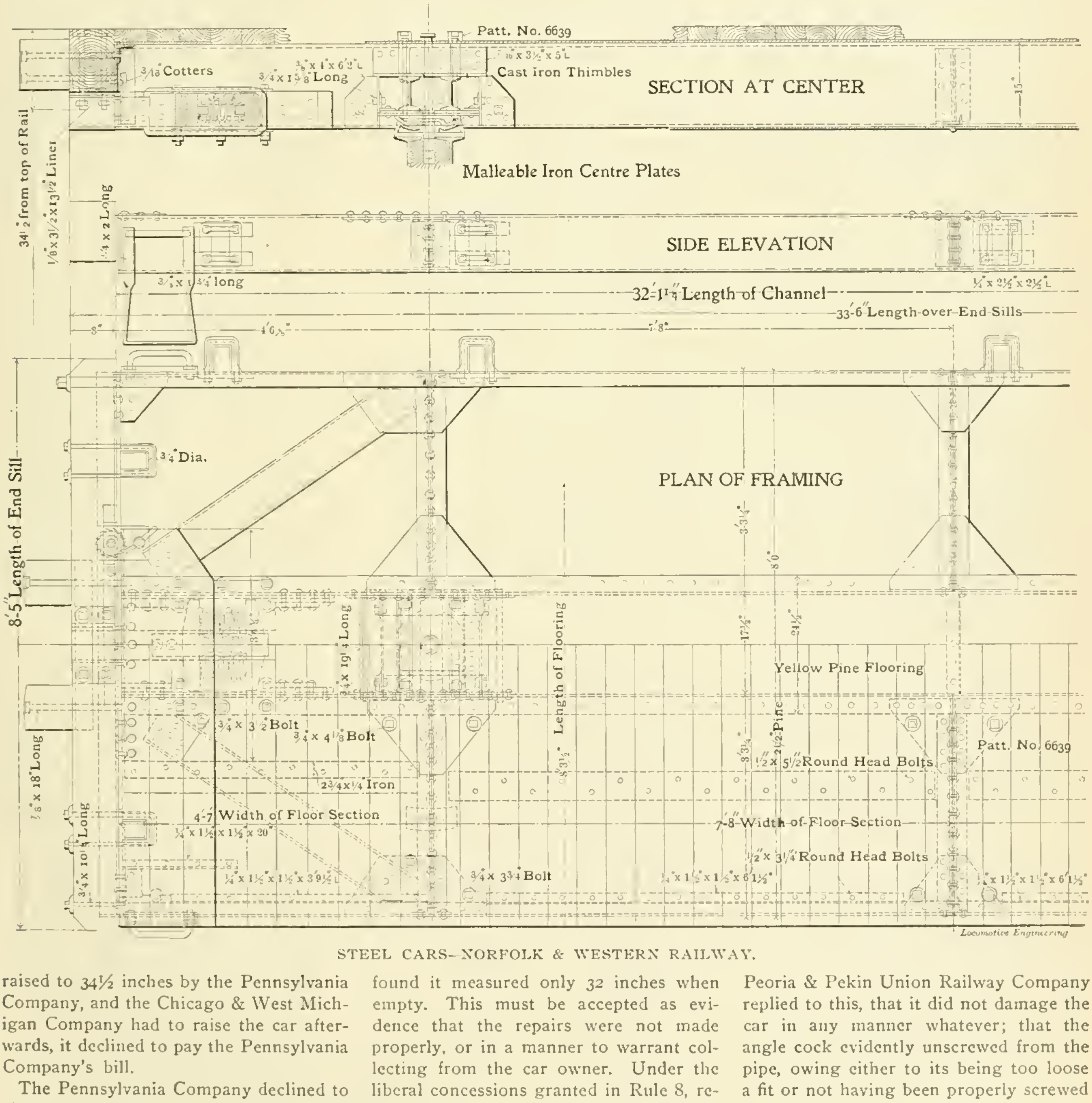
The Pennsylvania Company declined to change the bill, stating that the car came to it below the limit as prescribed by the law, that it was then loaded, and that it raised the car to 32½ inches loaded; it did not think it well to raise it to the maximum limit of 34½ inches, because when unloaded it would be above the limit. It claims that the car was repaired in accordance with the provisions of the Master Car Builders' rules. The case was then referred to the Arbitration Committee, by mutual consent, for decision:

Decision: The Pennsylvania Company does not claim to have made full and proper repairs. The correspondence states clearly that the car was only raised to 32½ inches loaded, but does not state whether the car had a full load or a partial load. Twenty days after repairs were made, the owners received the car back from the Pennsylvania Company, and found it measured only 32 inches when empty. This must be accepted as evidence that the repairs were not made properly, or in a manner to warrant collecting from the car owner. Under the liberal concessions granted in Rule 8, repairs should be made so that owners will have no room for taking exception to the character of the work done. In the opinion of the committee, the bill of the Pennsylvania Company is not correct and should be canceled.

On December 16, 1895, the Peoria & Pekin Union Railway Company rendered a bill against the American Refrigerator Transit Company for work done on October 5, 1895, to an American Refrigerator Transit Company car as follows: One 1¼-inch air hose, $2; one angle cock, $1.80. Total, $3.80.

The American Refrigerator Transit Company, returned this bill to the Peoria & Pekin Union Railway Company, and stated that the car left its Milwaukee shops in September with the air hose and angle cocks in perfect condition, and could not therefore pay the bill. The Peoria & Pekin Union Railway Company replied to this, that it did not damage the car in any manner whatever; that the angle cock evidently unscrewed from the pipe, owing either to its being too loose a fit or not having been properly screwed on.

The American Refrigerator Transit Company replied, that it was evident to it that this angle cock and hose and coupling were taken off the car; that the fact that the Peoria & Pekin Union Railway Company received the car in good order, and the parts were lost while in



STEEL CARS—NORFOLK & WESTERN RAILWAY.

its possession, makes it responsible for the lost parts; that is was not reasonable to assume that the parts in dispute could wear out between September 23d, the date they were applied to the car, and October 5th, after giving only twelve days' service. The matter was then referred by mutual consent to the Arbitration Committee, which decided as follows:

Decision: The air hose and angle cock formed part of the equipment of the American Refrigerator Transit Company's car. The owners show the fittings to have been in good order twelve days before the repairs were made. The Peoria & Pekin Union Railway Company does not submit any evidence from its men who made the repairs, showing that there were indications of improper fitting. In the opinion of the committee, the bill of the Peoria & Pekin Union Railway Company is not correct and should be canceled.

In October, 1895, the Chicago & Erie Railroad Company rendered a bill against the Chicago Great Western Railway for wheels placed under Chicago Great Western cars 12138 and 12096 in September. The cause of the removal of wheels from car 12138 was given as "seams," while the cause of removal of wheels from car 12096 was "sharp flange." In the column "shop marks on axles and wheels removed" the bill reads "none."

The Chicago Great Western Railway returned this bill, and asked the Chicago & Erie Railway Company to show the shop numbers on wheels removed, in order that it may keep its records in proper shape; that the wheels were comparatively new, and that it believed that certain shop numbers could be found on same.

The Chicago & Erie Railroad Company replied that its workman who did the work states positively that there were no shop numbers or shop marks of any kind on the wheels, beyond the record as given, which included the maker's initials, date cast and the number of the wheels, but no shop marks to show when the wheels were mounted.

The Chicago Great Western Railway replied that this series of cars is equipped with Haskell & Barker wheels of 1893, and as these wheels are a part of the original equipment, they must certainly bear shop numbers, as all these wheels were numbered by the manufacturer, the numbers being placed on the inner hub of the wheel with a steel die; that the axles are also numbered on the ends; that it is privileged to claim from the manufacturer a replacement of wheels removed by foreign companies, and a failure to furnish the numbers amounts to a loss of one wheel in each case, and it therefore does not feel like paying the bill until the numbers in question are furnished.

The Chicago & Erie Railroad Company said that it could give no further information than that already given, and in reply thereto the Chicago Great Western Railway proposed that, inasmuch as there might be some question in its obtaining a replacement of the wheels removed from car on account of "sharp flange," it would accept bill if the charge against car with "seamed" wheel were omitted, which would make the bill read $5.50 instead of $9.

The Chicago & Erie Railroad Company did not agree that this would be a fair settlement, and said that it renewed the wheels and axle in accordance with the Master Car Builders' rules, giving all the shop marks and numbers of any kind on the wheels, and insisted on the payment of the bill as rendered. The matter was mutually referred to the committee for settlement, who decided it as below:

Decision: Rule 9 states under what condition wheels may be removed and charged to car owners, and specifically names "seams" and "worn flanges." There is no assurance under the rules that any particular series or make of wheels can be maintained under freight equipment. The change of wheels incident to defective and worn-out axles, brasses and wheels would make such an attempt impracticable. A shop may inadvertently fail to procure wheel numbers; but unless evidence is produced tending to show that the wheels were not changed at all, this should hardly be regarded as sufficient to warrant non-payment of a bill. In the opinion of the committee, the bill of the Chicago & Erie Railroad Company is correct and should be paid.

Eight new day coaches and six new Wagner drawing-room and sleeping cars have been especially constructed for Dr. W. Seward Webb, to be used in a daily through service between New York and Montreal over the Adirondack and St. Lawrence division of the New York Central system. These new cars were put on June 20th, when the summer schedule went into effect. The new day coaches are uncommonly handsome and comfortable. They are fitted up somewhat in the Canadian style, with accommodations for first and second class passengers. The new Wagner coaches are up to the standard. New cars for mail and express service have also been provided.

Mr. John W. Cloud, secretary of the Master Car Builders' Association, has issued a circular intimating that the rules of interchange of cars, as revised at the Saratoga Convention, are now ready for distribution. Those who are interested in car interchange will find that material alterations have been made in the rules this year, and they had better begin studying them as soon as possible. Copies of the rules can be obtained from this office.

The J. A. Fay & Egan Co., of Cincinnati, have recently turned out a new extra large automatic car-gaining machine, with automatic feeding-head and carriage with quick reverse. The machine is more powerful than its predecessors. It is simple, substantial, and has a greater range and capacity than any gainer now in use. It is designed for hard service, and its capacity is for timbers up to 16 inches in thickness and 20 inches in width. The timber carriage is made of steel I-beams, to secure strength with lightness. It has an automatic feed of 100 feet per minute, under perfect control of the operator, through the upright lever in front. It is also provided with a hand-feed for bringing the carriage to a determinate point for accurate adjustment. The machine works very smoothly and noiselessly while at its highest capacity, and is certain to give satisfaction on the work for which it was designed.

When people first began to hear the expression "mineral wool," it seemed to be a sort of contradiction, that a soft material like wool should be made out of any mineral. A still greater anomaly is coming to us in the shape of the term "steel wool," a German inventor having worked out a material from steel which resembles wool, and which is very well adapted for certain purposes for which emery has hitherto been used. This steel wool is said to be very well adapted for rubbing off varnish from the outside of cars, and is likely to push emery cloth and sandpaper out of use for this purpose. There are said to be many advantages peculiar to this material, which will force it rapidly into use.

English railway papers mention a curious incident in train-operating: A through fast freight train arrived at London on the Great Western Railway, and one of the cars, whilst being switched, left the track. On examination, it was found that the derailment was caused by one of the wheels having no tire. When a search for the missing tire was instituted, it was found about one hundred miles away. The car had run that distance with a tire lost. The most curious thing about the case was that the wheels were tapped and examined several times during the journey.

The Lake Street Elevated of Chicago, which recently began to use electric motors in place of locomotives, has returned to the use of locomotives. This was done owing to an accident which sent a motor into the street. The officers intimate that the accident resulted from reckless running and the use of a defective truck, and that they will return to electric motors again as soon as the defect can be remedied.

PRACTICAL LETTERS FROM PRACTICAL MEN

Against Throttling Steam.

Editors:

In May number of "Locomotive Engineering," J. J. H., of Montgomery, Ala., asks: "Which is right, to run with wide-open throttle, or open it according to grade and train?" He says nothing about position of reverse lever.

The first link-motion locomotive I saw forty-five years ago, was the first one I had ever heard of, as I graduated on the "hook motion." She was 17½ x 24 inches, 5½ feet wheel, weight about 32 tons—an enormous engine in those days—quadrant not graduated to show point of cut-off, simply notched about three-quarters of an inch apart. She was a puzzle to me. I was a young runner, but had been taught to think. I had been instructed by the roundhouse foreman, Frank Rorp, in all there was to the valve motion that I was used to. I soon found the steam chest was the place to throttle the steam, and that the reverse lever was the means by which to do it. An opportunity soon turned up to prove my ideas to be correct.

The road was new and poorly fixed for water. When cold weather set in—and it was cold in the winter of 1851 and '52—all the water supplies on the line froze up completely, and the engineer of passenger train, with a 16 x 24, 6-foot wheel, could not go over the road without stopping to bail water, losing the New York connection every day, compelling passengers to lie over at the junction twenty-four hours, as there was but one New York train daily. Accident put me and my engine on the train, and I went through on time with 14½ inches of water—about ⅓ left in tank. I afterwards took the engine that had failed, and used only a little over a half tank of water doing same work.

Since then Holy Writ would not make me believe that wide-open throttle and shortest cut-off that will handle trains is not the only proper way to run a locomotive. Of course, if above conditions give too much speed, the throttle must be reduced to meet the case; but keep the lever up. The lower the lever, the more steam used. The more steam used, the more water. The more water, the more fuel used and the poorer the record for engine; and, as the latter cannot help herself, the record falls on the engineer, where it belongs.

A pressure gage on steam chest will show startling results under different positions of throttle and reverse lever, with same boiler pressure.

E. J. Rauch,
R. F. of Eng.

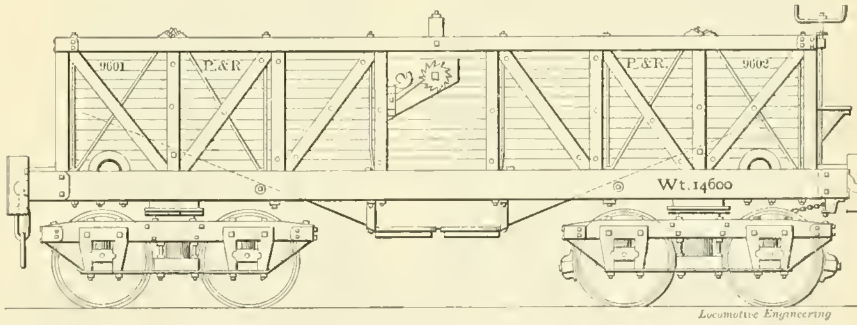
New York.

An Old-Time Coal Car.

Editors:

Many of the older readers of "Locomotive Engineering" will recognize the car whose picture accompanies this article. Such cars were built and used extensively by the Philadelphia & Reading Railroad Company during the early '60's, and the principal points were later incorporated into coal cars built and used by other railroad and coal companies, and many of these last-named cars still continue in service.

My first knowledge of the cars like the one shown in the sketch was obtained at a time when the Westmoreland Coal Co. engaged a large number of them to carry their coal to Eastern markets. One of my duties after school hours was filling up a report of the numbers of cars loaded each day, and these Philadelphia & Reading coal cars seemed the very incarnation of fiendishness, as each car bore two different numbers, and each of these numbers seemed to have a wonderful faculty of becoming separated from its proper companion and forming an unlawful alliance with one of some other car.



This double numbering was in accordance with a system which considered each four wheels as a car, and hence one of these eight-wheel cars would be numbered 9,801 at one end and 9,802 at the other end. I am not certain that these particular numbers were used, but do remember that the numbering consisted of four figures to each number and that they were well up toward 10,000.

The general form, as will be seen, consisted of two perpendicular sides and ends about 3 feet high and formed of a wooden truss lined with 1-inch sheeting. The two side stringers were about 4 x 8 inches and 19 feet long. No center stringer was used, but a heavy end sill was placed at each end of the stringer and united to them by corner bands and mortise bolts. The outer side of each of these sills was fitted with two wooden buffer blocks. Each of these blocks was about 20 inches long by 12 inches wide and 6 inches thick, and was covered on the face with ⅛-inch sheet iron. Most of these buffers were attached to an elastic (?) piece of oak running to the corner plate and separated from the end sill by two narrow distance pieces.

From the back of the end sills two intermediate stringers extended a few feet until they met, and were mortised into cross stringers which were placed at the points where the sloping floor crossed the top line of side stringers. This floor began in each at a height about 2 feet above the sills, and sloped downward at an angle of about 25 degrees, and to a depth of about 8 inches below the under side of the sills. A space was left between the ends of these slopes, the entire width of the inside of the car, and measuring about 30 or 36 inches from slope to slope. This space was closed by two doors hinged, respectively, to each slope, and held in position when shut by a windlass and chains, with ratchet and pawl of kind still used on most drop-bottom cars. This windlass was placed near the top of the car.

The sloping floor was, I believe, originally of wood; later was covered with sheet iron; then sheet iron alone was used; but still later construction restored the wood floor with iron over it.

The coupling irons consisted of a hook of the English type at one end, the straight part passing through the end sill and terminating with a nut and washer which held it against the sill through the medium of a large circular spring of india rubber.

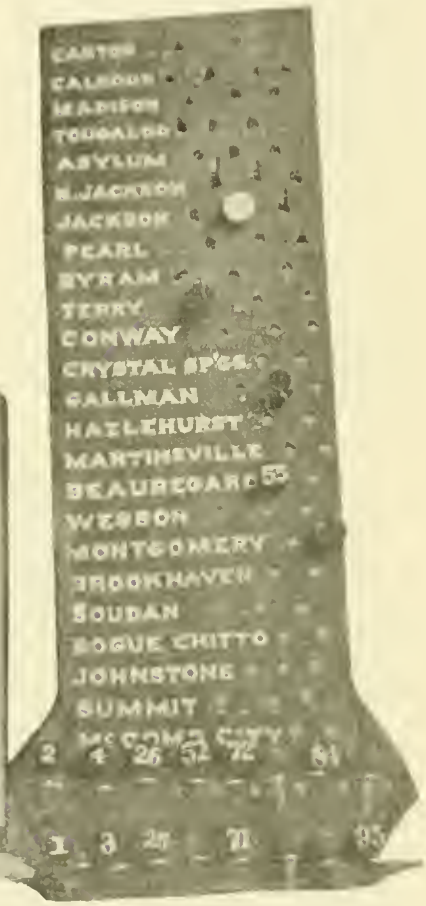
At the opposite end of the car the same arrangement of spring and straight bar through sill was used, but instead of a hook there was simply an eye-head with one end of a three-link coupling welded therein. This arrangement, of course, did not permit any of the cars to be turned; otherwise two of these blank ends were brought together and coupling was thus impossible unless the car was turned again or the hook and eyebolt changed to opposite ends. Such things did occur while these Philadelphia & Reading cars were in service on the Pennsylvania Railroad, and caused some annoyance.

The trucks were of the common wooden-frame type and used 28-inch wheels. Brakes of outside type were used, but only on one truck of each car, and they were worked by a mast at one end, which, instead of a wheel, was fitted with a wrought-iron double crank.

These cars were all painted black, with white lettering. On the Pennsylvania Railroad, where their height of draft center and various other details did not conform to the standard equipment, they gave some trouble and were frequently damaged, but on their own line were found to be very satisfactory. Their light weight ranged from 13,000 pounds to 14,000 pounds. Their capacity was about 20,000 pounds.

C. H. Caruthers.

Pittsburgh, Pa.



To Prevent Forgetting Orders.

Editors:

I send you photographs of a device which I have been granted a patent on. One is an order file for the use of locomotive engineers; the other a board containing the names, in cast aluminum letters, of all stations on the division. I can, by a series of pegs, give a reminder of any order that despatcher will give. It is time railroad officials and enginemen were realizing that a man's pocket is no place for train orders, and that no man lives today who is not liable to forget or make a mistake.

A conductor tolled me up to the edge of the brink of a precipice and then pushed me off. I got up and found myself out of a job. I had to sacrifice my home to sharks, break asunder all social and family ties, board the hog train, and go to Mexico and Central America to hunt a job, as there was nothing to be found short of there. I set myself to work to remedy the evil before I started, and give those I left behind with a job some protection against losing it.

On the board I use red peg to denote meeting-point between two extras—the numbers of regular trains opposite the station where they are to meet. A white peg for the terminus of an extra. A peg with red cross on black background for wait order. The two rows of numbers at bottom of board are schedule trains. The numbers of trains having right of track over train carrying board will only be left in sight.

A. W. Jennings.

McComb, Miss.

Tractive Power of Locomotives.

I was rather interested in your remarks this month about the tractive force formula in general use. It certainly, on the face of it, looks strangely inadequate; the reason of "this thusness" appearing, however, on looking into the matter. It is one of those things that get handed down from book to book without comment or explanation. Plenty of designers, to my knowledge, use it without knowing or caring how it was arrived at. It is simple enough, but have never seen it given anywhere:

If d = diameter of cylinder in inches, D = diameter of drivers, p = pounds per square inch mean effective pressure, and L = length of stroke (D and L to be in any and the same unit); then the work done in the two cylinders during one revolution equals:

$$2\left(\frac{\pi}{4} d^2 p\, 2L\right) = \pi d^2 p L \text{ (1)},$$

and during same time the engine moves through a space πD; and if mean resistance to traction = R, the work done = $\pi D R$ (2),

equating (1) and (2) $\pi D R = \pi d^2 p L$

$$R = \frac{d^2 p L}{D} = \text{tractive effort, } T.$$

for the mean resistance and mean tractive effort are identical; one is a consequence of the other. It is commonly expressed by saying that tractive force $= \frac{d^2 L}{D}$ pounds for every pound per square inch of mean effective pressure on the piston.

In the above is included the force necessary to overcome the frictional resistance of engine itself, both as to mechanism and also of flange friction on curves, etc. In short, the above "T" is by no means what is actually given off at the drawbar; the latter is about 75 per cent. of what is generally assumed. It is well known now what a lot of work is absorbed by slide-valve friction, especially with the flat unbalanced valves used on 99 per cent. of English engines (one of the penalties, by the way, attaching to their inside cylinders). In technical journals, in descriptions of locomotives, the tractive power is always given as above, so that, for aught shown to contrary, the layman may credit an engine with 33 per cent. more useful power than it really has.

It seems to me hardly necessary to test the accuracy of this formula; it is a mathematical fact, and bound to be true so far as it goes—and we know just how far it does go; it is near enough for a standard of comparison of various engines. When designing one, apply this formula and then make a deduction for internal resistance, as known by experiment on other similar locomotives, and bear in mind the kind of stock it has to haul—whether radial or fixed—kind of lubrication, etc. You can then get pretty well what you want; or, in the case of a particular one on the road, cards taken from both ends (both cylinders) at frequent intervals, together with a continuous record of drawbar pull, will give what we want. The conditions of a college test differ rather from actual working conditions, with their sandy roads, bad tracks and friction on curves. For that matter, I take it there is always flange friction when on the straight, owing to lateral deviations caused by unsymmetrical steam stresses (most marked in outside cylinder engines) and also by bad balancing.

For the ordinary 2-cylinder engine, I don't see anything wrong with the formula in use. It is useless to try and introduce a factor allowing for internal resistance, for that can only be found experimentally. If, however, the Franklin Institute Committee can give us an expression for drawbar pull of any locomotive, all the better; I shall await it with interest.

H. ROLFE.

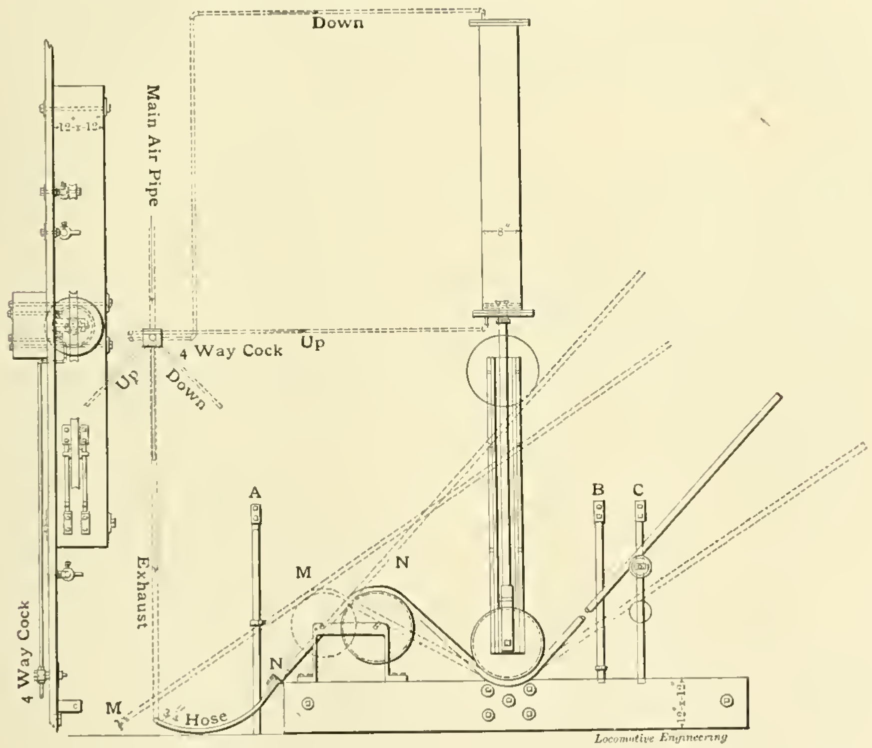
Hartford, Conn.

Pipe-Bending Apparatus.

Editors:

I have been greatly interested in one or two pipe-bending devices shown up lately by "Locomotive Engineering," which is very useful information at present, as a great many railroads are now equipping freight cars with air brakes, which requires the bending of lots of pipe.

Thinking it may interest some of your readers, I send you sketch of a machine designed and put in operation at Wall shop, Pennsylvania Railroad, by Mr. M. McDaniels, general foreman, and Mr. Chris. Gulland, foreman air-brake work.



A detailed description of this device is not necessary; the sketch tells the story.

It will be noticed that the ram and formers are made of grooved wheels, and that the required angle and length of bend are regulated by set screws on guide rods *A B C*. The ram is operated by an 8-inch air piston, and is controlled, both up and down, by a four-way cock. The exhaust air is used to blow out scale and dirt from the pipe as shown at *N*.

For the information of the operator, there is a schedule worked out to cover all kinds of pipe, which is printed and posted in a convenient place, that shows what exhaust nozzle to set end of pipe on, and where to put formers and set screws *A B C*.

We know from experience that this machine bends the pipe to a perfect standard, both to shape and length, and does the work as fast as the pipe can be put in and taken out.

J. R. ALEXANDER,
Gen. Insp., P. R. R.

Altoona, Pa.

Distortion of Flue Holes by the Expander.

Editors:

In the June number of "Locomotive Engineering" I note the comment of Mr. Chas. Miller, foreman boiler department, New York, Chicago & St. Louis Railroad. I am unable to explain why Mr. Miller did not get the same results with the use of the sectional expander that were obtained at these shops. I have met others since that article was written who said that they did obtain similar results, but not quite so considerable a movement of the flue sheet as we found here.

The holes in the flue sheet were not calipered after being drilled, as I do not presume that the riveting of the flue sheet into its place in the firebox would make any marked change in the form of the holes in flue sheet. Any drawing or compression at that time would fall upon the flange of flue-sheet. As to the movement of the flue sheet in a crown-bar boiler, as was shown in Fig. 2 in the April number, fireboxes have since been removed here that presented as marked an upward movement as was shown at that time.

I did not intend to reflect upon the efficiency of the Prosser flue expander, for I consider it a very good tool indeed for its purpose. The fault may have been with us that we were using it too severely, as no estimate of the strain put on to a flue sheet can be made when the tapered pin is driven with a hammer in the hands of a lusty boiler-maker; and whether it is used too severely, or just right, depends upon his judgment, and the difference in judgment was shown in the difference in the pressure it took to remove short pieces of flues from a flue sheet, as was referred to in that article.

I shall have something further to say in regard to this matter some time in the near future.

GEORGE H. BROWN,
Dist. M. M.

Dubuque, Ia.

Old Locomotives Ditched.

Editors:

In East St. Louis, not far from the W. St. L. & P. roundhouse, on what is known as the "Levee," are two very old engines. They are lying on their sides, just as they were unloaded off from flat cars several years ago. One of them is an old-time Baldwin, and the other is probably a Roger. She has outside frame, forged driving and engine-truck wheels and Bury boiler. On the hub of one engine-truck wheel is the word "Providence" and date "1854." Who can tell us anything about them? No doubt there is some scrap of old-time railroad history connected with them.

WM. BOSLEY,
H. & N. R. R. Station.

Mattoon, Ill.

"Forming and Enforcing Rules."

Editors:

The article on "Forming and Enforcing Rules," in your July number, reminds me of old times. I will illustrate a case in which I was principal, which will go far to show that Colonel Haines intended all rules to be strictly complied with while he was general manager of the Savannah, Florida & Western Railway. I was at that time running what was known as the "Jacksonville Express," which arrived at Savannah at 2:30 A.M., and connected with the Charleston & Savannah.

On the morning in question my fireman had fed the "41" a little too freely, and I held door open and worked steam much longer than usual for the purpose of cooling engine down, as she had to be left at passenger shed from 2:30 until 7 A.M. before hostler removed her to house. As train was running much faster than usual, I stood up with hands on brake valve and reverse lever, and closely watching the rail, aided by a good headlight. When about a quarter mile from stopping post, or brick wall, I noticed the rail leading in wrong direction. Although not blessed with the 20 pounds extra at that time, they being all plain triples, there was some quick-action performance on the part of the subscriber, which prevented a collision with the Charleston & Savannah by some 20 ft. The Charleston & Savannah hostler had gone to house for engine, and, thinking to save trouble for himself, had set the main line switch on Charleston & Savannah track, expecting to be back in time, of course, but was prevented by engine not being ready.

After the excitement was over the fireman exclaimed: "T'ank God, t'ank God; dat shure was dun well!" and I thought so too at the time. In a few days, however, I found I had reckoned without my host, on receiving a gentle reminder that, owing to violation of Rule No. — ("Engineers must see that switches are right before passing over them"), I had been fined one dollar, this being my first offense of the year and being otherwise in good standing. The latter information was worth the price, and prevented me from making any more records in Savannah yard.

W. H. Prendergast,
R. F. of Eng., C. of G. Ry. Co.
Savannah, Ga.

Flake Graphite.

Editors:

I have had some experience with flake graphite in valve oil, for valve and cylinder lubrication, and find that I can make 50 per cent. more miles to a pint than without it.

I also use it in oil cups on main pins, and find it very successful, keeping pins very smooth and running much cooler than without. We use the "needle feed" cup on back ends of main rods.

Chas. E. Dewing,
Eng'r, Wabash R.R.

Favors Thomas' Plan of Detecting Leaky Valve Strips.

Editors:

I notice in your July number an article explaining how Mr. C. F. Thomas, master mechanic at Alexandria, Va., proposes to tell positively which side the packing strips are blowing on a Richardson balance valve. This certainly is the best way, and would save many an hour's useless work lifting chest covers only to find strips "O. K." and trouble on the other side. I have for the last two years suggested this improvement for our engines, and in addition to its usefulness a set bolt can be used (in place of pipe) to be screwed down on valve in putting engine on one side. This would save much time in case of broken stem inside of chest.

W. H. Prendergast,
R. F. of Eng., C. of G. Ry. Co.
Savannah, Ga.

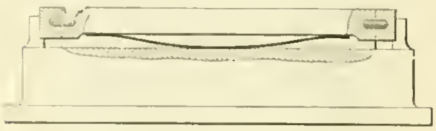
Prevent Packing Strips from Blowing.

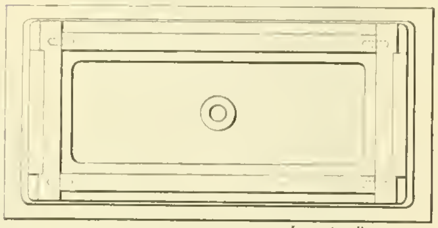
Editors:

I was interested in reading in the last issue of "Locomotive Engineering" the different articles on how to detect on which side of an engine the packing strips in balance valves were blowing. Why not fix them so they will not blow? I send you by this mail, tracing showing the way in which we put them in on the Missouri, Kansas & Texas Railway of Texas.

You will note that we use two long springs, front and back of valves, but the short strips at the end of valves are held in place by dowel on end of long strips. We fit them all in place, then scrape them to a bearing with face plate, and the job is done. If these springs should break, they cannot get out of place to catch on port and cause trouble.

We have some valves that have been





Locomotive Engineering

running about eighteen months, and have never given any trouble whatever. Roundhouse foreman tells me that he cannot recall a single instance where valves have been fixed this way, when he has ever had to take up steam chest cover to fix the packing strips.

I trust that this idea bay be of benefit to the fraternity.

C. T. McElvaney.
Denison, Tex. M. M.

Piston-Rod Fits.

Editors:

A mere stationary engine builder hesitates about offering a word on the construction of that apple of every mechanic's eye—the locomotive. Next to the steamship, the locomotive is to me the grandest product of the mechanic's brains and hands, and I feel entirely beyond my depth in a discussion connected with it. Nevertheless, perhaps I may safely and with all modesty offer a disclaimer even in such a discussion.

In your July issue, Mr. J. C. Haver gives experience which is unfavorable to the use of piston rods having straight fits in the pistons—his letter being drawn out by a communication of mine to the "American Machinist" which was re-published in your columns. If Mr. Haver will refer again to my article, he will see that what I advocated was a straight fit at the crosshead (not piston) end, the rod being made without a shoulder—or at most, only a shoulder deep enough to provide for returning—the rod being made to bottom on the end. In fact, I distinctly said in reference to the piston fit, "At that end the rod cannot be made to bottom on its end. To force on a collar is expensive, while to turn down for a shoulder of sufficient area reduces the area of the section of the rod. This area is still further reduced by the keyway or the threads for the nut, leaving a small net section unless the rod is of excessive diameter to begin with." A large number of stationary engines have been built from my designs with the straight fit at the crosshead end, and without any unfavorable developments so far as I know. The straight fit at the piston end I have neither used nor advocated.

New York. F. A. Halsey.

How to Locate a Blow in a Balance Valve.

Editors:

"How do you locate in which valve a balance strip is down?" is a question often asked by engineers. This blow is one so different from a cylinder packing or cut valve seat blow that it is easily distinguishable from them; but to locate on which side the balance strip is down is what puzzles some, and heaps a vocabulary of words not found in the Psalms upon the engineer when he reports the wrong side and the machinist has to lift both chests to find which valve is blowing.

When the valve is in the center of its seat, the rocker arm is plumb and the hole in the crown of the valve is directly over the exhaust port, causing the steam, when a strip is down, to blow through the exhaust until the movement of the valve brings the hole in the crown of the valve over the bridge; then the force of the blow is diminished. Consequently, the blow will act with the movement of the valve or rocker arm; being stronger as the rocker arm is plumb, and becoming weaker as the rocker arm nears the end of its travel. With a small hole in the crown of the valve, there is not much difference in the intensity of the blow; but the blow in both cases acts with the movement of the rocker arm. The blow can be located best when the engine is working full cut-off. If the force of the blow varies with the movement of the right rocker arm, give the right feed of the lubricator a drop or two more a minute, and report balance strip down in right valve on your arrival; if the blow is opposite to the movement of the right rocker arm, report balance strip down in left valve, and you will receive the encomiums of the roundhouse men.

W. J. Torrance.
Evansville, Ind.

Railroad Blacksmiths' Association.

Editors:

We would respectfully ask space in the columns of "Locomotive Engineering" to give expression to the aims and purposes of the National Railroad Master Blacksmiths' Association.

The National Railroad Master Blacksmiths' Association was organized in 1893 with a view to the improvement of its members by means of discussion and the dissemination of information which would better enable them to perform their duties. The aim of its originators was to accomplish these purposes somewhat on the lines of the Master Mechanics' Association. Its purposes are harmony, loyalty and efficient service. To this end, it is exceedingly desirable that all the railroad foreman blacksmiths, so far as possible, should become members.

We are well satisfied with what has been accomplished the past year; our members have worked with enthusiasm and devotion that has brought merited success. We have worked earnestly to increase the breadth and usefulness of our association. As we have said before, our aim is to increase information and strengthen the master blacksmiths, and strive to understand more fully the business we are engaged in.

By our annual conference of members once a year, we are helping one another by the way of suggesting methods of work that are a benefit to ourselves and our employers. The yearly meetings of our association not only favor the bringing-out of new ideas, but have value in developing the social nature. "Harmony and good-will" is our watch-word.

S. UREN, President.

GEO. F. HINKENS, Sec.-Treas.

Gladstone, Minn.

Wear of Cylinders.

Editors:

In May issue, page 424, a Schenectady correspondent raised an interesting point. Not wishing to obtrude myself upon your space, I have waited to see if anyone replied to it. I would like to refer him to some articles I wrote in London "Engineering" in 1894, more particularly that of November 23d. We might look for what he found, in a tank engine, which (in England) runs in back gear half its time. The crosshead thrust due to steam stress is always on the bottom bar, and the tendency is to use the stuffing box as a fulcrum and force the piston head on to the upper face of the cylinder; when running with steam off (or "drifting," as you concisely and expressively phrase it) the opposite is the effect during half the time. At commencement of outstroke, the resistance of the reciprocating parts to acceleration causes the main rod to lift the crosshead and press the piston on bottom face of cylinder. At the end of stroke, acceleration is negative, and crosshead is thrust down and piston up. On return stroke, things are just the same. In tender engines or others always in fore-gear, conditions are exactly reversed; the net effect when drifting is the same, but the steam stresses induce piston pressure on bottom cylinder face.

As a matter of fact, you would hardly expect the above to cut much ice, for you don't look for bars to run after they've got $\frac{1}{16}$ inch play; time then to "take up the slack." Still, when a certain condition of things obtains, we can only try and see what there is tending (in however slight degree) to induce it. Surely that procedure needs no excuse?

If T. H. W. can get the copy of "Engineering" referred to, I will reply to any specific question he may raise if he writes me as below, or else through your columns.

By-the-by, you hit the nail exactly when you talked of prolonging the piston rod through the front cover. I've always wondered why so few do it. Rather awkward on English non-bogie engines, as the rod casings would stick out right beyond the buffer beam. The objection of adding to the weight of the reciprocating parts may be met by using tubular tail rods, as I suggested in the number of "Engineering" referred to. Also gave a sketch of one last August in same paper.

H. ROLFE.

Hartford, Conn.

Graphite for Cylinder Lubrication.

Editors:

For the benefit of the mechanical departments I will give my experience in the use of Dixon's graphite for valves and cylinder lubrication.

On the engine I am handling I am able, by the use of about one pound pure flake graphite per 2,000 miles, to increase the mileage made per pint "Perfection" valve oil 100 miles in freight service. The engine is a standard, 18 x 24 cylinders, and my greatest trouble in making mileage on valve oil was from cylinder packing howling at each little job of switching, and it would take a considerable quantity of valve oil each time to stop those groans. As a consequence, my oil record suffered; for if there is anything on the engine with which to stop cylinder packing groaning I'll use it.

I find a small quantity of the graphite, mixed with valve oil, will accomplish what took a large quantity of the oil alone. A separate can should be used for the mixture, that will admit of contents being stirred up at beginning of trip; then shake well each time before taking, and don't have the mixture so thick but that it will draw into independent oil cups on lubricator easily.

Valve oil only should be used in the mixture, as other oils will burn up before reaching steam chests, leaving the Graphite to clog up oil pipes. The pure flake should not be used in lubricator, as it soon settles to bottom and is lost. The finely pulverized might not do this.

I find it a decided advantage to use it on all joints, gaskets and packing on the engine.

G. O. HUCKETT,

Wymore, Neb.

A foreign metallurgist recently made exhaustive experiments with the tempering of extra hard steel, which were interesting. A bar of steel was prepared by cementation in such a manner that the percentage of carbon varied regularly from one end to the other. It was then hardened and polished, and an ordinary sewing needle drawn along its surface. It was found that the needle would scratch the steel as far as the part which contained about .7 per cent. of carbon, at which point the marks ceased, but reappeared where the percentage of carbon is greater than 1.3. Under the microscope, the latter portion of the scratch is found to be discontinuous, proving that the steel is not homogeneous. Steel containing 1 per cent. of carbon is composed almost exclusively of the harder constituent, the proportion of the softer metal increasing until the carbon reaches 1.6 per cent., beyond which carbide of iron begins to separate. By using steel containing 1.57 per cent. of carbon heated to 1,832 degrees Fahr., and quenched in ice-cold mercury, the two varieties of metal may be obtained in equal proportions. Such a mixture was found to have less power of receiving and retaining magnetization than a similar sample heated to only 1,472 degrees Fahr.

Two inventors in Topeka, Kan., are determined to make it hot for train robbers if railroad companies will only patronize the invention which they have got out to make train-robbing dangerous. They propose making the running boards of the engine in such a shape that, when any train robbers get on to ply their nefarious trade, the running board will fold them up and squeeze them against the boiler. Spikes are secured on the edges of the running board, which are intended to hold the robbers the way that a spring rat-trap holds on to its victim. At the moment the running boards perform the rat-catching operation, steel shutters automatically enfold the cab, making a shot-proof fort for the engineer and fireman. Then an arrangement of steam pipes, which are about as numerous as the quills on a porcupine, has begun to discharge hot water and steam at every point where the robbers would be likely wait to be cooked. It is a great scheme, but we are surprised that any sane man thought it to be practicable.

The "Proceedings of the Thirteenth Annual Convention of the Roadmasters' Association of America" has been received at this office. It contains a variety of information concerning track matters that is likely to be very useful to those engaged in that kind of work. It can be obtained by application to Mr. J. B. Dixon, Secretary and Treasurer, Chicago & Northwestern Railroad Company, Sterling, Ill.

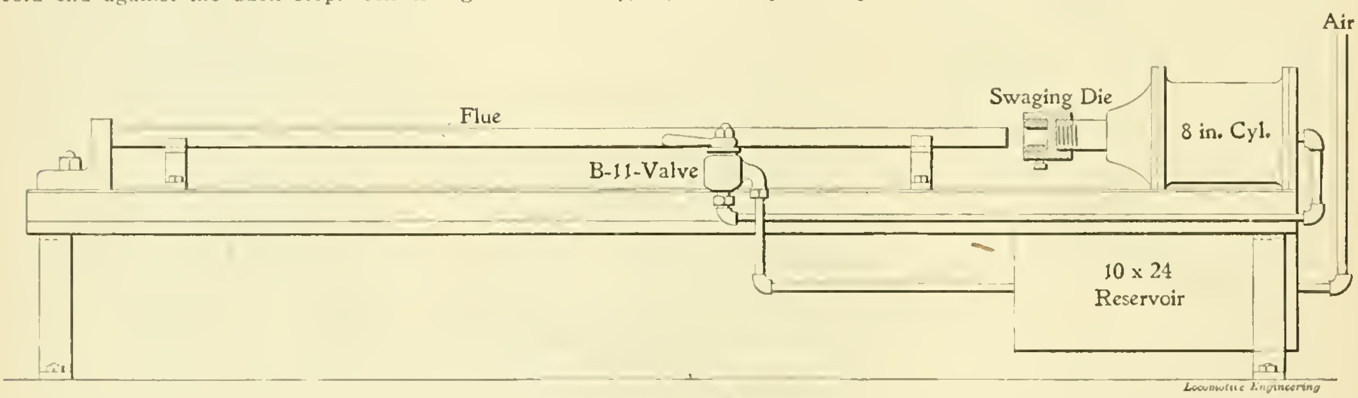
A Kink in Flue-Swaging—Susquehanna Shops.

Our illustration of the flue-swaging machine at Susquehanna shops shows another novel application of air to reach the end of cheapening the cost of work; and while this was the primary object in view, it was found that the quality of the output had not suffered by the change from the old hand process of forcing the hot flue end into a die; therefore the thing has been a success from the start.

The machine is cheaply gotten up from materials at hand in every shop. The bed is formed of a pair of T-rails inverted and resting on wrought-iron legs. On this foundation is secured an 8-inch air cylinder, which is piped to a B-11 valve. Underneath the cylinder is a 10 x 24-inch reservoir which had formerly done duty as an auxiliary; this reservoir is in communication with the shop air plant, and is also piped to the B-11 valve.

In operation, a flue with one end at a red heat is laid on the supports, with the cold end against the back stop. Air is applied to the cylinder, and the advancing piston, with its die, swages the flue. Upon releasing the air, everything is free and the machine is ready for another flue.

The work done by this machine is first-class—all depending, of course, on the condition of the die. The amount of work it is capable of turning out is measured by the ability of the operator to handle the flues.



FLUE-SWAGING MACHINE. ERIE R. R.

A Steam Locomotive Without Firebox.

In the city of Marseilles, France, a railroad has recently been completed, says the London "Locomotive Engineer's Journal," which possesses the original feature that its motive power consists of steam locomotives without firebox. This peculiar engine was adopted in order to effect the passage of a tunnel, half-a-mile long, without development of smoke. The locomotive consists of a cylindrical boiler, which is filled with hot water under a maximum pressure of 227.5 pounds per square inch. At the end of the line the pressure decreases to 43 to 70 pounds. The water is then heated again to 203 degrees, corresponding to a pressure of 227.5 pounds, by means of steam produced by the generators at the central station. The boiler is 10 feet long, 3.8 feet in diameter, and holds, besides 550 gallons of water, 21 cubic feet of steam. The steam from the generators is uniformly distributed through the water by suitably arranged pipes. After having been used in the cylinders, the steam is condensed in a condenser consisting of 1,154 pipes, provided over the boiler.

Mechanical Energy of Gunpowder and of Steam.

The 100-ton gun, with a 550-pound charge of powder, throws a projectile weighing 2,020 pounds at an initial velocity of 1,715 feet per second, thus communicating to it a live power or kinetic force of 92,597,000 foot-pounds. The thrust exerted by the gas due to the ignition of the powder lasts less than the hundredth of a second, the result being that during the active period of the work of the powder in the gun the mean power is greater than 87,000,000 foot-pounds per hundredth of a second—say 8,700,000,000 footpounds per second—and this represents a power of 12,000,000 kilowatts, or 17,000,000 horse-power.

Not long since, a boiler 60 inches diameter and 16 feet long, designed to carry 100 pounds pressure, exploded with disastrous results, and as it had been in use but a few years, and was in excellent condition, there was good reason to believe that the bursting pressure did not fall short of 500 pounds. Assuming this to be the case, and that the water level stood at the ordinary height, we find that the water had latent in it, in the form of heat, the enormous quantity of 299,834,371 foot-pounds of energy, while the available energy in the steam is 16,821,409 foot-pounds, in comparison with a negligible quantity. When the boiler let go, the heat was transformed into mechanical energy, which was expended in wrecking the plant. The immensity of these figures is beyond our limited comprehension, and the only way by which we can get some idea of their meaning is in making comparisons. How many pounds of gunpowder in exploding would liberate the same energy? The combustion of one pound of average gunpowder generates 250,000 foot-pounds of energy. The energy set free, therefore, by the exploding boiler is only rivaled by the explosion of 1,200 pounds of powder.

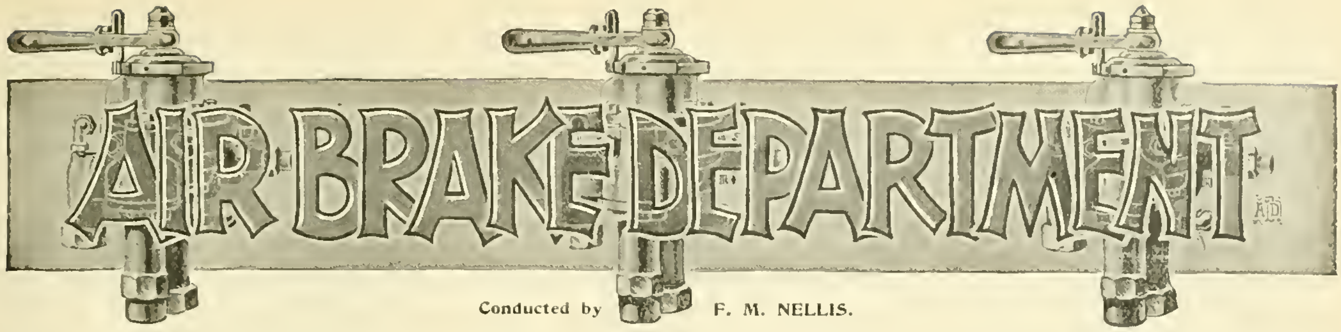
Effect of Valve Inertia on Port Opening.

In the course of a discussion on Slide Valves, Professor Goss, of Purdue University, drew attention to a fact in relation to the action of valves that is not generally understood except by those who have done a great deal of locomotive indicating. He said:

"There are many difficulties incident to showing the exact point of cut-off. It is said that a reverse lever in a certain position should produce the same cut-off, but it does not always do so. With the same speed, a difference of lubrication will vary the steam distribution; and as the speed changes, the inertia of the moving parts comes in to make considerable difference, and these differences are all proportionally greater for the shorter cut-offs.

"I have made a series of tests of speeds of 15, 25, 35, 45 and 55 miles an hour. We should expect that the mean effective pressure would gradually recede as the speed goes up. We did not find it to be so. We find there is a certain loss of mean effective pressure in changing from a speed of 15 to 25; there is a certain loss proportionally about the same from 25 to 35 miles per hour; but when the change goes from 35 to 45, there is very little loss of mean effective pressure, showing that the inertia of the moving parts has a considerable effect upon the steam distribution, the amount which the valve moves, and the time when it moves."

The writer has frequently been puzzled when taking diagrams from locomotives running at pretty high speed with short cut-offs, to see that the diagram for the high speeds kept up so well and approximated so closely to diagrams taken at considerable lower speed in the same notch. It appears to be highly probable, as Professor Goss said, that stretching of the valve motion, due to the inertia of the valves of the higher speed, produces a greater port opening than that produced at the lower speed.



Conducted by F. M. NELLIS.

The master car-builders have decreed that it is improper repairs to replace a triple valve with another of different make.

An air gage in the engine cab, connected into the signal-line pressure, seems to offer some good argument in favor of its use.

A big item in the cost of maintenance of freight brakes is saved by switching ahead and using all air-brake cars in partially equipped air-braked trains.

Encouraging and complimentary words, coming from a high official, go a long way towards spurring on ambitious employés to greater effort and consequent better work.

Correspondents sending problems must accompany same by all data possibly obtainable. Avoid unnecessary mention of things not bearing directly on the case, as it is liable to mislead. Send the answer with the problem.

If you have a special device for doing any kind of air-brake repair work, send it to "Locomotive Engineering" for illustration before someone else sends practically the same thing and gets the credit for priority of invention.

Mr. Ewing's method of recording and commenting on air-brake stops appeals to the pride and ambition of the engineman, and does not condemn or censure him. It merely tells him where he stands and in what particular part he may improve.

Something is needed to abate the shock caused by the use of the emergency application at water tanks, junction points, and other places where close "spotting" is necessary. Would not the use of Desoe's "marker" assist in producing smoother stops? Try it.

Mr. Ralph E. State's bushing extractor will no doubt perform its work in a quick and effective manner. Have not some of our correspondents or subscribers a device for dislodging the emergency valve seat of the quick-action triple without bruising the seat, as is often done in using a chisel or other equally improper tool for this purpose?

There is some considerable complaint that the heavy passenger equipment cars are not holding as they should, and that the lighter cars in consequence are compelled to assume more than their own share of the work. Are these cars not braking sufficiently high, or are their runs so long that they need a slack adjuster to keep the piston travel at a reasonable figure?

Fred Hain, general air-brake inspector of the Western New York & Pennsylvania Railway at Buffalo, N. Y., writes that he believes a pressure gage on the signal line is a good thing; and also, that if the pressure-reducing valve were placed in the cab, and connected to the main-reservoir pipe, there would be much less danger from freezing up in winter and rotting out of the rubber diaphragm in summer.

The Master Car-Builders' and Master Mechanics' associations have appointed a joint committee to revise the "Air-brake and Signal Instructions," as drawn up and approved by them at their 1892 conventions. Could not the committee draft, with profit, something on the lines of the "Progressive Form of Questions and Answers," as adopted by the Air-Brake Association at their third annual convention, at Boston, Mass., this year?

Little real good is accomplished in instructing employés in air-brake practice unless all air-brake cars are switched ahead and used, thereby giving opportunity to put into practical operation the teachings of the instructor. The men will remain brighter, the brakes will be better maintained, and money will be saved, by thus increasing the stopping efficiency of the train, if this be done.

It is a deplorable fact that there are certain fine air plants for cleaning cars on some railroads where no facilities whatever are provided for testing the air brakes, this work being done after the train is taken to the passenger depot and engine is coupled on. Piston travel is adjusted there, and if any considerable repairs are needed, the car is cut out until such time as it may be idle.

It would be considered rank negligence if the inspection of a locomotive should be delayed until it backed onto the train; yet this is analogous to the system of air-brake inspection followed on roads having air plants for cleaning cars, but no plant for testing brakes. In this case they are obliged to defer the test of brakes until the engine is coupled onto the cars in the depot a few minutes before leaving time.

The cam type of engine driving-wheel brake is fast disappearing, and is now seldom applied to new locomotives. It has been supplanted by the outside-equalized form, which is now being generally used on account of its simplicity and adaptability to all classes of locomotives. It is also free from intrigue with those unknowing and careless persons who indiscriminately use cams of the same radius on all classes of engines, regardless of their weights.

The importance of giving complete data when sending problems for publication in this department, and the difficulties attending an attempt to correctly diagnose a case at long range, are forcibly illustrated in the numerous requests for further data had from correspondents wishing to offer a solution to P. P. Haller's problem. Care should be taken that no data is overlooked or withheld. Troubles which are difficult to locate when every facility is offered, become problems totally impossible of solution when not accompanied by full and complete data.

Some certain air-brake men seem inclined to frown down on "problems," and regard them of insufficient importance to worry their brains about. If problems were puzzles especially sought out by one man to "stick" and mystify others, and thereby demonstrate his individual superiority, we would share the views of the above-named men; but we must differ with them, as problems will not be published with a view to puzzle, but, instead, to encourage research and to afford that wholesome mental exercise which if properly directed, cannot fail to land the student high up in the air-brake art.

The Master Car-Builders have declared that a triple valve which has not been submitted to their Committee on Tests, and has not passed a satisfactory trial, does not come within the requirements of the law. This wise decision should remove from service the numerous counterfeit triple valves that are not only incompetent themselves, but which pervert and demoralize the harmonious action of other brakes in whose company they are placed. A triple valve which attempts to steal into railroad service through the back-door, and evade the Master Car-Builders' tests, is a constant menace to train safety, and will detract from the efficiency of legitimate brakes and will reduce the value of the investment already made in air brakes in the same proportion in which they are used.

Concerning Wahlert's Rule.

Since Wahlert's rule for determining the brake power delivered by a cam brake was given in our columns, a number of correspondents have written us that, inasmuch as the rule gives no information concerning the radius of the cam faces, its value is therefore limited because of its failure to deal more fully with these important features.

As stated in the June number, the rule is applicable only to engines that are already equipped with cam brakes and is a simple and reliable means of ascertaining the power delivered at the brake shoes, regardless of what may be the radius of the cam faces and the proportion of the hanger levers. It accomplishes the object sought without bringing in a mass of tedious detail.

For the benefit of those who wish to acquire a closer knowledge of the process of designing cams for driver brakes, a progressive series of sketches with suitable accompanying descriptive matter is given in other columns of this department.

Recording Air-Brake Stops.

The method of recording air-brake stops, as adopted by Mr. W. D. Ewing, general manager of the Fitchburg road, and as will be found fully described elsewhere in this department, is a happy and effective scheme. That Mr. Ewing has faith in his method and is proud of the good work done by his men was quite forcibly demonstrated by his action at the meeting of the Air-Brake Association in Boston last April, when he sent his representative to the convention hall with a book of blank passes, properly signed, to invite the members to ride over his road as much as their time would permit, and criticise freely the air-brake stops made. Those who availed themselves of Mr. Ewing's courtesy had nothing but words of praise to offer. Someone may suggest that the engineer, knowing that air-brake men were aboard, made unusual effort to make fine stops; but those familiar with these matters know that, under such circumstances, an engineer never does his best work.

While the Fitchburg system of recording stops differs widely from the one used on the Great Northern Railway and St. Paul & Duluth Railroad, it possesses advantages not had by the latter system. The backward lurch, caused by a tardy release of brakes, and numerous applications made in quick succession, are recorded. The latter system has the advantage over the former system, however, inasmuch that it records in the engineer's own handwriting the pressures carried and the amount of the reductions, besides giving a general record of the condition of the several parts of the air-brake apparatus; while the former is open to doubt as to the accuracy of the recording gage and the correctness of the readings taken by the man watching the gage. Although the recording system is yet in its infancy, it is producing results that are interesting and highly beneficial.

It has been rightfully said that the majority of men do not need additional instruction as much as to apply what knowledge they have already acquired, and some means of knowing when this knowledge has been properly applied. This is quite true. Many men are really doing better work than they are given credit for, and never will receive that credit until it is given by the recorder system; while others are not doing so well. Roads where the recording system is used say that engineers ask to have their record taken frequently, which fact goes to prove that the system is not distasteful to the men upon whom "tab" is kept. The makers of Card No. 1, on page 477, and Record No. 2, in this number, are to be highly complimented. What a pity that we are unable to print their names and give credit where credit is due!

Rules for Calculating and Designing Driver-Brake Gear of the Push-Down Type.

Divide weight on drivers, less 25 per cent., by 4 = braking force on one shoe; multiply braking force on shoe by length of hanger lever between center of shoe-holder pin and hanger-lever stud, and divide by total length of hanger lever: The quotient will be the force required at the lower end of the hanger lever. Multiply one-half the value of the cylinder by the length of the cam between the centers, and divide by the force in pounds required at the lower end of the hanger lever: The quotient will give the offset in inches, or the point from which the radius or face of the cam is described.

VALUE OF CYLINDERS.

Six-inch, 1,400 pounds; 8-inch, 2,500 pounds; 10-inch, 4,000 pounds; 12-inch, 5,650 pounds.

In the accompanying drawings, which illustrate the progressive steps in laying out a design, the 8-inch cylinder, standard cams, levers and shoe-holders have been used. These meet the requirements of a large class of locomotives.

Special cases require special cams, shoe-holders and levers, but the principle of operation will be the same. Example:

Weight of engine on wheels ready for road, 60,000 pounds; 75 per cent. of 60,000 pounds = 45,000 = approximate braking power required; 45,000 pounds ÷ 4 = 11,250 pounds on each shoe; 11,250 × 18 ÷ 26 = 7,788 pounds required on lower end of hanger lever; 1,250 pounds (one-half value of cylinder) × $12\frac{5}{8}$ (length of cam between centers) ÷ 7,788 pounds = 2.026 = about 2 1-32 = offset in inches.

Fig. 1: Locate shoes and hanger levers; the lower ends *a a* of the hanger lever, and the lower ends of shoes, should clear the track at least 3 inches with the frames in the lowest position.

Fig. 2: Draw line *b* connecting *a a*, and set off $\frac{3}{8}$ inch on each side of the center line *c*, points *d d*. With a radius *a c* draw arcs *e e*. The line *a d* is the ***approximate*** working length of the cam between centers, and the center of link-pin will be located on the arc *e*.

Fig. 3: Having obtained the approximate working length of cam (in this case $12\frac{5}{8}$ inches), multiply this by 1,250 (one-half of the value of the cylinder) and divide by 7,788 (power required at lower end of hanger lever), and we obtain 2 1-32 = the offset required in inches. With *a* as a center and a radius of 2 1-32 inches, draw arcs *f f* and the tangent *g*. On this line, $\frac{3}{4}$ inch on each side of the center line *c*, set off the points *h h*, and with the radius *i* from the centers *a a* draw the arcs *k k*, intersecting each other and the center line *c* at *l*; this locates approximately the lower ends of the cams when the brake is off.

Fig. 4: With a radius of 3 inches, and with *l* as a center, draw the arc *m*, intersecting the arcs *c c*; connect *n n* to *a a*

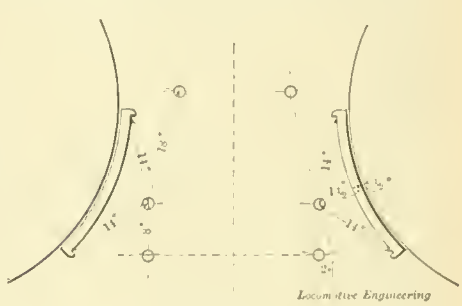


Fig. 1

with lines *o*, which are the center lines of the cams.

Fig. 5: At *a*, on the line *o*, and at right angles to *o*, draw the lines *p p*, intersecting the arcs *f f* at *r r*; connect *r r* by the line *s*; the intersection of this line with the center line *c* gives the true point of contact of the cams. From this point correct the work already done, as shown in previous diagrams.

Fig. 6: From the point *r*, and with $r\,l^1$ as a radius, draw the arc *t*, which is the true face of the cam. The distance between *w* and *t* should be $1\frac{3}{4}$ inches; if there should be a noticeable error, work back to and correct the offset. From l^1 (the true contact point), with a radius of 7 inches, draw arc *u*, locating the upper end of the faces of the cams. Draw the line *v* through *u* and *r*, extending it to *w*, $1\frac{1}{4}$ inches beyond *r*; from *w* the face of the cam as constructed is described. This is done in order that the braking force may reach its maximum only when the cam screw has been screwed out and the distance between centers increased $1\frac{1}{4}$ inches.

Fig. 7: We have now reached that state of the design where the radius of the face of cam, calculated and working offsets, can be given.

Figs. 8, 9, 10, 11 and 12 show progres-

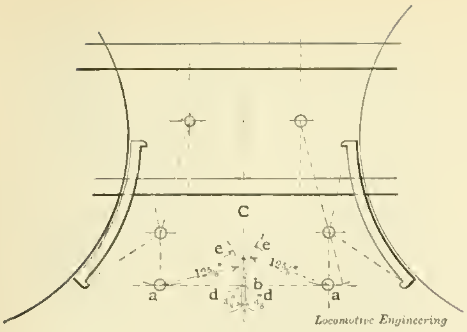


Fig. 2

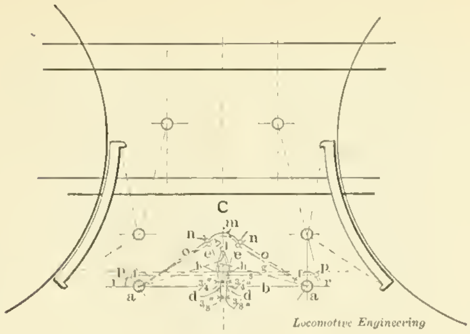


Fig. 5

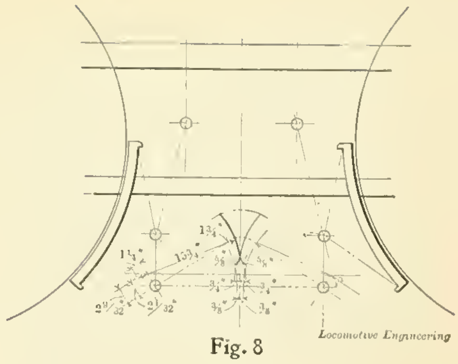


Fig. 8

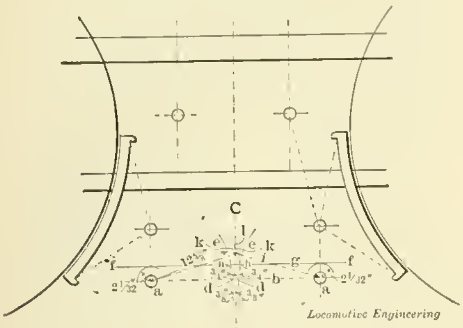


Fig. 3

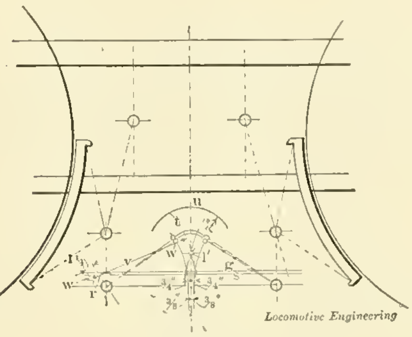


Fig. 6

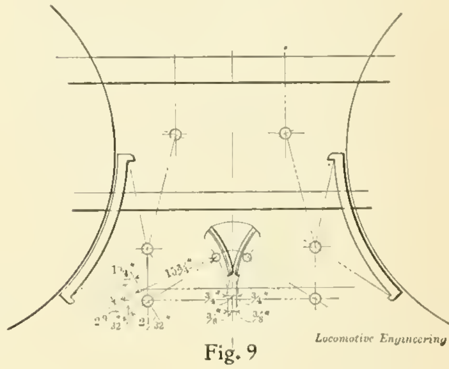


Fig. 9

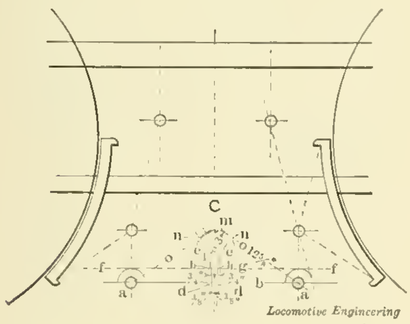


Fig. 4

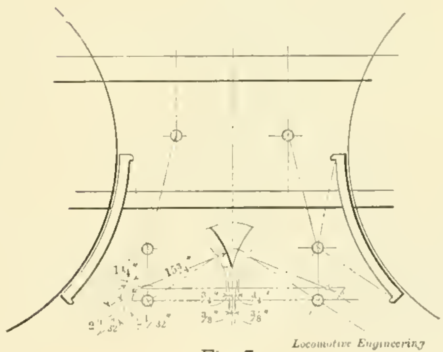


Fig. 7

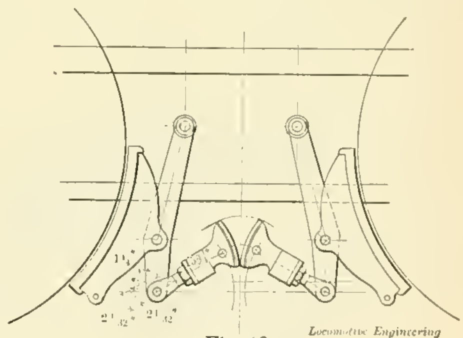
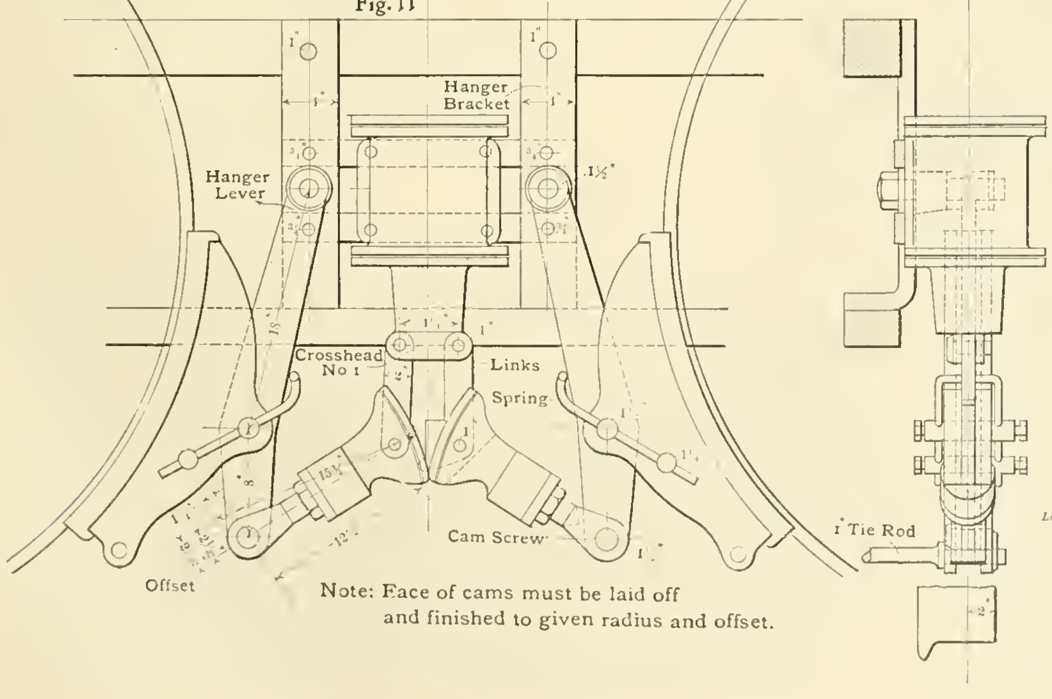


Fig. 10

Fig. 11



Note: Face of cams must be laid off and finished to given radius and offset.

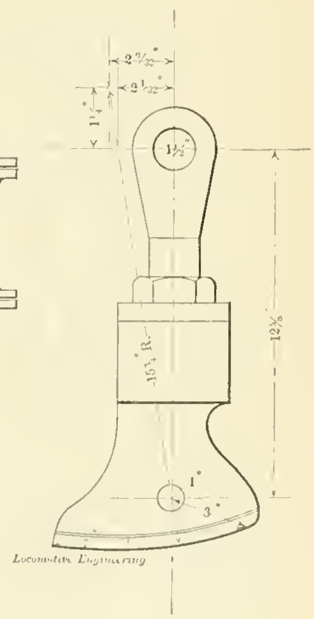


Fig 12.

sive stages of development to the finished design.

While the cams of the pull-up cam type of this brake are arranged to move in the opposite direction from the push-down, the same rules are applicable.

Air-Pump Exhaust Muffle and Lubricating Attachment.

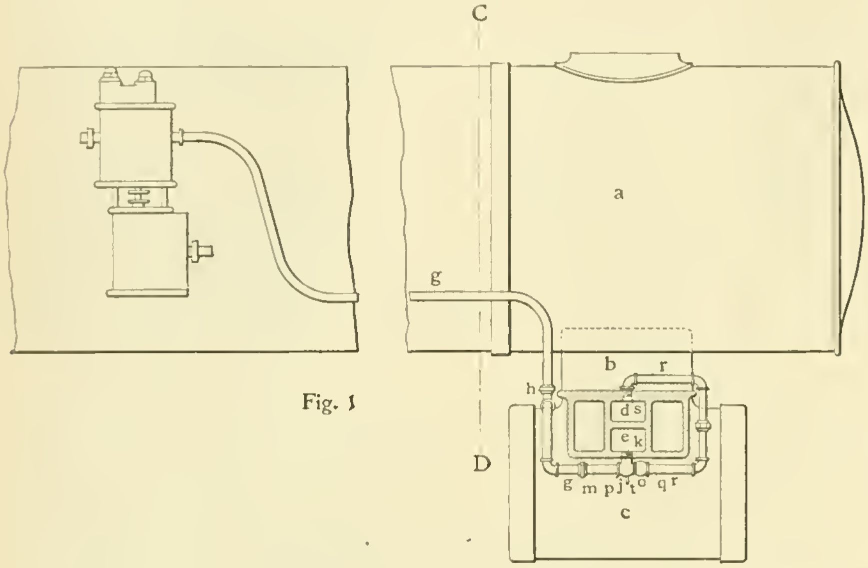
Editors:

Noting inquiry from D. A. S., Las Vegas, N. M., and your reply in April number, relative to air-pump exhaust being cut into exhaust channel of locomotive, we send you herewith a blueprint of circulating exhaust attachment, together with description of same, for illustration in "Locomotive Engineering." The attachment has proved to be a great saver for us. Its description is as follows:

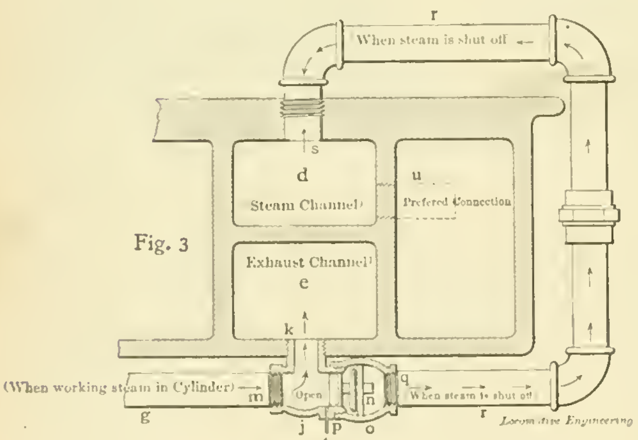
The invention relates to a method and means for connecting the exhaust channel of a locomotive with the steam channel when steam is shut off; also in passing the exhaust from the air pump through the steam channel, thus reducing wear on the valves, cylinders, cylinder packing, etc., by circulating exhaust and lubricating the various parts with steam, condensed water and oil discharged from the air pump, thus preventing the heating of cylinders by friction, yet keeping the cylinders warm, while wholly muffling the objectionable noise of the air-pump exhaust and destroying force draft, so damaging to fireboxes, flues, etc., and averting unnecessary consumption of coal.

Fig. 1 represents a view, part in side elevation and part in section taken at line *A—B*, Fig. 2, showing location of return exhaust and air-pump connection.

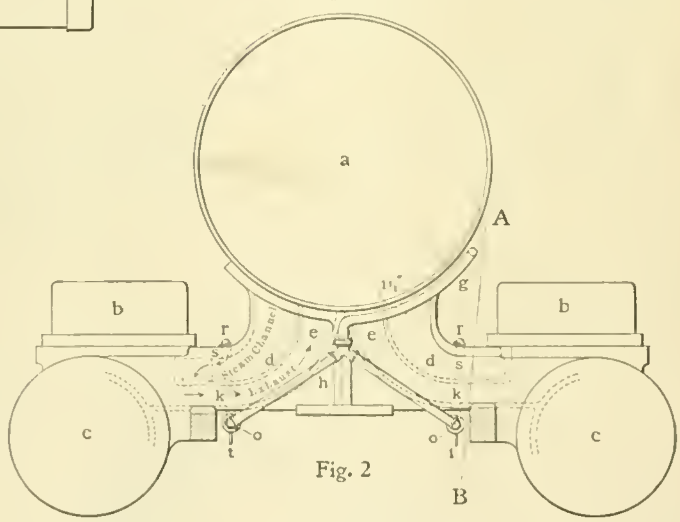
Fig. 2 represents a transverse section taken on line *C—D*, Fig. 1, looking to right.



Elevation and Partial Section on line "A-B"



Detail of Connection with Steam and Exhaust Channels.



Section on line "C-D"

Fig. 3 is an enlarged detail view, showing return exhaust pipe in connection with the return valve, the valve being shown in section.

Referring to the drawings: *a* represents the boiler; *b* the steam chest; *c* the cylinders, with which portions of the improvements are connected. The steam chest and cylinders being located on each side of the locomotive, it will be obvious that various parts of the device are also in duplicate, and will be so considered, even if spoken of singly. *d* represents the steam supply channel which connects the boiler with the ports of the steam chest; *e* the exhaust channel that connects the exhaust ports of the steam chest with the smokestack; *f* the air-pump; *g* the air-pump steam-exhaust pipe.

In the ordinary construction of locomotives the exhaust pipe of the air pump is connected directly with the smokestack, thereby creating a force draft on the fire when air pump is in operation, thus consuming unnecessary fuel when engine is at rest or running down grade. If fuel is not supplied, cold air is drawn through grates, causing unequal expansion and contraction, with damaging effect to boiler, and force draft is not desired. Said draft also causes an objectionable discharge of smoke and cinders from stack while engine is at rest in or at a station or other locality. Exhaust also creates an objectionable noise.

To avoid the objections mentioned, and to derive the advantages detailed further on, the air-pump exhaust *g* is extended, by means of suitable bent pipes and connections through "Y" *h*, to right and left and into back end of automatic tee valve *n* at *m*. *t* represents a drain from chamber of valve *n* when valve is open. From the cylinders, when the locomotive is running from its momentum, the pistons, which continue to reciprocate in the cylinders (to use a descriptive phrase), act as air pumps, exhausting the air from the steam channel *d*, and forcing it out through the exhaust channel *e* to the stack, with the result that a vacuum is at once formed in the steam channel, thus forming an unequal pressure on the valves in the steam chests, causing them to rock and wear unevenly and destroying their usefulness. With this, on long hills, cylinders are heated by friction, causing them to cut and wear.

By means of the device, as soon as main throttle is closed and steam is shut off, the pressure is released from the forward end of valve *n*, and the exhaust from air pump passes through said valve, through pipe *r*, and enters the steam channel *d*, instead of passing through the smokestack, as in ordinary construction; thus keeping up a constant circulation, materially lessening the vacuum created by the pistons; said method also serving to keep valves and pistons warm and lubricated, whether engine is running or at rest. From this reason, the exhaust from air pump carries oil and steam into the steam channels, even if piston is not reciprocating. The circulation thus described prevents the pump exhaust from passing out through the stack before being placed to use, and, when expanded, is little more than a "breath," thus causing a saving in fuel which would necessarily be consumed by action of the force draft.

A saving in oil by this attachment is had, instead of wasting it by direct exhaust to the stack. When engine is running under steam, the automatic valve *n* is closed by pressure of steam in pipe *r*, the air-pump exhaust passing out with steam exhaust through exhaust channel, *e*, thus creating an additional draft in smokestack at a time most required. The above-described attachment and method also completely muffles the objectionable noise created by the air pump when engine is at rest. There are other advantages derived from the use of the attachment which are obvious to those skilled in mechanics.

The first attachment was made on Atlantic & Pacific Engine No. 68, March 25, 1894, at Needles, Cal. Patent applied for September 25, 1895, and issued April 20, 1896, with nine lengthy claims allowed, of which the following is a summary: "In an engine, an attachment connecting, directly or indirectly, the air-pump exhaust with the steam channels or exhaust channels of a locomotive, and an automatically operative valve located in said attachment, substantially as shown and described."

GEORGE H. PERRY,
W. S. HANCOCK,
Patentees.

Needles, Cal.

Automatic Drainage Valves for Main Reservoirs.

Editors:

I have just received the July number of "Locomotive Engineering," and note Mr. Young's device for automatically draining the main reservoir.

In 1889 or '90 there was a drainage valve used on the Old Colony Railroad, which the engineers liked very much, and the inventor expected large returns from; but, instead of opening with low pressure, this relieved the reservoir of water at above maximum pressure, *i. e.*, the main reservoir was set at 93 to 95 pounds, and to drain the reservoir the pressure was run up until valve opened. This was an easy matter with the B-11 and D-8 valves; but the knock-out drops were administered to this device before the advent of the E-6 valve, by an engineer who attempted to drain his reservoir while in transit. A piece of scale lodged on the valve seat and consequently allowed all the air to escape from the main reservoir, and it condemned the device. Mr. Young's device is better in that respect, as pressure would hardly go below 10 pounds in main reservoir when coupled onto a train.

H. S. KOLSETH.

Boston, Mass.

New Hanger-Clamp for Train Pipes.

Editors:

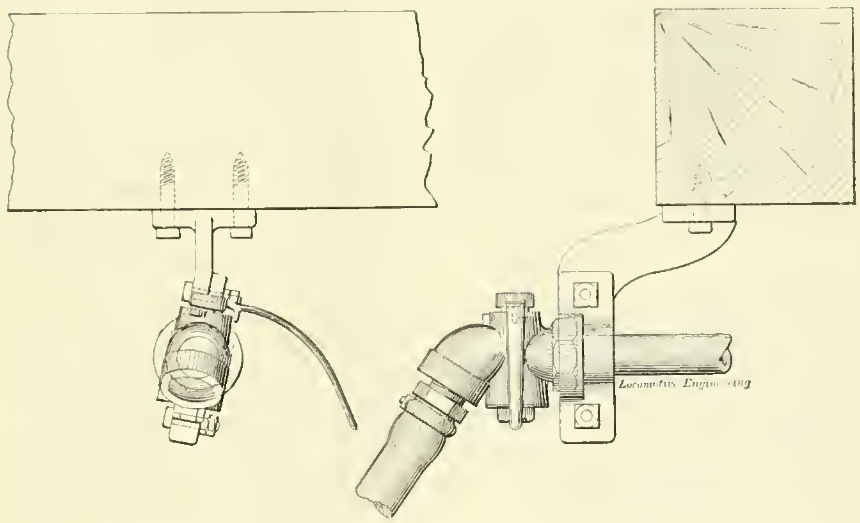
The Boston & Maine Railroad has adopted for use on their air-brake cars, a hanger clamp, designed by the writer, which holds the train pipe rigidly in place. Please find, under separate cover, a blueprint of the device.

The hanger is made to take the hexagon part of the angle cock as well as the pipe, and it is so constructed that the hose and angle cock are bound to be held in the right position, besides being of great support to the train pipe, both vertical and longitudinal. It is made of cast iron and rather heavy, but is so made for two reasons—anything that would destroy the cast clip would also ruin a malleable one; then, again, the castings can be had at a moment's notice, but malleable would have to be carried in stock; and last, the cast scrap would be worth nearly as much as the casting, while the malleable would be worthless.

We are using the same kind of hanger on the valves of the consolidated steam heat system. Recently a steam hose on one of the new passenger cars became detached from the chain that holds it up, and it got caught and was torn completely off at the nipple; but it did not move the pipe or break the hanger, so it demonstrates that it will stand a good pull before the pipe will move lengthwise of the car.

B. F. HUDSON,
A. B. Insp., B. & M. R. R.

Boston, Mass.



B. & M. FREIGHT ANGLE-COCK SUPPORT CASTING.

Pressure Gage on Air-Signal Line.

Editors:

I send you the following, which I think will be of interest to "Locomotive Engineering" readers:

I have always thought that a gage on the signal line in the cab was the proper thing, and I was convinced some time ago that it is really a necessity.

We had on this road two cases where a train ran some 75 miles without air enough in the signal line to give a signal, and no one knew it until they wanted to use it. The signal was tested on engine before leaving the house, and at the depot it was tested on the train and found to be "O. K." After a run of about 25 miles, the whistle blew one faint, and not very long blast. The engineer, according to rule, looked back to ascertain if everything was all right, and seeing nothing wrong, he proceeded. When at the end of the run it was found that the signal would not work, the train was inspected and a burst signal hose found. The hose probably burst gradually, reducing the pressure considerably before it allowed it to escape fast enough to operate the signal valve, and then the air escaped through the burst as fast as it was fed in through the reducing valve.

Another case experienced on this road was that of a train starting out all right, and when the train air signal was used to signal to stop, when about 10 miles out, it was found that there was not enough air to give the signal. In this case the small inlet port to the reducing valve had become stopped up after leaving the terminal, and slight leaks in the signal line had allowed the air to escape without sounding the whistle. A gage in each of these cases would have enabled the engineer to know the condition of the signal line.

We have since April been equipping our engines with gages, and have now a large portion of them equipped. From our experience thus far I cannot too strongly recommend this practice. I think any road will be more than repaid for their trouble and expense by the improved service obtained.

I was pleased to find that the gage not only provides means by which the engineer can at all times know the condition of his signal line and reducing valve, but acts as a "tab" on trainmen and others using the signal cord. They had just begun to use the signal on one of our branches, and the conductor, desirous of giving the signal of three blasts ("Stop at next station"), pulled the cord three times. The engineer got two blasts only (which is the signal to stop), and he stopped. The following is what the engineer said when he told me about it:

"That gage you had put on the signal line is great stuff. Mr. B——, my conductor, wanted me to stop at A——, and he tried to give me the signal to do so; but all I got was two blasts, and I stopped right off. He wanted to know why I stopped when he gave me three whistles. I replied: 'It did not blow but twice, and and no wonder, for you used 20 pounds the first pull, and the rest of it for the second; that did not leave you any for the third.'"

E. G. Desoe,
A. B. Insp., B. & A. R. R.

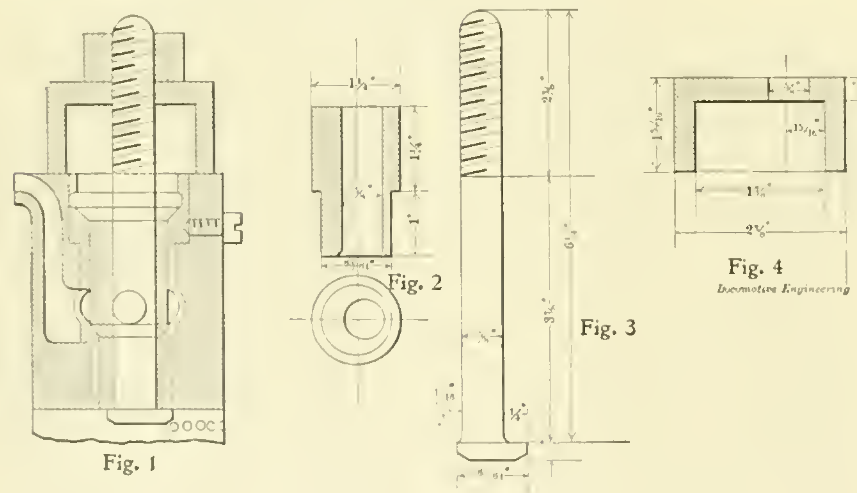
Springfield, Mass.

Handy Tool for Air-Brake Machinists.

Editors:

I inclose you a sketch showing appliance for withdrawing valve-chamber bush No. 43 of the Westinghouse Air-Brake Company's 8-inch pump.

Fig. 1 shows the bushing and eccentric



STATE'S BUSH PULLER.

bolt in place for removing bush No. 43. Figs. 2, 3 and 4 show the three pieces required. The only recommendation this appliance has, is that it will remove bushing every time, even if chamber-bush set screw No. 46 is broken and won't come out.

To use the appliance, the bolt, Fig. 3, with eccentric head, and end bushing, or sleeve, Fig. 2, are dropped down in valve-chamber bush No. 43. Cap washer, Fig. 4, is next put on; then the bolt is revolved one half turn, bringing the head fairly underneath bushing No. 43; the nut is run down, and out comes the bushing. Designed by the writer. No patent.

Ralph E. State,
Big Four Railway.

Bellefontaine, O.

Air-Brake Angle and Stop Cocks.

Editors:

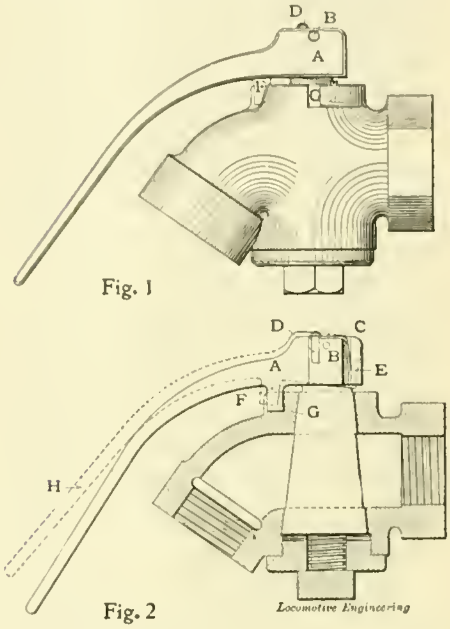
The angle and stop-cock handles now in common use on air brakes have no protection against being moved by accident or with malicious intent. One writer states that the angle-cock handle has been moved by coming in contact with the deadwood caused by the air pipe being loose at that point and the handle striking the dead wood or side of draft timber when the pipe vibrated under motion of the train. Others say that the stop-cock handle will of its own weight move from one position to another, and no one will deny that cock handles have been moved with malicious intent, resulting disastrously. A number of schemes have been proposed to prevent any occurrence similar to those above mentioned, but nothing has proven acceptable to manufacturers and users of air brakes.

The attached cuts represent a very simple device which will positively prevent the movement of the handle by accident, and ordinarily will forestall the malicious movement of the handle. The principal features of this device are that it can be operated almost as readily as the handles now in use, that it does not change the general plan of the cocks—only one additional piece being added, and that is the small spring between the plug and the handle—and that it can be applied to all classes of stop cocks.

To the expert, the cuts are self-explanatory, and a very few words will explain it to those who may not be so well versed in air-brake technique.

Fig. 1 shows the natural open position of an angle cock with the improved handle attached. The handle *A* is pivoted at or near the top end of the plug *B*. The lug *F* is placed one-fourth inch closer to the center of the plug, and enters a recess *G*, when open or closed.

Fig. 2 is a section through the center of an angle cock, showing the handle in its natural position when cock is open. The dotted lines *H* show the position that the handle will be in when raised to a line of movement to open or closed position, or



NEW HANDLE FOR AIR-BRAKE ANGLE COCK.

reverse. *C* shows a flat spring which is fastened to the top of the plug *B*, with set screw *D*. This flat spring is bent down between the head of the plug and the inside of the back end of the latch handle at *E*. The lower end of spring at *E* is given set enough, and bears against the lower end of the handle with sufficient pressure to hold the handle in its natural position.

The question, no doubt, will arise that it will not prevent opening or closing the cock with malicious intent; that the person wanting to cause trouble in this way can move the handle the same as anyone else whose business it is to do so. The natural inference is that the tramp or evilly disposed person would be in such a hurry to do so that, in first grabbing the handle, he could not pull it over, would not stop to find the reason, and would thus fail in his object.

The inventor of this idea has had considerable experience in the operation and maintenance of air brakes, commencing with the original set that were applied to the "Steubenville Accommodation," running between Pittsburg, Pa., and Steubenville, O., in the very early '60's, and up to the present time he has not lost sight of the Westinghouse air brake.

Further information will be cheerfully given upon application.

J. D. McIlwain.

Pittsburg, Pa.

Field Notes.

Editors:

The other day one of the trainmen pointed out to me an air-braked car they had hold of that day, which would not set at all with a service application; but when the train-line pressure was reduced enough, would go on with emergency at once; so they cut out the brake. "Now," thinks I, "we have at last found a triple that has a disabled graduating valve." So we took the triple valve down and examined it, expecting to find an object lesson for the boys.

On examination, every valve in the triple was found whole and in proper place, the graduating pin, stem and spring "O. K.," and valve had large enough opening to give a proper graduated application. It was gummed up pretty bad, as if it had at some time—a good while before—been oiled with a thick, gummy oil. The feed port *i* was almost stopped up, the opening being not much larger than a hair. The effect of this reduction of the feed port to so small a size was to retard the charging of the auxiliary. When the brakes were tested, this one had not charged as quickly as the others, and there was not enough pressure in the auxiliary to move the triple piston down against the train-line pressure. The trainmen said: "Give it all to her, and see if it will work." This rapid reduction of train-pipe pressure, of course, set the triple at work with emergency. The feed port was cleaned out, an air-brake engine coupled on, and the brake worked perfectly every trial.

There is a good deal of uncalled-for mystery about a broken graduating pin or disabled graduating valve; lots of trouble that originates from other causes is charged to this one. We once found a car that had the bell-shaped strainer in the train-pipe union at triple stopped up with sand and iron scales on the train-pipe side. It would not work with emergency or a service application. This strainer was cleaned out and the trouble ceased. Possibly the sand and scales stuck in the meshes of the strainer till train-pipe pressure was reduced enough to blow it out, and triple got a sudden reduction with usual result.

As triples are now made with the pins soldered in the piston rod, it seems impossible for them to come out or break, unless it is done by a willfully careless repairer. It is not unusual for a triple with this defect to work with a graduated application as often as it does with emergency, when a moderate reduction is made at the engine; but it is this very uncertainty as to what it will do that makes it necessary to cut out the disabled triple as soon as you find it.

We "caught on" to a new trouble the other day—a brake would charge up properly, but could not be set with any kind of a reduction. The triple was taken down, and the graduating stem 21 was found put through the hole in bottom cap from the piston side, instead of from the spring side; this, of course, kept the piston from moving down far enough to open any air ports to brake cylinder.

Here is an old one in engine equipment which may be new to some engineers. With a D-8 brake valve the pump would work till black hand showed 70 and red hand 90; then the D-9 governor, which has no vent hole drilled in side over air piston and was set at 70 pounds, would stop the pump. The red hand would begin to drop back till it got to 70, when the pump would start up again, pick up the excess, and stop till the excess was gone. This would sometimes take place every five or six minutes when running between stations. Several of our engines showed this peculiar action, but none of them with D-5 valve would do it. Now for the explanation: The train line was as nearly perfectly tight as possible; the governor was in good order and did not leak much air past the piston, which would be a leak from train pipe. When the pressure ran up to 70 pounds, the governor shut off the pump and would not let it start till train-pipe pressure could be reduced a little. Possibly, there might have been a very slight leak past seat of excess valve. The bell ringer used air from main reservoir, and would use up the excess in five or six minutes. As soon as main reservoir pressure dropped below train line, that would fall also, the governor would start up the pump, and main-reservoir pressure would rise 20 pounds. As soon as excess valve opened, the train-pipe pressure would rise and governor act again, shutting off the pump. With D-5 it never happened, as governor was operated by main-reservoir pressure; the bell ringer kept that down a little, so pump would work very slowly and supply just enough air to hold pressure up to 90, which is quite a point in favor of D-5 over D-8. A bad leak in main reservoir, or its piping, would operate the same as the bell ringer using air.

This engine puzzle was a combination that was very creditable to the men in charge of engine repairs, for it showed all pipe joints tight and everything in A-1 shape.

C. B. Conger, Trav. Eng.,
C. & W. M. R. R.
Grand Rapids, Mich.

Reversing Engine When Driver-Brakes are Applied.

Editors:

I was much pleased recently, when looking over the twenty-seventh annual report of the Massachusetts Railroad Commissioners, to read, in their report of the collision on the Old Colony division of the New York, New Haven & Hartford Railroad, at Hyde Park, October 24, 1895, their opinion of reversing an engine when driver brakes are provided and in working order. Following is a quotation from the report:

"It was a mistake, however—but a not uncommon one, and we do not make it here a distinct ground of censure—to reverse the engine. Attention has been called in previous reports to the fact that, if an engine is provided with efficient driving-wheel brakes, it does harm instead of good to reverse the engine, the effect being to increase not inconsiderably the length of the stop. This statement has been recently substantiated by experiments made at the instance of the Association of Air-Brake Men. Some means should be taken, by instructing engineers or otherwise, to prevent the practice of reversing the engine when the brakes are applied to the driving wheels. Such procedure is admissible only in case the driving-wheel brakes are out of order."

This goes to show that the Association of Air-Brake Men is doing some good work, and it also goes to show that they have an individual duty to perform in seeing that the driver brakes are kept in good repair, so that the shortest possible stop can be made. It is known that if there are leaks between the triple and the cylinders, or in and about the cylinders, brake-cylinder pressure will escape and the power of the driver brake will be greatly lessened. It is good practice for an engineer, when about to look over his engine, to apply the brake with 20 pounds reduction, and then notice if the shoes remain tight against the wheels. Too much cannot be said to interest the engineer and others in looking after driver brakes.

E. G. Desoe.
A. B. Insp. B. & A. R. R.
Springfield, Mass.

Air-Brake Practice on the Fitchburg Railroad.

Editors:

I have noted what has been said in the recent numbers of "Locomotive Engineering" regarding the use of the pressure recorder on the Great Northern and the St. Paul & Duluth railroads, and think that the following plan, recently substituted by W. D. Ewing, general superintendent of the Fitchburg Railroad, to increase an already creditable air-brake efficiency attained by his engineers, will prove interesting to your readers.

The air-brake inspector connects a pressure gage to the hose on the rear end of the last coach, and records in his notebook the number of applications and the amount of all reductions made over the division by the engineer. He also records the fact if a lurch is made through failure to release brakes at the proper moment. The record of each run is sent to the general superintendent's office, and is there compiled into a bulletin, which, with comments thereon, by the general manager, is then posted in the roundhouse for inspection and the information of all. The friendly rivalry thus created among the men, and the complimentary comments coming from a high official to a worthy employé, have made the scheme a profitable and popular one.

The following are two sample bulletins and a number of comments, which have been selected to give a better understanding of Mr. Ewing's scheme:

FITCHBURG RAILROAD COMPANY.

[Office of General Superintendent.]

Air-Brake Record of Train No. ——, Engine No. ——, Engineman ———; April 1, 1896.

	Applications.	Lbs. Used.	Stops.
Lincoln	1	15	Fair.
Concord	1	23	Fair.
South Acton.......	1	18	Good.
West Acton.......	1	15	Good.
Littleton	1	15	Good.
Ayer (Waterspout).	2 10 & 10	20	Good.
North Leominster.	1	22	Good.
Fitchburg..........	2 8 and 8	16	Good.

Stops are rated "Good," "Fair," or "Bad." Except where interrupted now and then or in making a water stop, it is desirable that the operation be accomplished by one application. I take pleasure in saying that the stops marked "Good" were very good; while all stops should be "Good," the two marked "Fair" were a mere shade off from "Good." The average number of pounds of air used per stop was 18. Perfect work, under similar circumstances, has been done on an average of about 11 pounds. For the information of all concerned these reports will, hereafter, for a time, be posted on the bulletin board, say one week in each case. It is hoped they will be of great assistance to all ambitious enginemen.

(Signed) W. D. EWING.
Gen'l. Supt.

FITCHBURG RAILROAD COMPANY.

[Office of General Superintendent.]

Record of Train No. —— (four Cars), Engine No. ——, Engineman ———; March 31, 1896.

	Applications.	Lbs. Used.	Stops.
Union Square.....	1	10	Good.
Somerville	1	10	Good.
Cambridge	1	9	Good.
West Cambridge..	1	11	Good.
Fresh Pond.......	1	10	Good.
Mount Auburn....	1	11	Good.
East Watertown...	1	11	Good.
Union Market.....	1	10	Good.
Watertown	1	10	Good.
West Watertown..	1	12	Good.
Bemis.............	1	11	Good.
Bleachery.........	1	11	Good.
Newton Street.....	1	10	Good.
Waltham	1	13	Good.

Average amount of air used per stop was $10\frac{9}{14}$ pounds. This report is the best, I believe, that has come to my notice up to date.

(Signed) W. D. EWING.
Gen'l. Supt.

The following extracts are the general superintendent's comments on other similar bulletins:

Results fine. Average of air used 11½ pounds per stop.

Got very good results, considering the condition of engineer's valve and driver brake. Average amount of air used, $12\frac{9}{10}$ pounds per stop.

Train on time. First application at Fitchburg too soon. Had to release and and start up again. In doing this gave train a disagreeable jerk.

Mr. ——— did very well, considering the condition of his engineer's valve. Stops all good. Average amount of air used, $12\frac{4}{10}$ pounds. Seems to understand how to release just right.

Engineman ——— has had the good fortune to secure another good report, and one which seems to be admirable in that it shows the least average of air that has yet been reached—viz., $9\frac{7}{13}$ pounds—and every stop perfect.

Averaged $14\frac{8}{10}$ pounds air per stop. Released just a little late at several places; Waltham worst. Wasted some air in not making first reduction, so as to carry piston past leakage groove promptly.

Mr. ——— has got the average of air down to a very reasonable figure, but does not seem to have the confidence in himself that is necessary to release at the proper time. The result is that several of these stops are marked "Fair."

Only four "Good" stops out of sixteen; the others are all "Fair." There was an average of $19\frac{13}{16}$ pounds of air used for each stop, which ought to have secured most excellent results. This is much below the average in results. Altogether too much air used.

Averaged 15½ pounds of air. All stops good. Used two applications at Millers Falls, on account of meeting Train No. 4 at that point. Was on time at all points. The water-spout stop at Ayer was said to be the best that has been made by anyone.

Mr. ——— ought to be able to reduce the average amount of air used somewhat; 13 pounds is not bad, but it is quite the proper thing to economize as closely as possible in this direction. Stops were excellent, and especial credit is due for the water-spout stop at Greenfield.

These stops were all made without jerking the train, but release was made a little too slow to get as fine results as are wanted. It is to be observed in this report that it is possible to make good stops even at a water-spout, but the average of air used per stop was excessive—$20\frac{1}{3}$ pounds.

The effect of making more than one application for an ordinary stop is brought out plainly in the above report, as this cost an average of 17½ pounds of air per stop, which is rather excessive; 25 pounds of air ought to get a first-class stop anywhere, but it was only "Fair" at Millers Falls. There is only one way to accomplish a good stop, and that is, to release at the proper time.

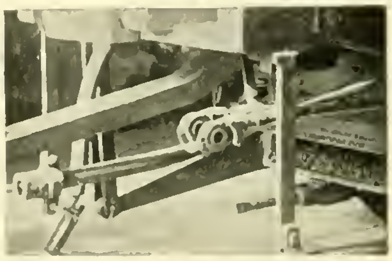
H. S. KOLSETH.

Boston, Mass.

Improved Form of Coupling Between Engine and Tender.

Editors:

I am sending you herewith two photographs of the signal and brake hose connection between engine and tender, as designed by Mr. N. J. Pritchard, air-brake



inspector Norfolk & Western Railroad Company.

Mr. Pritchard claims for this device that, by screwing one of the couplings on the pipe on the locomotive, it does away with one hose between engine and tender, and makes a more perfect and altogether a better coupling; it also keeps the coupling and hose well up out of the dirt and dust.

H. A. GILLIS, M. M.,
N. & W. R. R.

Roanoke, Va.

Cause of a Queer-Acting Brake.

Editors:

The triple which caused the "queer action" was among the first quick-action triples invented, and the stepping-stone to the present successful and reliable triple. This triple was patented by Mr. Westinghouse, March, 1887, and was subsequently called the "'87 triple." The quick-action device in this triple is a slide valve placed in connection with the graduating post, and is operated by the main piston. When a sudden reduction is made in the train pipe, the main piston travels out and forces the graduating post back, carrying with it the emergency slide valve, which opens a port from the train line to the brake cylinder. After train-line and brake-cylinder pressures equalize, non-return check valve closes, preventing the air in the brake cylinder from returning to the train pipe, thus allowing the auxiliary reservoir to complete the application.

There were two troubles arose in this brake, causing the "queer action"—one being in the cylinder, the other in the triple—*i. e.*, the piston sleeve had become disconnected from the brake piston in the cylinder, thus allowing it to tilt when air was admitted to the cylinder, which drained the main reservoir and train pipe. The piston sleeve stuck out of the cylinder head about six inches, causing one to believe it was applied by looking at the piston travel; this may have occurred before or after we left the terminal.

. Second—When we cut loose to set a car in the train, the brakeman properly cut the cars, and when coupling up again, being in a hurry to get away, he turned the angle cock wide open at once, causing quick action to take place, which broke the graduating pin in the above-stated triple. This caused the triple piston to travel its full length, which held the quick-action slide valve wide open. The port leading to the brake cylinder has a larger area than the auxiliary port; consequently, the air passed out of the cylinder as fast as it was delivered to the triple piston; so it will be seen the auxiliary pressure forced the piston to its full travel, and kept it in that position as long as air remained in the auxiliary. After the auxiliary had been exhausted, the graduating spring did its work by forcing the piston back and placing the emergency slide valve over the port leading to the cylinder, thus allowing train pipe to be restored, and the pump again was able to accumulate pressure.

P. P. Haller,
A. B. Insp. C. & O. Ry.
Covington, Ky.

QUESTIONS AND ANSWERS

On Air-Brake Subjects.

(48) F. L., Amboy, N. J., writes:

1. Why do the rear wheels of a truck on a pasenger car slide more easily than the front ones? 2. Which equalizes first in an emergency application, the plain or quick-action triple. A.—1. The action of the brake shoes tends to pull down the front end of truck and raise the rear end. This causes the rear brake hanger to assume a more obtuse angle and produces a wedging or toggle-joint action that tends to slide the wheels. The weight is also lifted somewhat from the rear wheels by the lunging forward of the car and the tilted position of the truck. 2. There is a little difference in favor of the quick-action triple.

(49) J. W. C., Waco, Tex., writes:

1. On page 90. in Synnestvedt's "Evolution of the Air Brake," reference is made to patent of Boyden's for recharging the auxiliary reservoir while brakes are applied. As I do not fully comprehend the method of doing this, I wish you would say whether it is with the use of one or two pipes. 2. Where can I get a full description of this improvement? A.—1. Only one pipe is used. 2. The idea of recharging the auxiliary reservoir while brake is applied is not new, and several patents have been issued on triples of this kind. You can probably obtain copies of the patent papers by applying to the United States Patent Office at Washington, D. C.

(50) H. M., Georgetown, Ky., writes:

In making a service stop with the D-8 brake valve, after ten pounds reduction it is found necessary to go to emergency position; why does the train-line hand go up to, say, 80 pounds instead of going down? A.—When brake-valve handle is placed about midway between the start and finish limits of the emergency position, port *j* in the rotary and equalizing port *g* in the rotary seat are brought into register, and the main reservoir and equalizing reservoir pressures are thereby connected. This causes the gage pointers to go together. This register of ports was not intentionally made, but was coincident with the arrangement of the ports in other combinations, and was not thought detrimental, inasmuch that there is no necessity for watching the gage when making an emergency application.

(51) W. K. T., Hornellsville, N. Y., asks:

1. What might cause the pound in an 8-inch pump, provided the main piston was all right and the reversing gear apparently in good condition? 2. Is crude or black oil suitable for use in air cylinder of pump? A.—1. Discharge valves having too much lift, or a loose air piston head. 2. Owing to the numerous qualities of oil having the same name, it is difficult to say. West Virginia ground oil of 33 degrees gravity is best suited for use in the air cylinder of the pump. Black oil, as a rule, is not suited to this service. In the absence of a proper ground oil, a good quality of valve oil may be sparingly used with good results. The better plan of oiling the air cylinder is to place a swab on the piston rod, and allow the lubrication to be carried down the rod, through the stuffing box, into the cylinder. Oil should never be put in through the air suction valves.

(52) J. S. D., Elmira, N. Y., writes:

If the train pipe is broken off at the engineer's brake valve, can the signal line be used in any way as a train pipe that will allow the brake to be used? A.—By removing the interior parts of the pressure-reducing valve, and by employing a special coupling, the signal line at the rear of the tender, or the train, could be coupled to the train line, and, by the use of the conductor's valve in the coach and the proper manipulation of the angle cocks, it would be possible to apply and release brakes. This process, however, would be laborious and impracticable. Should the breakage as described really occur, it would be a much more sensible plan to repair it, or brake in by hand, rather than to attempt this one. The time required to prepare the reducer and special coupling, and the uncertainty and unreliability of the stops made, would hardly be appreciated by the superior officers. The ingenuity required to thus prepare a train for braking by this extraordinary method might rightfully be mistaken for insanity.

(53) F. A. M., Jersey City, writes:

1. Why are brakes made to release so slowly? The chapter of "Don'ts" in the Westinghouse Air-Brake Company's Instruction Book says there is a good reason, but I have never heard it given. 2. I always understood that the rapidity with which the train-pipe pressure could be reduced in a service application depended on the lift of the equalizing piston in the angle fitting in which it seats. In your February number, page 186, you speak as if the restricted size of the preliminary exhaust port governed it in some way. Please set me right on this subject. 3. Mr. M. H. Neff's article in June number, on emergency applications on double-headers, causes me to ask what the result would be if a single engine were placed in the middle of an air-braked train? Could an emergency application be obtained on the cars both ahead and behind the engine? A.—1. The exhaust port is restricted in the slide-valve seat so that the brakes will release comparatively slowly, so that all brakes on a long train may release as nearly simultaneously as possible. If the port were made large, as could easily be done, the head brakes would be off before the train-line pressure would have time to reach the rear cars to move those triples to release position, and would probably break the train in two. Less air is also required and it is easier to make an accurate stop, provided two applications are necessary, with the port its present size than if it were made larger. 2. The lift of the equalizing piston does regulate the flow of air from the train pipe, and the size of the preliminary exhaust port in turn governs the lift of the piston. With the present size of port the equalizing piston lifts but very little with a one-car train, but lifts higher with ten cars, still higher with twenty, and lifts to its extreme height with a very long train. 3. Quick action would be obtained on all cars.

(54) J. C., New York, writes:

1. If a set of driver-brake shoes 24 inches in length be reduced to 16 inches, would they last longer and would the wear on the tires be less? Please answer and settle a dispute. 2. Why is the Hodge system of leverage, whose hand brake works in opposition to the air brake, better for passenger cars than the Stevens system, which works with the air brake on freight cars? I should think the latter system was best, as it could be used to assist in holding if the air pressure was low in case of emergency. 3. In May issue you speak in answer to a correspondent of allowing for losses due to piping and cooling of air through expansion. Will you give a little information in regard to losses through cooling, as I have never heard this subject discussed. A.—1. The 16-inch shoe would not last as long as the 24-inch, for the reason that it would receive a greater pressure per inch area, and would therefore wear faster. The wear of the tire would be the same. The fact that a driver brake will wear out shoes is evidence that it is holding and doing its share of the work, and is therefore a recommendation rather than a fault. Holding power should not be sacrificed to get longer wear out of brake shoes. 2. The Stevens system of brake levers, as applied to a passenger car, has numerous faults. The hand brake is connected to the top end of dead lever, and therefore works in opposition to the air brake, the same as the Hodge. The dead lever is inclined at the opposite angle from the live lever, and thus makes a transverse pull on the bottom rod. Both live levers being inclined in same direction will cause a varying piston travel when car is rounding curves. The Stevens system, as used on a freight car, is a compromise between the original Hodge and Stevens systems. The hand brake works with the air brake, which is quite important on freight cars, but of less on passenger cars. 3. Air will naturally heat when being compressed, and will likewise cool when expanded. If a certain volume of air under compression is raised in temperature, the pressure will be increased; if the temperature be lowered, the pressure will reduce. Write "Locomotive Engineering" for a copy of Richards' "Compressed Air," price $1.50.

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July Issue	*19,500*
August Issue	*20,000*

Notice.

The July number is entirely exhausted. Subscriptions can commence only with August. SINCLAIR & HILL.

Balanced Valves.

Strange as it may appear to the ordinary engineer and mechanic, there are still men in charge of railroad rolling stock who do not believe in balanced valves, and who give practical expression of their unbelief by running all their locomotives without balanced valves. It was owing to this lingering unbelief that a committee of the Railway Master Mechanics' Association was appointed a year ago to consider different types of balanced valves, their economy over plain unbalanced slide valves, and what difference in economy and efficiency would result if all balanced valves were provided with the Allen port. The report presented by the committee, of which Mr. G. R. Henderson, of the Norfolk & Western, was chairman, was one of the best engineering papers ever prepared, and consisted largely of facts discovered by carefully conducted tests and experiments. About a week was spent by Mr. Henderson, experimenting on the Schenectady locomotive at Purdue University, with apparatus made specially to test the power required to move slide valves under the varying conditions that a locomotive is subject to in ordinary service. The report submitted will form a permanent reference and authority on balanced valves.

The committee found that a wear of from 1-32 to 1-16 inch per 100,000 miles' service might be expected from balanced valves, and from two to three times as much with unbalanced valves. This information was drawn from replies to a circular. We consider that the saving of wear by the balancing of valves is underrated. We are aware of one railroad where the valves of the express locomotives had to be faced about every six weeks when they were unbalanced. Since the valves of the same engines were balanced they run without facing until the engines have to be taken in for other repairs. The saving on wear of link motion and other valve connections is found to be almost as great as the saving to valve rubbing surfaces after the valves are balanced. The experiments conducted by the committee demonstrated that a valve having about 55 per cent. of the pressure balanced could be operated by about half the power required to move one which has the full pressure of steam upon its back. There was no theorizing in this. The power required in operating valves under these diverse conditions was measured and recorded, and the facts made manifest are just as reliable as the indications of a steam gage. The report ought therefore to put an end to the scepticism concerning the utility of balancing slide valves. Those who continue to be doubters as to the economy of using balanced valves, and are still waiting to be convinced before they try any, are not rendering good service to the companies employing them.

It is wonderful how unprogressive men will find testimony which will give them the necessary aid and comfort for keeping them satisfied to remain stationary. In the early days of the Master Mechanics' Association, when locomotives were light and valves were small, reports were submitted several times on the use of balanced valves, and the general opinion expressed was not favorable. Valves were then so small, and steam pressure so low, that balancing did little good. While talking with a master mechanic, about a year ago, who did not believe in balanced valves, we were surprised to be informed that a committee of the Master Mechanics' Association had reported that the use of a balanced valve had doubled the cost of operating a locomotive on which it was tried. After a long search we found the statement was made in 1870 by a man who had tried an unmechanical sort of balancing arrangement, and an odd experience had been converted into a general deduction and carried down in the form of error all these years.

The men who look back over ancient history for guidance on modern practice with locomotives are certain to make expensive mistakes. An old belief frequently expressed was that balanced valves were an advantage for passenger engines, but that freight engines did not need them. The committee in making the investigations for the last report, met with replies which indicated that the opinion about freight engines deriving no advantage from balanced valves is still current mechanical doctrine among some master mechanics. This belief is on a par with another long-cherished, that by some means the pressure on the top of the valve was not nearly so great as calculators made it out to be; that somehow the steam forced itself under the valve face and made a floating medium which compensated for and counterbalanced the downward pressure. The use of measuring instruments for recording the work done by the valve rod has exploded this theory for ordinary men, and it is time that the theory that freight engines will not be improved when balanced valves are applied to them is something that intelligent men should be ashamed of talking about. The valves of modern freight engines are as large as those employed on passenger service; and if a device for relieving the pressure on the valve is an advantage in one case, it is of equal advantage in the other.

Another consideration makes it of greater importance that freight locomotives should have the preference if selection is to be made in the application of balanced valves. A passenger engine does its work with very little reversing, and there is not much hardship imposed upon the men who have to handle such engines when they are hard to reverse; but with a heavy freight locomotive it is different. The valves are becoming so large, and their connections so heavy, that the work of reversing is exceedingly arduous, and sometimes interferes with the rapid handling of the engine when switching has to be done. If sizes increase much more, power reversing gear will be a necessity. The use of balanced valves ought already to be imperative for humanity's sake, to stave off the demand for power reversing gear, and to save the extra expense for fuel and repairs caused by the unnecessary power wasted in operating valves that groan under the full pressure of steam carried on their broad backs.

Brakes that Do Not Meet the Master Car-Builders' Standard.

At the last Master Car-Builders' Convention a resolution was adopted concerning power brakes which deserves the careful consideration of the railroad companies which are applying to their rolling equipment any sort of brake that suits their fancy, without consideration of its efficiency. A discussion was raised on the question: "Will a railroad company be complying with the law requiring power brakes on freight cars, regardless of whether its power brakes meet the specifications adopted by the Master Car-Builders' Association?"

These specifications referred to were established with a view to conserve safety in train-operating, and their purpose was to secure uniformity of action in train brakes, of whatever make they might be. The Master Car-Builders' Association required that triple valves of all new brakes offered for use by railroad companies should be subjected to tests, to demonstrate that they would work in harmony with the Westinghouse brake. During the past year several new triple valves have been put upon the market, and the claim has been made for them that they worked satisfactorily with cars equipped with Westinghouse triples. At the same time, the owners of these brakes have not entertained sufficient confidence in their apparatus to submit them for tests by the Master Car-Builders' Association. The natural inference, then, is that the brakes are not capable of harmonious action with a Westinghouse brake; and that being the case, they are likely to be a source of danger in train operating. It is no secret that several of the triple valves "invented" within the last year are no improvement over the old Westinghouse triple, which was good enough for a short train, but was dangerous when suddenly applied to a train of fifty cars. There is good reason for believing that ten per cent. of the unauthorized triples that have been introduced within the last year, if mixed in a train of fifty cars with those conforming to the specifications, would so vitiate the action of the whole brake equipment that an emergency application would bring results little short of those produced by a serious collision.

The Master Car-Builders' Association, then, acted wisely when they unanimously adopted the resolution: "That it is the sense of this association that brakes whose triple valves have not had the approval of the Master Car-Builders' Committee on Triple Valves shall not be considered as proper brakes for use on railway equipment."

A resolution of this character is likely to have far-reaching effects. The Interstate Commerce Commission have displayed a decided inclination to be guided by the decision of the railroad associations concerning safety appliances and safety practices. Mixing up in a train brakes which do not work in harmony, will vitiate in a great measure the advantage to railroad companies of having their freight equipment supplied with a sufficient number of air brakes to enable the engineer of a train to dispense with hand-braking. The big majority of railroad companies who have invested large sums in providing their cars with efficient brakes, are not likely to tolerate the mixing-up of their brakes with inferior ones that are likely to cause accidents. The outcome of the matter will be that cars having brakes which have not passed the Master Car-Builders' requirements will be refused at interchange points.

Reforms in Railroad Management.

In the July number of the "Engineering Magazine," Mr. M. E. Ingalls, president of the Cleveland, Cincinnati, Chicago & St. Louis Railway, has an article on "The Turning-point in Railway Reforms," which contains exceedingly interesting reading. The length of the article prevents us from using it in full, but we give the following abstract: No better illustration of the growth of railways, he said, could be seen than a comparison of the traffic of the Pennsylvania Railroad in 1852 and in 1895. In the first year the company carried 102,000,000 ton-miles of freight, at an average rate of 3.76 cents per ton-mile; for 1895, 8,173,218,403 ton-miles of freight were carried, at the rate of .56 cent per ton-mile. Nothing like this has been known in the development of the human race. The combination of the iron way with the propelling power of steam has advanced the world more in fifty years than all else that has been discovered in the fifty centuries preceding. It has furnished employment to an immense army of men, most of whom require a peculiar education and training for the business. One million of men are engaged in this occupation, as many more in the furnishing of supplies and material necessary for the business, and over and beyond it all is the influence which this traffic has upon the life and civilization of the nation.

The author follows the rapid development of the railway system in America, and the high rates of transportation charged for a time, which led to the Legislature regulating the management of commerce. The impression is conveyed that the Interstate Commerce Law has been, on the whole, beneficial to railways and to the public. The belief is expressed that the Interstate Commerce Law requires amendments in various ways, but there would be no difficulty in securing the necessary amendments if railroad managers demonstrated that they are doing their best to comply with the law. Previous to that, rates were raised or reduced without any notice, and it was considered proper to make certain rates to one man secretly, and higher or lower rates to his neighbor. After this law was passed it was accepted by the greater body of railway managers, and for some little time was obeyed, and rates were fairly maintained. Some companies, in search of business, began to resort to their old tricks of securing it, and by various subterfuges evaded the law, and forced others to adopt illegal practices or lose their business.

The practice of secret rate-cutting seemed to culminate early last year, and the evil had become so depressing that a meeting of representatives of the leading railways was held at New York in June, 1895, to try and devise some remedy. Mr. Ingalls, who was at the meeting, said he had never seen a body of men, managing great enterprises, so discouraged over the situation, and so hopeless of any future. A few of the managers present thought it worth while to attempt a reform, and after some effort, succeeded in inducing all to join in an organization, which they called the "Joint Traffic Association." From the start there were hopes of this association proving a remedy for the evils from which railroad companies were suffering, and their work was aided at the beginning by decision of the Supreme Court, and the fact that parties under prosecution for giving secret rebates can be compelled to produce books and tell what they know, if they are not on trial themselves. The influence of this association has been so good that Mr. Ingalls acknowledged that, during the twenty-five years in which he has been managing a railroad, he has never known such close adherence to tariff as there has been for the last year.

Fifteen or twenty years ago, a man who had the reputation of being smart at getting business by surreptitious means was in demand. To-day he hunts a long time before he gets a position, and when he gets one, instead of attempting to make his reputation by making it known that he is cutting rates to secure business, he endeavors to build up a reputation for conservatism.

Railway officials of this country must be educated to respect their tariffs, and unless they do that there is no future for railways. When this principle is firmly established, railway operations will be profitable and railway management respectable.

One of the strange anomalies of the times, and one which shows how the public conscience is debauched and has lost its regard for the law, is the fact that there seems to be more trouble to-day in maintaining tariffs and obeying the law in the cases of railways in the hands of receivers than in any others. In other words, some of these railways are still reported to be securing business by secret contracts and illegal rebates. There is no question but that these practices are unknown to the court. One of these days some judge will wake up to this situation and put an expert accountant upon the accounts of his receiver, and then we shall get an example that will be useful.

Mention was made of the acceleration of the speed of passenger trains which has been made within the last years, and the author predicts that trains will, in the near future, leave St. Louis at noon and reach New York the next day at noon or sooner.

Railway clubs and other associations of railroad men are warmly commended. In the last twenty-five years there has been a wonderful advance in friendly feeling in the operation of rival railways. Just a little over a quarter of a century ago, when an important bridge on a certain Western road was burned, the president of the competing line hoisted the flag over his own company's terminal station in celebration of the event. To-day, should a bridge go down on either of these roads, the train despatchers would at once arrange to move the trains of the unfortunate railway over the other line, without friction or delay, and without reference to the presidents or general managers.

A good many railroad companies are exercised over a recent order, issued by Postmaster General Wilson, prohibiting railroad companies from carrying railroad mail in baggage cars. According to the postal laws, railroad companies are not permitted to carry letters unless they pertain to cargo being carried on the train, and the carrying of letters not relating to cargo is a direct violation of the United States revised statutes. A practice has grown up of railroad companies sending all letters relating to railway business in their own cars, outside of the United States mail. This violation of the law appeared to have been tolerated as long as it was done over a company's own lines, but the practice has grown up of railroads, in all sections of the country, sending letters relating to railroad matters over a variety of lines to reach the desired terminals. It has been a common thing for railroad letters to be sent in baggage cars from the Pacific Coast to New York. This practice has to be stopped.

We wish to direct the attention of those interested in the safety of train-operating, to a letter and illustration in another part of this paper, showing an invention which is calculated to prevent enginemen from forgetting orders. There are few railroad men who will not agree with the expression of the writer that "a man's pocket is not the place for train orders, and there is no man living to-day who is not liable to forget or make a mistake." Any invention of a simple nature, which is calculated to prevent the supreme mistake of forgetting meeting-points, is well worthy of general adoption. If the device patented by Mr. Jennings had been in general use for the last twenty years, a great deal of property that has been destroyed through collisions would have been saved, and many men whose lives have been blotted out in accidents of that character would be still alive and useful members of society.

Recognizing that the tendency of the time is to make publications of a smaller page, "The Railway Age" has followed "Locomotive Engineering," and has now published a paper of the standard size, 9 x 12. "The American Engineer, Car Builder and Railroad Journal" has adopted the same form, and others are likely to follow at the beginning of the year. In making the change "The Railway Age" says: "Undoubtedly a paper of this smaller size is handier and easier to read. It is less tiring to hold, does not flop over when you are reading, and is easy to fold up and put in the pocket for home perusal. It also has the very great advantage of going through the mails without being folded, so as to reach the subscriber clean and uncrumpled."

There is a disposition among railroad master mechanics and others engaged in mechanical manufactures to believe that machinists will gradually come to be classed under the heads of first-class mechanics and ordinary mechanics. Under the first classification will be workmen capable of doing work similar to that done by tool-makers; under the second head, the handy men who can run a planer or milling machine, and who are handy men for other work. The opinion is general that there will always be plenty of remunerative work for first-class men.

It is reported that a rather peculiar experiment will be tried soon on a railroad, under construction from Lake Superior to a point fifteen miles inland to important ore mines. An ascent of eight hundred feet is made in the fifteen miles, and the intention is to apply electric generators connected with the axles of the cars. It is expected that in going down hill, enough electricity will be generated to carry the empty cars back up the ascending grade. It is thought that the difference in weight of the loaded and empty cars will give power sufficient to make up for the waste due to leakage and friction.

Enginemen on British railways are agitating to have their locomotives provided with cabs as good as those in use in America. It is surprising how long this agitation has been delayed, for the men on locomotives have to endure terrible hardships in the bad climate of the British Isles. The old argument is still advanced by the officials, that the men would not attend to their duties properly if they were comfortably housed; but it is likely that the advocates of humane treatment for enginemen will eventually carry the day.

The indications are that there will be a renewal of the racing between the East and West Coast lines of Great Britain this fall. Unusually powerful engines and commodious cars have been built for these races during the past year, and the intention is to run as fast as an engine will make steam freely between stops.

PERSONAL.

Mr. Wm. Rutherford, superintendent of motive power and equipment of the Plant system of railways, has resigned.

Mr. C. F. Barnhill has been appointed general foreman of the Chesapeake & Ohio shops at Clifton Forge, Va.

Mr. D. C. Courtney has been appointed division master mechanic of the Baltimore & Ohio, with headquarters at Grafton, W. Va.

Mr. Court Ewing has been appointed road foreman of engines of the Toledo division of the Pennsylvania, with headquarters at Toledo, O.

Mr. W. F. R. Mills has been appointed general superintendent and purchasing agent of the Denver, Lakewood & Golden; headquarters, Denver, Col.

Mr. T. F. Griffin, formerly roundhouse foreman at Riverside, O., has been appointed general foreman at Indianapolis, Dillon street, Big Four shops.

Mr. C. H. Davis has been appointed trainmaster of the San Luis Potosi division, Mexican Central Railway, with headquarters at San Luis Potosi, Mex.

Mr. J. T. Walch has resigned as master mechanic and master car-builder of the Bellingham Bay & Eastern, to accept a similar position on the Oregon Central & Eastern.

Mr. F. O. Tarbox, trainmaster of the Chicago & Northwestern, has been promoted to assistant superintendent of the Ashland division, with headquarters at Ashland, Wis.

Mr. W. H. Sherman, trainmaster of the Chicago & Northwestern, has been promoted to assistant superintendent of the Ashland division, with headquarters at Kaukauna, Wis.

Mr. C. H. Hartley, assistant superintendent of the Chicago & Northwestern, has been promoted to superintendent of the Ashland division, with headquarters at Kaukauna, Wis.

Mr. Edward Shamp has been appointed general superintendent of the Maricopa & Phoenix and Salt River Valley railroads, with headquarters at Phoenix, Ariz. He was formerly on the Southern Pacific.

Mr. W. A. Bell, formerly general foreman at Dillon street, Big Four shops, Indianapolis, has been appointed master mechanic of the Louisville & Jefferson Bridge Company, with headquarters at Louisville, Ky.

Mr. George F. Bidwell, for the last seven years superintendent of the Ashland division of the Chicago & Northwestern, has been appointed general manager of the Sioux City & Pacific, with headquarters at Omaha, Neb.

Mr. Jesse C. Martin, who has been for the past twenty years employed as locomotive engineer on the lines of the Southern Pacific Company, has lately been appointed fuel expert for the Pacific system of the above company.

Mr. Joseph McWilliams has been appointed general manager of the Marietta & North Georgia, with headquarters at Marietta, Ga. He resigned as general superintendent of the Texas Central, to accept the position named.

Mr. Cornelius Vanderbilt, chairman of the board of directors of the various Vanderbilt lines, suffered from a shock of paralysis last month and was for a few days in a serious condition. He is now on a fair way toward recovery.

Mr. Robert E. Meehan has resigned as general sales-agent for Paul S. Reeves & Son, of Philadelphia, to take charge of the business lately acquired by his father, Mr. James Meehan, the Monterey Foundry & Machine Co., Monterey, Mex.

Mr. W. S. McGowan, Jr., has accepted the position of general sales-agent for the Hancock Inspirator Co. Mr. McGowan is well and favorably known to the railroad trade, and is certain to make a success in pushing the inspirator.

Mr. Frank Ray has been appointed road foreman of engines of the Pittsburgh, Youngstown & Ashtabula, the Erie & Pittsburgh and the Alliance & Niles divisions of the Pennsylvania, with headquarters at Lawrence Junction, Pa.

Mr. J. B. Kilpatrick has been appointed master mechanic of the West Iowa division of the Chicago, Rock Island & Pacific Railway, with headquarters at Valley Junction, Ia. He also has charge of the K. & D. M. and D. M. & Ft. D. division.

Mr. Thomas Aldcorn, formerly master mechanic of the West Shore Railroad, has been appointed one of the railroad representatives of the Hancock Inspirator Co. The other is Mr. Chas. E. Randall, who has been with the company for a number of years.

"The Bailie," a weekly illustrated paper of Glasgow, Scotland, which gives in each a full-page engraving of some prominent Scotchman, has in a recent issue a very good likeness of Mr. John F. MacIntosh, locomotive superintendent of the Caledonian Railway.

Mr. C. Peter Clark has been appointed general manager of the New England Railroad Company, with office at 180 Summer street, Boston, Mass. The office of assistant general manager is abolished. Mr. Clark has been for some years general freight agent of the Old Colony.

Mr. James H. Barrett has been appointed division superintendent of the Southern Railway, in charge of the Atlantic terminals. Mr. Barrett has had a great deal of experience on different railways, and is best known to railroad men through his connection with the Erie.

Mr. A. L. Studer has been appointed master mechanic of the Southwest division of the Chicago, Rock Island & Pacific Railway, in charge of the car and locomotive departments, with headquarters at Trenton, Mo. Mr. Studer has been for several years in charge of the division shops at Stuart, Ia.

Mr. B. E. Taylor has been appointed purchasing agent of the Louisville, New Albany & Chicago, and assistant to the general manager. His headquarters are in Chicago. Mr. Taylor has risen on the Chicago & Alton, where he commenced work as stenographer for the general superintendent in 1887.

Mr. Horace G. Burt has been appointed general manager of the Chicago, St. Paul, Minneapolis & Omaha Railway, with headquarters at St. Paul, Minn. He has been general manager of the Sioux City & Pacific for the last seven years, and before that was chief engineer of the Chicago & Northwestern.

Mr. A. C. Ridgeway, assistant superintendent of the Second and Third divisions of the Denver & Rio Grande, has been appointed general superintendent of the Florence & Cripple Creek road, which is part of the Denver & Rio Grande. He is the son of Mr. R. M. Ridgeway, one of the oldest superintendents of the Denver & Rio Grande.

Mr. Joseph A. Jordan, general manager of the Hannibal & St. Louis Railway, has been made vice-president of the Green Bay & Western, the reorganized Green Bay, Winona & St. Paul. He will have charge of the operation of the Green Bay line and will also retain the general management of the Hannibal & St. Louis. Mr. Jordan was for many years connected with the Chicago & Alton.

Mr. B. F. Yoakum, since 1893 general manager of the Gulf, Colorado & Santa Fé, has been appointed vice-president and general manager of the St. Louis & San Francisco Railroad. Previous to his connections with the Gulf, Colorado & Santa Fé, Mr. Yoakum held consecutively on the San Antonio & Aransas Pass the positions of assistant general manager, general manager, receiver and traffic manager.

Mr. Joseph H. Green has been appointed superintendent of motive power and machinery of the South Carolina & Georgia, with headquarters at Charleston, S. C. Mr. Green learned the machinist's trade in the shops of the Charlotte & South Carolina road and was afterwards for thirteen years general foreman of the Raleigh & Gaston shops. From there he went to be master mechanic of the Charlotte, Columbia & Augusta shops.

Mr. A. G. Elvin, for several years general foreman of the Chesapeake & Ohio Railway shops at Clifton Forge, has been promoted to be general foreman of the principal shops at Huntington, West Va. Mr. Elvin is a particularly able foreman, and has displayed great skill and ingenuity in the devising of special tools and special methods for the production of finished parts. We congratulate Master Mechanic Stewart on getting such a valuable assistant.

Mr. W. F. MacKenzie has been appointed traveling engineer of the entire Mexican Central system. In making this announcement, Mr. F. W. Johnstone, superintendent of motive power, says: "Master mechanics will please render Mr. MacKenzie every facility in the discharge of his duty. Engineers and firemen will follow any instructions given by Mr. MacKenzie as to the proper handling of their engines. Books of Instruction calculated to assist engineers and firemen in the better understanding of their duties, in the economical use of oil and fuel, will be put into the hands of our engine crews within a short time."

"The Mogul" recently contained a portrait of Uncle Ben Hafner, of the Erie, who is claimed to be the oldest locomotive engineer in the United States. He was born at Baden, Germany, in 1821, his father having been a first lieutenant in Napoleon's army which marched to Moscow. Uncle Ben began his railroad career in 1839 as a fireman, and a year later was running a locomotive on the Baltimore & Cumberland. In 1848 he went to the Erie, and, with a short break, ran a locomotive till March, 1892. Since that time he has been station-master at Port Jervis, and is highly popular with high and low.

Mr. George A. Haggerty, the well-known master mechanic, is now president of the White River Valley & Western Railway, with headquarters at Fayetteville, Ark. Mr. Haggerty has had considerable railway experience in the Southwest, where he was a very successful superintendent. By a note on the letter-head of a letter recently received from Mr. Haggerty, we learn that the length of the main line is 275 miles, east to west through Northern Arkansas, serving a territory of 9,000 square miles (rich in timber, agriculture and mineral products) and 175,000 industrious people that have no railway facilities whatever.

We had a very interesting call recently from Mr. Jacob Greenwold, superintendent of machinery of the Norwegian State Railways at Drontheim, Norway. Mr. Greenwold is a very warm friend of "Locomotive Engineering," and takes a great deal of interest in its pages. The Norwegian State Railways have been making an extension lately into very rich iron-ore fields, and it was necessary to obtain four new locomotives to put into service in September next. Mr. Greenwold was instructed to purchase the locomotives, and he found that he could not get them built in time anywhere except in America, so he came here and contracted with the Baldwin Locomotive Works for the engines. They are moguls of the Vauclain compound type for metre gage. There are already some two-cylinder compounds on the Norwegian State Railways, and the Baldwins will have a chance to compete with them. Mr. Greenwold is quite at home in America, for he came to this country some twenty years ago and worked in various machine shops. He came first to Montreal, but shortly afterward removed to Manchester, N. H., and worked for several years in the Manchester Locomotive Works. Then he went to the Lake Shore and worked in different shops there, rising to the position of foreman. The experience gained here was of great use to him when he returned to his own country, for he rose rapidly to the position which he now occupies.

BOOK REVIEWS.

"Do You Use Machine Belting?" By the Schultz Belting Company.

This is the title of a new catalog of belting, which is also a work of reference for those wanting information on the care and management of belting. It also has several chapters devoted to calculation of proper size of belting to do given work, and comparison of efficiency of belting as governed by width of same and arc of contact. The little work should be in the hands of every shop manager.

"Press Working of Metals." By Oberlin Smith. New York: John Wiley & Sons.

This is a very interesting and valuable book concerning various processes of metal-working. It begins at the beginning, describing in interesting fashion the kind of work done by Tubal-Cain and his successors, and brings us down to the very latest methods and appliances for metal-working. The work is by no means confined to press working of metals, but describes all sorts of processes and the tools by which they are done.

"The Wisconsin Engineer" is the name of a magazine published in the University of Wisconsin, the first issue having appeared in June. It is a very handsome magazine, 6¾ x 9¾ inches, and contains 160 pages. It deals with a variety of subjects likely to be of interest to engineering students, and is also of general interest to civil and mechanical engineers. Besides a variety of well-written articles, it contains an index of engineering literature similar to that published by "The Engineering Magazine." We wish every success to this new venture for public patronage. It will be published quarterly, at $1.50 per year. The address of the publisher is Madison, Wis.

EQUIPMENT NOTES.

The Erie Railroad are about to build 2,500 freight cars.

It is reported that the Lake Shore Railway are in the market for ten new engines.

Two locomotives are ordered for the Hidalgo Railway, and one for the Pajarra Valley Railway.

Five hundred freight cars are under way at the Union Car Works for the Philadelphia & Reading.

The Schenectady Locomotive Works are building five engines for the Michigan Central Railway.

One engine is being built for the Dominion Atlantic Railway by the Baldwin Locomotive Works.

The Missouri Car & Foundry Co. are building eleven cars for the Arizona & New Mexico Railway.

Two locomotives are being built for the C. G. de Chemin de Fer B. by the Baldwin Locomotive Works.

The Pullman Car Co. have under construction six passenger coaches for the Lehigh Valley Railway.

Five locomotives are under construction at the Brooks Works for the Chicago, Rock Island & Pacific Railway.

The Quebec Central Railway are having two engines built at the Canadian Locomotive & Engineering Works.

The Southern Railway have ordered three 19 x 24-inch 10-wheel engines, and one 19 x 24-inch switcher, from the Richmond Locomotive Works.

Air-brake equipment is ordered for eight freight cars for the San Francisco & San Joaquin Railway, and also for ten freight cars for the Texas Midland Railway. Both orders are to be filled at Pullman's.

The Northern Pacific people are increasing the capacity of five thousand box cars from 40,000 to 50,000 pounds. The enlargement is made by strengthening the arch bars and body bolsters. We will give detailed particulars in a future issue.

The Brooks Locomotive Works have recently furnished an oil-burning locomotive for the Congress Gold Company, of Congress, Ariz. The engine is a 6-wheel switcher, the cylinders 17 x 24 inches, and it weighs 105,000 pounds. It is similar in every respect to the oil-burning engines in use on the Southern California Railroad.

The Erie Railroad are having twenty new engines built. The order is divided: five to the Rogers Locomotive Works, five to the Brooks Locomotive Works, five to the Baldwin Locomotive Works, and five to the Cooke Locomotive Works. These engines have been ordered to take the place of smaller ones that have to be double-headed for the trains hauled. The company was not in need of the power, but it was decided that making one engine do the work of two would save enough money to pay for the investment.

Painting by Compressed Air.

Four or five years ago a representative of "Locomotive Engineering," while traveling in the West, found in one of the Southern railway shops an apparatus for painting by the use of compressed air. The apparatus was described, and since that time has been adopted by a great many railroad companies all over this continent. We now find from an English paper that the apparatus has been patented in England, and put on the market by Wells & Co., patentees of the well-known Wells light. It is meeting with considerable favor for the painting of railway cars, bridges, and also for ship work. A writer who describes the machines as used in England says: "These machines will be found of equal utility in the applications of varnish and of tar, or, indeed, any other liquid compound. I have to add that I was convinced by the repetition orders and testimonials received that these machines have passed their experimental stage, and are really what the patentees claim for them—great time and money savers."

We should think they were past the experimental stage; they were past the experimental stage when used in the Southern Pacific shops five years ago, and we do not see that any improvements have been effected on them by the English patentees.

A local paper reports a curious incident which happened lately on the Deadwood Central. An engine was doing some switching at a mine, and the engineer received a signal to pull ahead over the switch, and he did so, but on reaching the required point he found that he could not stop the engine. There was a 6 per cent. grade at the place which makes stopping a difficult matter unless there are good brakes to do the work. The engine must have been deficient of these, for she ran away, jumped the track and dashed over the rocks, being badly wrecked. The engineer and fireman jumped, about fifteen hundred feet before the engine left the track, without either sustaining much injury.

We have received from Mr. Sauvage, chief engineer of the Western Railway of France, a pamphlet on "The Apprentice System in the workshops of the Railways of France." The pamphlet contains a great deal of interesting information about the apprentice system, which we will have occasion to present to our readers at considerable length in another issue.

Milwaukee Fast Passenger Engine.

The annexed engraving illustrates one of the two fast passenger locomotives recently built by the Baldwin Works for the Chicago, Milwaukee & St. Paul. As will be noticed from the picture, the engines are of the Vauclain compound type, with general dimensions as follows:

Gage of road, 4 feet 8½ inches.

Cylinders diameter, high-pressure 13, low-pressure 22, stroke 26.

Driving wheels, 78 inches diameter.

Total wheel base, 25 feet 6 inches.

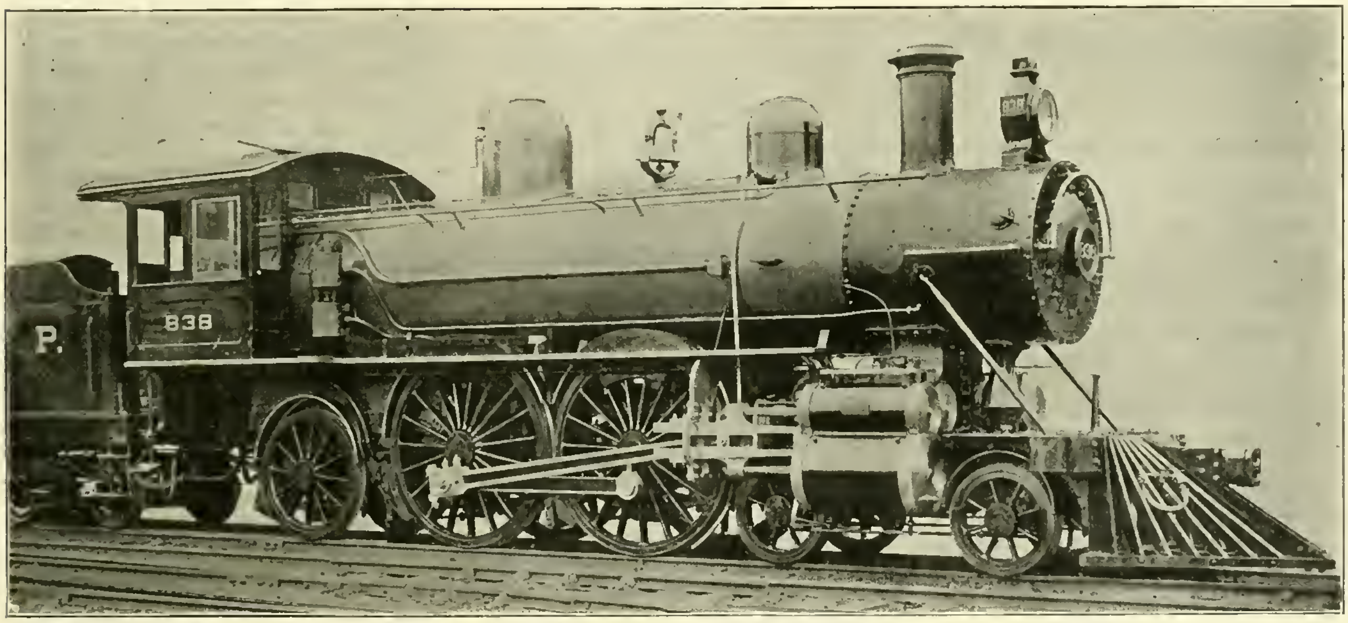
Rigid wheel base, 13 feet 9 inches.

Driving wheel base, 6 feet 9 inches.

Weight, total, 140,700 pounds.

Weight on drivers, 71,600 pounds.

Weight on trailing wheels, 29,100 pounds.



EXPRESS COMPOUND FOR C., M. & ST. P. RAILROAD.

Weight on truck, 40,000 pounds.

Boiler diameter, 60 inches.

Number of tubes, 264.

Diameter of tubes, 2 inches.

Length of tubes, 15 feet.

Firebox length, 103 3-16 inches.

Firebox width, 42⅛ inches.

Firebox depth, 71½ inches front, 69 inches back.

Heating surface firebox, 171 square feet.

Heating surface tubes, 2,073.5 square feet.

Heating surface, total, 2,244.5 square feet.

Truck wheels diameter, 36 inches.

Truck journals, 5½ x 10 inches.

Trailing wheels diameter, 54 inches.

Trailing journals, 7 x 12 inches.

Tender tank capacity, 4,500 gallons.

Tender wheels diameter, 33 inches.

Tender journals, 4½ x 8 inches.

In the British Isles a division master mechanic is called "locomotive inspector."

Notes on the Nickel Plate.

The 18 x 24 eight-wheelers pulling the "Limited" on the Nickel Plate have long shown a remarkable economy in fuel consumption. They were designed and built by Mr. Jno. McKenzie, superintendent of motive power, who has made it a point to embody the best modern mechanical ideas in their construction.

Observations made during a ride over a 132-mile division on one of these engines, showed a highly satisfactory performance in hauling an 8-car train on a sharp time schedule. The coal gate might as well be made a permanent fixture, for it was not taken out on the run, which was made at a fuel expenditure of 50 miles per ton.

The firebox construction of these engines is such as to give a large water space between side sheets at the top. They are made with a space of 8 inches at the top and taper to 4 inches at the mud ring, which gives a chance for proper water circulation, and there is no doubt that the superior steaming and fuel economy noted can be traced to this feature of boiler construction.

A particularly good thing is the reverse lever latch on these engines; it is made 5 inches long, with teeth ¾-inch pitch, which leaves tooth and space each ⅜-inch thick, and gives a bearing surface equal to 10 inches in length on the two sections of sector, to resist the thrust of the reach rod. This latch has been in service sixteen months, and is entirely free from shake and its annoying clatter, showing what can be done by a liberal bearing surface when put in the right place.

The dining-car service on these trains is something that strikes the traveler as approaching perfection. With the system in force referred to in these pages before, of certain officials of the road being a standing committee to pass on the cuisine, there is not much room for a "kick" from anybody. The windows of these cars are ingeniously arranged for removal in cleaning; being double, it was impossible to keep them in a presentable condition without great expense. The trouble was surmounted by pivoting the top of the inside windows, the pivots traveling in a slot for a short distance, after which they were free to lift out from between the posts, as they are held in place by the pivots at the top and the usual catch at the bottom. No battens are used.

The kitchen end of the car presented an inviting appearance, with the cutting and warming tables covered with galvanized iron, instead of the regulation copper, as seen in most cars of the kind. Copper, when new, is a good-looker; when old, and the corners filled with verdigris, it is an abomination for kitchen purposes.

Railroad Blacksmiths' Convention.

A circular issued by the president and secretary of the National Railway Master Blacksmiths' Association, intimates that their national convention will be held at Chicago, beginning September 1st, at the Tremont House. The circular says:

"The indications are that the attendance will be large. A specially interesting program of pertinent topics has been arranged. The members of the several committees have been quick to respond, of their own accord, relative to papers, etc. The importance of the work should appeal with such force to the members of the committees that a systematic effort should be made to have their papers in the hands of the chairman of their respective committees in due season, so as to have everything in readiness for the proper dispatch of business.

"Arrangements have been made whereby we secure a rate of $2 per day at the Tremont House, which will be official headquarters. It is located on the corner of Lake and Dearborn streets, and is one of the popular hotels in Chicago.

"Members will kindly notify Mr. John Buckley, of the Illinois Central Railroad shops, Chicago, Ill., whether they intend to attend the convention; also if they are going to be accompanied by members of their family, and how many."

What Made a Lubricator Siphon?

The question was recently asked us why a lubricator would siphon when the steam and water valves were open and the feed valves were shut. In our reply we gave some of the probable causes for such performances, and cited an imperfect casting as one of the most likely causes of failure. Since that opinion was written, there has come under our observation an actual case of siphoning that was caused by a small blow-hole in the wall of the oil cup which forms the partition between the reservoir and the choke plug passage. While the builders take every precaution to prevent a defective casting from going on the market, by testing them under steam at a pressure sufficient to show any weakness from blow-holes or thin sections due to moving cores, there is still the possibility of such a weak spot being reinforced for a short time by a hard scale that will stand the test pressure, but will let go after a short time in service. We have been assured by builders that they would be glad to have any such case reported to them at once on their discovery.

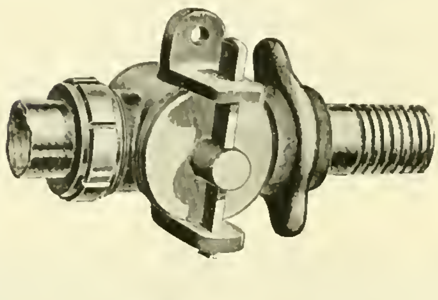
The officials of the Plant system of railways have displayed great animosity to brotherhoods of railway men. They have persecuted the Brotherhoods of Locomotive Engineers, Locomotive Firemen and Trainmen, and now they have opened war upon the American Railway Union, and have notified employés that no one will be permitted to remain with the company who is a member of the union.

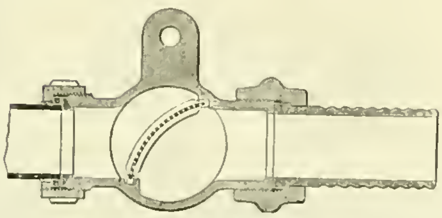
Some idea of the great changes taking place in machine work can be obtained from the fact that when the first monitor was built the tapered bolts used in fastening the turret plates together were turned in a common lathe, each one separately centered and turned in the usual way. Now there are machines by which one man can turn out 1,200 tapered bolts in ten hours.—"Engineer."

Mr. John Evans has been appointed master mechanic of the Washington & Columbia River Railway, with headquarters at Wallula Junction, Wash.

An Efficient Water Strainer.

The hose strainer apparatus, illustrated by perspective and section in the annexed engravings, is a design which will readily appeal to the favor of everyone responsible for keeping the feed pipes of locomotives free from obstructions. It consists of a perforated copper plate in a metal frame which fits into slides in the body. By removing the tapered key, the bonnet





can be easily taken off and the copper plate removed and cleaned. The bonnet is fitted with a ground joint, and the seat is so located as to be protected from damage. The perforated plate rests at such an angle that coal or other sediment from the tank will drop below the plate and not interfere with the waterway. The strainers are made right and left, one end fitted for the size of hose coupling to be used, and the other end to fit standard sizes of iron and copper pipe as desired. This admirable strainer has been put on the market by the Hancock Inspirator Co., of Boston, Mass.

Electricity on a Surface Road.

The General Electric Co. lately substituted a third rail for the overhead trolley previously used on the Nantasket Beach branch of the New York, New Haven & Hartford.

A trial of the new system was made a month ago. A party consisting of President Clark, Vice-President Kendrick and nearly all the prominent officials and superintendents of the New York, New Haven & Hartford Railroad, together with Mayor Frank E. Clark, of Bridgeport, Conn., W. J. Clark, general manager of the railway department of the General Electric Company, and a number of officials of that company, boarded the large motor car at Pemberton and ran with the trolley as far as Nantasket Junction. The track on which the third rail was laid was clear, and the motor ran easily from the trolley system to the third rail system of contact without stop, the trolley being merely pulled down and hooked. This was the first motor car run by electricity over the third rail, and the success of its operation fully justified the belief of Colonel Heft and the General Electric officials in the feasibility of the system.

The car sped along without any difficulty or accident whatsoever; crossings were passed, and the shoe struck the third rail again imperceptibly. Near West Hingham is a crossing some 1,200 feet wide; added impetus was given to the motor car, and this crossing was passed without difficulty. On the tangent on the West Hingham side of East Weymouth, the motorman threw over the handle of the controller, and it was estimated that a speed of from 70 to 80 miles an hour was attained. On arrival at East Weymouth, the car was switched over, and the return trip was made from East Weymouth to Pemberton in about eleven minutes, the distance being about ten and a half miles.

President Clark, of the New York, New Haven & Hartford Railroad, and the other officials, expressed full satisfaction with the success that attended the first trip made by a steam railroad car over a steam railroad track by means of electricity, although when Colonel Heft closed the switch which threw the electricity for the first time into the third rail, considerable doubt existed in the minds, not only of the president, but in that of the other officials as well.

Should the operation of this road prove successful it is probable that the third rail system will be extended as far as Braintree, a station ten miles out of Boston; and if the success of the new method under the ordinary conditions of constant travel fulfills all expectations, suburban service throughout the country will probably undergo a change.

What Railroads Have Done for Mexico.

"Modern Mexico came in with the railways. The locomotive was the great missionary of new ideas; it brought with it emancipation from routine, from ancient and musty prejudices. At first the cry of the 'Pacific Conquest' was raised, but it soon died out, for the intelligent and educated section of the Mexican people came to see that the dreaded Yankees were coming with capital, and were only desirous of co-operating with them in developing the resources of the country. Numberless business alliances have been formed between Mexicans and Americans, and also with Englishmen, and the two races are getting to have a good understanding the one of the other. The railways have brought punctuality of habit, have reduced enormously the cost of interior exchange, and have cheapened the laying-down of grain all over the land.

A famine is no longer possible anywhere in the interior. The Mexican people are now as exigent in their demand for the best possible railway accommodations as Americans. They are familiar with the costly and luxurious 'Pullman' as formerly with the interior of the dusty and stifling *diligencia*. The furnishing of houses has undergone a revolution, especially here in the Federal District, and the change in this respect is now noted all through the larger interior towns. People need more to make them contented than in the ante-railway days; they are not so simple in their habits. There is more personal ambition, and more love of domestic comfort, and people have come to regard life less as a lottery, and dread a civil overturn. Revolutions are unpopular. Every year will make Mexico a more delightful country in which to live. It will attract immigration, and, now that the interstate and intermunicipal taxes have been abolished, trade will be freer everywhere within the confines of the Republic, and this will lead to a higher standard of comfort. Mexico is distinctly modernizing herself."—"Mexican Herald."

Rolling Stock in Japan.

Recent advices from Japan indicate that the establishment of a large factory for turning out the rolling stock required for Japanese railways is under serious consideration. The native papers are discussing the subject, and point out that even with the present mileage there is a deficiency of rolling stock, as compared with the standard of English railways, to the extent of 275 locomotives, 1,390 passenger cars, and 15,950 freight cars. They suppose that it is possible that the mileage in operation may be increased during the next ten years to 20,000 miles—that is, to about ten times the present amount—and they calculate that if the rolling stock be purchased abroad, nearly 15,000,000 yen will be required. (A gold yen is about the same value as a dollar.) If to this be added the funds necessary for other material, rails, bridges, etc., the exodus of money from Japan will aggregate an enormous total.

In order to ward off this danger, arrangements are being made to establish workshops for the making of locomotives and cars in Japan, sending abroad in the meantime for the raw materials. It is proposed to establish workshops in Tokyo and Osaka sufficient, to begin with, to turn out 12 locomotives, 50 passenger and 200 goods cars per annum. In order to show the profits which may be expected, it is stated that in 1893 a four-wheeled locomotive, purchased by the Railway Bureau in Glasgow, cost 19,499 yen, and that if this locomotive had been constructed in Japan with material purchased from abroad, the cost would have been 13,369 yen, a difference of 6,130 yen.

Safety of Radial-Stayed Boilers.

There was a discussion at the last Master Mechanics' Convention, on "Radial-stayed Boilers," which put the Board of Railroad Commissioners of the State of New York in rather an embarrassing position.

In reporting one boiler explosion which had happened a short time previously, the Railroad Commissioners said: "In the explosions of locomotive boilers which have taken place in this State in several years past, many of them have been of boilers with crown sheets secured by radial stays. While there have been explosions of boilers where the fireboxes were constructed with crown bars and rivets, the complete destruction of fireboxes in the former type was absent in the latter. Much has been said and much will be said as to the relative merits of radial stays and crown bars in boiler construction. The board believes that this is a subject which should receive the earnest consideration of all persons engaged in boiler construction."

The implication of that report was that fireboxes secured by radial stays were not as safe as those secured by crown bars. The report was read at the Master Mechanics' meeting, and the convention at once determined to make "Radial-stayed Boilers" the subject of discussion for the next noon hour, and the secretary was instructed to invite the Railroad Commissioners to be present.

Commissioner Rickard appeared at the convention to represent the board. He was invited to give his views on radial-stayed boilers, and from the remarks he made it was evident that he did not understand the difference between an ordinary radial-stayed boiler and a Wootten type of boiler. The impression received was that the Railroad Commission would oppose the Wootten firebox and consider that it was not safe. The members discussed the subject of boilers very freely, and the consensus of opinion expressed was that radial-stayed boilers are as safe as those with the firebox supported by crown bars, and that the radial-stayed method of construction is much better adapted to modern boilers than the old plan.

It is too late in the history of boiler-making for railroad commissioners, who know practically nothing of engineering matters, to attack the present and most approved method of boiler construction. The development of the boiler has gone on gradually, and the devices used for strengthening have been devised with full knowledge of their ability to withstand the strains imposed. Those most familiar with the science of boiler-making believe that, instead of being the strongest form of securing firebox crowns, the crown bar is the weakest and least mechanical. It is very difficult to secure all the stays connected with crown bars to hold the same tension, and it is more difficult still to bind the crown bars and the outer shell so that the whole structure will be a unit with fortifying braces taking an even share of the strains.

The experience of the mechanical world has not been that fireboxes secured by crown bars were less liable to violent explosions than those secured with radial stays. In fact, the opposite has been the case. It would be a good plan for railroad commissioners to find out something about boiler-making before they cast reflections upon the ability of railroad master mechanics and locomotive designers to make their boilers strong enough to insure against accidents.

Make Minor Parts of Cars Uniform.

One of the favorite subjects of speakers in meetings where men connected with railroad rolling stock come together, is the desirability of having a uniform freight car. Some men are ambitious to have the whole of the body made so that every part would be interchangeable with any other car body, and others devote their attention to trucks. If a standard truck could only be adopted that all roads would use, they would be happy and see visions before them of repairs being reduced to an exact system.

During the leisure hours at the last convention we heard a group of superintendents of motive power discussing this subject of uniformity and interchangeability, and one of them remarked:

"If you will only make the minor parts of the car interchangeable I shall not complain about the large parts. While some of our friends are shouting themselves hoarse for an entire interchangeable car, the parts that might be made uniform at little cost are so diverse in small details that we have to carry tons of stuff where pounds ought to serve.

"I was over our road a short time ago, looking up the car repair places, and was impressing upon the men the necessity of keeping their stock as low as possible. In one place I saw sixteen brake ratchets set up on a long bolt. I said to the car repairer: 'It will be a long time before you need to use all those ratchets; you had better send some of them to headquarters.' 'I cannot do that,' he replied, 'because every one of these are different; I have only got one of each.' On examination, I found his statement to be correct.

"I made up my mind that before striving hard to get a standard truck I would say a word in favor of a standard ratchet for brakes. Many other parts of a car are in the same condition as the ratchet."

Hard-riding engines can be greatly improved by oiling sides of driving and engine truck springs, so that oil will work between leaves. Use signal oil.

The Ton-Mile Rating of Engines.

At the last Master Mechanics' Convention a resolution was adopted expressing it as the sense of the association that the statement of performance of locomotives should be made on a basis of ton-miles of train load, in lieu of train-miles or loaded car-miles, as is the prevailing practice. This was giving the association's indorsement to a movement which has been gaining rapid headway during the last few years, and which is working to end the uncertain estimate of loads by car-miles for the definite measure of ton-miles. The expression "car-mile" was always unsatisfactory and indefinite, but every year it has been growing more uncertain as a measure on which to estimate the work done by a locomotive. When the ordinary car was built to carry ten tons or thereabout, the variations of load were not very great, because cars could be loaded to their carrying capacity, and generally were so loaded, and the whole of the cars hauled over a division struck a fair average in weight. With the increase in the capacity of cars, the loads that are carried vary to a much greater extent than they did with small cars; and in addition to that source of unevenness there are cars varying in capacity from 30,000 pounds to 80,000 pounds, and the tendency is still towards even greater carrying capacity. Unless it be loaded with metals or minerals, the huge car seldom has a full load. When loaded with small quantities of goods picked up in small towns, the heavy car denominated "loaded" is often as light as other empty cars. But under the old way of reckoning loads it figured as high as the car carrying 60,000 pounds.

The guess way of loading engines under that plan was often unjust toward the trainmen, and was nearly always expensive to the railroad companies. The men who did the rating of loads for locomotives had to strike the best average they could, and the best was generally far from being good. One train would be made up of cars that were lightly loaded, and the locomotive would be much underloaded; the next train would have loads above the average, and the engine would fail to haul it over the maximum grades. In the first case the railroad company lost part of the work the locomotive was capable of doing; in the second case the train service was likely to be demoralized through the overloaded engine having to double hills, and the engine and engineer would be abused for failing to do the work expected of them. These are not imaginary cases. They are happening daily.

Another advantage that will be derived from the rating of loads by actual weight will arise from yardmasters and trainmen finding out the exact load carried by cars. Under the old system a car partly loaded at one seaboard and sealed up might go to the other side of the continent without anyone finding out that it was half empty. When the load carried by every car is noted at the beginning of every division, there will be much less hauling of half-loaded cars than there has been in the past. There have been half-hearted efforts made repeatedly to prevent partly loaded cars from being forwarded if there was any means of completing the load; but there was so little attention directed to finding out the weight comprising loads, that underloading was rarely checked. The new system will provide a good check upon those responsible for seeing that cars are not sent out partly loaded. The rates for transportation of freight are so low that it is very difficult to make the cost of haulage less than the rates paid. A system which tends to increase the paying load of cars will help to keep railroad companies out of the hands of receivers, and will be a benefit to all concerned in the operating of trains.

Cast-Iron Car-Journal Bearings.

Mr. J. J. Thomas, Jr., master mechanic of the Birmingham & Atlantic Railroad at Talladega, Ala., has for several years past been using cast iron "brasses" for cars in ore service that do not go off the home road. The face of the bearing is ground out, tinned and faced with babbitt. Mr. Thomas says they have no trouble at all with them; they give just as good satisfaction as brass bearings and cost about one-fifth as much.

Sellers' Restarting Injector.

We are informed that Jenkins Brothers, of New York, have been appointed selling agents for the restarting injector recently brought out by Wm. Sellers & Co., of Philadelphia. This injector was designed for use on stationary and portable boilers, traction and hoisting engines, tugboats, etc. The house of Wm. Sellers & Co. (Inc.) has a wide reputation as makers of high-class injectors for locomotive and other service. The injectors made by this house are the most perfect boiler feeders known, and are the result of many years of careful and scientific study and experiment to determine the proportions and shapes that will give the widest possible range with the most economical consumption of steam, and at the same time be perfectly reliable.

Their system of manufacture is such that, the pipe sizes and proportions having once been determined, they are strictly maintained by having parts made to a perfect system of gages, so that they are thoroughly interchangeable; and although this injector may have been in service until quite well worn, a new tube or part can be furnished that will fit perfectly and give exactly the same results as the original.

This new restarting injector is made in the same careful manner, is thoroughly automatic in every respect, and has been designed with a view of having as few parts as possible. There are no levers; no fittings except ordinary globe valves are required; it is very easily repaired, only a screw driver and a monkey wrench being required to take it apart when necessary to clean or renew parts. In designing this injector, particular care has been exercised to obtain a wide range, to enable it to work hot water and to get maximum lift. There is no valve or other obstruction in the overflow; so that when the injector is out of service, if the steam supply valve should leak, there is no danger of heating the water in the service pipe to a very high temperature.

The Hon. H. S. Pingree, known as the "Reform Mayor" of Detroit, has incurred the enmity of several orders of railroad employés, which is likely to obstruct his way to the position of Governor of Michigan, which he is anxious to attain. "Mayor Pingree has posed and has been represented," says the "Railway Conductor," "as being directly and deeply interested in the welfare of the common people. In this position he considers it the right thing to act as meanly as he knows how toward railroad companies, and the result is that the railroad employés are determined to frustrate his ambition. At a union meeting held in Jackson a short time ago, attended by representatives of the Brotherhood of Locomotive Engineers, Locomotive Firemen, Railroad Trainmen, Order of Railroad Conductors and others, a plan was arranged to systematically oppose Pingree in the fall election."

A writer in the "American Machinist" calls attention to a peculiarity of metal, which very few mechanics and engineers are aware of, and which may account for distortions in machinery after the finished article is put into use. He says: "Tool-makers are well aware that forms of metal which involve tension and compression of material, change if left at rest, and that this change progresses slowly through long periods of time in case of, for instance, steel gage plugs and rings. Experienced gage-makers rough-grind a plug and ring nearly to gage, and then let them stand a year or eighteen months before finishing them if they expect to make a fine job that will keep in shape."

There are some curious practices in vogue in connection with the United States Navy. When an ordinary manufacturing concern or a railroad company wants to have steel inspected, they appoint someone thoroughly acquainted with the physical properties of metals to do the work. When any metals have to be inspected for the Navy, instead of sending an engineer to do the work, they send a line officer who has been trained in handling ships. The consequence is that the inspection is a farce.

Investments by Workmen.

In the course of a discussion at a meeting of the Western Railway Club, Mr. A. E. Manchester, assistant superintendent of motive power of the Chicago, Milwaukee & St. Paul, said:

"The average workingman does not, as a rule, know how to make a safe and proper investment of his savings. His weekly or monthly surplus will be deposited in the savings bank until it has reached a few hundred dollars, when he will begin to look for an investment. There is usually some one to let him in on the ground floor in some scheme that he tells him is gilt-edged in security and a perfect bonanza as to profit. The results are too often that the whole thing is a failure, that his savings are lost, and the man becomes discouraged in his efforts at saving. If means were placed before our men so that they might invest their savings profitably, I believe it would be one of the steps toward getting good men without the enforcement of discipline to make them so.

"Some years ago, at the West Milwaukee shops, through the instrumentality of Mr. Barr and others, a Building and Loan Association was established among the men at the shops. The first two series of the association have closed, with the following results: Series No. 1 realized in mortgages—that is, there were men who borrowed from the association for the purpose of building themselves homes, and when the series expired their mortgages were released and they owned their homes. In the first series there was $132,000 worth in mortgages released; in the second, one, $86,000 worth of mortgages released. That amount represented homes that were gotten through the instrumentality of the Building and Loan Association of the employés of West Milwaukee shops. There were about seven hundred stockholders in the first two series of the association. The investors drew out in principal and interest $251,000, making nearly a half million dollars that was accumulated and saved by the employés of those shops, the larger portion of which would, I believe, never have been saved if it had not been for the Building and Loan Association. They later started two more series which are now running. The men are putting into these two series about five thousand dollars per month. A great many of the men who were borrowers in the first two series are either borrowing again for the sake of becoming capitalists by building other houses to rent, or are investors who accumulate their money through the aid of the association. We find that the men who take an interest in this association are those that are easiest to handle, the ones who are most desirous of doing their work well; and that leads me to believe that wherever the men are prospering and are accumulating something, and feel that they are becoming better to themselves, that it makes better men for the company. I have always found that the hardest men to control, those whom we had to use the most discipline on, were those who didn't have anything in the world; but whenever you get a man reasonably well off, he is desirous of keeping his position, and is willing to work hard and give good service."

Effect of the Counterbalance Weight.

The mechanical department of Purdue University has made very exhaustive tests of counterbalancing locomotive driving wheels by means of the Schenectady locomotive which they have mounted on a stationary plant. In a paper giving an account of experiments made, Professor Goss arrived at the following conclusions:

"Wheels balanced according to usual rules (which require all revolving parts, and from 40 per cent. to 80 per cent. of all reciprocating parts, to be balanced, the counterbalance for the reciprocating parts to be distributed equally among the several wheels connected) are not likely to leave the track through the action of the counterbalance, and cannot do so unless the speed is excessive.

"A wheel which, when at rest, presses upon the rail with a force of 14,000 pounds, and which carries a counterbalance 400 pounds in excess of that required for its revolving parts alone, may be expected to leave the track through the action of the counterbalance whenever its speed exceeds 310 revolutions per minute.

"When a wheel is lifted, through the action of its counterbalance, its rise is comparatively slow and its descent rapid. The maximum lift occurs after the counterbalance has passed its highest point.

"The rocking of the engine on its springs may assist or oppose the action of the counterbalance in lifting the wheel. It therefore constitutes serious obstacles in the way of any study of the precise movement of the wheel.

"The contact of the moving wheel with the track is not continuous, even for those portions of the revolution where the pressure is greatest, but is a rapid succession of impacts."

Black Smoke and Heat Loss.

It is generally assumed that the emission of black smoke from a factory chimney is an unmistakable indication of imperfect combustion and loss of heat. While this is, of course, in the main correct, there is a predilection to exaggerate the extent of this waste. This is proved very conclusively by some investigations recently made in Germany, and in which the fuel experimented upon contained 37.63 per cent. of gas, tar, etc., 49.97 per cent. of carbon, 0.4 per cent. of sulphur, 2.72 per cent. of ash, and 9.28 per cent. of water. If the quantities of heat given out in burning be estimated from these data, it will be found that the volatile constituents, such as gas, tar, etc., only give up 15 per cent. of the carbon, but 85 per cent. of the collective heat. Coals used for industrial firing, however, do not even contain 37 per cent. of volatile matter, so that their share in the general heat production is still less than 15 per cent. Thus, if all the volatile matter be dissipated by combustion—which, of course, cannot be the case —the loss of heat cannot amount to more than 15 per cent. An analysis of the gases resulting from the combustion of the fuel referred to above shows that the actual heat loss is less than 1 per cent. Thus, an analysis of very thick smoke showed 5 per cent. by volume of carbonic acid, traces of carburetted hydrogen, 79.9 per cent. of nitrogen, and 15.1 per cent. of oxygen, while the soot contained 7.15 milligrammes per cubic metre of carbonaceous, and 4.78 milligrammes per cubic metre of mineral matters. Now, 1 metric ton of coal yields on an average 26.32 cubic metres (929 cubic feet) of gas, with a mean carbonic-acid content of 5 per cent. by volume, measured at the ordinary pressure and temperature; so that these contain 18.8 kilos. (41 pounds) of carbonaceous and 12.6 kilos. (27 pounds) of mineral substances, and consequently only 31.4 kilos. (69 pounds) to the ton. It follows from the above that the loss of heat by smoke, compared with the theoretical calorific capacity of the fuel, is about 0.74 per cent. This does not seem to afford room for the marked saving of fuel claimed by some makers of smoke-preventing appliances.—"Transport."

Mr. John J. Ellis, master mechanic of the Chicago, St Paul, Minneapolis & Omaha Railway, has started an educational scheme at St. Paul, in the way of an instruction room, and will add to its equipment as fast as circumstances will permit. It is under the charge of Traveling Engineer P. K. Sullivan, who has injectors, lubricators, and all valves pertaining to air, cut so as to show the interior of the different fittings, thus actually illustrating his lectures with "cuts." There is also a valve-motion model here, built by Pedrick & Ayer. The interest taken in this move is already shown by an easily noted increased desire for more light, and this feeling, we are pleased to note, is shared to the fullest by Mr. Sullivan.

Speaking of size of driving wheels, Mr. John Medway, superintendent of motive power of the Fitchburg Railroad, said: "The use of small driving wheels which are proportionately too small for the cylinders causes serious waste of fuel. Our consolidation engines, having the smallest driving wheels, show the greatest expense in fuel and repairs; while the moguls, with wheels 63 inches in diameter, give the best results."

The Sellers injector is becoming very popular on French locomotives.

A new form of safety valve for his car heating devices has been invented by Mr. E. E. Gold, of New York.

We learn from Henry L. Leach, of North Cambridge, Mass., that during the month of June 170 sets of his pneumatic sanding apparatus have been ordered by railroad companies and locomotive builders.

A somewhat ingenious form of pneumatic track sander has been patented by Mr. Francis M. Dean, Huron, S. D. A movable needle, similar in some respects to those used in oil cups, is employed to regulate the flow of the sand, air pressure being applied to force the amount of sand through which may be required.

So well pleased is the management of the Panhandle lines with running engine and train crews on the fast trains through from Indianapolis to Columbus, 188 miles, that it is proposed to commence running engine and train crews through between Columbus and Pittsburgh, 193 miles.

The Grand Trunk Railway has been slow to make the improvements that have been considered necessary on American railroads for train-operating, and the system has suffered in consequence. When General Manager Hays took charge he proceeded to introduce the practices that have been found beneficial in the United States, and a great deal of oppositon has been manifested to his improvements. He requires men to be examined for competency, just as they are on nearly all American railroads, and this action is creating a great deal of discontent. There is said to be a movement on foot to get a Canadian alien contract law passed, similar to that in use in the United States, for the purpose of preventing Mr. Hays from employing Americans in the regeneration of the Grand Trunk.

"Chain Blocks" is the title of an illustrated catalog recently sent out by the Yale & Towne Manufacturing Co., of Stamford, Conn. It gives very plain illustrations of the various block and hoisting applications made by the company, and has descriptions of their *modus operandi*. Those who are unable to calculate the power required to operate various chain hoists can find information in this catalog which will enable them to figure out the various problems

The Armstrong Mfg. Co., Bridgeport, Conn., have issued an illustrated catalog showing the machine specialties which they make. It contains illustrations and information about all sorts of thread-cutting appliances, and a variety of other tools used in well-equipped machine shops.

The Bignall & Keeler Manufacturing Company, of St. Louis, Mo., have issued Catalog No. 13, which illustrates "Peerless" and "Duplex" pipe-theading and cutting machines. Besides giving good illustrations of a variety of machines for thread-cutting purposes, it contains a variety of tables and information that will be found very valuable to mechanics interested in thread-cutting; in fact, the catalog will prove a useful handbook for the machinist employed on thread-cutting. A number of testimonials are published which give expressions of admiration for the machines handled by the Bignall & Keeler Manufacturing Company.

We understand that the Sams automatic coupler, which attracted considerable attention at the last mechanical conventions, is making considerable headway with the railroad companies in the West. It is a link-and-pin coupler, designed so that it can couple automatically with those of its own kind and with other link-and-pin couplers. It is as good a link-and-pin coupler as has ever been made, and is said to give very good service with other couplers of the same class. A thing about it which commends itself to railroad companies at present, is its cheapness. It costs little more than the ordinary link-and-pin coupler, and enables the companies purchasing it to comply with the requirements of the Interstate Commerce Law.

A dispatch recently sent out from Providence, R. I., says: "The Rhode Island Locomotive Works has closed for an indefinite period. The concern is in the hands of a committee of its creditors, on a five-year extension to run from February, 1896. The contracts which the company had are completed, and the committee ordered the shut-down. A plan is on foot to reorganize the company, and enlist capital from New York, as well as this city. It is known that two of the foremost financiers of this city, men with plenty of capital, were asked to go into such a project, but declined. The company's machinery was all right, but the plant was considered too large and expensive; that is, the same mechanism in a modern structure of but one floor could be made to pay far better than the present plant."

The Dayton Malleable Iron Company, of Dayton, O., have put on the market the Hoey safety drawbar attachment, a device invented by Mr. N. J. Hoey, of the Columbus, Hocking Valley & Toledo Railroad. No change of draft timber is necessary with this attachment, and the old tail-pins can be used without fear of the coupling pulling out and falling on the track. In case of the tail-pin breaking, a safety bar, which passes through a hole in the shank of the coupler attachment, holds the coupler in place and brings the train to its destination safely. This attachment has been in use on 2,700 cars belonging to the Columbus, Hocking Valley & Toledo, and gives satisfactory service.

A rather ingenious form of screw jack, to be used in jacking up cars so that bearings can be put in, has been invented by Mr. Alexander H. Moyes, of Ogden, Utah. The jack has a projection which engages in the plate of the car wheel and prevents the wheel from being lifted as power is applied to lift the axle box.

A curious device has been patented by Mr. Wm. P. Shelley, Independence, Kan., for holding the pilot bar of a locomotive. It consists of a forked hook, connecting with a bell crank and located under the push bar of the pilot. By means of an air cylinder the lever is pushed up to the required height, raising the push bar so that it can be coupled without anyone going between the engine and the car.

In spite of the numerous safety appliances for railroads that are being constantly introduced, there seems to be a great many serious accidents in the operating of trains. In its report of train accidents in June last, the "Railroad Gazette" gives information of about forty collisions, forty-nine derailments and five other accidents. In these accidents, thirty persons were killed and fifty-six injured. Only three passengers were killed in train accidents during the month of June, and these were drovers riding in the caboose of a freight train. The number of tramps and other trespassers in this month's record was, however, quite large and constituted the principal part of the fatalities. The most striking accident in June was the motor of the Lake Street Elevated Railroad falling into the street. In this connection it was a fortunate thing that the passenger cars were equipped with Westinghouse automatic brakes, which prevented the passenger cars from following the motor into the street. Had they been equipped with the same brakes as are used on the Manhattan Elevated Railroad, of New York, there certainly would have been a serious loss of life.

Presents and Testimonials to Glide.

BY SAM SHORT.

It took you a long time to find room for my letter about "Stealing a Blacksmith," but I am glad that you did not send it to the waste basket, for it is one of those narratives which "point a moral and carry a tail," as my friend Dunby says. Dunby says that the case ought to be a warning to master mechanics who chase after new-fashioned notions, and turn blacksmith shops and boiler shops into manufactories. Most of us look at it in a different light.

Glide lost his job. When he resigned, a report was circulated that he had quit work on account of impaired health brought on by overwork, and that he was going to Florida to enjoy a well-earned vacation.

From my long acquaintance with Glide, I came to the conclusion that his strong point in a business way was craftiness. His management after his resignation was called for amply vindicated this opinion.

Phil Ramshell, the general foreman of the main shops, is Glide's brother-in-law, and he never would have risen higher than a gang boss had his sister's husband not risen to be a master mechanic. As soon as it was understood that Glide must go, Ramshell whispered around that the change would be temporary, and that when properly rested, Glide would come back—perhaps to a better position. It was whispered that family connections made him strong with the president of the company.

That sort of information was industriously circulated for a few days. After it had time to ferment a little, a suggestion was made that it would be a good thing for the employés of the mechanical department to get up a testimonial, to manifest their profound respect and admiration for their departing chief.

Now, Silas is far from being a good subject for an Admiration Society. He is essentially a selfish man, ever ready to sacrifice the interests or comfort of others if doing so is likely to help himself the smallest trifle. Moreover, he is too deficient in tact to avoid doing and saying hard things where good nature would be much more profitable. Another weak point about the man is either to like or dislike every man under his charge; that is always a dangerous characteristic. The favorite he was ready to pet and make much of. The easiest way to his favor has always been a little judicious flattery and tale-bearing. Listening to tale-bearers he considered a strong point in his system of managing his department; of his policy in that respect he made no secret.

"When you get men to come and tell what the other fellows are scheming against the company's interests," he would say, "a man in charge is always prepared to forearm against plots. No use of these fellows trying to get ahead of me. I am always informed in advance of what they are going to do. Forewarned is forearmed."

The trouble with this kind of policy is that only the lower grade of humanity can be made its instruments, and they are generally as ready to deceive the boss as they are to betray their fellow-workmen. They nearly always lie to injure those they dislike. But a tale-bearer and a flatterer always was favored by Silas. There were so many of these reptiles to favor that a man attending to his business, and depending for justice on the merit of his work, was constantly finding himself worsted for the benefit of men inferior to himself.

There is one standing injustice in the policy of favoritism which those who practice it do not seem properly to appreciate. If you take a portion of men in a service, and confer favors upon them in the line of duty, it is done at the expense of others who are probably more deserving. None are more ready than the men interested to see where the injustice comes in and to find out its origin.

When Ramshell began exhibiting a subscription list for a testimonial to Glide, he found little response at first. To his dismay, the "suckers" who had done the most to make Glide unpopular were the most outspoken in opposition to workmen and trainmen giving presents to railroad officers. But there is no class of workmen who are so ready to put their names to a subscription list as railroad trainmen. By persistent keeping at them, and well-timed deception, Ramshell got most of the men to subscribe something, from a day's pay downward.

A goodly sum was raised, and a committee was appointed to arrange for the kind of presents to be given and the manner of presentation. They decided that a purse of gold dollars would be the most useful thing for Glide, and they supplemented that by an illuminated testimonial, setting forth in glowing terms the popularity of the subject of their friendship and devotion. A triple-plated silver tea-set was to be given to Mrs. Glide.

Mr. Robert Vamson, foreman painter, was chosen as a suitable person to make the presentation. He rose like a giant to the occasion. Vamson is highly gifted with illimitable "gab;" he had been a reader of history, and he found in Glide a subject worthy of panegyrics equal to those bestowed upon ancient heroes. When the presentation address appeared in the local papers, and was duly sent, in the form of marked copies, to all the leading railroad managers of the country, Glide stood forth as the most desirable man of the day to take charge of a railroad mechanical department which needed a strong and able head.

The praise of the man, so judiciously circulated, is already bearing fruit, and Glide has received several intimations that men high up in railroad circles have their eyes upon him. He has had the assurance to answer in every case that he will be prepared to consider any offer when his health is sufficiently restored to enable him to return to work.

"Chordal" on Wire Gages.

About seventeen years ago the "American Machinist" began publishing a series of letters that were signed "Chordal." They were kept up for three or four years, and treated in a wonderfully interesting, lucid and humorous style a great range of mechanical and engineering subjects. It is safe to say that technical subjects were never written about in such an alluring fashion. We have heard ladies say that they found the book (they were afterwards published in book form) as interesting as any novel they ever read. Here is what "Chordal," who turned out to be the well-known mechanical engineer, James W. See, had to say on wire gages:

"When you write to a man to know how big a certain wire is, it is presumed that you want to know just what you ask; that is, how big the wire is. In reply you are generally told that it will fit tolerably nice, or 'scant,' or 'full,' in a certain hole marked No. 14.

"If you don't care much, this may satisfy you. If you care a little about the matter, you had better send for the identical hole referred to. If you care very much you will send for a sample of the wire.

"From the looks of things, one would suppose that, in the year one, some man made the first piece of wire and filed a notch to fit it. After being some time in business, he had made several sizes of wire and filed several notches. Then these notches were numbered and became the happy standard of an intelligent people. Nobody knew the dimensions of these wires or these notches, and probably there was then no particular reason for caring. After a while, somebody wanted wire which wouldn't fit any of these notches. Here was trouble in the camp. What business had any man to want anything which would not fit any of the old holes? The wire-drawer forgot, the day before he numbered the notches, the day when there were but three notches, maybe. In obedience to the law of progress, the wire gage was overhauled, and new notches, to fit new wire which had been made, were added, and all were renumbered. The new gage, we will suppose, was 'adopted.' Now, it is very much easier to universally adopt a new thing than to universally throw away an old thing, and, as a consequence, there were two wire gages in use very early in the game. Then troublesome customers got more odd sizes, and new gages were adopted; and even to-day there are in use in wire and sheet mills gages bearing the following distinctive names, viz., Birmingham, Stubs, Washburn & Moen, American, Brown & Sharpe, Trenton Iron Co., Standard, Music Wire, Steel Wire, G. W. Prentiss and English. Some of these gages are just alike, and simply have two names; but it's well for a man to know what he's doing when he orders by numbers. Why not abolish all those long names and give the different gages, designating numbers? It would be so handy, you know.

"Somebody took a notion to measure wire gages one day, and then we came into possession of memorandums of the sizes. But these sizes were all in fractions, and not in units. They could not be pronounced hardly, and didn't sound like a size at all. For instance, No. 32 brass English gage is .01125 of an inch thick—if you know how thick that is—and No. 16, instead of being half as thick as No. 32, is .065 of an inch, or no relation at all.

"Brown & Sharpe, in devising their system, found that in existing gages the sizes jumped irregularly. There was a big difference between two neighboring large sizes—sometimes there was and sometimes there wasn't; it was all haphazard. If our coinage was on the same plan, we would have a five-cent piece, then a seven-cent piece, then a twenty-cent piece, then a sixty-cent piece, then a dollar piece, then a two-dollar-and-eighteen-cent piece, and so on, skipping around at random; so we would have to use big money to make small change.

"The fault with every plan of fine measurement is that it gives us results in awkward fractions. The inch being the unit, everything small must be some unpronounceable fraction of an inch. What we want is a unit so fine that the minute measurements of modern practice may deal in whole numbers.

"The much-abused metrical system, whether we ever fall in with it or not, possesses one great virtue. Its divisions become units. While the name of millimeter implies a division or fraction of a meter, it nevertheless is a unit and stands on its own bottom, which a vulgar or decimal fraction can't do. If a millimeter was small enough, we could give minute sizes in them, without division. But it is not fine enough for the coarsest work of to-day. It is about four one-hundreths of an inch, when we want our fine unit to be at most a quarter of a thousandth. If we carry the metrical division two steps further, we have some kind of a meter which will be about the third of a thousandth, or about the difference between the two finest numbers on the American wire gage. This extraction has a name, but I don't know what it is.

"The metrical system has been carried upward and downward from the meter, and the results have been named, I presume; but the everyday books don't give anything finer than millimeters. Somebody who knows more about French than I do, can probably tell you what the name of this fine unit really is, or what it properly might be.

"This nameless little meter could be read on a pocket vernier gage, and would give you a simple expression to any fine practical dimension dealt with in the work of artisans. With such a tool, it might be possible that some day a paper-maker would know something about the thickness of paper. I never saw a paper-maker yet who had an earthly conception of the difference in thickness between two pieces of paper. One is heavy; the other is light. If these paper men were bright, they would devise some system of numbers for the thickness of paper."

Philippine Islands Railway.

There has been a great deal of talk lately about the building of railways in Japan and China, and railway men seem anxious to learn full particulars about everything connected with railway construction and operating in these strange countries. A neighbor of these countries, which is quite as strange and interesting, has gone into railway building of late years, and little has been heard about the enterprise.

Southeast of China the ocean is dotted with islands that are known as the Philippine Archipelago, there being about six hundred of them. The largest is Luzon, which has an area of 51,000 miles, nearly equal in extent to England and Scotland, and 5,000 miles less than the State of Illinois. These islands are called the home of the earthquake and typhoon, but they are extraordinarily fertile in tropical productions. To develop the natural resources of Luzon, a railway about 120 miles long has lately been built by English capitalists. It is of 42-inch gage, and has been built in the substantial style usually followed by English engineers. There are certain characteristics of the country that render a substantial roadbed a necessity. The rainfall is said to be about 2 metres, or 78 inches, per annum, and earthquakes send the track dancing at frequent intervals.

An interesting paper published by the Institution of Civil Engineers, describing the building of that railway, says: "A severe shock occurred on March 16th and increased in severity towards the north end of the railway. Nearly all of the Government buildings, convents and churches were more or less destroyed, and several lives were lost. In the town of Dagupau great damage was done and nearly half the houses were destroyed. The railway bridges suffered very little and there was no interruption to traffic. At one place the embankment sank gradually in a regular curve for about 9 chains (600 feet) to a depth of 2 feet, and at another place the track was moved horizontally. One abutment of a large bridge sank 11 inches and was moved forward 19 inches. The principal station building sank 4 inches.

"When it rains at an inch-an-hour gait, washouts are frequent. Sometimes a lake develops oves a portion of the line."

When we make notes of foreign railways, we generally receive numerous letters asking us to give the addresses of the officers, for the use of parties wishing to secure employment on the roads mentioned. Luzon is noted for cholera, yellow fever, distemper, malaria, snakes, tarantulas, scorpions, blood-sucking bats, wild cats, sand flies and all sorts of terrible pests and diseases. Under the circumstances, we are bound to refrain from doing the first thing which would enable an American citizen to commit suicide by going there.

Color Blindness on British Railways.

The practice of testing trainmen for color blindness has reached the railways of the British Isles, and the men who have to go through the ordeal are kicking as vigorously as American railroad men kicked a few years ago. Here is a representative letter on the subject, taken from the pages of the English "Locomotive Engineer's and Fireman's Journal":

"We all know that enginemen must have excellent sight; but why do they not test these men's sight by the work they have to do, not by the absurd method of counting dots on a card, or with the names and colors of wools. I say that the sight of an engineman should be taken on the line, by day, by seeing if he can see a signal-arm at a certain distance, and at night by seeing the colors of signal-lamps at a certain distance from them. At the present time, on the M. S. & L. line, the result of this test has been the discharge of from twenty to twenty-five men in the district of Manchester, and from twelve to fourteen in the district of Sheffield, who failed to pass this absurd test.

"If these men were tested by the work they had to do, it would be a fair test; and then, if they failed, their own common sense could tell them they are not fit to be in charge of a locomotive engine. As it is now, if a man fails to pass, they discharge him at once—not for a moment thinking he may not be able to obtain employment directly. If, when a man fails to pass this test, they found him some other work to do, it would be a great deal better than discharging him altogether. However, I think it a dirty way of getting rid of their aged servants, who have proved both true and faithful to the company."

They are making artificial silk in France from wood pulp, and the industry is about to be introduced into England on a large scale. One thick quality of the material is said to be well adapted for covering car seats.

Reminiscences of a Missouri Foundry.

"A Tramp Molder," who contributes amusing articles to "The Foundry," in a recent issue writes:

"I had often heard of Jake Hart and the curious specimens of natural history which he had gathered around him at the Missouri Car and Foundry Company's shop or the 'Mizzou Penitentiary,' as most of the hoboes call it, and as a last resort I went over and tackled Jake for a job. I had on a new suit of clothes that I had bought just before I left Memphis, and I guess I looked too new for him.

"'What kind of a job d'ye want?' said Jake, sizing me up. 'Superintendin' the shop?'

"'Oh, no,' said I; 'I wouldn't be guilty of running a shop like this. Just give me a job on the floor; but I don't want any car work.' But Jake wouldn't give me a job. Said he hadn't any use for dude molders, but wanted men who could 'hump' themselves and do a day's work; and I thought by the humps some of them wore that Jake had a crowd which suited him.

"Queer stories they tell about some of the old-timers in the 'Mizzou Penitentiary.' There was one man, it is said, who worked on the same floor for nine years, and never knew there was a skylight over his head until Jake fired him for making more money than he (Jake) was getting. You see, he started in before daylight every morning and worked until long after dark every night, and he never had time to raise his head to see what was above him. After Jake fired him, although he was well off and could have lived comfortably without working, he just hung around the shop brooding over his trouble until he died of a broken heart, and the men in the corner of the shop say that Charley's ghost still haunts his old floor.

"Then there was another character there, by name Jesse Walker, a 'plug' molder, who managed to put in about fourteen hours out of every twenty-four in the shop. It was said that the company gave Jake orders to keep Jesse on steady and on no account to fire him, because, on account of the high price of scrap, Jesse could make it cheaper than they could buy it. Jesse was so industrious that he spent the most of his time at home of nights making wooden slivers, so that he wouldn't have to stop and hunt for nails during the day. He was economical, too—wouldn't let his wife buy any kind of meat but corned beef and rib roasts, because the skewers with which the butchers fastened the meat came in mighty handy for carrying deep pockets. On his way home from work Jesse had to pass a brickyard, and, it is said, he carried home enough bricks, two or three every night, to build himself a four-room brick house. Jesse got into the habit of carrying so many things that the police got onto him, and one morning, about five o'clock, while on his way to work, he was arrested on suspicion of being a burglar. When searched at the station house, in addition to his tools, which he carried home regularly every night and brought back in the morning, they found in his pockets three wedges, a long clamping bar, which easily could have been mistaken for a jimmy, and three pieces of candle. This would have been enough to convict him had he not been able to establish his identity.

"'Bad' Jack Ryan was another notorious character who was raised in the 'Mizzou,' but he only worked there periodically. Jack was one of those fellows who only worked in order to buy whisky enough to give him strength to earn money enough to enable him to buy more whisky. He and Jack Manning would have been a good pair to draw to, with this difference, that while 'Bad' Jack could never tear himself away from St. Louis, Jack Manning is known from Duluth to New Orleans and from Chattanooga to Denver. It is said that on one occasion, when the thermometer was down to zero, 'Bad' Jack came into the shop entirely naked, except for a mismated pair of shoes, an old straw hat and a long linen duster, with a stone in each pocket to keep the wind from blowing it over his head. This suit had been donated him by some friends after having been robbed of his own apparel by a crowd of bums. Jack was in bad shape, and he knew that a linen duster wasn't going to keep him warm, no matter how much liquor he carried. Staggering up to Jake, he said: 'Jake, gi'me a job; an' I wants a stiddy job, too.'

"Jake wasn't in a very good humor, and he yelled: 'Outside the guy ropes; outside, I say,' and hustled poor Jack out into the snow with his linen duster flying about his heels.

"A friend of mine was on his 'uppers' once and struck Jake for a job. He was told to come on in the morning. When he went to work at seven o'clock the assistant foreman gave him a car center to make, two in a flask, and showed him a big floor with three heaps of sand. He cut over one of the heaps and started to work, and after a while he asked the man across the gangway what was the matter with the fellows on those floors, pointing to the other two heaps. He almost collapsed when he was told the three heaps belonged to his floor, and unless he filled them Jake would give him 'the run.'"

Patents have been awarded to the late E. F. C. Davis, who was general manager of the Richmond Locomotive Works, for improvements in intereceptive valves on compound locomotives. The patents are assigned to the Richmond Locomotive Works, and we believe the valves are those which are making the engines such a decided success.

Electricity Direct from Coal.

Ever since the electric current began to be applied to the arts, there has been a dream of scientists that the time would come when the potential energy of coal would be converted into electric energy direct, without the intervention of steam boilers, steam engines and dynamos. Electrical enthusiasts have always been predicting that electricity would, in the near future, take the place of steam engines, even when it had to be generated through the roundabout process of burning coal under a steam boiler, using the steam to drive an engine, which in turn operated the electrical generators. Those who looked upon the subject in the light of reason and accurate calculations, saw little likelihood of the electric motor pushing the steam engine out of the field, unless for special purposes where cost was not of great consequence. The same class of men, however, have insisted that should the time come when electricity could be made direct from coal, the days of the steam motor would be numbered. There is very good reason to believe that inventors have succeeded in beginning the solution of this great problem, which would be the most stupendous that has come to the world since steam was first applied as a prime mover.

According to an article published by George Herbert Stockbridge in the "Engineering Magazine," on "The Direct Production of Electricity from Coal," a true carbon-consuming electrical furnace, showing an efficiency of 85 or 90 per cent., has been invented by Dr. W. W. Jacques, of Boston. Many attempts have been made by scientists to obtain electricity direct from coal, and some little success has been achieved, but that obtained by Dr. Jacques is greatly in excess of any apparatus previously tried for the purpose.

Dr. Jacques began his investigations some five or six years ago, and he has found that if oxygen, whether pure or diluted, as in air, is caused to be combined with carbon or carbonaceous materials—not directly, as in the case of combustion, but through an intervening electrolyte—the potential energy of the carbon may be converted directly into electrical energy instead of into heat. He has devised a furnace to meet the necessary conditions, and has been entirely successful in obtaining electricity direct from the combustion of coal.

It has been reported recently that, with a Jacques battery of 100 iron pots, 12 inches deep and 1½ inches in diameter, a current was obtained averaging 90 volts and 16 amperes, and supporting thirty 16-candle power incandescent lamps for nearly 19 hours. In this test about 8 pounds of carbon were consumed in the pot. If the consumption taking place in the pot were all that is to be taken into account, this result, representing an efficiency of about 94 per cent., would be of enormous interest and value. The importance of this invention will be realized when we reflect that the highest efficiency ever obtained from a steam engine was about 15 per cent. of the coal energy. There are, however, few steam engines that have an efficiency over 10 per cent., and 5 per cent. is very common.

There are many things yet to be learned about the new invention, and it may have drawbacks which we are not aware of, but the indications are that a successful process of obtaining electricity direct from the energy of coal will be evolved from it. The practical effect of such an invention will be the pulling-down of all the steam boilers used in the country, and the substituting of electrical generators.

There is a foundry company in East Chicago which have gone into the business of making ductile cast iron, and they are said to be remarkably successful with the product turned out. The "Iron Age" says that a test bar with the breaking section turned in on both sides was tested by Fraser & Chalmers, and showed a tensile strength of 63,000 pounds to the square inch. Other tests have shown over 80,000 pounds. After being heated to a dull red and plunged into cold water it can be cut easily with a file, showing that it takes no temper. Specimens of castings are shown which have had portions heated and drawn out flat under the hammer, afterward being twisted cold and pounded flat, without a sign of fracture. Gates from castings are shown which have stood remarkable torture of this character. A notable piece of work is a heavy chain, of which the links were cast open, then joined and the open spaces welded without the use of flux. Valve stems, crank shafts and other similar pieces are shown which have been finished to pattern in a lathe, exhibiting a smooth surface without a suspicion of a blowhole. Intricate castings are exhibited which have been reproduced regularly without a failure, while a very high percentage of losses has been reported when made by other methods of producing very strong castings.

Mr. Peter H. Murphy, East St. Louis, Ill., the well-known maker of iron car roofs, appears to be gradually working into quite a varied line of appliances for railroad rolling stock. A very strong and simple form of draft rigging for railway cars, recently patented by Mr. Frank L. Lankey, has been assigned to Mr. Murphy, and also a very substantial form of iron brake beam. Another device, recently patented by the same inventor and assigned to Mr. Murphy, is an iron car truck of very good design. It is understood that Mr. Murphy will lose no time in putting these devices upon the market.

To Make the Best of Milling Cutters.

The Brown & Sharpe Mfg. Co., Providence, R. I., have sent out a small pamphlet containing directions about the care of milling cutters. Among the suggestions made are:

"Cutters should be kept sharp. As soon as there is any appearance of dullness, pass them once or twice in front of an emery wheel. This, in the long run, will save time in sharpening, will prolong the life of the cutters, and will enable them to do their best and most rapid work.

"Plenty of lubricant should be used in milling wrought iron and steel. Lard oil is generally the best, but in some cases the following soda-water mixture will answer very well: One-quarter pound sal-soda, one-half pint lard oil, one-half pint soft soap, water enough to make ten gallons. Boil one-half hour.

"A cutter of small diameter, other things being equal, is better than one of large diameter. It also costs less. Formed cutters are usually the most economical when duplicate pieces are required. They last a very long time and all pieces cut by them are practically interchangeable. When stock cutters or combinations of stock cutters can be made to answer the purpose, it is usually better to order these than to have special cutters made.

"In selecting a cutter, except for finishing cuts, it is usually best to err on the side of having too few rather than too many teeth. The tendency in everything, except finishing cuts, is toward coarser speeds and relatively slower feeds. To do its best work, the cutter must be used in a powerful and rigid machine."

A curious discovery has been made by a London chemist while experimenting to try and convert carbon compounds direct into electrical energy. He found that carbonic oxide gas unites directly with metallic iron and nickel forming new gases which are called "carbonyls." The most curious thing about the discovery is that the process goes on at ordinary atmospheric temperature, and the gas will drop the metallic element on being heated. There is good reason for believing that the rapid corrosion of iron in roofs of engine houses, blacksmith shops and other buildings where carbonic oxide is present in large quantities, may be due to the gas combining with the iron. The corrosion has hitherto been attributed to acids of sulphur, formed through a combination of oxygen with sulphur fumes.

A curious accident was caused by some juvenile scientists in Belgium of an experimental tendency. They found a foot-warmer, which is a flat, oblong vessel, and which they fill with water in winter to keep the feet of travelers from freezing solid. These boys thought it would be a good plan to make some experiments with this particular foot-warmer. They put one end of the warmer upon the rail of an electric tramway, secured a copper wire to the other end, and threw it over the trolley wire. This made a good connection, and the electric current at once began to heat up the water. About the time that an inspector happened along to see what the youths were doing, the foot-warmer had become so thoroughly heated that it exploded with a great crash, throwing the hot water and consternation in all directions. Fortunately it did not kill anybody, but the youthful scientists are not liable to make experiments of that kind again.

Several experiments are going on with compressed-air motors for street-car purposes which indicate that there is a fair probability of compressed air taking the lead for street-car motors. Rather exhaustive experiments were made in that line about twenty years ago, and the Baldwin Locomotive Works built some exceedingly strong tanks for holding compressed air; but still, they did not have a capacity above six or seven hundred pounds pressure per square inch. The invention, by David Mannesmann, of seamless tubing brought new possibilities to compressed-air motors, for by the use of these tubes as an air reservoir a safe pressure can be carried up to five thousand pounds per square inch. In the latest experiments made with highly-compressed air motors, the air has been saturated with moisture before being pumped to the cylinders, with much improvement in utilizing the pressure.

A trip for record purposes was recently made from London to Paris, special service being employed throughout. The entire distance was covered in 6 hours 32 minutes. From Victoria Station, London, to Dover, 78½ miles, was made in 1 hour 22 minutes 35 seconds, or at 59.9 miles per hour; from Dover to Calais, by boat across the English Channel, 25 miles, was made in an hour and a quarter, or at 20 miles per hour; and from Calais to Paris, 185½ miles, was done in 3 hours 34 minutes, or at 52 miles per hour, including three stops.—"American Machinist."

There is some reason for believing that American railways will be used as the model for those that are projected by the Chinese Government. Li Hung Chang, the great Chinese potentate, who represents the Emperor, has been attending the coronation fêtes at Moscow, and will visit the United States on his way home. It is reported that he will make a careful inspection of our railroads while on his way from New York to San Francisco, and on the impressions which he receives during the journey will depend the kind of railways to be built in China.

Hard on Track.

The engineering and track departments of railways are rather strongly opposed to the increasing weight of rolling stock. "Jerry Sullivan," an interesting writer for the "Roadmaster and Foreman," appears to voice the sentiment when he says in a recent issue: "Technical journals of recent date illustrate cars having a capacity of 80,000 pounds and even 100,000 pounds. These cars are manufactured at various shops and are built largely of steel. One company's advertisement claims their cars are almost indestructible, capable of standing any amount of abuse or overloading, and clinches the statement with a cut taken from a photograph of a car loaded with 159,200 pounds of pig iron. Illustration of trucks shows no increase in number of wheels under the cars. After a train of such cars passes over a section at the rate of forty miles per hour, a foreman should be governed by rule relating to cyclones, viz.: "Take all your men, tools and red flags, and go over your track at once."

An English railroad paper tells a rather mixed-up story about an experience of Lord Aberdeen, Governor-General of Canada, while acting as an amateur engine driver on a Scottish railway. That thing of getting on to a foot-plate of an engine and holding the regulator was a great feat with British noblemen at one time, and they imagined they were running the engine so long as they held the throttle open, but the driver in charge never failed to have his hand on the reverse lever to regulate the speed. Lord Aberdeen, it appears, was one of the British noblemen who was inflicted with this form of mild mania. The railroad paper referred to says that "while Lord Aberdeen was traveling from London to Aberdeen on the foot-plate, one of the proudest moments of his life was when he was on an engine in Scotland and took it upon him to go around the bearings of the engine, in order to turn the oil cups into the cylinders, while running at full speed, and he lost his cap in the process." It is something amusing to read of even a lord being able to go around the bearings of a locomotive running at full speed. We incline to think, from some personal experience with that kind of amateur engineer, that the feat which his lordship performed was that of opening the cups for oiling the cylinders.

A railway to the summit of the Jungfrau, to the "Elegant Virgin," will be finished in about five years. The "Majestic Virgin" is nearly 14,000 feet high; the summit of Mont Blanc is 15,800 feet. It is likely that within a short time the summit of Mont Blanc will be reached by railway. The terminus at the summit of the Jungfrau will be underground, to prevent the structure being destroyed by avalanches. The power for operating this aerial railway will be electricity, generated at a neighboring waterfall. Only one car, capable of seating ten persons, will be used in operating the line. An innovation in railroad traveling will be introduced, which will require all travelers to pass a medical examination before they take the trip. Those who have any signs of heart disease will be refused admission to the car.

There are good reasons to believe that a region in New Zealand will at some time become one of the greatest iron-making districts in the world. The iron ores are in the form of sea sand. In one locality forty miles of beach is formed of magnetic iron sands, perfectly free from sulphur, phosphorus or other impurity, except a small percentage of titanium. The sands are many feet deep, and have been proven to extend three hundred yards beyond low water. Several attempts have been made to establish iron works there; failure resulted principally through mismanagement.

The Northeastern Railway of England has introduced a coupon system for travelers which one of our English contemporaries describes as being both at once interesting and novel. Books of that kind have been in use in this country for many years, and the novelty of them has been worn off long ago; but there is really one novelty connected with the system newly introduced in England: Instead of giving ticket slips to the conductor or ticket taker, the holder of the ticket must go to the ticket office and exchange coupon checks for a ticket. When this has to be done we cannot see much advantage to the practice.

A committee of the Traveling Engineers' Association is investigating the subject of "Discipline of Enginemen for Infraction of Orders." They have sent out a circular asking for information as to the most successful way of punishing violations of rules. They want to find out all they can about the Brown System of Discipline, which is certainly the fairest way in use of dealing with trainmen.

Snaps.

We will send a Boston binder—holds a year of "Locomotive Engineering"—to anyone sending us three 2-cent United States stamps—got fifty on hand; don't want 'em.

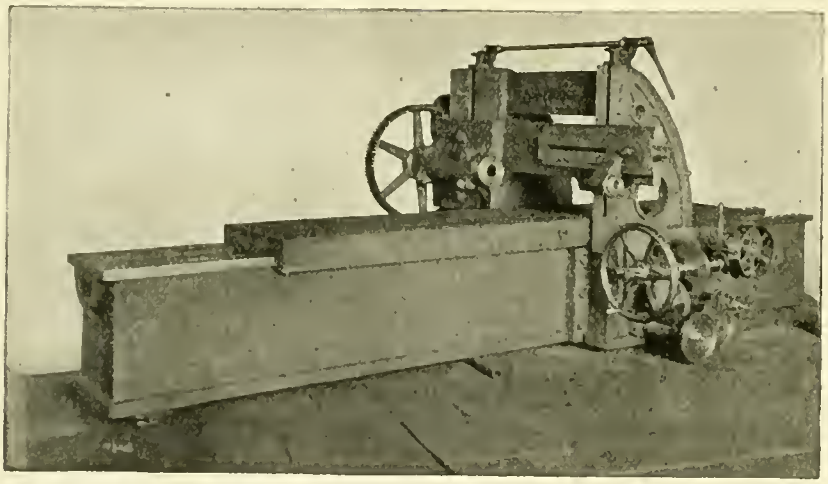
We will send a bound volume of 1894 for $2—only a dozen left—in the way.

Only two copies of 1895 bound volumes left—$3.

You can't buy back numbers at any price; take the volumes now.

Special Locomotive-Rod Milling Machine.

We illustrate a special locomotive-rod milling machine, built by the Newton Machine Tool Works, of Philadelphia. The tool is specially adapted for modern requirements in heavy and rapid milling. The driving spindle of this machine is 6 inches in diameter and very powerfully geared. It is capable of fluting two side rods at one time. The machine has a carriage 30 inches wide and will admit work to the width of 36 inches between the uprights. The carriage of the machine is 12 feet long and is capable of milling 11 feet in length. The main upright carrying the driving mechanism to spindle head is a boxed upright, the outside support being of the ordinary planer type. The machine is fed with a steel rack and a spiral gear, giving a very steady, even motion under the cut and a quick movement with the return of the carriage. The feed of this machine, as shown by the illustration, has four changes through cones of gearing. As can be seen by the illustration, the machine is of an exceptionally heavy design, weighing about 25,000 pounds.



The Prussian State Railway officials have lately conducted a series of tests with a new lubricant composed of oils and fats, for lubricating the journals of railway cars. The material is a sort of dope, which has never been popular on American railroads, but it seems to do the work of lubrication very well. Very exhaustive tests, under trains of all kinds in very severe weather, show that 1½ grains of the lubricant were sufficient to keep the journal in good order for 100 miles.

The United States Metallic Packing Company announce that they have entered suit against the American Pneumatic Tool Company, of New York, manufacturers of the "McCoy" tool, and against the Boyer Machine Company, of St. Louis, manufacturers of the "Boyer" hammer. In connection with this intimation, they say that they are prepared at their own expense, and through attorneys of their own selection, to defend the manufacture of their tools, and all users of the "Chouteau" hammer, against any and all claims of infringement of patents.

The Buffalo Forge Company have issued an illustrated catalog showing their disk wheels, and giving a variety of useful information about them. These wheels are rapidly coming into use for a variety of industrial purposes where rapid circulation of air is necessary. They are used to a great extent for carpet-cleaning and for ventilating all kinds of buildings, and are particularly well adapted for general house and machine-shop purposes.

A pamphlet entitled "Two to Fifteen Days' Pleasure Tours," has been issued by Mr. Geo. H. Daniels, general passenger agent of the New York Central Railroad, New York. It is a very attractive and interesting pamphlet, showing a great many beautiful views of interesting scenery. It will be sent to any applicant who sends a two-cent stamp to Mr. Daniels.

Any of our readers who are fond of hunting or fishing, or of the scenes where that kind of sport is followed with most success, should send ten cents to pay for the "Maine Central," published by the New England Publishing Co., Portland, Me. To linger over the pictures on a hot day is the next thing to loitering by the running brooks brought before one so vividly in the pages of the journal named.

In making some tests of a new third-rail trolley for its electric suburban railway at Boston, the New York, New Haven & Hartford people recently attained a velocity of 80 miles an hour with an electrical motor and train.

The Q. & C. Co., prominent manufacturers of railway supplies and special machinery, Chicago, Ill., have received their award for a very fine exhibit of metal-sawing machinery and tie-plates at the Atlanta Exposition. This award consists of a very finely designed gold medal. The special meritorious features of the metal-sawing machines offered by this company are that they are low in price, effective in service and economical in action, each machine sold by them being provided with positive automatic feed, greatly reducing the time ordinarily required to cut metals of all kinds.

If there is anything about twist drills, milling cutters, taps and dies that you don't know, send for the latest catalog published by the Cleveland Twist Drill Co., Cleveland, O. It is got out in excellent shape, very profusely illustrated, and contains a great deal of information that will be of value to mechanics and purchasers. The secretary of the company intimates that he will send this catalog to anyone who makes application for it.

Mr. A. O. Norton, of Boston, manufacturer of the Norton ball-bearing jacks, is now in Canada, enlarging and adding new machinery to their plant there. Notwithstanding the dull times, this firm's shops in Boston and Canada are working full capacity, to keep up with the constantly increasing demand for these justly popular jacks.

The fifteenth annual edition of "The Railway Official List" for 1896 has been received in this office. It contains a very full list of railway officials, has a good finding list, and contains illustrated descriptions of the Master Car-Builders' standards, besides a variety of other information that will be useful to railroad men. It is for sale by "The Official Railway List," The Rookery, Chicago, Ill.

The Shoenberger Steel Co., Pittsburgh, Pa., have commenced the erection of a plant for the manufacture of basic steel for boiler purposes. They find that many boiler users prefer to purchase a cheaper steel than that made by their well-known acid process, and they are determined to supply the quality of steel which customers want. They will start with two furnaces, but provision will be made to put in others as the demand increases.

The Armstrong Manufacturing Company, Bridgeport, Conn., have issued an illustrated catalog showing their water, gas and steam fitters' tools and machines for cutting off and threading pipe. The catalog contains a great deal of information about taps and dies, and will be found a very useful reference to mechanics and others interested in that sort of work.

WHAT YOU WANT TO KNOW.

Questions and Answers.

(60) W. R. W., San Marcial, N. M., writes:

Please give me the formula for finding the tractive power of a locomotive. A.—You are referred to the following issues of "Locomotive Engineering" for above information: December, 1895, page 782; February, 1896, page 168; June, 1896, page 516; July, 1896, pages 619 and 641. If there are any points in the subject not as clearly defined as you desire, they will be furnished on application.

(61) G. B. V., Massillon, O., writes:

We have twelve new 19 x 26-inch Cooke engines on our road, with the Detroit triple-feed lubricator, the piping of which is ¼ inch. I claim that the pipe from the fountain to the lubricator should be larger, in order to properly supply the three feed pipes, for on the hills we sometimes have to shut off to allow the oil to reach the valves. Am I not right? A.—We think you are right; the pipe should not be less than ⅜ inch inside diameter.

(62) H. M., Georgetown, Ky., writes:

I desire to ask for information through your most valuable journal. Please tell me the proper way to take in a mogul engine with a back tire broken, the middle tire being plain. A.—Jack up the wheel clear of the rail, and place a block of wood between the jaw-brace and journal, to carry the broken side. Chain the tank to the engine by diagonal corners, so as to cause the tender to force the engine as much as possible towards the uninjured side, and thus have the good flange on the rear driver closely hug the rail. Abandon the train and go ahead slowly, particularly on curves and over switches.

(63) C. H. G., Springfield, Mass., writes:

I would like to know the best way to pump an engine to avoid leaky flues. I give two ways; please say which is best. First—Filling the boiler at the start and pumping light. Second—Starting with two gages and pumping hard, get the third gage on the hill; that is, on a hilly road. A.—The first method is the correct one, for the reason that you are obliged to feed the boiler in accordance with the amount of work done by the engine, and thus have a more equable firebox temperature than would be possible with the alternate thawing and freezing process in plan two; again, it is not a safe policy to pursue, to wait for the third gage until the hill is reached.

(64) A. S. F., Saxton, Pa., writes:

Will you please explain in "Locomotive Engineering" the following action of a No. 8 double sight-feed Nathan lubricator, and give a remedy for same if there is one? Engineer reported oil siphoning out of lubricator, whether engine was standing or running. Lubricator is connected by standard size steam valve and pipe. The engineer states that the oil disappears in gage glass the same as when it is going through feed valves; that is, it flows from the bottom to top of glass. This disappearance takes place when feed valves are shut and the steam and water valves wide open. The feed valves are tight—do not leak. The lubricator was removed and thoroughly cleaned; the equalizing and oil pipes were carefully examined and all parts found to be in good working order. When it was again attached, the engine made one trip and the lubricator was reported as working the same as before cleaning. While defective lubricator was being inspected it was replaced by one of the same kind, which performed its functions perfectly satisfactorily. Any information that will throw light on this puzzling case will be appreciated. A.—It is a difficult matter to name all the causes for this performance of the lubricator. The Nathan people, to whom the above question was referred, say that "there are many probable causes for it, such as an old or worn choke plug; or one having the small hole in same enlarged to such an extent that steam is not sufficiently throttled at the outlet end of lubricator, to maintain boiler pressure at that point; or when the passages through which steam passes from the equalizing tubes in the condenser to the choke plugs are clogged. These conditions are all favorable to siphoning. In the case of the feed valves being closed and the steam and water valves open, the disappearance of the oil can be accounted for by the cup being a defective casting. A small blowhole in the wall of the cup at a point passing from the oil chamber into the passage connecting the equalizing tubes with the choke plugs, will allow the oil to escape through the choke plugs just the same as when the lubricator is working normally, and this is likely to be the cause of your trouble. It will be impossible to siphon the oil out of the cup when the lubricator throttle is open, if the cup is tight and all the passages are in proper condition."

(65) W. P. T., Caspar, Cal., writes:

I have read much in "Locomotive Engineering" about the cutting of wheel flanges. I am running on a very crooked road and know something about cut flanges; have used water with poor results, as it requires a great deal of water and it is not satisfactory, for water in a clean, clear state has but little lubricating effect. I then concluded to experiment with oil, and invented a device for applying same to the flanges of engine-truck wheels. After using it about two months I could not detect any cut or wear on the flanges; but as the device for applying the oil was troublesome, it was abandoned for a time. I have now invented a device that will oil the flanges without any trouble to the engineer; it can be applied to any wheel on the engine, tender or train. The oil only reaches that part of the flange that comes in contact with the rail; it leaves oil on that portion of the rail and lubricates the next flange that comes in contact with it. It is impossible to get any oil on the tread of wheels with this device. My experience in railroading leads me to believe that this invention is a valuable one. Do you know of anything of the kind in use? I will be thankful for any information you can give me on this subject. A.—A device to accomplish the results you set forth was in use on the Denver & South Park Railway, in 1880. It was also in use on the Suburban Rapid Transit road, now a part of the Manhattan Elevated Railway, several years ago, and on the London, Brighton & South Coast Railway, in England. We understand that those roads have long since stopped the practice of lubricating wheel flanges.

(66) L. R. A., Madison, Wis., writes:

I would greatly appreciate some information about the value of certain characters used in mathematical formulæ, and would like to know whether they have a constant significance, or are they variable with each writer, who may let them represent any quantity desired. I have noticed that, in general, the character π represents the value 3.1416, which equals the ratio of circumference to diameter, and I therefore assume that mathematicians are in harmony in this instance. Will you please say how far this agreement obtains with other familiar characters used by them? A.—There are certain Greek letters which have a constant significance, such as the letter π, or Pi, quoted above, and also the letter Σ, known as Sigma, which is used to represent the sum of any number of quantities. There are other letters, however, which have a variable significance, as the letter η, known as Eta, used by some writers to stand for efficiency. The letter Δ, or Delta, is also used for various values, and may therefore represent anything. The letter θ, or Theta, is used by nearly all mathematicians to refer to angles, and the letter Φ, or Phi, is sometimes used for the same purpose. In calculations of kinetic energy we have English letters, as v, which always represents velocity in feet per second, and g, which denotes acceleration of gravity; these last are constant factors used by nearly all writers. There is little occasion for doubt as to the meaning of any of these characters, for their value for any particular case is usually to be found somewhere in the text.

(67) J. N. P., Nashville, Tenn., writes:

I have recently had a discussion with the master mechanic of one of our roads in regard to the amount of pressure on an ordinary unbalanced slide valve on a locomotive, and, as we differ materially, I will state the position of each of us, and ask you to say who is right. My position is this: Given a valve of, say, 100 square inches area, and a steam pressure of 150 pounds per square inch, with the valve placed at the middle of its stroke, and steam admitted at full boiler pressure, the amount of pressure on valve is represented by $150 \times 100 = 15{,}000$ pounds. I claim that it will require a considerable force to move the valve along on its seat; certainly more than an ordinary man can exert on a dead pull. The master mechanic's position is this: Given same valve, and all conditions the same as above, the amount of pressure tending to force the valve against the seat is found by taking the sum of the areas of the steam and exhaust ports in square inches, and multiplying this by the steam pressure per square inch, as before; it is claimed that the valve can be easily moved on its seat while under this pressure, by an ordinary man, with a dead pull on the valve stem, by one hand. No account to be taken of the friction in the stuffing box, and in both cases the valve is supposed to rest on the seat. A.—The force necessary to overcome the friction between the valve and seat is measured by the total pressure on top of the valve, the condition of the rubbing surfaces, and the character of the lubricant used. In the example given, the total pressure was found to be 15,000 pounds. Taking the co-efficient of friction of cast iron on cast iron, lubricated with tallow, and wet (which are the conditions usually supposed to obtain in a steam chest), at one-tenth (0.1) of the total pressure, we have $15{,}000 \times 0.1 = 1{,}500$ pounds as the force required to move the valve. The resistance to motion would be less, however, if the valve moved far enough to allow steam to reach its under side, for the reason that a reacting upward pressure would then exert its influence against the downward pressure.

Rails and nails are the highest-priced metal on the market to-day so far as selling price and cost of production are concerned. The combination that keeps up prices is bringing forth new works which will overstock the market, with the usual results.

The Newton Machine Tool Works, Philadelphia, have issued their illustrated catalog No. 32, illustrating and giving information about their horizontal boring, drilling and milling machines. It also contains illustrations of milling and slotting machines, and drilling, boring and cold-saw cutting-off machines, and a variety of others. Those interested can obtain the catalog by application to the firm.

The Boston Belting Co., of Boston, Mass., have issued an illustrated circular relating to belting, hose and a great variety of rubber goods used in machine shops and by railroad companies. Besides being a good reference book for purchasers, this catalog contains a great many facts relating to the goods handled, which will be found valuable and interesting by mechanics.

INDEX TO ADVERTISEMENTS.

Buyers' Finding List.

Air Brake Fittings.
Crane Co., Chicago, Ill.

Air Brake Hose.
Boston Belting Co., Boston, Mass.
N. Y. Belting & Packing Co., New York.

Air Brakes.
Westinghouse Air Brake Co., Pittsburg, Pa.

Air Brake Gage.
Utica Steam Gage Co., Utica, N. Y.

Air-Brake Pump Governors.
Foster Engineering Co., Newark, N. J.

Air Compressors.
Clayton Air Compressor Works, New York.
Ingersoll-Sergeant Drill Co., N. Y. City.
Norwalk Iron Works Co., South Norwalk, Ct.
Pedrick & Ayer Co., Philadelphia, Pa.
Rand Drill Co., New York.
St. Louis Steam Engine Co., St. Louis, Mo.

(Continued on page 718.)

BUYERS' FINDING LIST—*Continued.*

Air Drilling Machine.
C. H. Haeseler & Co., Philadelphia, Pa.

Air Hoists.
Pedrick & Ayer Co., Philadelphia, Pa.
Whiting Foundry Equipment Co., Chicago, Ill.

Arch Bars.
Cambria Iron Co., Philadelphia, Pa.

Asbestos.
H. W. Johns Mfg. Co., New York.

Axles.
Cambria Iron Co., Philadelphia, Pa.
Gould Coupler Co., Buffalo, N. Y.
B. M. Jones & Co., Boston, Mass.
Krupp (T. Prosser & Son, New York).

Balanced Slide Valves.
Am. Bal. Slide Valve Co., San Francisco, Cal.
M. C. Hammett, Troy, N. Y.

Bearing Metal.
Ajax Metal Co., Philadelphia, Pa.
Paul S. Reeves, Philadelphia, Pa.
U. S. Metallic Pkg. Co., Philadelphia, Pa.

Bell Ringer.
Trumbull Mfg. Co., Warren, O.
U. S. Metallic Packing Co., Philadelphia, Pa.

Belting.
Boston Belting Co., Boston, Mass.
N. Y. Belting & Packing Co., New York.

Boiler and Firebox Steel.
Shoenberger Steel Co., Pittsburg, Pa.

Boiler Checks—Inside.
Foster Engineering Co., Newark, N. J.

Boilers.
Pittsburg Locomotive Works, Pittsburg, Pa.

Boiler Testers.
Rue Mfg. Co., Philadelphia, Pa.

Boiler Tools.
Richard Dudgeon, New York.
Hilles & Jones Co., Wilmington, Del.
Long & Allstatter Co., Hamilton, O.

Boiler Washers.
Nathan Mfg. Co., New York.
Rue Mfg. Co., Philadelphia, Pa.

Bolt Threading Machinery.
Acme Machinery Co., Cleveland, O.
Detrick & Harvey Machine Co., Baltimore, Md.

Books.
H. C. Baird & Co., Philadelphia, Pa.
Philadelphia Book Co., Philadelphia, Pa.
D. Van Nostrand Co., New York City.

Brake Adjusters.
Q. & C. Co., Chicago, Ill.

Brake Shoes.
Ramapo Iron Works, Hillburn, N. Y.
Ramapo Wheel & Foundry Co., Ramapo, N. Y.

Brass Castings.
Ajax Metal Co., Inc., Philadelphia, Pa.
Paul S. Reeves, Philadelphia, Pa.

Buffers.
Gould Coupler Co., Buffalo, N. Y.

Bulldozers.
Williams, White & Co., Moline, Ill.

Cars.
Allison Mfg. Co., Philadelphia, Pa.
Lima Locomotive & Machine Co., Lima, O.
Ramapo Iron Works, Hillburn, N. Y.

Car Couplers.
Gould Coupler Co., Buffalo, N. Y.
McConway & Torley Co., Pittsburg, Pa.
National Malleable Castings Co., Chicago, Ill.
St. Louis Car Coupler Co., St. Louis, Mo.
Sams Automatic Coupler Co., Denver, Col.
Smillie Coupler & Mfg. Co., Newark, N. J.
Standard Coupler Co., New York.
Trojan Car Coupler Co., Troy, N. Y.

Car Heating.
William C. Baker, New York.
Gold Car Heating Co., New York.
Safety Car Heating & Lighting Co., New York.

Car Lighting.
Safety Car Heating & Lighting Co., New York.

Car Paints.
Detroit White Lead Works, Detroit, Mich.

Car Roofing.
P. H. Murphy Mfg. Co., E. St. Louis, Ill.
Standard Paint Co., New York.
Warren Chemical & Mfg. Co., New York.

Car Seats.
Hale & Kilburn Mfg. Co., Philadelphia, Pa.

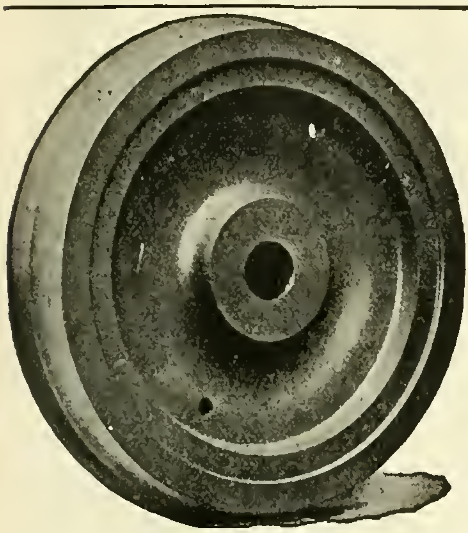
Car Ventilators.
M. C. Hammett, Troy, N. Y.

Car Wheels.
Kalamazoo R. R. Velocipede & Car Co., Kalamazoo, Mich.
Krupp (T. Prosser & Son, New York).
Lima Locomotive & Machine Co., Lima, O.
Ramapo Wheel & Foundry Co., Ramapo, N. Y.
Standard Steel Works, Philadelphia, Pa.
Washburn Car Wheel Co., Hartford, Conn.

Cattle Guards.
Q. & C. Co., Chicago, Ill.

(*Continued on page 719.*)

THE STANDARD STEEL WORKS ...



Philadelphia.

TIRES

Wrought Iron Centers,
Spoke and Plate
Steel Tired Wheels.

REPRESENTATIVES.

Chicago: FITZHUGH & SPENCER, 1634 Monadnock Building.

St. Louis: ANDREW WARREN RAILWAY SUPPLY CO., 516 N. Third St.

Cincinnati: E. A. KINSEY & CO., 333 West Fourth Street.

Boston: JOHN KENT, 52 Mason Building.

William Sellers & Co., Incorp.

PHILADELPHIA, PA.

MODERN MACHINE TOOLS.

NOTE:—Our Improved Tools are designed to meet the most exacting requirements of Modern Railway Machine and Repair Shops. In addition to all the Standard Tools, we frequently make modifications thereof for special purposes.

TRAVELING CRANES, SWING CRANES, CAR CRANES, etc.

Turntables, Testing Machines, Steam Hammers, etc.

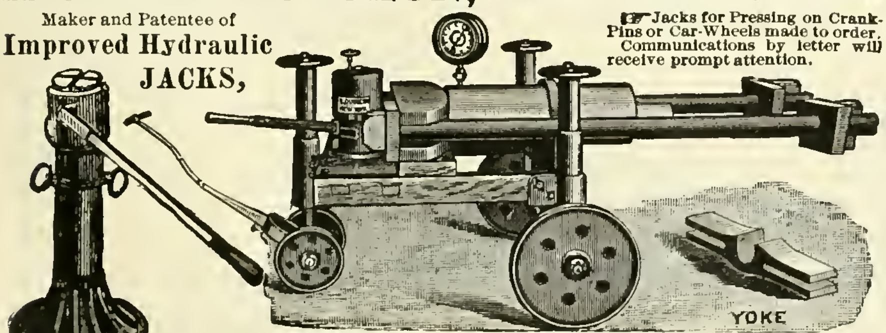
INJECTORS FOR LOCOMOTIVES,

SHAFTING AND ALL ITS APPURTENANCES FOR TRANSMITTING POWER.

RICHARD DUDGEON, 24 and 26 Columbia St., New York.

Maker and Patentee of
Improved Hydraulic
JACKS,

☞ Jacks for Pressing on Crank-Pins or Car-Wheels made to order. Communications by letter will receive prompt attention.



Punches, Roller Tube Expanders and Direct Acting Steam Hammers.

CRANE COMPANY,

Manufacturers of AIR BRAKES,

Also, Air Brake Repairs,
Air Brake Pipe,
Air Brake Fittings,

CHICAGO.

BUYERS' FINDING LIST—*Continued.*

Chain Pulley Blocks.
Moore Mfg. & Fdy. Co., Milwaukee, Wis.

Chime Whistles.
Crosby Steam Gage & Valve Co., Boston, Mass.
Star Brass Mfg. Co., Boston, Mass.

Clocks.
John J. McGrane, New York.

Coal Handling Machinery.
Link Belt Engineering Co., Philadelphia, Pa.

Coal Chutes.
Williams, White & Co., Moline, Ill.

Correspondence Schools.
Internat'l Corres. Schools, Scranton, Pa.
The Scientific Machinist Co., Cleveland, O.

Corundum Wheels.
Sterling Emery Wheel Mfg. Co., Tiffin, O.

Cranes.
Manning, Maxwell & Moore, New York.
Maris Bros., Philadelphia, Pa.
William Sellers & Co., Philadelphia, Pa.
Whiting Foundry Equipment Co., Chicago, Ill
R. D. Wood & Co, Philadelphia, Pa.

Crank Pin Gages.
M. C. Hammett, Troy, N. Y.

Crank Pins.
Cambria Iron Co., Philadelphia, Pa.
B. M. Jones & Co., Boston, Mass.
Krupp (T. Prosser & Son, New York).

Drills.
Cleveland Twist Drill Co., Cleveland, O.
Standard Tool Co., Cleveland, O.

Drilling Machines.
Gould & Eberhardt, Newark, N. J.

Electric Lighting and Power Apparatus.
Westinghouse Elec. & Mfg. Co., Pittsburgh, Pa

Emery Wheels.
Sterling Emery Wheel Mfg. Co., Tiffin, O.

Enamel.
Detroit White Lead Works, Detroit, Mich.

Engines.
St. Louis Steam Engine Co., St. Louis, Mo.

Engravings.
Bradley & Poates, New York.
Standard Engraving Co., New York.

Exhaust Pipe.
The General Agency Co., New York.

Expanding Mandrel.
Geo. L. Weiss, Cleveland, O.

Files and Rasps.
Arcade File Works, Anderson, Ind.
Nicholson File Co., Providence, R. I.

Filters.
A. Major, New York.

Flexible Shaft.
Stow Flexible Shaft Co., Philadelphia, Pa.

Flexible Steam Joint.
Moran Flexible Steam Joint Co., Louisville, Ky.

Flues and Tubes
Allison Mfg. Co., Philadelphia, Pa.
Tyler Tube & Pipe Co., Washington, Pa.

Forges.
Buffalo Forge Co., Buffalo, N. Y.

Forging Machinery.
Williams, White & Co., Moline, Ill.

Foundry Equipment.
Whiting Foundry Equipment Co., Chicago, Ill.

Frogs and Crossings.
Ramapo Iron Works, Hillburn, N. Y.

Graphite.
Jos. Dixon Crucible Co., Jersey City, N. J.

Heating System for Shops.
Buffalo Forge Co.
B. F. Sturtevant Co., Boston, Mass.

Hoisting Engines.
Earle C. Bacon, New York.

Hollow Staybolts.
Falls Hollow Staybolt Co., Cuyahoga Falls, O.

Hydraulic Tools.
Richard Dudgeon, New York.
Watson & Stillman, New York.
R. D. Wood & Co., Philadelphia, Pa.

Indicators.
Ashcroft Mfg. Co., New York.
Crosby Steam Gage and Valve Co., Boston.

Injectors.
Automatic Injector Co., Cincinnati, O.
Hancock Inspirator Co., Boston, Mass.
Hayden & Derby Mfg. Co., New York.
Nathan Mfg. Co., New York.
Ohio Injector Co., Chicago, Ill.
Rue Mfg. Co., Philadelphia, Pa.
William Sellers & Co., Philadelphia, Pa.

Jacks
E. C. Boyer, Dayton, O.
Richard Dudgeon, New York.
A. L. Henderer, Wilmington, Del.
A. O. Norton, Boston, Mass.
Watson & Stillman, New York.

Laggings for Locomotives.
H. W. Johns Mfg. Co., New York.
Keasbey & Mattison Co., Ambler, Pa.

(*Continued on page 720.*)

BUYERS' FINDING LIST—*Continued.*

Locomotives.
Baldwin Locomotive Works, Philadelphia, Pa
Brooks Locomotive Works, Dunkirk, N. Y.
Cooke Loco. & Machine Co., Paterson, N. J.
Dickson Mfg. Co., Scranton, Pa.
Lima Locomotive & Machine Co., Lima, O.
Pittsburg Locomotive Works, Pittsburg, Pa.
H. K. Porter & Co., Pittsburg, Pa.
R. I. Locomotive Works, Providence, R. I.
Richmond Loco. & Mch. Wks., Richmond, Va.
Rogers Locomotive Works, Paterson, N. J.
Schenectady Loco. Wks., Schenectady, N.Y.

Lubricators
Detroit Lubricator Co., Detroit, Mich.
M. C. Hammett, Troy, N. Y.
Nathan Mfg. Co., New York.

Lubricating Oils.
Galena Oil Works, Ltd., Franklin, Pa.
Leonard & Ellis, New York.
Signal Oil Works, Franklin, Pa.

Machine Tools.
Bement, Miles & Co., Philadelphia, Pa.
Detrick & Harvey Mach. Co., Baltimore, Md.
W. D. Forbes & Co., Hoboken, N. J.
Gould & Eberhardt, Newark, N. J.
Hilles & Jones Co., Wilmington, Del.
Jones & Lamson Machine Co., Springfield, Vt
Manning, Maxwell & Moore, New York.
National Machinery Co., Tiffin, O.
Newton Machine Tool Wks., Philadelphia, Pa.
Geo. Place, New York.
Pratt & Whitney Co., Hartford, Conn.
Prentiss Tool and Supply Co., New York.
William Sellers & Co., Inc., Philadelphia, Pa

Mechanics' Tools
Armstrong Bros. Tool Co., Chicago, Ill.
Keystone Mfg. Co., Buffalo, N. Y.

Metal Polish.
G. W. Hoffman, Indianapolis, Ind.

Metal Sawing Machines.
Newton Machine Tool Works, Phila., Pa.
Pratt & Whitney Co., Hartford, Conn.
Q. & C. Co., Chicago, Ill.

Milling Machines.
Cincinnati Milling Machine Co., Cincinnati, O.
Newton Machine Tool Works, Phila., Pa.
Pratt & Whitney Co., Hartford, Conn.

Mining Machinery.
Earle C. Bacon, New York.

Molding Machines.
Tabor Mfg. Co., New York City.

Over Clothes.
H. S. Peters, Dover, N. J.

Packing.
Boston Belting Co., Boston, Mass.
Gould Packing Co., East Cambridge, Mass.
H. W. Johns Mfg. Co., New York.
Jenkins Bros., New York.
N. Y. Belting & Packing Co., New York.
U. S. Metallic Packing Co., Philadelphia, Pa

Paints.
Standard Paint Co., New York.
Detroit White Lead Works, Detroit, Mich.
Detroit Graphite Mfg. Co., Detroit, Mich.
H. W. Johns Mfg. Co., New York.

Patents.
John Wedderburn & Co., Washington, D. C.
George P. Whittlesey, Washington, D. C.

Perforated Metal.
A. J. Beckley & Co., Meriden, Conn.
The Hendrick Mfg. Co., Ltd., Carbondale, Pa.

Photographs.
F. Moore, London, Eng.

Pipe Threading and Cutting Machinery.
Armstrong Mfg. Co., Bridgeport, Conn.
D. Saunders' Sons, Yonkers, N. Y.

Piston Rods.
Cambria Iron Co., Philadelphia, Pa.
B. M. Jones & Co., Boston, Mass.
Thomas Prosser & Son, New York.

Pneumatic Tools.
Chicago Pneumatic Tool Co., Chicago, Ill.
C. H. Haeseler & Co., Philadelphia, Pa.
Pedrick & Ayer Co., Philadelphia.
U. S. Metallic Packing Co., Philadelphia.

Pressed Steel Materials
Schoen Pressed Steel Co., Pittsburg, Pa.

Pressure Regulators.
Foster Engineering Co., Newark, N. J.
Newark Regulator Co., Newark, O.

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Boston Belting Co., Boston, Mass.
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Long & Allstatter Co., Hamilton, O.
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R. D. Wood & Co., Philadelphia, Pa.

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Page Woven Wire Fence Co., Adrian, Mich.

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Standard Ry. Gate Co., Saginaw, Mich.

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(*Continued on page 721*)

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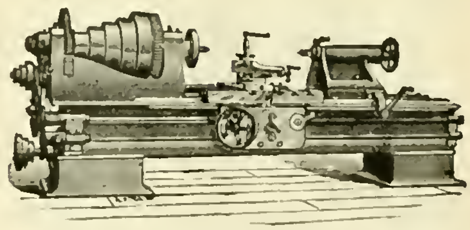

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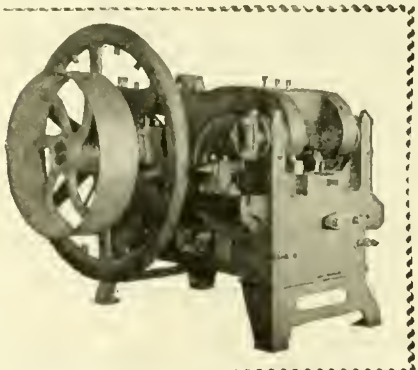

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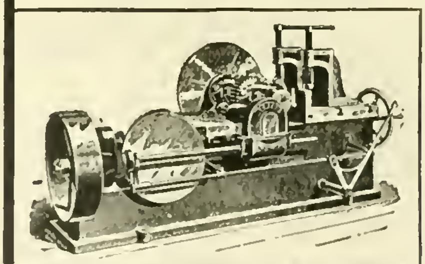

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R. Dudgeon, New York.

Turnbuckles.
Cleveland City Forge & Iron Co., Cleveland, O

Turret Machines.
Jones & Lamson, Springfield, Vt.

Twist Drills.
Cleveland Twist Drill Co., Cleveland, O.
Standard Tool Co., Cleveland, O.

Valves.
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Coale Muffler and Safety Valve Co., Baltimore Md.
Jenkins Bros., New York.
Star Brass Mfg. Co., Boston, Mass.

Valves, Reducing.
Foster Engineering Co., Newark, N. J.
Ross Valve Co., Troy, N. Y.

Varnishes.
Detroit White Lead Works, Detroit, Mich.
F. C. Reynolds, New York.

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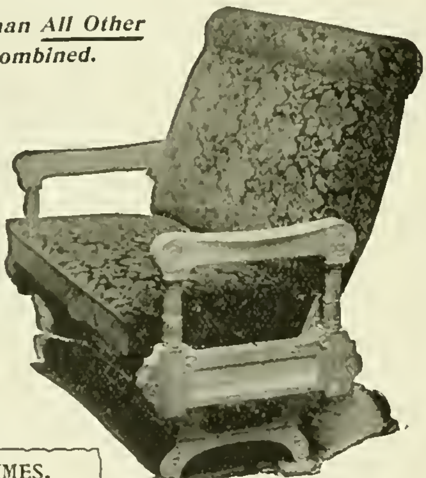

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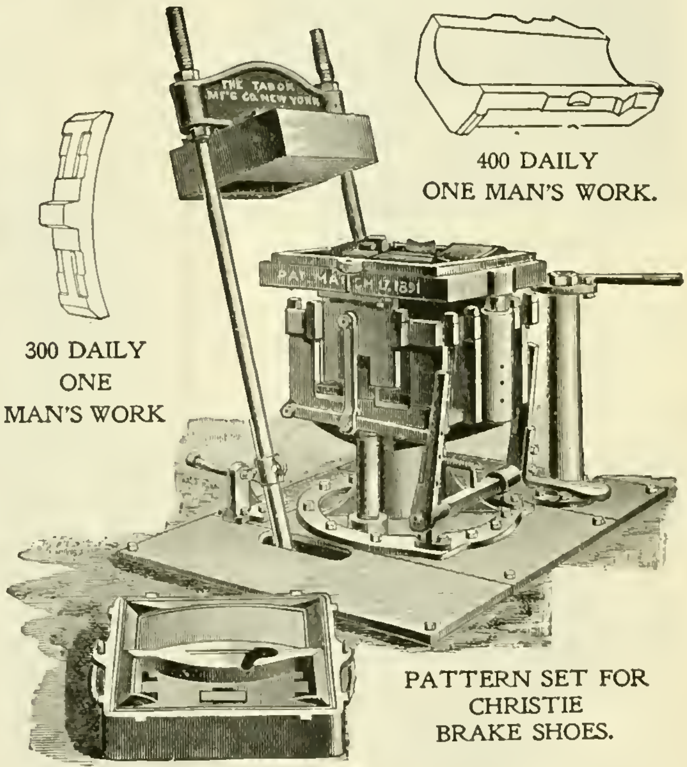

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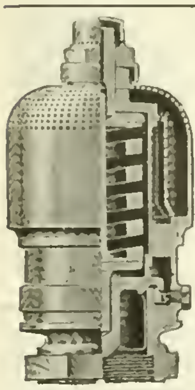

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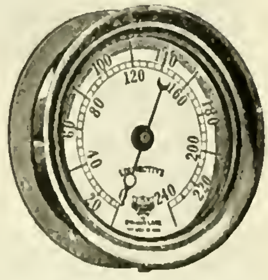

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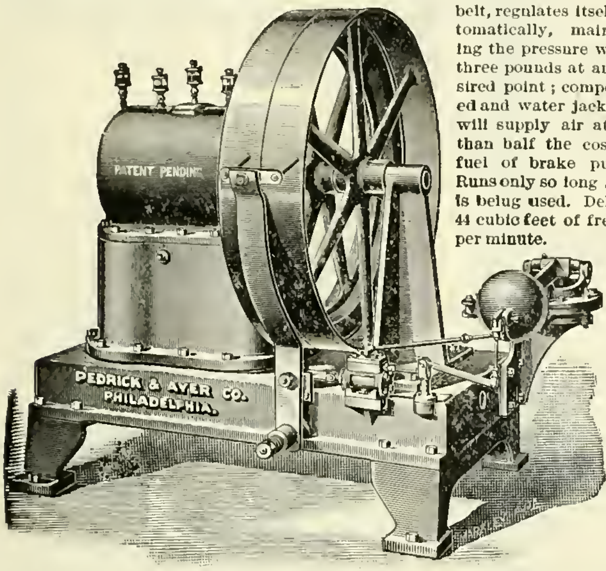

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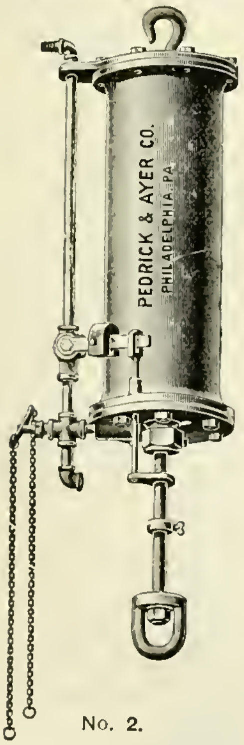

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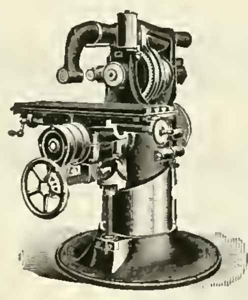

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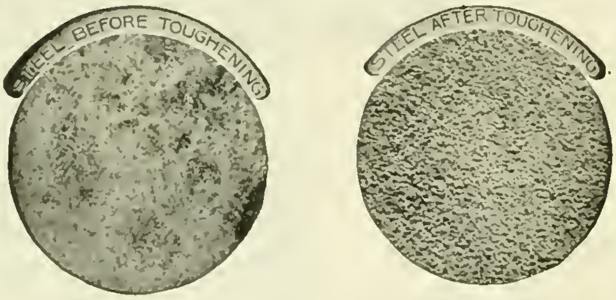

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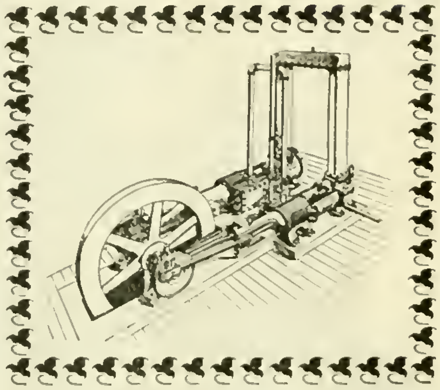

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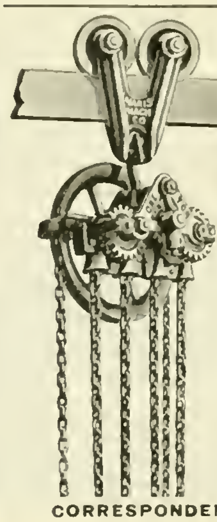

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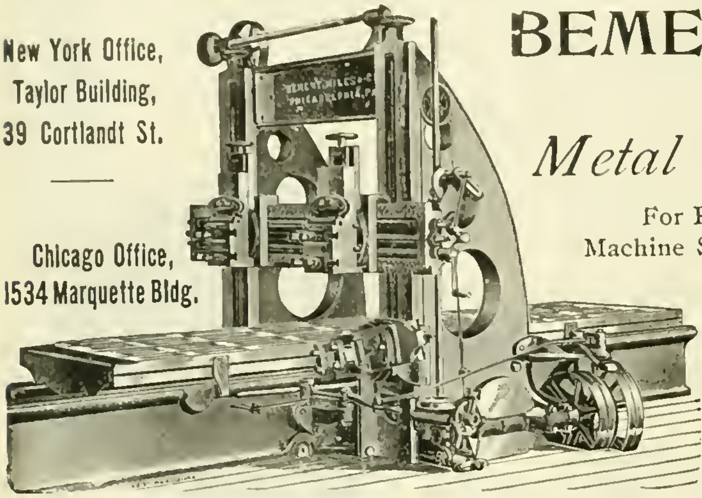

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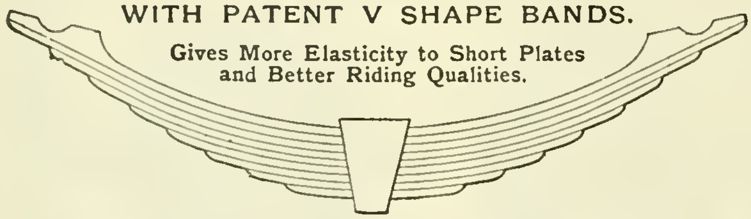

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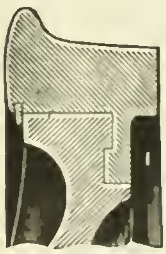

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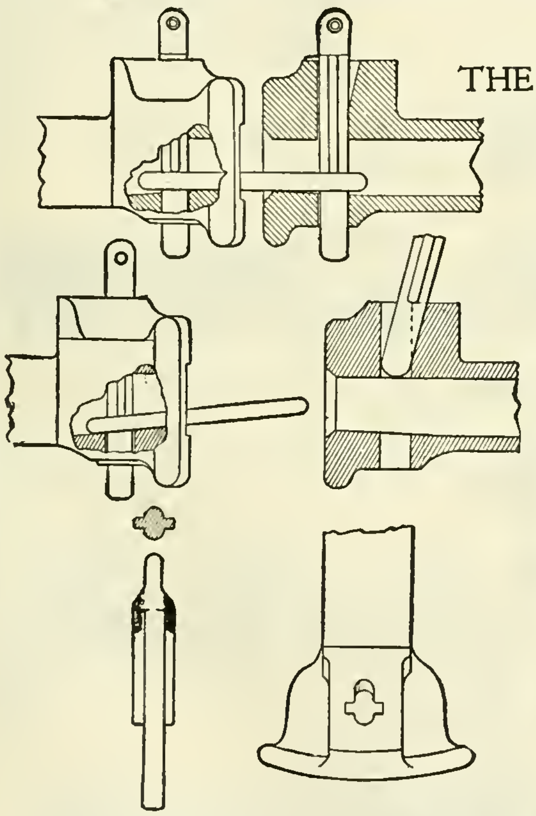

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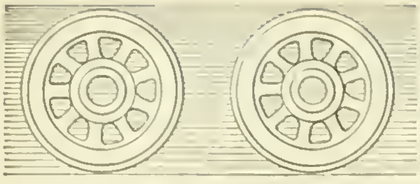

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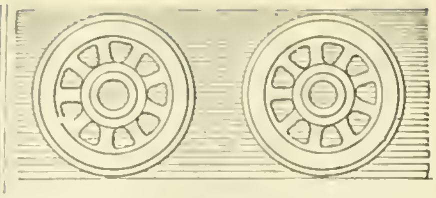
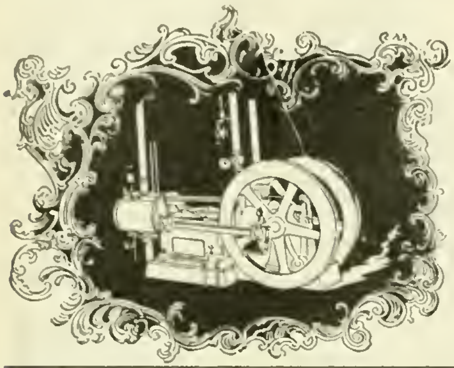


"A STRAIGHT LINE IS THE SHORTEST DISTANCE BETWEEN TWO POINTS."



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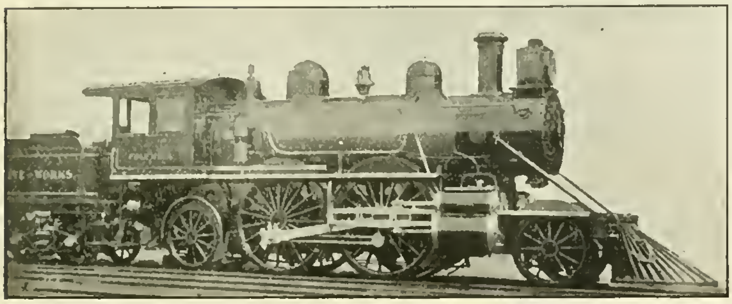

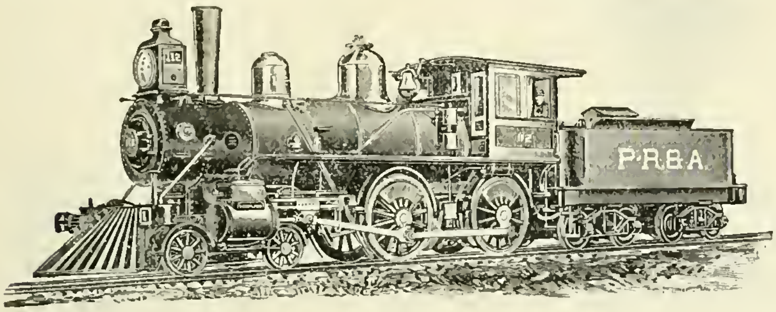
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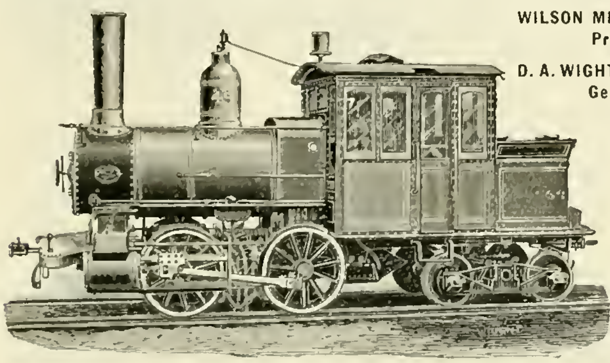


LOCOMOTIVE ENGINEERING

A PRACTICAL JOURNAL of RAILWAY MOTIVE POWER AND ROLLING STOCK.

[Trade-Mark Registered.]

Vol. IX. NEW YORK, SEPTEMBER, 1896. No. 9.

Notes from Argentine Republic.

BY AI DOLF.

Having served an engagement on an up-country railroad in Argentina, where I was for over four years, and connected with railroads and railroad men, from stoker to general manager, the whole of that period, I offer to give a few remarks on the iron roads of the Far South and what I was a witness to—the work of a "calm cud-chewer"—with my experience and knowledge of petroleum wells in that country and working of locomtives under petroleum fuel.

There are some twenty different established lines of railroads in all parts of Argentina (a country nearly as large as the United States, or the size of Europe, without Russia), which are entirely (with the exception of two or three little State lines up country) worked and financed with English capital; the managers, in all departments of responsibility, the drivers and most of the firemen and mechanics are British, to the antipathy of the Argentines. The main railroads going out of Buenos Ayres, the capital, and what may be regarded as the "New York of the Southern Hemisphere," are: Ferro-Carril de Sud (longest, best-managed and paying railroad in the Republic), Ferro-Carril de Buenos Ayres Rosario, Ferro-Carril del Oeste (the Western), Ferro-Carril de la Plata y Ensenada, Ferro-Carril del Norte (Northern), the Buenos Ayres and Pacific, which joins one of the principal up-country lines at Villa Mercedes in the province of San Luis, called the Ferro-Carril Gran Oeste Argentina (Argentina Great Western Railway), and upon this line your correspondent was engaged, and from it I give my future comments.

Like all its colleagues away from the capital and the Argus eyes of government officials, it was a good old delinquent in the way of half-day-late arrivals, late starts, engines giving out on inclines and having to wait for auxiliary locomotives from first station where any were or might happen to be; "washaways," and having to wait for permanent way gang to come along and repair; not often collisions, but slipping of wheels, hot axles and shortage of water were hourly events. "Getting off track" was often at back of drivers' reports, or "waiting for cattle" was cause for delay.

ONE PHASE OF THE COW QUESTION IN SOUTH AMERICA.

COW ON THE TRACK.

The photo illustration here gives an idea to readers of how and why were sometimes occasioned the delays on the belated Argentine Great Western Railroad. Cows that the passenger sees from the carriage window, calmly chewing the cud in the wayside field, are little thought by him or her to be the wreckers of a train, and at times of human life. From the photograph now reproduced it will be shown, as a matter of fact, that they are. In this particular case the driver reports that, having opened the whistle to its fullest extent, he was unable to frighten one cow of a herd off the line, and as he had been losing time by the cattle running along in front of his engine for a great distance, he at last determined to "run for" the last persisting cow, and so, putting on all speed (hoping to make a "clean cut"), the animal was approached with the result as seen now. The cow being knocked down, lifted the bogie wheels of the locomotive off the track, and the line having a sloping bank at each side, the engine went off and turned completely on one side. When the camera man came along it had been partly raised from its side position, and much had been done to spoil the scene of "a wreck," inasmuch as rails had been fixed to the locomotive wheels, for having it pulled up onto the line, before setting it up in its normal position so that later on it might be drawn into "dock" to undergo necessary repairs, where, on examination, it was found to be "internally" damaged. On the picture I have marked out your correspondent and his work-fellows who were present at that which is "powerful yet helpless" in such a condition.

PETROLEUM FUEL.

Argentina is in the north, west, and east a very "minerally" country (though true, coal has not yet been found); one of the products is crude petroleum abstracted from wells at a locality known as Cacheuta, in the Department of Lujan in the Province of Mendoza. Several perforations were made; some proved successful, others did not. As the consumption of this oil for engine fuel is in constant demand, perforations are not only made in this province, but in all the surrounding provinces. Of the wells that were working during my late connection with the said railroad there were three; these were worked by means of a crank wheel from the principal engine shed, the oil running through pipes to two large tanks in the hollow, which have a capacity of 200 cubic meters. From these tanks the crude liquid is conducted through 5-inch pipes to the chief depot, located at a hamlet called San Vicente, 1½ miles from Mendoza City, where is the terminus of two railways—the Argentine Great Western and the now completed Transandean (going to Santa Rosa de los Andes, Chile). Both of these railroad companies use a large quantity of the native mineral liquid for fuel in place of coal, which costs, in that part of the world, at least $20 (United States currency) per ton! A large gas company in the Andean city—Mendoza—is another purchaser of crude petroleum, which is similar to black tar. A company called La Compañia Mendocina de Petroleo, formed at Buenos Ayres with a capital of 1,000,000 Argentine dollars, was started for the purchase and working of many square leagues of ground at the foot of a spur of the Cordilleras de los Andes.

THE FINEST AND MOST RECENT BUILT PROVINCIAL STATION IN LA PLATA.

The petroleum is vended in Mendoza according to the money market, but the average price is $12, gold, the cubic meter, or 55 cents per gallon. Since the first borings commenced at Cacheuta (Mendoza) over 3,000 tons of fluid have been produced, which seemingly made a difference in the figures on imported petroleum from Russia and the United States for the year 1894, when only 2,300,000 gallons of that oil were received in the Argentine Republic against 3,100,000 in 1890.

The railroad upon which your correspondent had long practical experience ran from Villa Mercedes (San Luis) via Mendoza to San Juan (province and capital of the latter, all same name)—a distance of 513 kilometres, equal to 318 miles—and possessed some fifty-eight locomotives, passenger and goods combined, twelve of which, upon my recent retirement from that company, were then being worked with petroleum; and to show practical proofs of the economy effected by using oil (especially where coal never is had at lowest rates less than $12 to $15, gold, per ton) as engine fuel, I give an extract from one of my monthly engine mileage and storage sheets (Argentine Great Western Railway Company) of two locomotives for one month, viz: No. 50 (running on coal and wood) ran 683 miles; consumed 21,709 pounds of coal, 1,550 cubic feet of wood; oil and tallow, 117 pounds; total vehicles hauled, 10,383. No. 51 (fired with petroleum and little coal at starting) ran 1,312 miles on 35,155 pounds of petroleum, 8,593 pounds of coal (no wood), consumed 174 pounds of oil and tallow, and hauled 24,484 vehicles. Here below is a *resume* of averages upon the above-mentioned engines:

	Number.	Total Miles Run.	Average of Coal per Mile by Each Engine.	Average of Oil and Tallow per 100 Miles by Each Engine.	Average of Vehicles Hauled per Mile by Each Engine.
			Lbs.	Lbs.	
Engine. .	50	683	31.78	17.13	15 20
Engine. .	51	1,312	6.28 26.79 Pet.	13.26	18 66

The above figures have been accurately worked out, testified to by the locomotive superintendent of that railroad, and forwarded to the directors in London; and their reply thereto at the satisfactory and successful manner in which the native crude oil had been brought into practical and superior use (as petroleum engines were generally put on for the passenger trains) commends itself to all railroad companies where coal is dear, or even where it is cheap and petroleum is abundant. Thorough knowledge, experience and practical skill may very easily turn the balance anywhere, under those conditions, in favor of petroleum as fuel, as it has been done on some railroads in South America; and now the facts that came under my observation and have been roughly put on paper, perhaps may give a light to some locomotive engineers and superintendents of the Northern Hemisphere.

The A. G. W. Ry. takes away about 10,000 cubic meters (2,210,000 gallons) monthly for supplying the twelve engines worked with petroleum. At present the railway company have to carry it in iron tanks from the petroleum company's depot at San Vicente to their own shops at Mendoza; but as the distance is under two miles and all down hill, it is proposed to lay pipes down for the self-transportation of the oil, as, when once done, it will be cheaper and quicker than the railway company can carry it at.

The driver prefers petroleum to coal, as there is less work for both him and the fireman; but the chief point gained, he says, is that the oil fuel is far easier to handle and cleaner for the locomotive than coal.

Illustration No. 2 is of the "mule-cart train" making a halt on the road between Mendoza and Villa Mercedes, which is now replaced by the "iron horse;" and the journey that took three days, from starting place to destination, is now accomplished in fifteen hours by the ordinary passenger raiload train.

Illustration No. 3 shows the finest and most modern constructed provincial railroad depot in La Plata. Its style is after the Renaissance; the central roof is all glass; and the ground upon which this station is built for the second time (first one was burnt right down some eight or nine years ago, leaving only just the outside walls) covers more than a block square. The entire building is lighted throughout by elecricity, as is the city of La Plata, more popularly known as the "Washington" of Argentina; it is the capital of the Province of Buenos Ayres.

BEFORE THE ARGENTINE G. W. RAILROAD DAYS. THE "MULE CART TRAIN" FOR PASSENGERS AND LUGGAGE ONLY.

We are in receipt of a photograph of a very handsome model, afloat, of the United States battleship "Indiana," built by W. de Sanno. The model is built on a scale of $\frac{1}{16}$ of an inch to 1 foot, and complete from pennant to bilge.

The Weak Engine Truck.

Mr. James M. Boon, who is an exceptionally good authority on rolling-stock matters, insists that the engine truck of the modern locomotive is too weak for the work it has to do, that the journals are too small, and the wheels not large enough for the velocity at which trains are run. He says that the velocity of a 28-inch wheel when run 40 miles an hour is something appalling. "When we think of the weight of iron used in a locomotive twenty years ago and the size of the frame, etc., and then measure the truck to-day of a 45 or 50 ton engine, we will be astonished to see what a little difference there is in weight. There is little wonder that, with engines of this character, the truck boxes give trouble from heating. On examination, we found that the trucks would spread.

"The only way to get over it was to make a brass that would accommodate itself to the truck; then fit the box loose from the pedestal, so that when it gets springing it will accommodate itself to the work. After that we had no further trouble.

"It is sometimes very troublesome to find out the cause of boxes running hot when you have many hot boxes. The first question is 'What is the matter with the oil?' We investigate and find the oil to be all right. Then 'What is the matter with the brass, for everything is done and it is still running hot?' Frequently it is discovered that the cause of heating reaches away back.

"The weight on each of the boxes of the locomotive ought to be the same, but the spring breaks some day. It may be a spring of thirteen leaves. They have not a spring of that kind in the shop, and they put in one with fourteen leaves. The consequence is that the springs are thrown out of adjustment, and heating will take place in spite of anything you can do. In another case the hanger breaks, and a shorter or longer one is put in, so that the engine is thrown out of adjustment. The same with the truck—one spring is put on one side different from the other and heating follows. It does not make any difference what the load is or what the oil is, unless all the points bearing on the journals are equally good, and there is proper adjustment, you are going to have trouble. When the boxes of any kind begin to run hot, look beyond the oil and the character of the brass when you are searching for the cause of trouble."

Orders have been issued by the Pennsylvania Railroad Company which reduce the working time in the extensive shops at Altoona to five days a week of eight hours each. The reduction affects 5,000 men.

Metal for Journal Boxes.

Cast steel is making its way steadily into use for the making of driving boxes and driving-wheel centers, but on some roads they are experiencing considerable difficulty with hub-cutting of wheels that come into contact with steel boxes. Some parties have tried to run steel to steel, but it has been an entire failure. Gibs of a softer metal are absolutely necessary where steel driving boxes or steel wheel centers are employed, and it is just as well not to wait to see how steel works before putting in a softer metal. Railroad companies found out long ago that they could not properly use cast-steel crossheads without putting a gib on. That experience ought to have been sufficient to prove that steel in either case, where rubbing or abrading goes on, will cause trouble.

The increased use of steel axle boxes is brought about by the breakage of cast-iron boxes that were too small and weak for the work put upon them. Builders were very slow in making locomotive pedestals large enough to admit of a box strong enough to give durable service. Increased speed of trains, which has been becoming greater every year, has called in many instances for larger driving axles, and this has served to make the weakness of the small axle box more pronounced.

Cast iron makes very good durable axle boxes, and they give very little trouble indeed if they are only large enough; but when circumstances reduce them to be a mere shell, the expense of maintenance becomes very great, and the breaking of an axle box is a very expensive accident, for it is liable to take an engine out of service for several days.

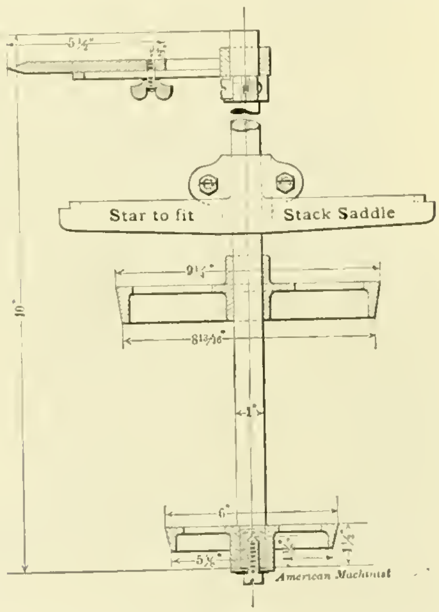
Cast steel provides a strong substitute for the cast-iron driving box, but it has several disadvantages besides that of cutting the hub of the wheel. In case the box gets hot, there is more trouble with it then than with the cast-iron one. The steel expands more than the brass, and the consequence is that, after the hot box has been cooled down, it is almost invariably found that the brass is loose in the box and pounding commences. Much care has to be exercised in adjusting the wedge on the cast-steel box, for if the wedge is set up the least thing too tight it will jam and cause heating, so an engineer is all the time threatened with the two extremes of the box pounding through the wedge being too loose, or jamming through its being too tight.

Bronze appears to be becoming popular as a metal for driving boxes, but we notice that in some places where it has been tried it has been abandoned. However, others have taken it up, and there are more bronze or Ajax metal driving boxes in use to-day than there ever were before. The box is more costly at first; but when it is worn out, there is enough metal left to balance the first cost and make its use no more expensive than that of cast iron.

A solid box of alloy has some advantages over both steel and cast iron as a driving-box material. It runs with no more side friction than cast iron, and there is no fitting of the brass to be done. Besides the expense of fitting, the driving-box brass is a troublesome article, because it distorts the shape of the box when being pushed into place, and it even causes cracks which eventually lead to a broken box. Those who have gone back on brass boxes have generally employed metal that was not well adapted for the purpose. Where metal especially adapted for driving boxes has been used, the results have nearly always been satisfactory.

A Tool for Centering Nozzles.

Every roundhouse mechanic and engineman knows the time and trouble it costs to "plumb a stack" to get the nozzle



central. Only the mechanic realizes the botches that are made in this plumbing business because the engine did not sit level.

The General Agency Co., of this city, are applying hundreds of Smith exhaust nozzles to locomotives all over the country, and have seven or eight traveling engineers out doing this kind of work all the time. It is important that these nozzles—which have an opening nearly as large as the stack base—be located central to the stack. To do this work quickly and accurately, they have devised and put into use the little tool shown herewith.

The Smith exhaust pipe has a large opening at top, and a central opening that is smaller and lower down, inside the main pipe. Two light disks were made to fit these openings; the lower one was fastened permanently to the end of a steel shaft, and the larger one left free to slide on same. When these disks are fitted into the exhaust pipe, the shaft will be in the exact center line of the blast.

A star, or cross, is used to fit the stack saddle, and an adjustable pointer is located on top of shaft. By swinging this pointer it is easy to find just where the line of exhaust is "out" and to so adjust the pipe that it comes central.

A modification of this tool could be used to advantage with any kind of nozzles.

Causes of Trains Breaking Apart.

A St. Louis paper prints some statistics of the causes of "break-in-twos" of freight trains on a Western road, where a record is kept of the number charged to each crew, the point at which trouble occurred, together with the cause. Out of 213 trips made during June, there were 13 cases where freight trains broke in two. From January 1st to June 30th, inclusive, there were 280 break-in-twos, out of 5,162 freight trains run. The record is kept against the name of every engineer and conductor, so that it can be readily noticed if any one crew has more than its share of this trouble. The number of break-in-twos on the west end of the road during the year ending June 30th has slowly decreased from 4.5 cases in every 100 trips made during July, 1895, to 2.9 in June, 1896, which demonstrates the success attained by keeping a check on irregularities.

Out of the total number of break-in-twos, 20 per cent. were caused by drawbars pulling out; 49 per cent. by pin breaking; 6 per cent. by pins jumping or working out; 5 per cent. on account of standard Master Car Builders' couplers becoming uncoupled; 7 per cent. by links breaking; 5 per cent. by breaking drawbars; 4 per cent. by drawbar keys coming out or breaking; .04 per cent. by knuckle breaking; .08 per cent. chains breaking, where drawbar had been previously pulled out and car chained up; .04 per cent. by someone pulling pins; cause not given, 2 per cent. Steel pins break more frequently than iron.—"Railroad Gazette."

Traveling Engineers' Convention.

A circular has been issued by Secretary Thompson, of the Traveling Engineers' Association, intimating that the fourth annual meeting will be held at the West Hotel, Minneapolis, beginning Tuesday, September 8th. Those intending to be present at the convention are urged to engage hotel accommodations as soon as possible. The circular says that the committees have been working hard during the past year and have gotten up some able reports on the subjects assigned for investigation, and it is the intention of the committee of arrangements to see that the members of the association are properly entertained. It is expected that the meeting will be addressed by one or more of the prominent railroad men in the Northwest, and it is thought that this will be the most interesting and instructive meeting that has yet been held.

Accident to the West Coast Racer.

The rival railway companies owning the trunk lines between London and Scotland, and known as the East and West Coast routes, respectively, each dispatch a flying express from London every evening. An unfortunate accident befell the West Coast company's train on Sunday, the 12th inst., leaving Euston (London) at 8 P. M. and timed to arrive at Aberdeen at 6.25 A. M. next morning, 539¾ miles. It reached Preston in Lancashire about a quarter past twelve, midnight, all well but a trifle late, with two 4-coupled engines of the London & Northwestern Railroad, six sleeping cars and one day coach belonging to the joint companies. The train was fitted with both automatic air brakes and automatic vacuum brakes, and as it was running at the time over the London & Northwestern road the latter apparatus was in service, the air system not being put in operation until the Caledonian Railway Company take the train at Carlisle. Preston platforms were safely passed at a speed variously estimated at from 25 to 50 miles per hour; but on reaching the curve immediately at the north end of the station, the leading engine, from some cause at present unexplained, suddenly jumped the track and the second engine followed; then, after tearing their way along the ballast for some eighty yards and smashing everything in their way, the two engines stopped. The sleeping cars were all overturned and scattered about the yard, as shown in the accompanying photograph taken by Mr. Winter next morning. Luckily, there were very few passengers, it being Sunday night, and all escaped without serious injury, excepting one, a German named Mavor, who was riding in the day coach and must have been instantaneously killed, as nearly every bone in his body was broken, besides terrible injuries to his head.

When the drivers found they were off the track they stuck to their engines and applied the vacuum brakes, thus probably preventing the locomotives from tumbling over into the street below, which they assuredly would have done had they gone another twenty feet. The engines remained upright, but the tenders overturned. Many of the passengers owe their lives, no doubt, to the strong construction of the sleeping cars; these all had steel underframes and steel-framed trucks, and appear to have gone through their trying ordeal remarkably well, as will be noticed from the picture, copies of which can be had from Mr. F. Moore, of 9 South Place, London, E. C., who advertises in our columns.

PRESTON YARD THE MORNING AFTER THE ACCIDENT.

The speed of all trains passing Preston is ordered to be restricted to 10 miles per hour when taking the curve; but from the evidence at the coroner's inquest, the drivers of this train, to do the 105 miles from Wigan to Carlisle in the 112 minutes allowed, made the curve at a much higher speed, with the lamentable consequences depicted.

The effect of this accident is to practically cross out the West Coast companies from any attempt at supremacy in speed to Aberdeen, as it is highly improbable they will now repeat the contest they carried on so keenly last season. This, from a railway view, is to be regretted, as there was every indication of a most determined conflict. Both combinations of companies had trump cards to play, and the records of 1895 would in all probability have been left far behind. The East Coast, with their shorter route, now hold the field.

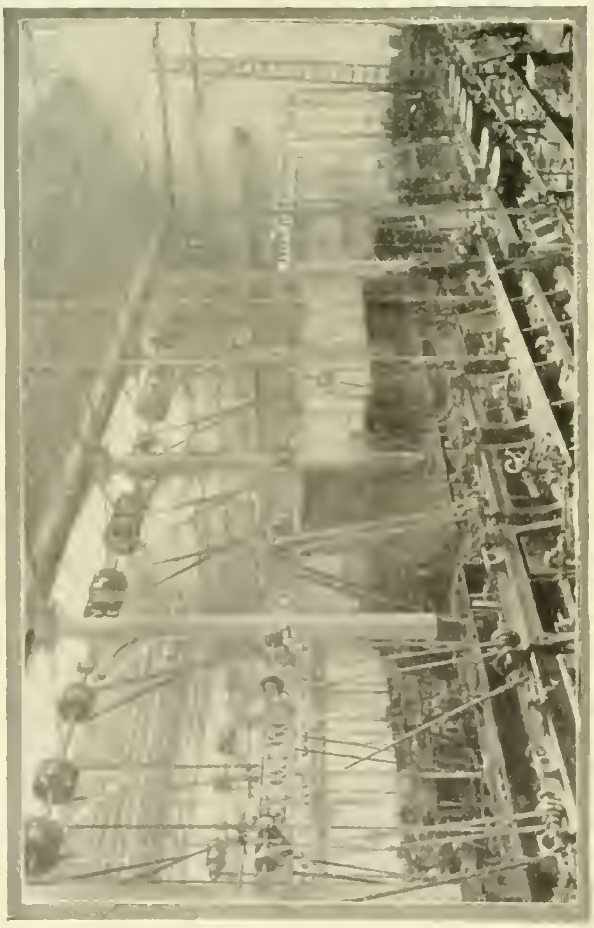
Swindon Works.

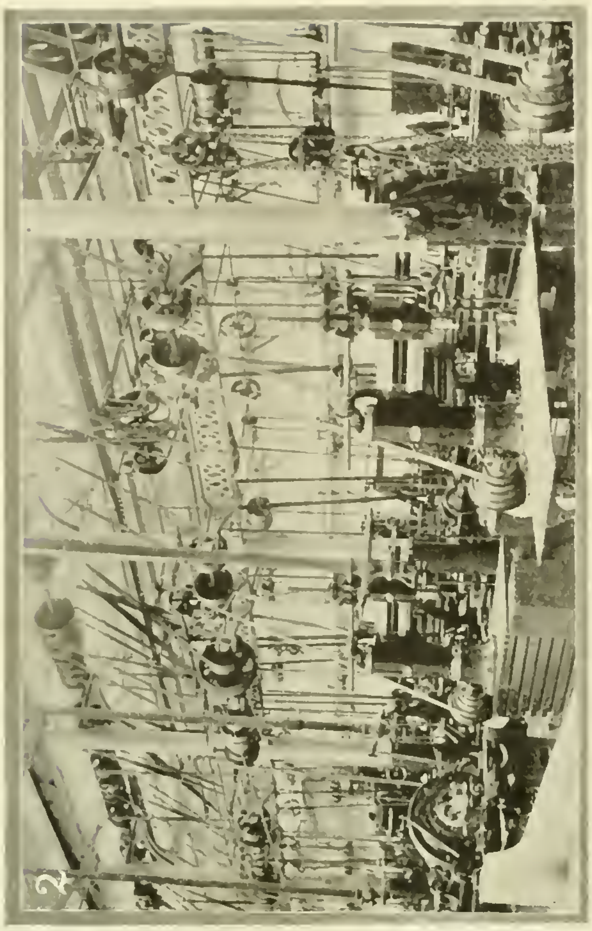
The illustrations shown were made from photographs taken for "Locomotive Engineering" by Mr. P. J. Cowan.

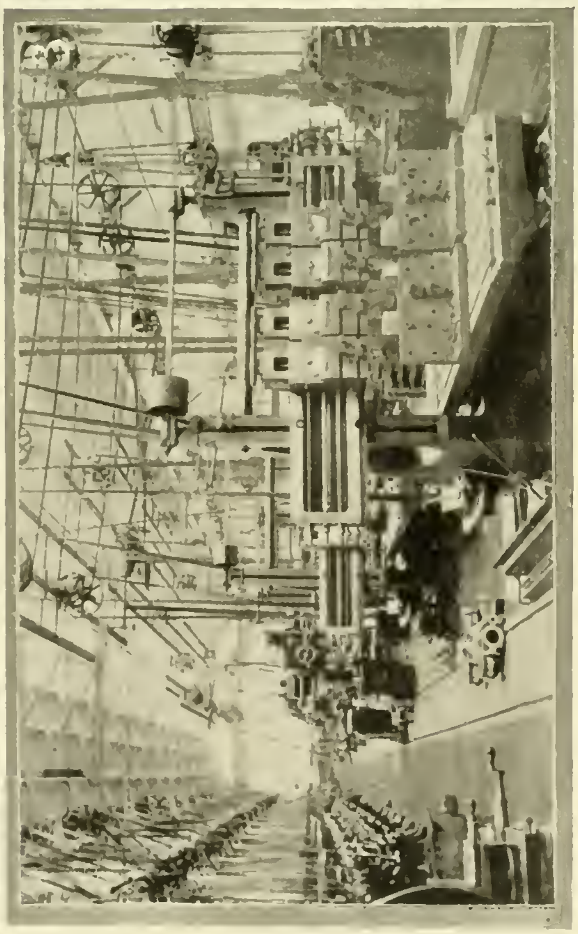
The Great Western Railway Company, like all other of the large lines in England, has works of its own where it turns out its locomotives, cars and trucks, and in general all rolling stock. The works of the Great Western Railway are situated at Swindon in Wiltshire, about 77¼ miles from London. They are said to be next to Crewe* in size, covering an area of 208 acres. These works were commenced in 1842, and since that date they have been considerably added to till they have reached the present large dimensions. Among the principal things turned out now at these works are locomotives, carriages, trucks and wagons, there being also gas works, grease works, masons' yard, brick fields, rolling mills, etc., etc. The locomotive works proper comprise twenty-five shops, besides two rolling mills and the steam-hammer buildings.

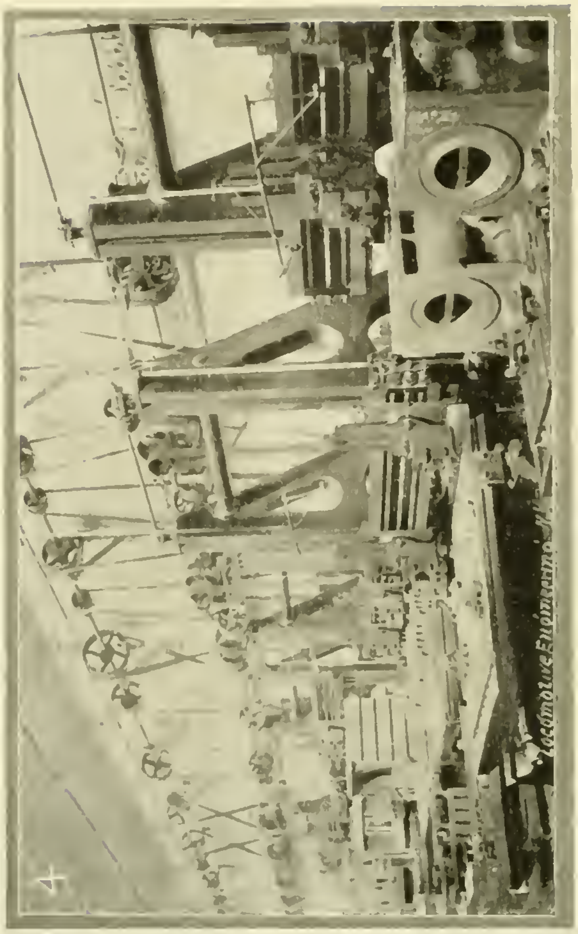
The "R" shop, of which an illustration is here given, measures 246 x 161 feet and consists of three bays, the roofs being supported on light cast-iron columns. In fact, this is the style of building through-

* At Crewe there are only rail, steel and locomotive works, so that only the size of the locomotive departments are here compared.

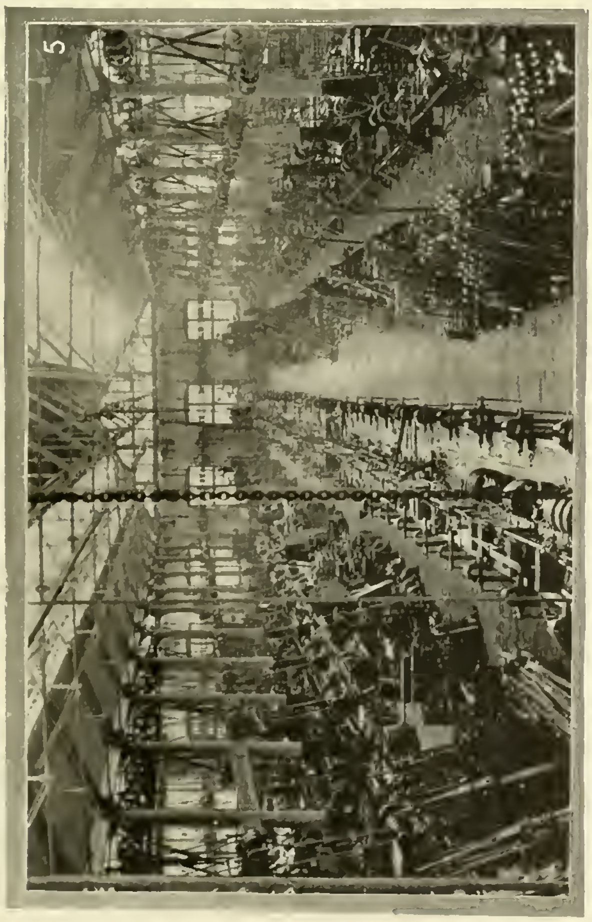


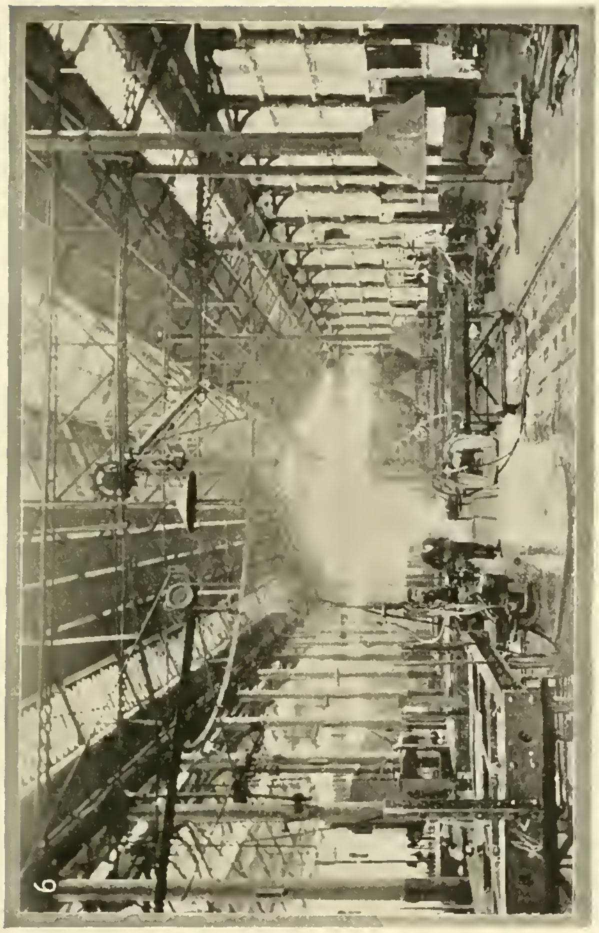


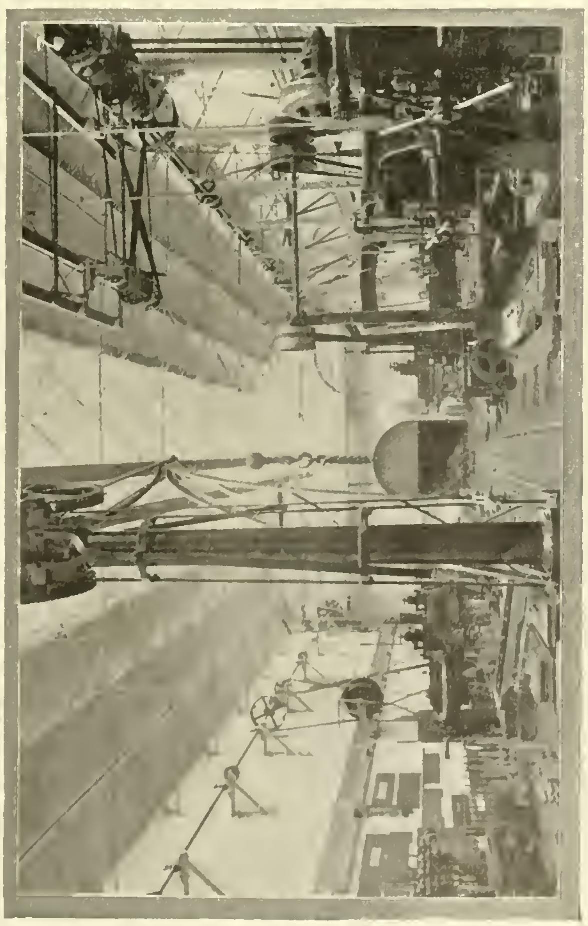




1. BRASS FINISHERS' SHOP, "T" SHOP. 2. THE FITTERS' AND TURNERS' "W" SHOP. 3. VIEW IN "W" SHOP. 4. CYLINDER SHOP "P" SHOP







5. THE "R" SHOP. 6. FRAME SHOP, SHOWING CIRCULAR OVERHEAD RAILWAYS, CARRYING RIVETERS. 7. FRAME SHOP, "P" SHOP. 8. WHEEL SHOP, "N" SHOP.

out the works, most of the shops being of one story only. Besides large turning work, smaller drilling and lathe work is done here—i. e., in the "R" shop—and several special machine tools will be seen here. There is a special machine for cutting the oval sides of the cranks. This is a form of shaping machine in which the tool box travels in a slide, curved to the curvature of the oval it is required to cut. There are several planing machines in which, at the end of the stroke, the tool-holder is turned round so as to cut on both the forward and backward strokes. Another interesting machine is the one in which the journals of the cranks are planed and in which the tool is moved round in a circle.

In one of the wheel shops, the "N" shop, there are some tools worthy of notice. In the foreground on the right is a very neat tool for cutting out the inside of the rims of wheels. The tool holder is carried on a rocking lever, and the wheel being fixed to the bed plate is caused to revolve slowly with a given feed. Next to this, on the right, is a machine for milling round the edges of the crank bosses on the wheels. Then comes a drilling machine for heavy drilling work, such as drilling out the holes for the crank pins in the bosses. At the farthest end of the shop is the largest face-plate lathe for turning up the 7-foot 8-inch drivers in use on some of Mr. Dean's engines. The third rail laid on the floor of this shop was for the old broad gage, which was finally abolished in 1892.

There are three foundries at Swindon. One of these is the large iron foundry, where cylinder casting and such like work is done. The second is the chair foundry, which has an output of nearly 300 tons of chairs per week for the permanent way. The third is the brass foundry. Close to this last is the brass-finishers' shop (Fig. 1), in which all the small products of the brass foundry are finished, and next to this is the "P 2" shop (Fig. 4), where large planing work is done. In the boiler shop there is a large hydraulic press for flanging boiler plates. Hydraulic machinery is used wherever practicable. Among the machines are countless hydraulic riveters of various sizes and shapes, suitable for any kind of riveting work. In the wagon-frame shop are several circular overhead railways, from each of which are hung three hydraulic riveters; there are also riveters on jib cranes attached to the pillars.

The testing department includes a laboratory, chain-testing shop and oil-testing machine. There is also a large drop-testing machine out-of-doors.

The total number of hands employed by the company at Swindon at the present time amounts to 10,577, of which 5,684 are engaged in the locomotive department, 4,428 in the carriage department, and the remaining 465 in the stores, signal and permanent way departments. All these men are well looked after by the company. In 1844 a Mechanics' Institute was built for the use of employés of the company, and in 1892 it was partially rebuilt and enlarged. In it are lecture halls, a men's reading-room supplied with about 230 newspapers and magazines, a women's reading-room with fifty magazines, and a smoking-room also supplied with about sixty periodicals. There was also a chess and draughts room and a billiard and bagatelle room. There are a library of 20,000 volumes and a reference library of 4,000 volumes. In connection with the works there is also a medical fund, the committee of which, among other things, manages large swimming baths for men and women, Turkish and washing baths. Besides all this there is, belonging to the company, a beautiful park and a large drill hall for the use of the Swindon Volunteers. A large mess-room is also provided for the use of the men in the works.

What is Steel?

Of late years there has been great difficulty among customs officials and others to decide the difference between steel and iron. The usual plan has been to say, that when there is a certain percentage of carbon in the metal, that it is steel; and when it is below certain proportions, that it is iron. This is by no means correct, as was shown by a lecture delivered by Mr. W. F. Durfee. He showed, by a great many analyses, cases where the percentage of carbon in iron was greater than in soft steel. The description he gives is that steel is iron freed from mechanically mixed impurities, by a melting process, during which there is combined with it chemically a small percentage of other impurities, introduced for the purpose of modifying its strength, hardness, elasticity or ductility, in such way and degree as to adapt it to the particular use to which it is to be applied. Wrought iron is iron having its impurities mechanically mixed therewith; steel is iron having its impurities chemically combined.

Foremost among the substances chemically combined with iron to convert it into steel, is carbon. When this element exceeds 0.12 to 0.15 of 1 per cent., it begins to confer a hardening property upon the iron with which it is associated; but at the same time, it does not destroy the forgeability of the metal until its proportion attains about 1.5 per cent. Other substances have been added to iron in connection with carbon, for the production of special qualities of steel, and of these manganese, nickel, aluminum, chromium, tungsten and titanium are the most important.

The most notable distinguishing difference between low steel and wrought iron is the want of fiber in the first-named material and its presence in the last. All steel, save the comparatively unimportant product called "blister steel," is made by some process involving melting and casting; and although the various methods employed all practically free the metal from an admixture of cinder, and in consequence tend, so far as the elimination of cinder is concerned, to produce a homogeneous crystalline structure, still, owing to defects inherent in the method of casting, the ingots of steel are too often far from homogeneous. In fact, their structure may be such that, when hammered or rolled, the resulting bar, although destitute of cinder, may, nevertheless, show evidence of fiber. This evidence of fiber, which we have heard sellers declare to be a feature of merit in some kinds of steel, is caused by blow-holes or cavities in the metal after it has been poured into an ingot. When such an ingot is forged or rolled into a bar, it is seldom or never subjected to a welding heat; hence the blow-holes do not weld and become as solid as the homogeneous parts of the ingot. Under the process of rolling or forging, the blow-holes are flattened and extended in the direction of the length of the bar and produce a fibrous structure. This does not influence the tensile strength of the metal to any great extent; but when it is subjected to compression and tensile strains in boiler or firebox sheets, the metal is liable to laminate or blister, shortening the life of the plate.

Mr. H. S. Haines, the retiring president of the American Railway Association, in a paper read before that body at their meeting in Cincinnati, referring to the attendance of a delegation from that association to the International Railway Congress in London, last year, speaks of the incredulity with which the Europeans received certain statements from American delegates. He says in part: "When the American delegates spoke at the London Congress of handling 50 or 100 trains a day, and 30,000 or 40,000 cars a month over a single track, the statements were evidently received as specimens of American brag." When we know that it is the train dispatcher who makes the safe movements of this immense traffic possible, and that his finger is held on the pulse-beats of this mighty artery of life by the operator, we understand the immense pressure on both, but no adequate idea of the tenseness can be formed by one not thoroughly familiar with such work.

A curiosity was exhibited at the last Master Car-Builders' Convention, in the form of a piece of steel $\frac{2}{1000}$ of an inch in thickness, used by the Pratt & Whitney Company for making saws to mill the smallest notch in the new Master Mechanics' Association gage for sheet-metal tubes and wire. Five hundred of these gages have already been made and distributed among railroad companies.

West Shore Kinks.

The West Shore Railroad shops at Frankfort, N. Y., stand well to the head of that numerous class of shops that were built for conditions of greatly less magnitude than those they are called on to satisfy to-day, and while there is some congestion apparent in every shop comprising the plant, managerial ability of an order that knows how to surmount any difficulty, makes the most of the situation —and for that reason only, these shops have earned the proud distinction of being second to none in turning out the best quality of work at a reasonable cost, notwithstanding the serious handicap of insufficient room.

Contributing to this end are special appliances of a kind best suited to the work in hand. Among them we find an ingenious arrangement for determining whether crank pins are sprung or wheels are "out of quarter." Fig. 1 shows this device and how it is used. It consists of but three tools, namely, a level and plumb; the first of which is made of a thin steel T-shaped plate with a plumb-bob attached, to hang perpendicular to top edge when pin and axle are in the same horizontal plane; the second is a plumb of peculiar construction to fit this particular case. It is made up of a cast-iron base having three bearing points at one end to rest against the end of the axle, the base being bored to receive a spindle having a ball at its inner end which fits into the axle center and is held in its extreme position by a small coiled spring. It is bored at its opposite end for a sliding-fit spindle which has its tapered end sawed to receive a plumb-bob wire. The whole thing is of such a length as to reach from the end of axle to outer face of crank pin, and it is plain that when the ball is in the axle center and the base is forced up to the end of axle, overcoming the tension of the spring, that the device will be central and square with the end of axle, the purpose for which it was designed. The third part is simply a ball divider of a constant radius by which to find the true center of the axle.

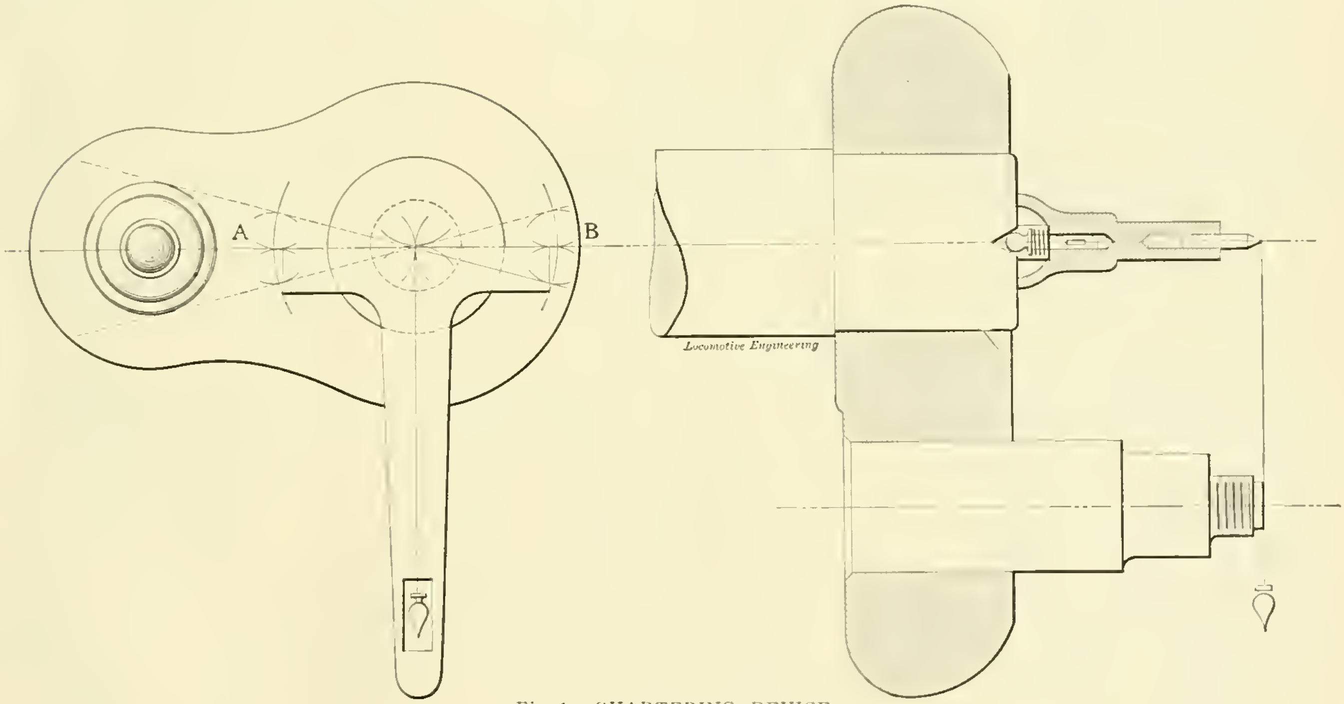


Fig. 1. QUARTERING DEVICE.

In operating these tools, a line *A B* passing through crank-pin and axle centers is drawn on the face of wheel hub. The T-level is applied to this line, and the wheel is adjusted until the line shows horizontally by it; the wheel is then blocked in this position, and the plumb with the ball center is applied to the opposite side. If its line passes through the center on the end of the crank pin, it is a safe assumption that the pin on that side is not sprung and that the wheels are "in quarter."

This is seen to be a valuable tool, for the reason that it is not necessary to take a set of wheels out from under an engine, or place them in a quartering machine to see how square they are; a roundhouse application of the tool dispels all doubt, with no more outlay of time than would be necessary to tram the same engine.

The taper attachment used on the turret machines was invented and built at these shops, it having been found that this feature of the tools was defective. With the arrangement shown in Fig. 2, which can be applied to any lathe, a taper is turned on a bolt with absolute certainty of being correct and each bolt a counterpart of its mate. The reason for this lies in the fact that there is no possibility of juggling with the adjustment, as the machine is constructed to give one taper only, which in this case is $\frac{1}{16}$ inch to 1 foot, a taper accepted as standard by all builders.

As constructed, the machine consists of a base or frame *A* and a hub A^2, by which the device is attached to the turret or tail stock of a lathe. *B* is the tool post on a base b^3, which is movable in guides *a* on the top of frame *A*. On the under side of the base b^3 is a lug B^1, which is guided in a corresponding slot *d* in the adjusting plate *D*, which is movable in the guides a^1 in the frame. The guide *d* of the adjuster is tapered from one end to the other, in a plane at right angles to that in which the tool support moves within the guide *a*. The taper of this guide *d* is what determines the taper of the bolt, and must, of course, be built to turn the required degree of departure from a true cylinder.

The contact plate *G* is movable at right angles to tool post *B*, and has an adjustable shank secured by a clamp g^1 to a post g^2, which rises from the rear end of the adjuster *D*.

On one edge of the adjuster *D* is a rack d^2, into which works the pinion *H*, and as the crank H^1 is turned, the pinion *H* engages with the rack and moves the adjuster *D* back and forth.

In turning a bolt, where the end for the threaded portion is cylindrical and the body tapered, the adjusting plate *D* is moved until the contact plate *G* is within a distance of the cutting tool equal to the length of the threaded portion. As the bolt is fed against the tool *C*, it is turned cylindrical until its end comes in contact with the plate *G*, which it forces backward, and thus automatically moves the adjuster *D* backward, turning the body of the bolt tapering. This is done without the necessity of skilled attendance, and with rapidity, accuracy and absolute uniformity. From our observation of the performance of this tool, we are satisfied that no bolt lathe, turret or otherwise, is complete without it.

Until recent years all the details of sanding locomotives—and this includes everything from drying of the sand to delivery in sandbox on the engine—have been of the crudest character; but little thought appears to have been devoted to the improvement of any of these, with the exception, perhaps, of methods of drying, in which operation a great deal of versatility and wealth seem to have gone to waste.

In Fig. 3 is illustrated a very complete arrangement for handling sand at division terminals, which for convenience will recommend itself to all. First we have the dryer, which is a hopper-shaped box, in which is a system of 1¼-inch steam pipes at the sides and center, with return bends, around which drops the dried sand through a wire netting into a box immediately below. On top of the dryer is a track on which is run a small iron car having a box 4 feet 6 inches by 2 feet 6 inches, and 21 inches average height, equipped with drop doors so as to deposit its load of sand into the dryer below with as little ceremony as possible, gravity doing all the work until the sand is within the reservoirs below.

The drying apparatus is thus seen to differ from the usual practice in refine-

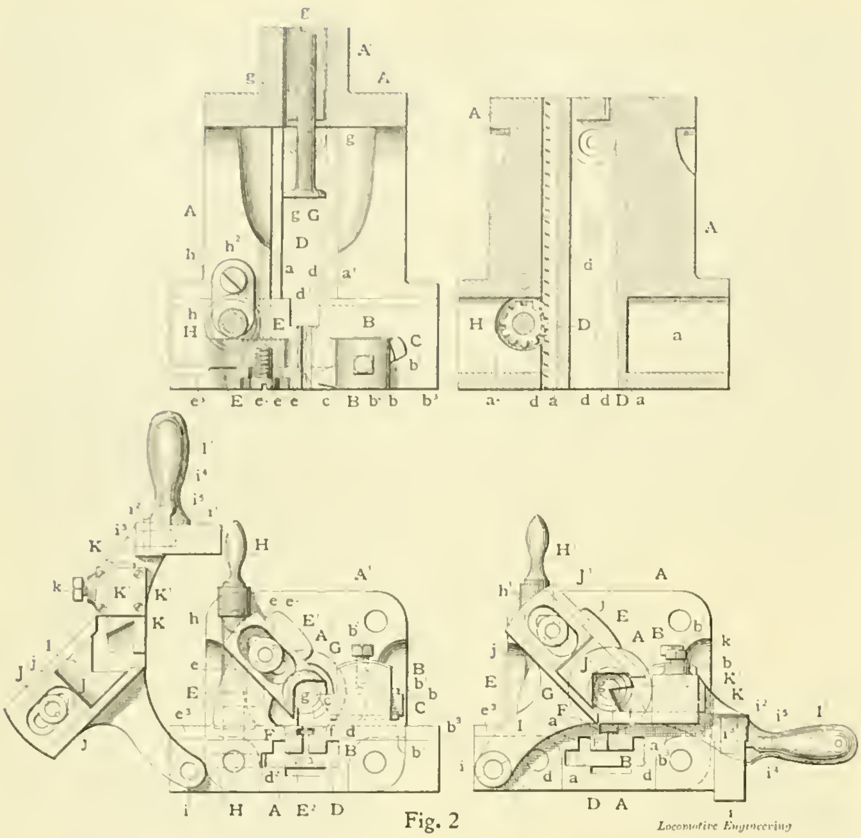
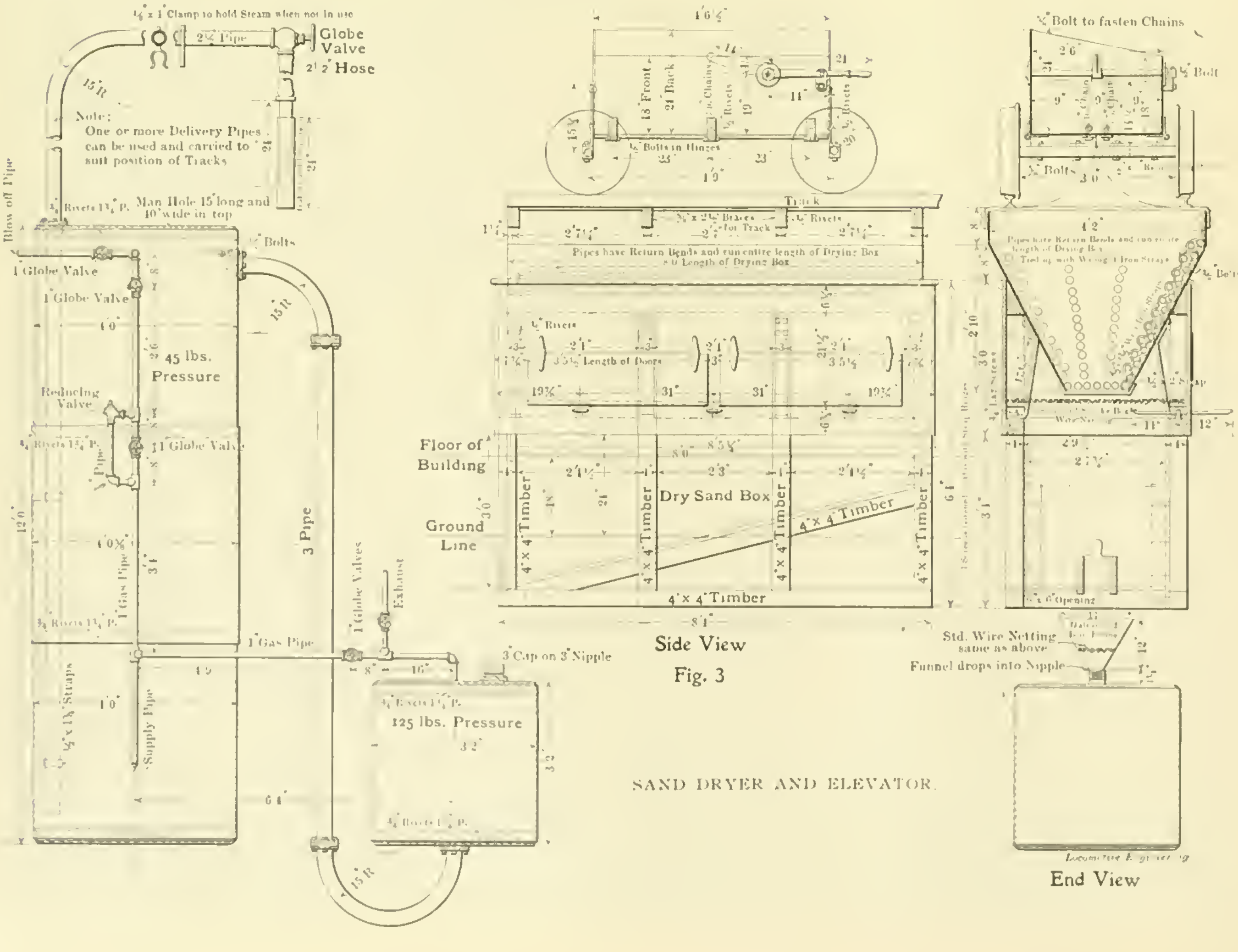


Fig. 2



Side View
Fig. 3

End View

SAND DRYER AND ELEVATOR.

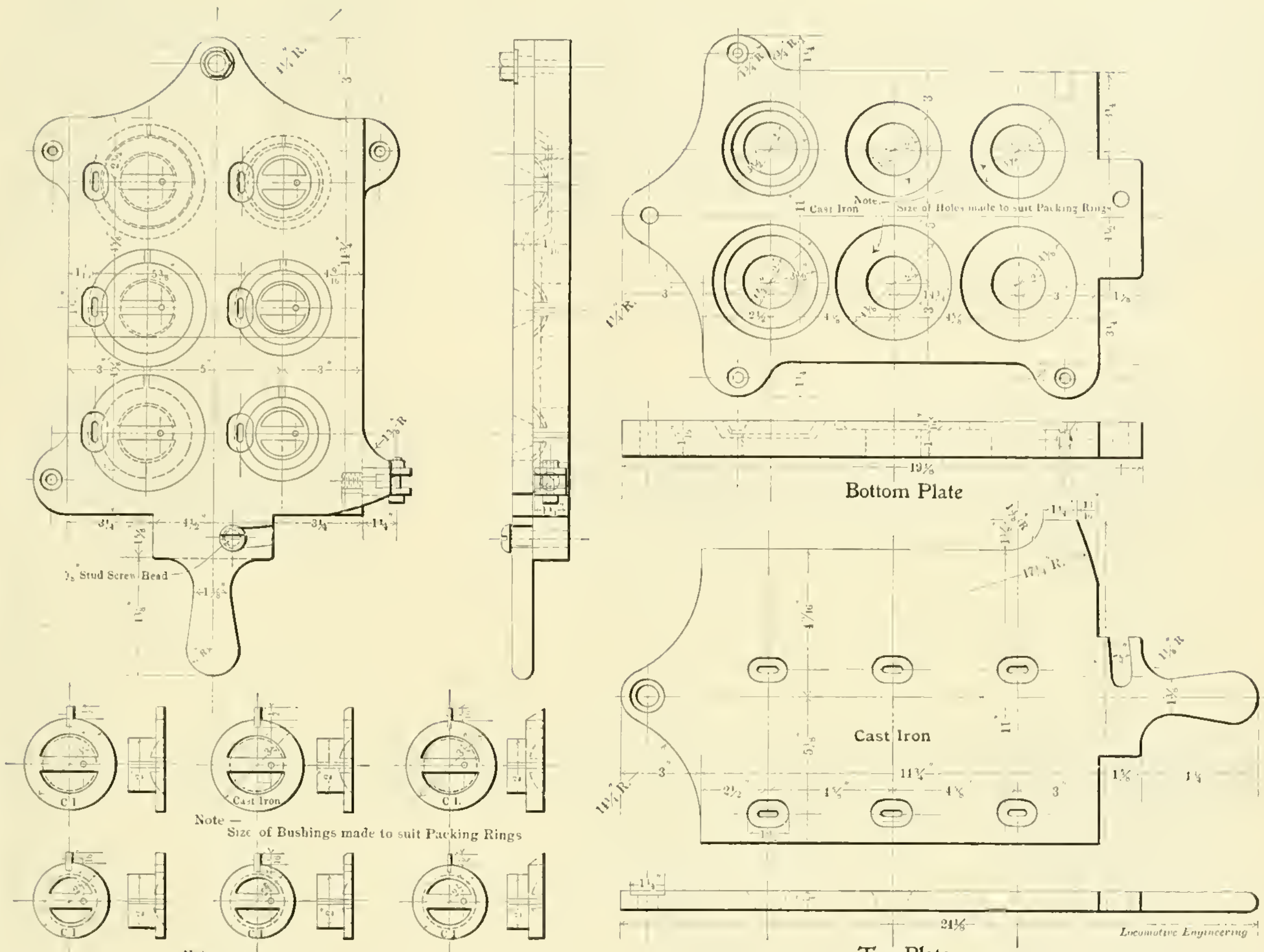


Fig. 4

MOLDS FOR CASTING PISTON ROD AND VALVE STEM PACKING.

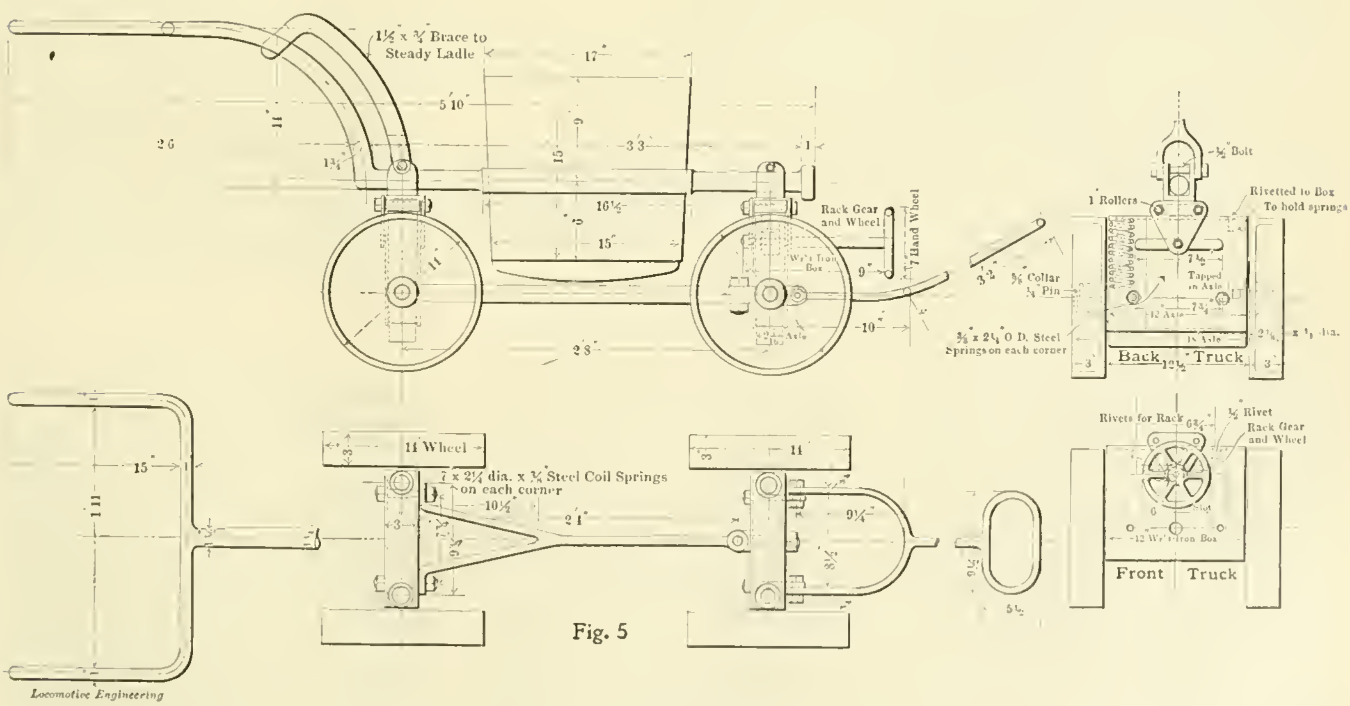


Fig. 5

LADLE AND TRUCK.

ment of method, and that is the point we desire to emphasize sufficiently to give it necessary prominence, since it is in perfect accord with an elevating and delivery system that has so far shown little room for improvement. This system comprises a cylindrical iron tank 38 x 38 inches, which is located immediately under the dry-sand box, from which it receives its supply through a funnel which also is provided with a netting. Connected with this tank by a 3-inch pipe is another cylindrical receiving tank 12 feet high and 4 feet diameter, the 3-inch pipe delivering sand from the bottom of the small to the top of the large reservoir, under an air pressure of 125 pounds per square inch.

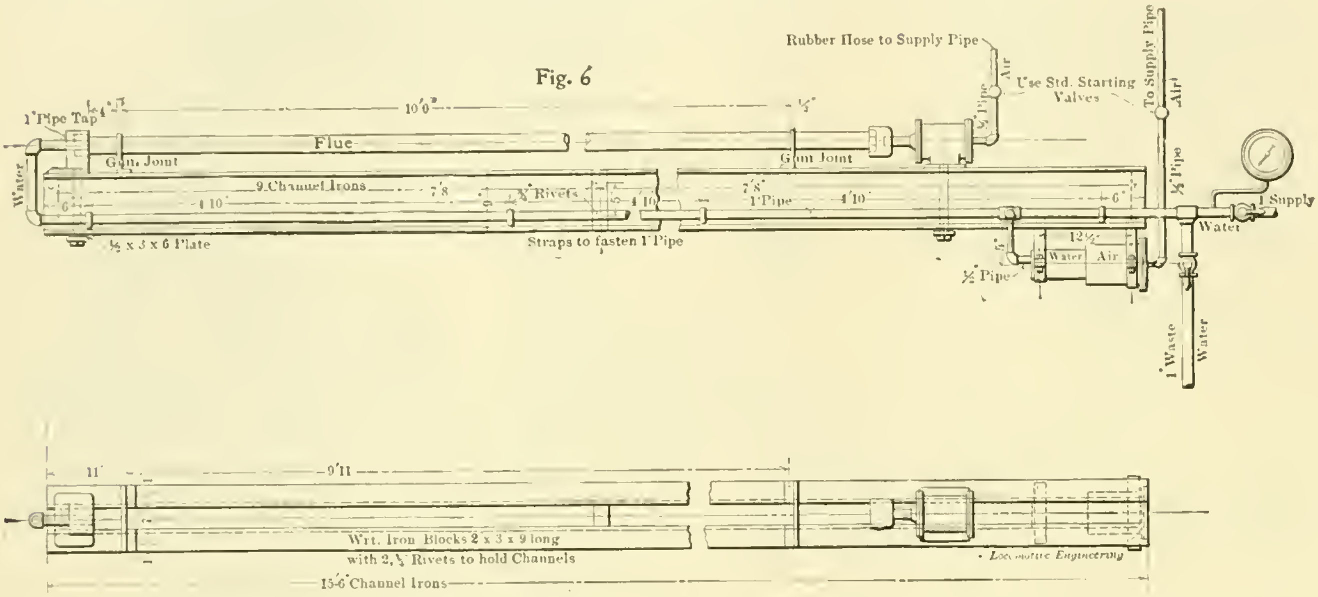
Extending from the top head of the large reservoir to a point near the bottom is a 2½-inch delivery pipe through which passes the sand to the engine sandbox, forced there by compressed air at 45 pounds per square inch, coming into the top of the large reservoir through a reducing valve shown on the elevation. An inside check valve on the 3-inch pipe is counterweighted, to be closed when the operation of filling sandboxes is going on. There are few sanding schemes that show such marked improvement, or evince a clearer conception of what is needed to put one of the most miserable make-shift operations on a purely mechanical plane.

It has been the practice of the West Shore for some time to make their packing for piston rods and valve stems, pouring them in cast-iron molds, which are shown in Fig. 4. These molds, made of two plates pivoted at one end, are machined, thus leaving the surfaces of the cast rings so true and smooth that they are fit for service at once on leaving the molds, without any tool work whatever.

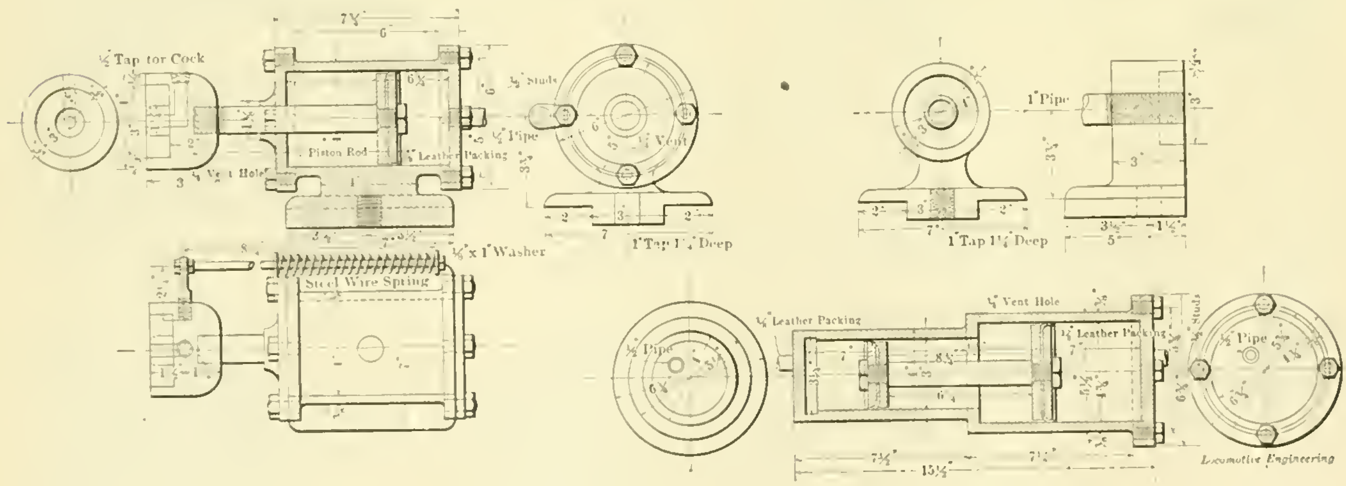
This device has solved the metallic packing problem from 65 cents down to 16 cents per set for piston rods. They are turned out in lots of 200 sets at a time.

A foundry ladle and truck are a combination that most people would not worry their inventive faculties over. Here is one, however, that has a certain touch of originality about it that makes it a handy device on small work in the foundry. Fig. 5 shows a ladle mounted in the usual way, with the difference that it can be shifted laterally on the truck, and can thus be brought over a flask exactly where desired. This is accomplished by means of a rack and pinion operated by a hand wheel at one end of the truck.

The truck is mounted on a helical spring at each corner, and has a steadying brace swiveled on the rear ladle bearing, both of which features make it a safe thing to operate rapidly on work set up by the Tabor molding machines, which are in extensive use in the foundry of the West Shore shops.



FLUE TESTER.



DETAILS OF FLUE TESTER.

Great attention is paid to flue work in these shops, and the record made for welding (which, by the way, is the butt-weld), and the kindred operations in repairing a set of flues, stands at the head of the best work in this line. Fig. 6 illustrates a novel application of water and air in testing of flues after the weld. The machine is made up of a pair of rubber joints in suitable iron sockets, for the end of the flue, mounted on a pair of channels for a frame. The joint at the right is secured to the piston rod of a 4-inch air cylinder, and has a movement of 6 inches by which to secure and release a flue under test.

At the right, on the under side of the frame, is seen a combined water and air cylinder with differential pistons, 3 and 4¾ inches diameter, respectively, secured to a common rod. The piping is arranged so that water is admitted to the flue through the rear stop, and at the same time enters the water end of the combination water and air cylinder, forcing the pistons to the end of their travel to the right. The flue and piping now being filled with water at a low pressure, air is admitted to the air side of the differential piston which moves against the confined water, and gives the flue the test pressure.

We are informed that, while the device was built at these shops, the idea was not conceived here. In any event it does good work, and that, too, without the shop being afloat, as is too often seen with this class of work.

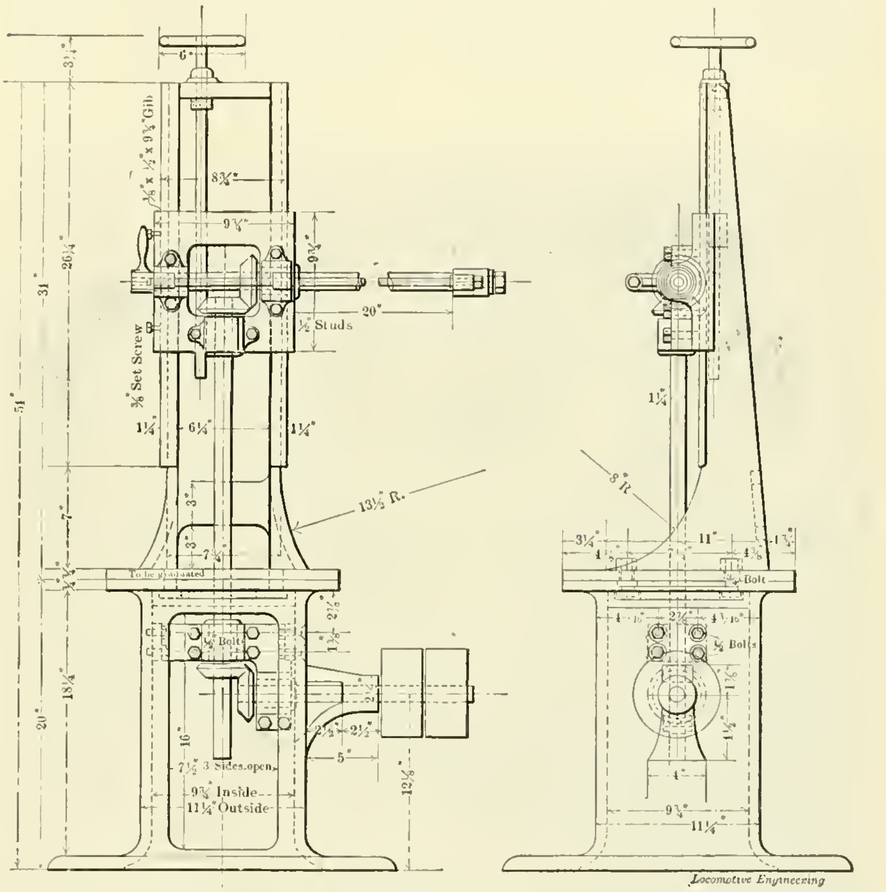
A radial or angle-boring machine has been needed in many wood-working shops, just as it was required here, without doubt, but the simile ends with this statement of the case. While the others had to do without the tool, this one did not; for the tool was designed and built as soon as it was shown that money could be made, or, what is the same thing, saved by it.

Fig. 7 shows this tool in two parts—a cast-iron base, small and light, on which is a bracket carrying the tight and loose pulleys; and a top section with a vertically adjustable head carrying a horizontal boring spindle. At the junction of these two sections, which have flanges circular in form, there is a circular groove into which fits a tongue on the upper section, and which allows a horizontal movement of the boring spindle about a complete circle, the power being transmitted to the spindle through bevel gears and a splined shaft. The design of the tool is mechanical; it fulfills all expectations, and, like the other devices shown from these shops, is an evidence that the superintendent of motive power, Mr. J. M. Boon, has not parted with any of his oldtime ability, and that he lends every encouragement to his subordinates to reach net results.

Liquid Fuel.

The Bureau of Steam Engineering of the American Navy has been engaged in making a series of tests on the value of liquid fuel, having a petroleum base, for steam-making purposes. There have been so many high claims made for the advantages of liquid fuel in steam-making that it seemed certain that liquid fuel would be preferred to coal for torpedo boats and war ships, where compact storage was an important consideration. It appears, however, that the fuel experimented with did not create a wholly favorable impression as a substitute for coal in its results, apart from the question of safety. Reports received from foreign countries also indicate a lack of reliance on liquid fuel there, although perhaps there may be further experiments before it is definitely abandoned. The Germans were reported some time ago to be intending to introduce liquid fuel into several of their newest battle ships and cruisers, such as the "Ersatz-Preussen," "Ersatz-Leipsig," "Ersatz-Freya," and so on, but not much more has been heard of that alleged purpose. It has further been said that, although a French Naval Commission once reported adversely in regard to the use of liquid fuel, it would be resorted to on some French war vessels as an auxiliary, in combination with coal, to allow higher speed with forced draft. Of this purpose also little has recently been heard.

It would be a great advantage in many respects if, for torpedo boats at least, this fuel could be used, since it occupies less space in proportion to weight than coal, can be used with more facility, being simply turned on from pipes as needed, and requires a much smaller force of stokers. In addition, it is said that steam can be got up much more rapidly, which is an advantage for a torpedo boat, and then, the absence of smoke, which would aid her in keeping an enemy in ignorance of her presence, must be reckoned an advantage. Still, even for torpedo boats, the use of oil as fuel does not yet secure the approval of Chief Engineer Melville, who has had the recent experiments conducted.



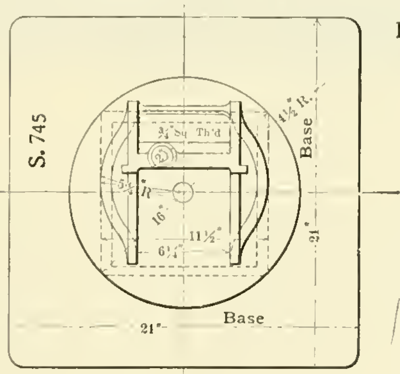


Fig. 7.

ANGLE BORING MACHINE.

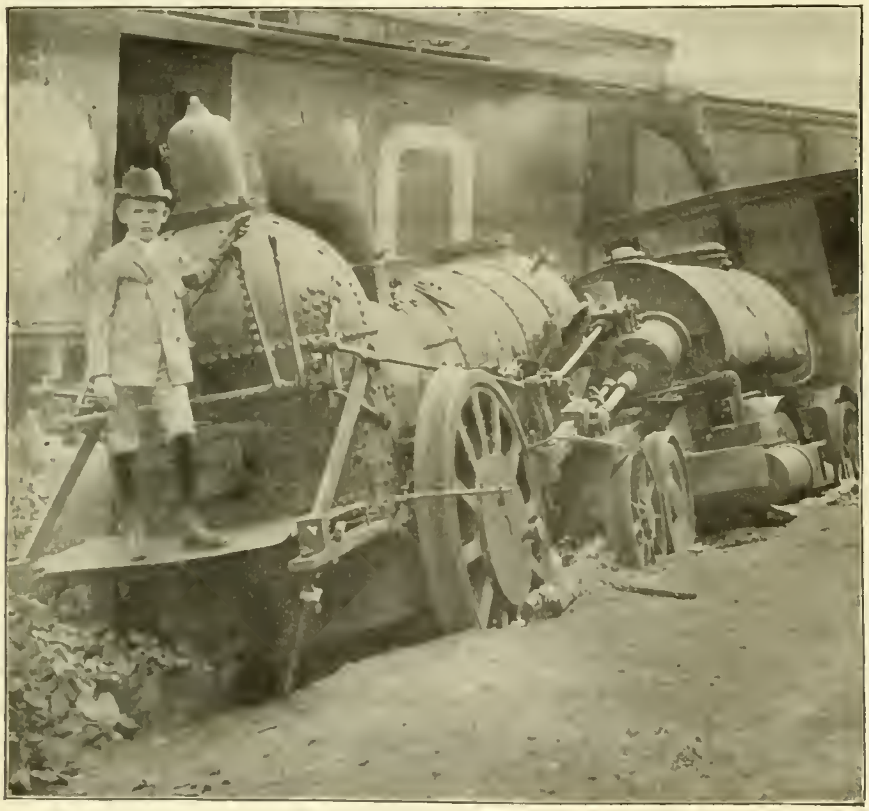
"The Ottawa Convention," says the "Locomotive Engineers' Journal," "paid out in charities the munificent sum of $41,730. This was distributed among 393 beneficiaries, mostly widows and orphans. Many of these beneficiaries, and perhaps all (as we are already in receipt of many), desire to express their appreciation and thankfulness to the brotherhood, and to those immediately associated, for their many acts of kindness and generosity. It will readily be seen that three or four hundred of these will require extensive space in the 'Journal,' and we believe this statement will answer the purpose of these many letters from the beneficiaries. They are full of thankfulness, and we can all realize what a help the charitable thought and act of the convention brings to these many in need."

An Old Hook Motion.

Mr. Theodore C. Becke, one of our subscribers in St. Louis, writes as follows:

"Seeing an article in August number of 'Locomotive Engineering,' headed 'Old Locomotives Ditched,' I herewith send you photograph of the engines mentioned, which I took on July 26th, with Master Arthur Becke at the throttle.

"The front truck wheel is blank and bears the date 1854, but must have been substituted for the original, which evidently was a spoked wheel. The pump barrel serves as a guide for the crosshead to travel on."



ON THE POOR FARM.

The "Railway Herald," an English railway employés' paper, expresses surprise to see that there is a tendency on the part of the officials of some of the British railways to put six-wheel bogies under their new passenger cars. The paper says that the reason for so doing is hardly apparent, as four-wheel bogies cost less, will carry the weight equally well, and it stands to reason that the friction between them and the rails on curves must be considerably less. If our contemporary would ascertain the weight of the cars and the size of the journals, it would soon be able by a little figuring to tell why six-wheel trucks are often a necessity, although they doubtless increase the resistance of railway trains on curves. We have learned in America, long ago, that six-wheel trucks were a necessity, for the simple reason that sufficient bearing surface, to keep the journals running cool, could not be obtained with a four-wheel truck.

Handling Trains on Heavy Hills.

Mr. J. N. Barr, of the Chicago, Milwaukee & St. Paul, appears to have very sound views on the way to get trains over hills. They were considering at the Western Railway Club a paper on locomotive rating in fuel, in which the sentence occurred: "The only tendency which we have to combat is one of crawling up hills and running down them at too great a speed." In reply to that statement Mr. Barr said:

"I do not know that that tendency should be combated very seriously if we are looking for the best results for the railroad. If we are looking to make a 'fly' run, then I think that the tendency should be very seriously combated. I have always found that, in driving a team, a good driver will generally go slower up hill than he will down, and the engine with its train is almost on an exact parallel with a team of horses. The driver knows that if he rushes the team up hill he will play it out. He will not get any hot box, but he will get a foundered horse. Now, if we rush with a heavy load up hill we get difficulties of the same kind. We do get hot boxes, and we sometimes get them foundered, if leaky flues can be called 'foundering.'

"I think that the adage which was in use a few years ago, 'that the proper way to run a train was to go as fast up hill as down' is one of the most pernicious that has ever been brought forth. I think that the persons who started the adage did not know anything practically about the operation of a train, and I do not think, so far as economy is concerned, that you could follow a worse principle that that of going up hill as fast as you go down.

"There is another point: In going down a hill there seems to be an objection to going fast. I do not know whether it originated from the fact that a horse going down hill is liable to stumble; but hills that we take on the railroad are not the hills that we encounter when driving a team—not by a great deal—almost the maximum grade is 50 feet to the mile (the average is probably considerably less than that); still they are called hills. Now, the objection to running fast down hill is that if the engine gets off the track you will do more damage than if you are running on a level; but I would like someone to figure out, or to give me an idea of, how much farther the train would run if it got off the track going down a good grade than if it should have got off at the same speed on a level. I question whether you would find much difference. I question whether, if it did get off, you would find an additional broken coupler if you were on a 36-foot grade as compared with being on a level.

"It appears to me that the rule to run up hill as fast as down has done considerable mischief. While a great many of us have broken loose from that opinion, still we, to a certain extent, hang onto the objection of making as good time as we can down hill when Nature, through the medium of gravity, is helping us all it can to move that train for the least amount of money and make the best time; and if we throw away our opportunities when we have got them, on account of some theory, I think we are making a great mistake. If we lose a little time going up hill, we get to the top with an engine in good shape, the engine boxes are cold, the boxes on the cars are in good shape and ready to move off lively. If we don't do that we don't avail ourselves of the advantages that are given to us, because we are following a theory."

On this subject Mr. John Mackenzie, of the Nickel Plate, was reminded by some of Mr. Barr's remarks about a story of a man who made pretty good time going down hill and was never able to go very fast up hill. That man never had any more cars put onto him, but the fellow who went up hill fast always had more cars put onto his train. "I think if any of the superintendents found out that we were running down hill very fast they would put on more cars at the next station. This has a good deal to do with loading trains nowadays. They make them so that the engineer cannot run very fast, whether up or down. Whenever we think the engines are not pulling enough, we look up the tonnage and see what they are doing. We are pretty well satisfied that they are pulling about all they ought to, but the more investigations we make the more the coal record suffers."

Consolidation Freight Compound Locomotive for the Lake Superior & Ishpeming Railway.

The Pittsburgh Locomotive Works have just turned out for the Lake Superior & Ishpeming Railway, some very heavy consolidated compounds, one of which is illustrated on this page.

These engines weigh 147,600 pounds ready for the road, and have a high-pressure cylinder 20 x 28 inches and a low-pressure cylinder 31 x 28 inches. This is an exceptionally heavy and powerful engine and will be used in the iron country of Lake Superior.

When engines of this class come to be used on level roads, or roads that are comparatively level, the people in charge of the building of freight cars will have to change some of their methods and some of their materials, for such engines will haul more than will hang together.

The following are the general dimensions of the engines:

Fuel, bituminous coal.

Gage of track, 4 feet 8½ inches.

Total weight of engine in working order, 147,600 pounds.

Total weight on drivers, 132,800 pounds.

Driving-wheel base of engine, 15 feet 6 inches.

Total wheel base of engine, 23 feet 6 inches.

Total wheel base of engine and tender, 52 feet 10½ inches.

Height from rail to top of stack, 14 feet 11¼ inches.

Cylinders, high-pressure, diameter and stroke, 20 x 28 inches.

Cylinders, low-pressure, diameter and stroke, 31 x 28 inches.

Slide valves, Richardson balance.

Piston rods, steel, 3¾ inches diameter.

Type of boiler, straight.

Diameter of boiler at smallest ring, 64 inches.

Diameter of boiler at back head, 67 inches.

Crown sheet supported by radial stays, 1⅛ inches diameter.

Staybolts, 1 inch diameter, spaced 4 inches from center to center.

Number of tubes, 240.

Diameter of tubes, 2¼ inches.

Length of tubes over tube sheets, 14 feet 7 inches.

Length of firebox, inside, 108 inches.

Width of firebox, inside, 42⅜ inches.

Working pressure, 180 pounds.

Kind of grates, cast-iron, rocking.

Grate surface, 31.78.

Heating surface in tubes, 2,049.5.

Heating surface in firebox, 148.6.

Total heating surface, 2,198.1.

Diameter of driving wheels outside of tire, 56 inches.

Diameter and length of journals, 8 x 9 inches.

Diameter of truck wheels, 30 inches.

Diameter and length of journals, 5 x 9 inches.

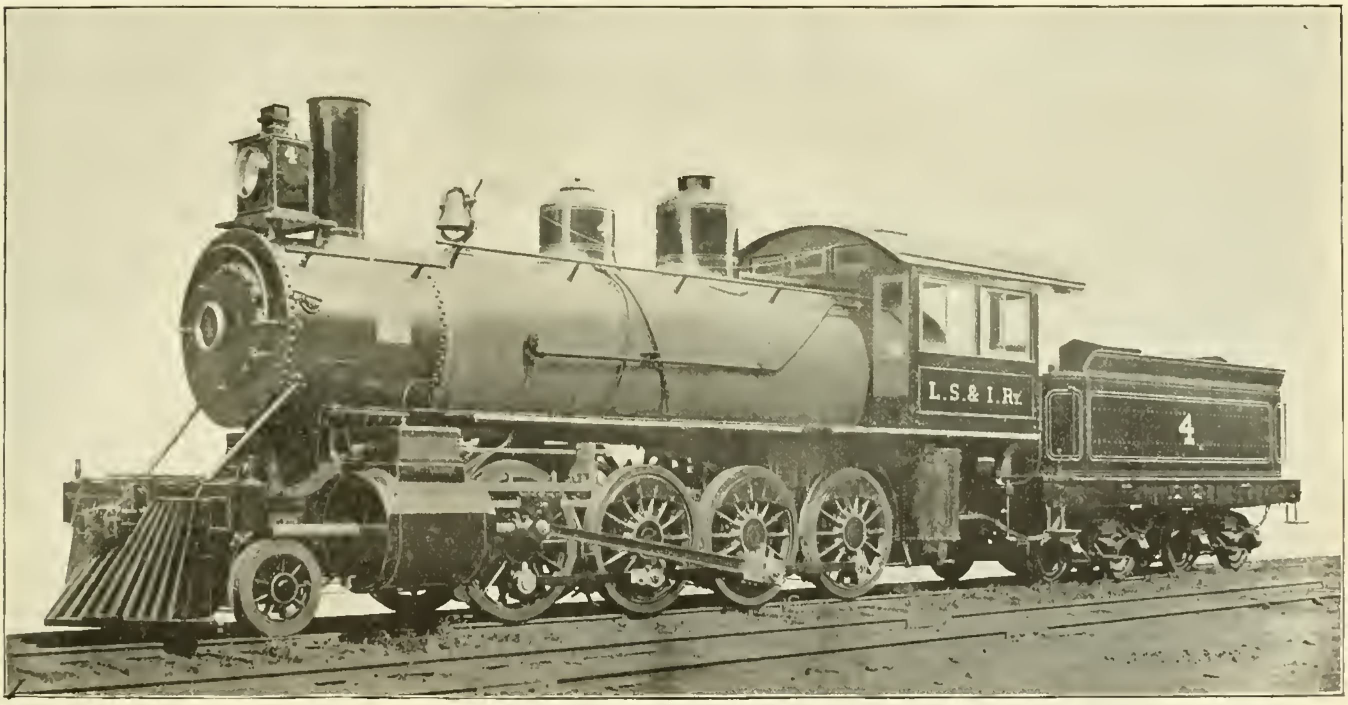
Type of tank, level top.

Water capacity of tank, 4,000 United States gallons.

Fuel capacity of tank, 280 cubic feet.

Weight of tender with fuel and water, 76,200 pounds.

Type of brakes, Westinghouse-American automatic.



COMPOUND CONSOLIDATION FOR LAKE SUPERIOR & ISHPEMING RAILWAY.

The Pennsylvania Railroad people have abandoned the practice of securing the piston rod to the crosshead by means of a split nut, and have returned to the use of a key.

Modern Locomotives.

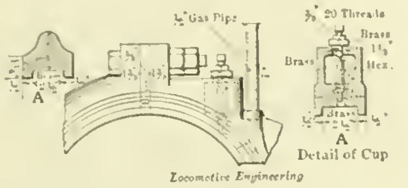
Of all the patented gimcrack locomotives that have been devised in the past ten or fifteen years not one is in service to-day. The Holman and the Fontaine locomotives met with a speedy and disastrous downfall; the Strong locomotive, with its peculiar valve gear, which was to render the link motion obsolete, was also short-lived; the Hall four-cylinder locomotive was a disappointment in its performance, and of the "James Toleman," an English locomotive upon new lines, the same must also be said. The standard locomotive in use to-day on all American railroads is an evolution; step by step, and detail by detail, improvements have been made; it is a survival of the fittest practice and embodies the practical experience of intelligent men in the use of locomotives. Persons who are about to invent new locomotives and think they have made discoveries in that direction, should read up the subject and profit by the experience of others before taking out patents all over the world and forming companies.—"Engineer."

The Chesapeake & Ohio people have had a Richmond compound in service for over three years, which ought to be sufficient time to demonstrate the comparative value of the simple and compound type for freight service. The "Railway Age" has recently published a statement, supplied by Mr. W. S. Morris, superintendent of motive power, which shows that when compared with a simple engine of the same type the compound did the work on a saving of 23.9 pounds of coal per engine-mile.

Kinks from the Omaha Road.

The difficulty of handling driving wheels in and out of the lathe has caused considerable scheming by those interested. Air has been found to be the deliverer from these troubles, as almost all of the best devices for the purpose of quickly accomplishing the desired results are now manipulated by compressed air, but there is a wide difference in the way the end is reached.

Among the best of these, we illustrate one of five tons capacity in operation at the Chicago, St. Paul, Minneapolis & Omaha shops at St. Paul, by permission of Master Mechanic Jno. Ellis. It is shown as secured to the under side of the roof truss, above the driving-wheel lathes and at right angles to them. Suspended to the truss is a pair of 50-pound T-rails, 28 feet long, which serve as guide rails for a four-wheeled trolley carrying a 14 x 31-inch lifting cylinder having a movement to and from the lathes by means of its trolley.



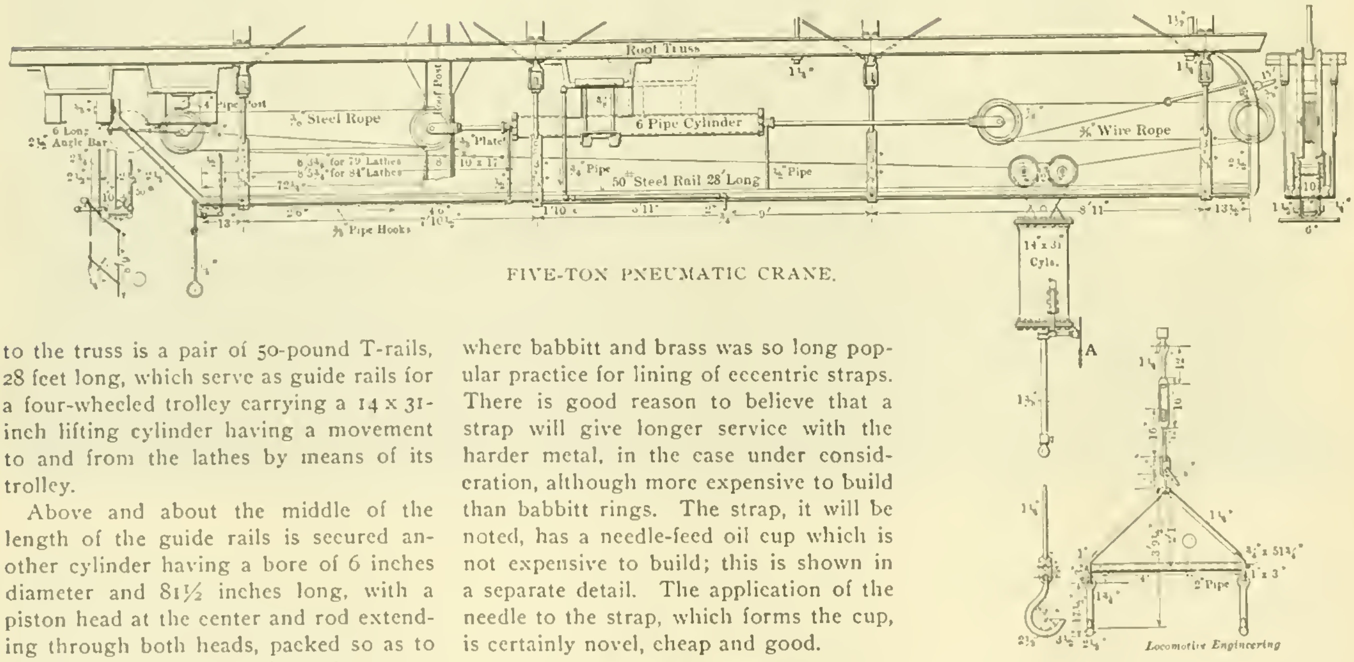
STEEL ECCENTRIC STRAP WITH BRASS LINER.

Above and about the middle of the length of the guide rails is secured another cylinder having a bore of 6 inches diameter and 81½ inches long, with a piston head at the center and rod extending through both heads, packed so as to move in either direction from the center. The two piston rods of this cylinder are fitted with a two-groove sheave at the outer ends, over which pass a ⅜-inch steel cable to two fixed sheaves, and from thence down to the carriage of the lifting cylinder.

In operation, the driving wheels to be raised are rolled up to the lathe, and the lifting hooks are passed under the axle; the wheels are then lifted to the height of the lathe centers by admitting air to the 14-inch cylinder, and while suspended, air is admitted to the 6-inch cylinder, which, through its connection with the ⅜-inch cable, moves the large cylinder and its load horizontally between the lathe face plates, when air is turned on to both sides of the 6-inch piston, locking the load in position, and allowing the lathe centers to be adjusted and the wheels to swing, ready for turning. The whole rig is one of the best things for the purpose that has come under our observation.

A steel eccentric strap with a brass liner has been in use on this road for some time—long enough, however, to demonstrate its right to stay and rank as an improvement over the plain cast-iron straps. The strap is bored out as shown at *A A*, after a brass liner ⅝-inch thick is introduced between the two halves. A brass ring is then turned to a light driving fit in the strap, after which the thickness of the flat liners is cut out of the opposite sides, leaving the ring in two sections. The job is then put together and the ring bored out to fit the eccentric.

The advantages claimed for this construction, after over two years' trial, is that brass and iron give better wear and longer life than iron, or steel on iron, and also that wear, when it reaches the allowable limit, is so easily taken up by reducing the thickness of the flat liners. This form of construction will be recognized by those who served their time abroad, where babbitt and brass was so long popular practice for lining of eccentric straps. There is good reason to believe that a strap will give longer service with the harder metal, in the case under consideration, although more expensive to build than babbitt rings. The strap, it will be noted, has a needle-feed oil cup which is not expensive to build; this is shown in a separate detail. The application of the needle to the strap, which forms the cup, is certainly novel, cheap and good.



FIVE-TON PNEUMATIC CRANE.

To Prevent Forgetting Orders.

In the course of a letter about his invention, Mr. A. W. Jennings, whose device for preventing the forgetting of orders was illustrated in our August number, writes us:

"In calling the attention of the public to this device, it would be well to say that engineers who forget orders, and are not killed from an accident resulting therefrom, are invariably discharged, and shunned to a great extent even by their brother engineers, and treated worse by the railroad companies than if they had been caught robbing or stealing the company's property. I speak from experience, as I have been so unfortunate as to overlook an order, and have been refused a job, even as engine wiper, by one of the largest roads in the South, officered by men who are looked upon as possessing fine business qualifications. Railroad officials seem utterly oblivious of the fact that, in the Standard Code of Train Rules, Rule 516 calls for orders to be kept before the engineer's eyes until executed or annulled. Had the device for displaying train orders been in use on the Chicago & Northwestern, that dreadful catastrophe of July 11th, near Logan, Ia., in all probability would have been prevented. It can hardly be disputed that railroad companies deserve censure as well as criticism for not making some effort to comply with rules for which they hold others to strict accountability. A conductor's tongue, tied in the middle and loose at both ends, caused me to overlook an order. He forgot it himself, and never stopped until he got it out of my mind, and kept it out by his incessant gabble."

It is wonderful how insistent ignorance is in some quarters where light and knowledge ought to prevail. It is not long since we heard a man in charge of a steam engine remark that he did not think much of expansion, anyhow. He considered that the best way to make a steam engine work successfully was to get the steam out of the cylinder as quickly as possible after cut-off took place. He had heard that getting the steam out of the cylinder of high-speed engines was an important object, and he imagined that it could be got out best by opening the exhaust just when cut-off took place.

The Bethlehem Iron Company can now roll open-hearth boiler plates 126 inches wide.

CAR DEPARTMENT.

Conducted by ORVILLE H. REYNOLDS, M. E.

Renewed Interest in the Steel Car.

The steel cars exhibited by the Universal Construction Company at the Saratoga conventions in June, have awakened an interest in that type of construction that is likely to lead to their early adoption for special service on a prominent trunk line. Two well-known motive-power officials are said to have been investigating the good features of these cars, with the view of giving them an opportunity to demonstrate their right to the good name so ardently pressed for them by the advocates of steel cars.

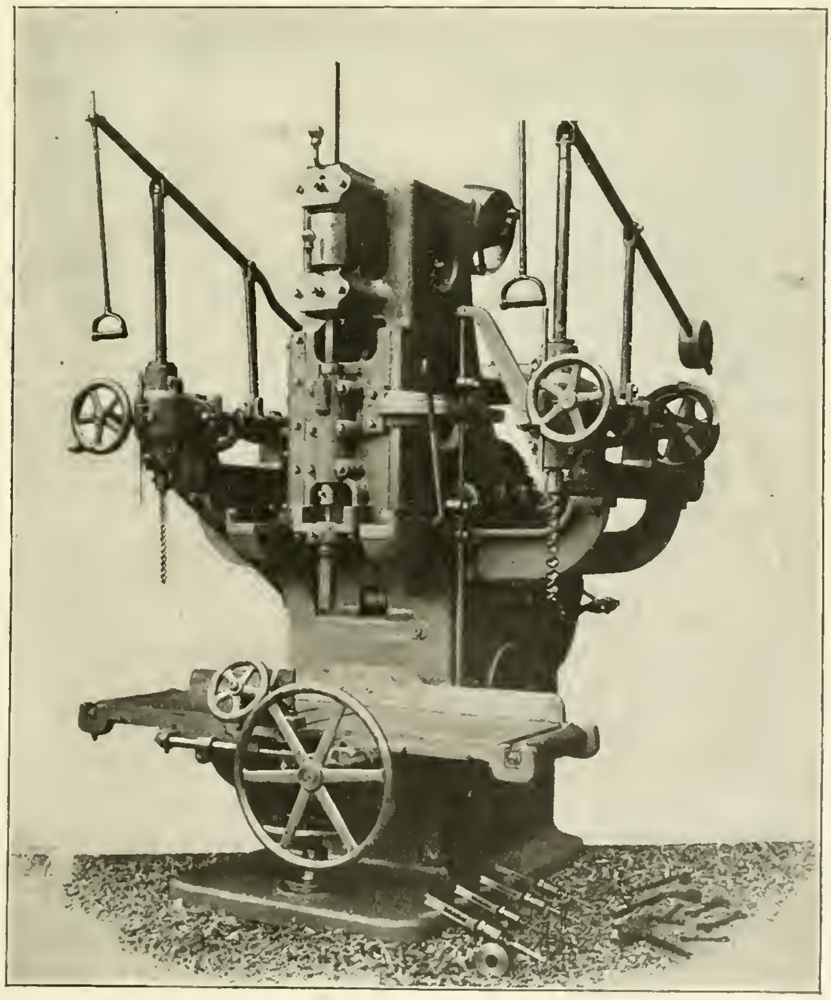
There has been no unseemly haste in the rush for this comparatively new thing in car construction, and it is well that a proper conservatism should hedge about and govern those who will ultimately be responsible for their appearance as factors in the transportation problem. History is full of instances to prove that the solution of momentous questions requires time, not for the purpose of establishing the point of merit alone, but more often to batter down the walls of prejudice nearly always surrounding an innovation in the field of mechanical construction.

A road trial under the most exacting conditions has been given a few samples of these cars, and they have thus far borne out all claims made for them; it is therefore seen that this revival of interest is a timely one if it will prove for us whether a steel car is, or is not, the proper thing to use. It is time to view the case from the standpoint of utility, and not let personal bias decide a matter fraught with so much consequence to railroad companies.

An exhibit of the latest and best ideas in steel, worked out by practical men, is directly responsible for the growing interest in the new car. These object lessons in steel have prepared the way for further thought and future effort on lines leading up to a higher development of the car. There can be no doubt of the result, simply because men are in this business of inquiry at the present time solely for the purpose of knowing what is best to do for the improvement of rolling stock, and their verdict will be in harmony with the facts, and therefore, reliable—confidence can be placed in it, because it will be a disinterested one.

New, Vertical, Hollow Chisel Mortising Machine.

Our half-tone illustration of the new hollow chisel mortiser is a fine example of the tool-builder's art, telling pictorially how closely the wants of the wood-working shop are watched and provided for by those whose business it is to equip them.



This machine has two universal auxiliary boring attachments, and a traveling table operated by hand as seen in the engraving, or it is arranged with an automatic traveling carriage of any length desired to suit any special output. The weight will range from 6,600 to 14,000 pounds. Its construction embraces the best mechanical features found in tools of this character, in addition to the improvements noted, which enables the operator to do the best work in the shortest time. Representing as it does the results of the ripe experience of its builders, J. A. Fay & Co., Cincinnati, O., its value in a manufacturing plant or repair shop cannot be over-estimated.

Standard Size of Car Material.

The necessity for a common standard in the sizes of material entering into car construction has been vigorously agitated by those who know how to put a stick of timber in a car and what its functions are after it is in, but the unreasoning opposition of some who think it is impracticable to make such a move has tended to block progress for a time; the feeling, however, is growing that will be productive of results.

Framing of a car cannot now be done by guesswork, as in the old days when no one thought to ask, "Why do you not use lighter material and reduce the weight of your car?" That question is a fateful one now. The science of car-building is founded on principles just as plainly defined and as easily understood as any other that is based on mechanical laws, and that is the reason why an adherence to a system that does not look to uniformity of dimensions would be ridiculous if it were not rather too expensive to come under that head. The cost of it divests the practice of all humorous features, and makes it assume a serious aspect to railroads that are wedded to that haphazard way of doing business.

There is certainly a large field for improvement if each road would make an earnest attempt to form its own standard, and enforce its adoption, in the matter of posts, braces, sills and plates, and thus straighten out its own tangle of diverse sizes of materials. It is not pleasant to contemplate the fact that cars of the same capacity on many roads cannot be repaired with the same material (although they had a common designer),simply because there was too much experimenting going on instead of an intelligent working-out of the problems involved. Thought given to the sizes of these parts will cheapen the cost of production and maintenance, and also reduce the amount of material to be carried in stock, three factors that represent the difference between good and bad management.

Opposing Steel Cars.

Some of our contemporaries which represent lumber interests are very much worried over the agitation in favor of steel cars, and they perceive nothing short of financial ruin for the railroad companies which are prepared to use steel cars for the transport of freight. The number of steel cars used by railroad companies in Europe has been steadily increasing, and the prevailing testimony is that they are more durable than wooden cars and come out of a wreck in better shape. Yet a correspondent of the "Hard Wood Record" writes:

"In the kingdom of Prussia, where about nine-tenths of all railways have been bought and are now owned by the Government, which is also owner of ore mines, rolling mills and extensive car shops, these experiments were taken up with great interest and zeal, and kept a little army of the most skillful engineers in pursuit of the very best and most practical construction since about 1869. The Royal Niederschlesische Maerkische Railroad line, between Berlin and Breslau, is the trial field for any novelty to be introduced in the construction of railroads or their rolling stock.

"There, and on the line of the Rechte Oder Ufer Railway, a heavy coal, ore and lumber carrier, at the time in the hands of a private stock company, the most practical and best-built cars, entirely of iron or steel, were in operation since 1870. Minute and strict statistics kept track of these metal cars and wooden cars, constructed and employed at the same time, in same capacity and work. After a period of about five years these statistics proved what was plainly visible to the attentive, that the wooden cars took less damage, that the damages of metal cars were more serious, required in every instance the sending of the car to the shops, while light damaged wooden cars could be repaired where the accident occurred. Cost of all repairs of metal cars at the end of the period stated figured enormously over and above the expenditures for their wooden competitors. Many metal cars damaged in the same wreck next to the wooden cars in question were irreparable, had to be sold as scrap iron, while the wooden cars, after their broken parts were soon easily repaired, could be returned to the service. Such and other technical evidence of which I shall mention in the further part of this article induced the railroads named above to only maintain some short steel cars, but principally to return to the 'old faithful' wooden cars, though wood is more expensive over there than in the United States.

"In the United States the same proposition busied since scores of years the most ingenious talents. Mr. Porter, connected with the Illinois Steel Company and with the Chicago & Eastern Illinois Railroad, has made what our best car-building engineers pronounce 'the most exhaustive computations on the subject,' after the Illinois Steel Company had made plans for steel cars, in order to determine their utility, expense (for both construction and maintenance) and the wear of such cars. The result was congruent with the finding of another expert, whose experience is expressed in the following opinion: 'Investigating the value of a car built entirely of steel in comparison to what we call a wooden car, we have only to consider the body, as the trucks are now largely made of steel altogether. Undoubtedly a greater carrying capacity will be obtained from short cars, constructed entirely of iron or steel and properly trussed; but in building longer cars, which are chiefly in demand, we are compelled to use such large sections of structural iron or steel for sills that the weight increases very inordinately, compared to the carrying capacity.'

"At the present time most of our railway cars are constructed 36 feet in length for a capacity of 35 tons, and anybody who has any knowledge of the prices of both steel and lumber material used in the construction of such cars will easily discover his computations suggest 'wooden' cars. The publications of which I mention at the beginning of this article laid great weight upon the increase of the capacity of steel cars, but they do not consider the consequent danger deriving from such overburdening of the railroad bridges and roadbeds if we do not increase in proportion the number of wheels under such cars. Considering these few technical points, the expense for construction of a steel car must nearly be double that of a 'wooden' car, according to the opinion of said expert authority.

"The question is, Are our railroads in a position to pay for this additional cost of their rolling stock, for the immense expenses which the strengthening of bridges, trestles, roadbeds, turnstiles, etc., would require, and is the value of this steel car commensurate with these immense expenditures? The fact that our largest railroads are in the hands of receivers, and pay since many years no dividends or next to none, is sufficient answer.

"One of the most important factors in the superiority of 'wooden' cars is the possibility to employ them without endangering their material, in the shipping of all kinds of freight, while metal cars would be seriously damaged by a cargo of, or containing partly, chemicals, which destroy metal. The more carefully and specially we investigate into the details, the more we find preference for the wooden car. The momentum of an iron or steel car is so much greater than that of a wooden car of same size that our present brakes, machinery and power operating them would have to be largely increased in a train of steel cars. The space allotted in this periodical to the discussion of the matter in question does not permit of going further into details. But I deem it necessary to cast some rays upon the subject from a business standpoint. At present the railroads of the United States have the choice between so many existing car-building institutions, which in recent years, by free competition, offered cars at the lowest possible prices. Should the steel car become omnipotent, the situation would soon be changed. No matter how cheap such steel cars would be at present, in the future they would be the dearer. The raw material for these cars is manufactured and monopolized by one or two very independent concerns. No competition will disturb them for many years, on account of the immense plants and capitals necessary in the manufacture of steel. To the mercy of these magnates the railroad companies which need cars would be delivered, and when then the return to wooden cars would be necessary, many of the present car-building institutions will be out of business and competition so much less. Witnessing the loading or unloading of timber and lumber into thousands of flat and other cars, I experienced very many accidents caused by the slipping of the feet of laborers during all seasons, but more during the winter time. The greatest care was therefore necessary, and the work in loading or unloading was greatly delayed. Laborers, as well as their principals, disfavored the steel cars, and were glad when they could obtain wooden cars for shipments.

"The facts and experiences above stated may be sufficient to prove that lumber is and probably will be for many years to come the preferred material in the construction of railway rolling stock.

"Manufacturers of timber and lumber for car-building purposes should therefore not feel alarmed by the publications of steel-car scare articles."

Letter Ballot on Revised Standards.

The letter ballot, long since adopted by the Master Car Builders' and Master Mechanics' Associations, as a means of helping out business between the annual meets, is a good one for the reason that it gives members an opportunity to weigh any question with more care than would be possible in convention, where business is necessarily conducted with a rush.

It is worthy of note that the forty-three questions submitted to the members of the Master Car Builders' Association for letter ballot, closing August 10th, resulted in the adoption of all. The ballot referred to a modification of the "Revised Standards and Recommended Practice" of the association, and was remarkable for the unanimity of the members in keeping pace with the progress of events.

English Dining and Sleeping Cars.

Our English cousins know how to get all there is out of the cars in their passenger service without reaching into the realms of dead weight to the extent that is done in this country. The Great Western Railway is running dining "saloons" that weigh 27 tons, 14 cwts., 2 quarters, and sleeping "saloons" that weigh 26 tons. By reduction the first becomes 62,000 pounds, and the second 58,200 pounds.

When it is understood that the greater of these weights is about the average of our first-class coach, it would appear that our roads do not attach much importance to a little thing like non-paying dead weight, and this feeling grows to a certainty when we compare the above figures with our "diners" and "sleepers," the former of which reach over 95,000 pounds, and the latter over 100,000 pounds.

It may be said that the difference in carrying capacity of these cars precludes any comparison in weight, but we believe that an average of the passengers carried in them will not be so greatly different, for it is well known that their patronage is very light in certain sections of this country, and a car of much less capacity would be amply large to handle the travel. It is rarely the case that our "sleepers" are filled.

Loading of Lumber and Timber on Open Cars.

The Master Car Builders' Association has published the rules adopted as "Recommended Practice," on the above subject, in pamphlet form, 6 x 9 inches, showing the loading of lumber and timber under the most varying conditions imaginable, or ever likely to arise in practice, with the fullest written instructions to cover every case illustrated. The latter make the rules particularly valuable in the matter of overhung loads and how to secure the same in the safest manner.

Little has been left undone in these rules to make them of the greatest value to shippers, and at the same time preserve cars from the evils of overloading, especially in the case last cited, where one truck is carrying more that its share of the load. The document is comprehensive, and one of the best things turned out by the association.

The Imperial Parlor and Sleeping Car.

A wide departure from the present well-known arrangement of the upper berths in a sleeping car was seen in a quarter-size model, showing one section of a sleeper, which was on exhibition in New York recently under the above title.

The lower seats make up into the regulation double berth, and the proposed improvement was not apparent until the entire absence of the upper berth was noted; there was nothing visible that looked like an upper, the whole interior of the car being, in fact, similar to a day coach in appearance, except in the matter of seats, giving an airy and roomy effect wholly wanting in a sleeping car.

In construction, the model was made to work as perfectly as though of full size, and the whole thing was therefore not open to the criticism of being on the toy order. The novelties, or proposed improvements over the old plans, lie exclusively in the partitions, the manner of constructing the upper berths, and the added ventilation for the same. The partitions are made to rise from their places between the seat backs, up to the clear-story of the car, instead of being detachable and stowed away in the upper berths when not in use. These partitions are counterbalanced and move up to position with no expenditure of energy to speak of and drop to their places between seats when unlocked. This would appear to be a commendable feature in case of sudden illness or desired privacy, as the berth can be instantly transformed into a state room.

The supports for the upper berth are made of steel and are concealed behind a door forming the face of the pilaster between windows. They are pivoted so as to be in a horizontal line when extended out from the side of car and in position for supporting the berth, which is made on the principle of the roll-top of a desk, and disappears from view by rolling up under the car roof. When down for use, it has a certain elasticity, owing to its open construction, that would seem to make it an easy bed.

It was seen that an increased height of window was possible by using a disappearing upper berth, and this fact was utilized to give proper ventilation to the occupant, who has a screen in his part of the window and can control the ventilation in his berth to suit his needs.

There are some two or three more inches between these berths than in old practice, which is room badly needed in most sleeping cars, as all will testify to who have ever tried to dress in the cramped space of one of them.

If this car will do any part of what the inventors claim for it in the way of additional comfort during the hours devoted to sleep, it will be a boon to the traveling public. There was one thing noticeably lacking in the scheme, however, and that was, there was no tangible evidence of any provision for circumventing the sable gentleman who wields the brush in the morning.

Disputes in Car Interchange.

In May, 1895, the Illinois Central Railroad Company rendered a bill against the Chicago & New York Refrigerator Line for repairs to its cars in April, 1895, including therein charges against Car 5063, for one draft spring weighing 35 pounds, and against Car 4039, for one draft spring weighing 35 pounds, draft filling and seven draft bolts. The springs were billed at 3½ cents per pound.

The Anglo-American Refrigerator Car Company, which operates these cars, returned the bill on account of overcharge on these two cars, claiming that the draft springs should not weigh over 28 pounds; also, that Car 4039 was not used fairly, or else the draft filling would not have been broken and seven draft bolts at the same time.

The Illinois Central Company referred the question to the shop where the work was done, and answers that the springs used weighed 35 pounds, which is the weight of the springs which it uses. Also, that Car 4039 failed under fair usage; the draft filling block, from its appearance, had been giving way for some time, and the bolts had apparently broken one at a time; that the bill as rendered is correct and should be paid.

The Anglo-American Refrigerator Company replies further in detail that the spring applied to the car was a 6½ x 6-inch double-coil spring, outside coil 1⅛ inches, inside coil ¾ inch, and that it should not exceed 26 pounds in weight; that the pocket is only 9 inches long on the draft rigging on this car, and that it has one 1½-inch and one 1-inch follower plates, which leaves only 6½ inches room for the spring, and this is the size of the spring the Illinois Central Railroad Company placed in Car 5063; therefore the bill against that car should be corrected. The same company further adds in regard to Car 4039, that if the draft filling failed under fair usage, the Illinois Central Railroad Company could not charge it for one draft spring on the car; that if the spring and all the other articles mentioned on the bill were broken, it was not done by fair usage, and therefore again declines to pay for the repairs of Car 4039.

In further correspondence, the Illinois Central Railroad Company shows by the foreman at the shop where the work was done on Car 5063, that he weighed the draft spring and that its weight was 35 pounds as billed. Failing to reach a settlement, the matter was mutually referred to the Arbitration Committee, who decided as follows:

Decision: A double-coil draft spring measuring 6½ x 6 inches, with outer coil 1⅛ inches diameter, and inner coil ¾ inch diameter, will weigh from 24 to 26 pounds. A double-coil draft spring weighing from 33 to 35 pounds will measure 8 inches high, with 1¼ inches outer coil, ¾ inch inner coil. The Illinois Central Railroad Company does not give the dimensions of the springs used, but only gives the weight. The Chicago & New York Refrigerator Line gives both the dimensions and weight of the springs, namely, 6½ x 6 inches, with outside coil 1⅛ inches diameter, and inside coil ¾ inch diameter, weight 26 pounds. From the correspondence submitted, it is the opinion of the committee that the Illinois Central Railroad Company is in error as to the weight of the springs applied to the cars, and that its bill should be corrected, charging and crediting not more than 26 pounds per spring. The Illinois Central Railroad Company's statement is that the draft filling blocks had, from their appearance, been giving way for some time, and that the appearance of the bolts did not indicate damage in a wreck, or by improper usage. There is nothing in the Chicago & New York Refrigerator Line's correspondence to warrant questioning this statement. In the opinion of the committee, the Illinois Central Railroad Company's bill in this respect is correct and should be paid.

In March, 1895, the Elgin, Joliet & Eastern Railway Company rendered a bill against the Cudahy Refrigerator Line for work done on the latter's cars, including a charge on March 16th against Cudahy Refrigerator Line Car 3255, at McCool, as follows: One Janney coupler, complete, $10; two hours' labor, at 20 cents, 40 cents; total, $10.40. Credit, 180 pounds of malleable scrap, at ½ cent, 90 cents; credit, 37 pounds of wrought scrap, at 1 cent, 37 cents; total, $1.27. Net charge, $9.13.

This bill was returned by the Cudahy Packing Company, objecting to the charge against the car, claiming that the fact that it was credited with scrap on all parts of the broken coupler is evidence of rough usage, as no part was saved, and stating that the car arrived at South Omaha a few days later with the following defects: "One foreign drawbar yoke, two strap bolts, one follower strap, two lug castings, one deadwood bolt and one truck bolt broken," which further shows that the car had rough usage. It claims that investigation shows that no repairs were made on the car after it left the Elgin, Joliet & Eastern road, and it therefore asks the cancellation of the charge against Car 3255.

The Elgin, Joliet & Eastern Railway Company replied that the car had to be set out of the train at McCool by the conductor, on account of having one broken coupler and knuckle; that it put in a Janney coupler and yoke the same size as the one removed; that there were no broken follower straps or bolts on the car when it left the road. It also shows, by the conductor who had the train in charge when the car was set out, that the car received no rough usage when the coupler was broken, but that the fracture showed old defects. It also states that it investigated the matter, and the record at the point where the car was received from the Chicago & Northwestern Railway Company shows that the coupler and knuckle were cracked, showing old defects at that time; and on account of the defects being covered by Rule 10, it had no right to ask the Chicago & Northwestern Railway Company to furnish a defect card; that on account of the weakened condition of these parts at that time, they were broken in ordinary service in one of its trains.

The Cudahy Packing Company replies that if the defects were on this car when the Elgin, Joliet & Eastern road received it from the Chicago & Northwestern Railway, they must have occurred while in the possession of that road, as the car was not defective when it left home. Further correspondence failing to adjust the case, it was referred by mutual consent to the Arbitration Committee, with the following result.

Decision: The broken bolts and straps discovered by the Cudahy Packing Company at South Omaha cannot be laid to the Elgin, Joliet & Eastern Railway Company, as South Omaha is a point some 500 miles from the Elgin, Joliet & Eastern road. It is shown that the wrong strap was on the bar put in by the Elgin, Joliet & Eastern Company, and card should have been demanded from the delivering road for any wrong parts not already carded. It is shown that the bar and knuckle had old cracks when received from the Chicago & Northwestern Railway. The broken drawbar and knuckle clearly are chargeable to the car owner under Rule 3, paragraph (n), and Rule 10. In the opinion of the committee, the bill of the Elgin, Joliet & Eastern Railway Company is correct and should be paid.

Fancy Woods in Car-Building.

Railway cars have always been built of wood and usually finished in more or less fine hardwoods, but the tendency has constantly been, and especially maked within the last few years, toward the use of the finest hardwoods obtainable. Though the car-manufacturing companies are known as heavy buyers, there is seldom any mention made of their purchases of fancy hardwoods. The lumber trade at large is interested more in their purchases of sills, decking, siding, etc.; but, as a matter of fact, companies like the Wagner or Pullman, or many others that could be named, are very extensive purchasers of the finer, more expensive hardwoods, and it would not be surprising to learn that this demand for some woods exceeds any other. Perhaps mahogany is a favorite finish for the better class of passenger cars, whether day coaches or sleepers; but the finest quality of quartered oak is also used in large quantities, perhaps equaling or even exceeding the consumption of mahogany. But in addition to these woods, which are standard, are curly red birch, cherry, rosewood, white mahogany, curly and bird's-eye maple and many others. Outside of the piano trade, it is doubtful if any industry uses so many and varied kinds of wood.

The forests of the world are drawn upon for materials with which to make beautiful the interior of these traveling palaces. The wood mosaics and inlaid work give place to wood of every shade and color.

Furthermore, we believe that these exhibitions of refined beauty, as well as luxury, have had much to do with the tastes of the people. The traveler who sees with what artistic effect woods can be used, is very likely, in his own building, to attempt something along the same line. Of course, the expense of such construction prevents its general adoption; but there are thousands of residences in this country that are more beautiful because of the lessons taught by car-builders.—"Timberman."

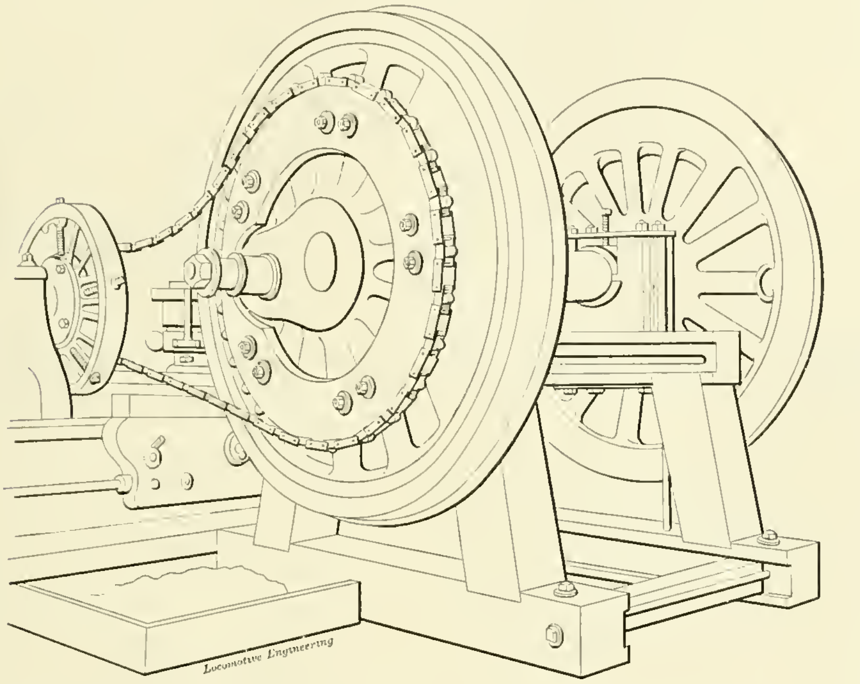
The Facer Forged-Steel Car Wheel and Locomotive Wheel Co., of Philadelphia, has been organized to make wheels by a patent process invented by Mr. J. A. Facer. The process is a stamping method, the work being done in an apparatus which forms the wheel out of a blank.

An apparatus has been invented and patented by Mr. Peter Rasch, for hoisting and unloading railway cars. It consists of a huge platform with apparatus for lifting the car bodily and turning it over, to dump the load.

It is reported that the Grand Trunk Railway will require 30,000 vertical plane couplers to complete its equipment, and that the Gould coupler, now being applied to all their cars, is the one chosen for adoption.

A Novel Method of Turning Tires.

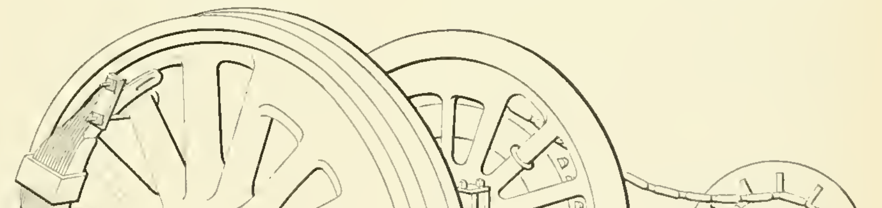
The line engraving of a pair of driving wheels driven by a sprocket chain from a lathe, will have a strange appearance to most readers of our paper. It tells of the dire straits many shops are yet put to from lack of facilities to handle their work. It also tells of ability of the highest order when schemes of this kind are worked out to save the price of a tool which, through a pinch-penny policy, is never bought.



Mr. W. M. Saxton, late master mechanic of the Washington & Columbia River Railway, at Wallula Junction, Wash., evolved the above rig to help himself out of the hole that always yawned for tires in his shop, and furnished us with photograph from which the engravings were made. In connection with the subject, Mr. Saxton writes:

"I inclose to you, under separate cover, photographs of a driving-wheel lathe that I made and have used for the past two years. Briefly, the accessories are few, and the whole process of rigging up is not a costly one. First, the driving boxes are fitted to their journals and made ready for the road; they are then turned bottom side up on a trestle or pair of horses made of 10 x 12-inch oak, securely bolted together and to the floor. The wheels are then mounted in their boxes, which thus form journals bearings for them to revolve in and perform the function of lathe centers in carrying the load. On top of each journal is fitted an old brass taken from the scrap pile, and secured in position by a clamp which is bolted to the open or cellar end of the box; these clamps have set screws tapped through them, which, bearing on the crown of brass, hold the wheels securely in place.

"A pair of sprocket wheels and a chain complete the portions made new for the job. The chain is 1 x 3/8-inch iron, with steel pins 3/4 inch in diameter and 3 inches pitch. The sprocket wheels are of cast iron and have a ratio of 4 to 1; the large one is ring bolted to the driving wheel, and the small one is driven from the chuck of a 36-inch lathe. We have run the wheels in either direction, but usually invert the tool and run the wheels so that the top turns from the lathe.



"Small jacks are put in between the lathe and trestle carrying the wheels, and enough strain put on to keep everything as rigid as possible. Perhaps, if a journal was badly worn, this way of solving the question would not do a good job; but just what the limit of wear should be in order to decide this point I never was able to say, simply because we had to turn tires. This we did at an average of about twenty-two hours to a tire.

"I hope this description of the way we turned tires without a driving-wheel lathe may help someone out who has to ship wheels three hundred miles for that purpose, as we did before this arrangement was put in force."

Such cases as the above serve to emphasize a condition of things that will ultimately react on the managers, or more properly the mis-managers, who are responsible for them. It has come to be pretty well understood at this time, that it does not pay a road to run the machinery department without a proper shop equipment to keep up its power and rolling stock.

Small Swindles at Conventions.

A little case of "bunco" that has developed at the Master Mechanics' and Master Car-Builders' conventions is deserving of mention, not particularly for finesse or statesmanship in the art of swindling, but simply to show up an instance of cold, cultivated nerve. It has been a time-honored custom at these conventions for photographers to group the attendants at every opportunity and get a picture, from which a goodly revenue was derived. There was nothing crooked in this transaction until the gentlemanly agent passed among the recently posed crowd and took orders for the picture. If that was all he took there would be no occasion to chronicle the event; but he also demanded a dollar from the innocents, and getting the same without making any return in the way of a picture is what constitutes the "head and front of his offending." Of course, he will not catch the same party the second time; but there are always others ready to make martyrs of themselves, and to those we want to say that the only way to "beat" those robbers is to get the picture and pay for it afterwards.

Thoughts and Suggestions About Applying the Indicator to the Locomotive Engine.

BY F. F. HEMENWAY.

In all the ever-increasing variety of steam and other pressure engines, covering almost every purpose of man, there is none to which the systematic application of the steam engine indicator is a matter of greater importance than in the instance of locomotive and marine engines. I mean taking engines just as custom, which we must all assume represents wisdom, provides for their being operated. In the instance of either of these engines the cost of fuel is important, but in each there is a good deal more to the matter—the economy—of its operation than the cost of fuel. There is this, at least: Boiler capacity is limited, necessarily, and the truism comes constantly to mind that a locomotive or marine steam engine is never larger than its boiler or boilers, to which might be added that sometimes it is a good deal smaller. Things are always likely to come to the question of getting steam enough, and steam enough is likely to be a question—largely a question—of how the steam is used. Nothing but the indicator will tell the story of this. Just that, to the uninitiated, inconsequential circumscribing line that might be drawn by an expert sweep of the hand, might be so drawn and tell nothing, when drawn through the agency of a simple little instrument, the indicator, speaks in terms that are never successfully questioned or wisely disregarded. Its record is as much a part of the day-by-day record of the modern steamship's progress as colliding with an iceberg would be. Its language is a universal language, readily acquired and seriously attended to. Mutely but eloquently it points out ways to "break the record," and how a ton of coal will carry more passengers and more freight, and bring the distant foreign port nearer by. No questioning mind will doubt the wonderful influence of the steam engine indicator—its systematic use—in the evolution of the modern marine engine.

The regular employment of the indicator on the locomotive engine is just as much a matter of importance as in the instance of the marine engine. The sum of the littles make the whole; when the littles are many the whole is large. There is too much of belief that if the indicator does not at once point out the way to revolution of construction or management, or both, its use does not amount to much. Sudden revolution may come in these directions, but nothing in the line of mechanical possibility is more improbable. Revolution will come, but it will come by accretion; come by adding a little here and taking away a little there. If the indicator helps in this work of adding to and lopping off—and it will help if persistently used—it will be of the same service in the instance of the locomotive engine that it has been in the instance of the marine engine, which to-day is the confessed pride of engineering achievement in a mechanical direction. It is in every way satisfactory to know that a change is coming—all too slowly to be sure—in regard to the vital importance of the use of the indicator on locomotive engines. The question is passing from "Why do you use it?" to "Why do you not use it?" This is a healthy indication.

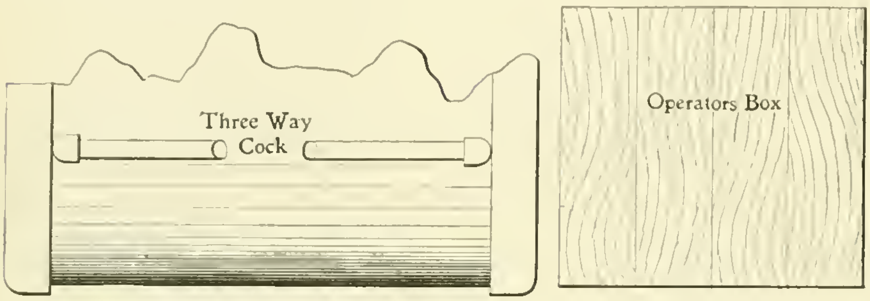


Fig. 1

It is not meant by this that the indicator is to be applied to any particular locomotive daily, as it is to the marine engine, but above all things it should be systematically applied. By the employment of some suitable system it should be provided that its application should be once in the year, or once in six or three months. Let it be applied during these intervals, and let the record show that it has been so applied. As many of the diagrams taken as seems advisable, together with a brief summary of what seems important, should be filed away and be preserved at least one year.

If any considerable repairs or changes are made, let diagrams be taken before and after the repairs or changes are made and let the memoranda as to changes and results be reasonably complete—quite complete.

In the instance of new engines, the indicator should be applied as soon as the engine gets well settled to its work. No pains should be spared to make the first trial by the indicator as complete and exact as practicable, and the diagrams then taken should be preserved during the lifetime of the engine, for reference as a primitive record.

When from any cause, known or unknown, an engine goes unsatisfactorily, the indicator should be at once applied. If the trouble is not known it will point it out, if in the steam distribution.

Nothing like a formula is intended in the foregoing; a few points only are referred to; points that, amongst others, may be of interest. The matter complete is mainly one that must be formulated according to circumstances.

There is, even at this late day, a rather prevalent feeling that a good deal is in the way of applying the indicator to the locomotive engine. The idea that doing so is something quite different from applying it to an engine firmly anchored to brick and stone seems to have a hold on the popular mechanical mind that it is hard to loosen. There is nothing of truth in the idea that the locomotive engine is a hard engine to indicate. On the contrary, it is a fairly easy one. The large clearance helps out the indicator in its only moderately rapid responses to pressure, and a little tact on the part of the operator will make of the job of indicating an easy and agreeable one. To the man whose work, whatever it may be, is for the most part inside brick walls, "a ride on a buffer beam," as Charles T. Porter felicitously puts it, is exhilarating in every way, and when this ride has for its object a matter of importance—an educational object—it is doubly so. The liberal doses of ozone put a man's perceptive faculties at the best; if there is anything of good at all in him that induced breeze of sixty miles an hour will bring it out. He has at first a vague feeling, at which his friends of the footboard commiseratingly smile, that somehow the indicator and he will never keep pace together in the race; then succeeds the feeling that they are both standing still, and the least and last item of trouble

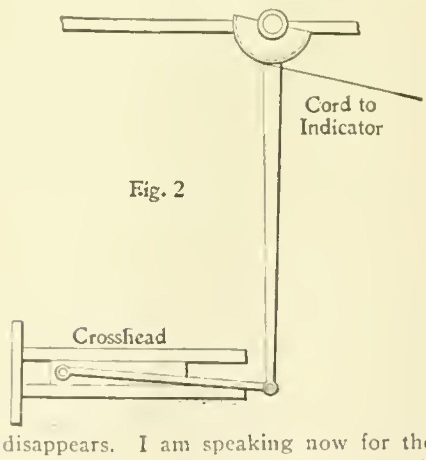


Fig. 2

disappears. I am speaking now for the first trip. It is an outing with about all there is of good in the term. No sleep-inducing element of brick and mortar, and confined air, about gathering in information at sixty miles an hour.

In the matter of attaching the indicator, the first thing is, usually, the drilling of the holes in the cylinder for the connecting pipe. These should be on the side, as indicated in the rough sketch Fig. 1. These holes should be so far back and front that the piston will not over-travel them. The indicator, mounted on the three-way cock, is ready for business on both ends of the cylinder.

I am well aware that the length of pipe necessary for connecting in this way is being very vigorously, and in some instances senselessly, criticised. I am equally well aware that, *per contra*, investigators have not found any difference as between short pipes and those of considerable length—materially much greater length than those represented in the sketch. Probably, as in most similar cases, truth lies between the extremes. One does not have to torture things very much to prove what he is anxious to prove —considers proven before beginning to take testimony. Things torture themselves, as it were.

Personally, I have tried locating the indicator as represented, and under precisely similar conditions, with the same engine, using the shortest practicable connection. This I have never done in a way or with an intention of putting results forward as having any of the requisites of a test, but simply to satisfy myself in a way sufficiently accurate to be convincing to myself, practically. The conclusion I came to was, that connecting the indicator, as represented, satisfied all practical requirements. The pipe employed is a mighty large steam pipe for the insignificant displacement of the indicator piston. If the pipe connection was excessively large and exceedingly short there would undoubtedly be a difference between the pressure in the engine cylinder and that in the indicator cylinder, but it might take something finer than the ordinary instruments of precision to measure it. Indicator diagrams, as herein referred to, are those taken for everyday, and not for scientific, purposes.

There is in this connection one thing I should be inclined to recommend: In each branch of the three-way cock, and at the lowest point in the branch, drill a small hole, say ⅛ inch diameter; these holes to be always open when diagrams are being taken. I have never tried this; my reason for believing that this drip would be advantageous is that when one branch is closed off—one or both are likely to be closed for considerable periods of time—the tendency is to bank up water in the connecting pipe and cock, which becomes rapidly cold by this banking-up. When taking diagrams, the intention is to get them from the two ends of the cylinder as nearly simultaneously as possible, avoiding loss of time in blowing through and heating up the pipe and cock; in fact, one is apt to think scarcely further than getting the cock open and the pencil against the paper. These small holes in the bottom of the branches would keep the pipe free from cold, stagnant water, and hence hot. They would also keep a slight current always established.

The holes need not be so large—perhaps $\frac{1}{16}$ inch instead of ⅛ inch would be better —as to make a perceptible difference in the pressure in the pipe. If the steam escaping through them should prove to be a nuisance, which it is very likely would be the case, the arrangement could be such as to carry it a little out of the way by small pipes.

I believe the Brumbo pulley, Fig. 2, to be the best plan for reducing the motion of the crosshead, all things considered. With it the cord can be led to the indicator at any required vertical angle. It may be argued that this reduced motion is not absolutely correct. Scarcely one reducing and transmitting motion in a hundred is absolutely correct, and still ninety-nine in the hundred may be nearly enough so for all practical purposes.

In regard to the operator's position, a box-like inclosure should be provided for the front end. This should be arranged to bolt in a position quite close to the cylinder, and should be strongly made. It should be of sufficient depth to invite his confidence in the security of his location. Thus provided for, he has the necessary feeling of absolute safety, which is very essential to his purpose.

One word in regard to the stability of the indicator. I have quite frequently found a tendency towards sympathetic or other vibratory motion, and cured it by one or more small wooden braces, wedged or sprung in between the cock and some part of the cylinder, and perhaps between the lower part of the indicator and the cylinder, so as to slightly spring he parts. The indicator should stand quite rigid in its position, or the diagrams will be distorted to an extent greater or less If a cord is employed instead of a wire (the cord, I believe, all things considered, is the best) for transmitting motion to the paper drum, it should be well stretched under strong tension before using. Suspending a weight by it for a day or two is a good way to stretch it. The cord should be moderately waxed, the wax being well rubbed in while the cord is in tension.

The various parts of the reducing motion should be well made, particularly as to the fit of joints. The whole of the equipment for one engine will serve for all others of that class, and with some slight modification for all the engines on the road.

The blank diagrams should be so arranged as to be readily come at.

An extra spring should be taken along, as well as plenty of cord. It is, to say the least, exasperating to break a spring or cord with nothing to replace it.

Tender Telescoping the Foot Plate.

In several railroad accidents that have happened during the last few months, fatal results have been brought about to the enginemen through the tender mounting into the cab of the engine when a violent collision took place. This matter of preventing the tender from telescoping the cab, in case of accident, has not received so much attention from locomotive designers as the importance of the matter deserves.

Designers of passenger cars have devoted a great deal of attention to preventing cars from telescoping in case of accident. The Miller platform was the first great improvement in this direction, and its use has saved many lives in cases of accident. Ever since that platform was applied, inventors have been striving to improve on it, and the connections to-day are so well made that it is very rare that telescoping takes place, even in case of the most severe collisions. If a little of this attention was given to the connection between engine and tender, it would be a great benefit to the men whose lives are so often put in jeopardy in the engine cab.

An accident which is even more common than the tender mounting the foot plate of the engine, is the tank breaking from its fastenings and being projected bodily into the cab. The ordinary method of securing tanks to the frame is surprisingly defective, and seems merely to be designed to keep the tank in its place in the ordinary working of the engine. Some builders and railroad companies have been improving on this lately, and their example ought to be followed by every railroad company in the country, for a very small expense can overcome this very serious source of danger.

We believe that the Norfolk & Western have the tanks of some of their newest engines secured in a way that leaves very little to be desired in this respect. They have a steel frame, and at the back of the coal space there is a heavy angle iron, riveted on, wide enough to come between the two center channels, and the angle is provided with two rows of rivets and projects down below the top of the frame. There are two plates of iron across the top of the frame, against which the angle iron rests, making it almost impossible for the tank to slide up without ripping the bottom out of the tank. It seems to us that this is a line of improvement which deserves much more attention than it has received.

Australian papers give highly complimentary accounts of the performance of what they call the "Australian Consolidation" engine, which has lately been built in Scotland according to designs prepared by the chief mechanical engineer of the New South Wales lines. The engines are to all intents and purposes American consolidations, except that they have plate frames, copper fire boxes and brass tubes. The cylinders are 21 x 26, the diameter of the driving wheels is 51 inches, a pressure of 160 pounds per square inch is carried on the boilers, and the heating surface is 2,211 square feet with a grate area of 29.75 square feet. The engines have Westinghouse air brakes applied to engine and tender.

Writing Preferred to Marks in the Brown System.

We have received from Mr. G. R. Brown, general superintendent of the Fall Brook Railway, the following copy of a letter which was written by Mr. Brown to Mr. J. A. Fillmore, manager of the Southern Pacific Railway. Mr. Brown thinks that the publication of this letter will serve to make his system more familiar to railroad men, and will save him the labor of writing many letters. Among roads that have recently adopted the Brown system are the Southern Pacific; Kansas City, Fort Scott & Memphis; Wabash; West Michigan; and the Detroit, Lansing & Northern:

"I am in receipt of your letter of July 20th, inclosing me circulars, etc., preparatory to adopting the 'Fall Brook System of Discipline' on August 1st, for which please accept my thanks, and I hope that both your company and employés will be pleased with the results. You ask if I have any suggestions to make in regard to same. I notice that in your system the reprimands and suspensions charged against employé's record may be canceled by a perfect record for a given number of months. I infer that your record is kept in writing rather than by marks, as many of the Western roads have adopted. If by marks, I beg to state that I have had no experience with merit and demerit marks; but with my limited acquaintance of this practice, I am satisfied that the method of keeping a memorandum account in writing, in place of straight marks, is far superior for many reasons. The plan of arbitrarily imposing demerit marks to a stated number on each man alike is liable to finally force you to dismiss a man in whom you had confidence to give a further trial, and on the other hand keep a man when your judgment would warrant his immediate dismissal. A new man who has been in the employ but a few weeks or months is put on a par with a man who has been in the service from five to twenty-five years, and whose services on general principles have been quite satisfactory. The character of each offense should be written in plain, unmistakable language, and duly considered in connection with the general make-up and adaptability of the man for the business, his age in service, previous record, etc., giving him the benefit of all doubts. Again, when from any cause a new superintendent takes the place of the old one, the record book gives him a written standing of each man in detail; this is a business acquaintance that it would be impossible for him to acquire if he depended wholly on merit and demerit marks. Even the old superintendent might forget for what offenses the marks were made. Memorandums made against men who occupy inferior positions are carefully considered before promoting them. If a fireman or brakeman neglects his duty or shows signs of incompetency, he is still more liable to prove unsatisfactory when promoted to the more responsible positions of conductor, engineer or flagman. Our men understand that their record must be good from the commencement of their service with the company; otherwise the record affects their promotion. Men who fill inferior positions satisfactorily are more apt to fill more important ones with entire satisfaction. By adopting this method we hardly ever make a mistake when we promote a man to a flagman, conductor or engineer When a man apparently cares but little for these entries or memorandums, it is good evidence that his services are not going to be satisfactory. We always enter memorandums of meritorious service, such as deeds of heroism, loyalty, good judgment in emergencies, etc., and in my opinion these memorandums made in writing have a greater significance than straight marks, notwithstanding these marks may be of merit; they are comparatively meaningless unless you chance to remember what they are for. Would be glad to have you call it 'Fall Brook' rather than the 'Brown System of Discipline.' I will take pleasure in giving you any further information that you may desire."

The Reward of Being Too Slow.

Ever since the mechanic arts began to grow to the extent that workmen were employed in trades, there has always been opposition to improved devices and improved methods which were calculated to reduce the time and cost of production. A new machine that greatly increases the speed of production generally brings hardships to some workman, but it nearly always opens new fields and increases employment in other lines. The law of competition renders a constant effort towards improved methods of production a necessity, and the firm which is contented to remain stationary soon finds its business departing.

A "kicker," writing in "The Foundry," gives a good illustration of how competition leaves in the lurch the firms that like to follow the practices of their ancestors without change: "We entered the employ of a prominent firm of engine builders," says this writer, "and the second day of our stay the desire to 'kick' manifested itself when we were told to make a dozen castings from a pattern requiring considerable parting to be done, without being furnished a follow-board. Approaching the foreman, we made a plea with facts and figures enough to have moved a statue to give us a follow-board; but his answer was: 'I ain't going to start making follow-boards, because if I make them for one job I will have to make them for another one, and it makes so much to keep track of.' We continued 'kicking,' and the old man sought to soothe us by exclaiming: 'Young man, what in thunder are you "kicking" for? If I gave you a follow-board you would make six a day instead of three. I am perfectly satisfied with the amount of work you are turning out, and if you did turn out twice as much you would get no more for it. Where have you got any "kick" coming when you are getting your day's pay for making castings?'

"We have always held to the opinion that the workman who could produce the greatest output with the least expenditure of material and time should be classed amongst the cheapest men a firm could employ; but here was a case where things were good enough. Here was a firm, alluded to as being modern at that, who were willing to leave well enough alone, and although the work could have been done in half the time with proper facilities, yet they were seemingly getting more than their share of the coin. We quit 'kicking' for two months, drew pay for making partings, and then we got work up in a way that made us sorry we had not kept on 'kicking.'

"One day a typewritten notice was posted in the shop, saying that, owing to keen competition, etc., a reduction of ten per cent. would be made in the wages of all employés. Then we did 'kick,' and so did others who had been satisfied for twenty years. If the firm was justified in making this reduction, and we will take it for granted that they were compelled to for reasons stated, were we not equally, and more so, justified in making a 'kick' when the output of the shop could easily have been increased twenty-five per cent., and thus have avoided inflicting the punishment of a reduction, bringing in its trail dissatisfaction, carelessness and incompetency?

"An increase in output is always preferable to employer and employé alike, against a reduction of wages. The most productive labor is the cheapest, and he who does not strive to this end is digging a hole in the form of smaller pay for himself to fall into."

In connection with this case, the question is worth asking: Why is the foundry about the last shop in an engineering establishing to receive the benefit of improved appliances? If an agent for machine tools goes into the office of a machine-making shop and begins to tell that he can reduce the cost of certain operations ten per cent by the use of an improved machine, he is listened to with keen interest and very likely carries away an order. But when another man offers to sell a machine for the foundry that will save twenty-five per cent. and relieve molders from tiresome work, his words seldom excite any attention. The use of crude appliances has been traditional with the foundry, and there is unwillingness to disturb the ancient lethargy.

The American Air Power Co., 160 Broadway, New York, are building a motor for the Manhattan Elevated Railroad.

PRACTICAL LETTERS FROM PRACTICAL MEN

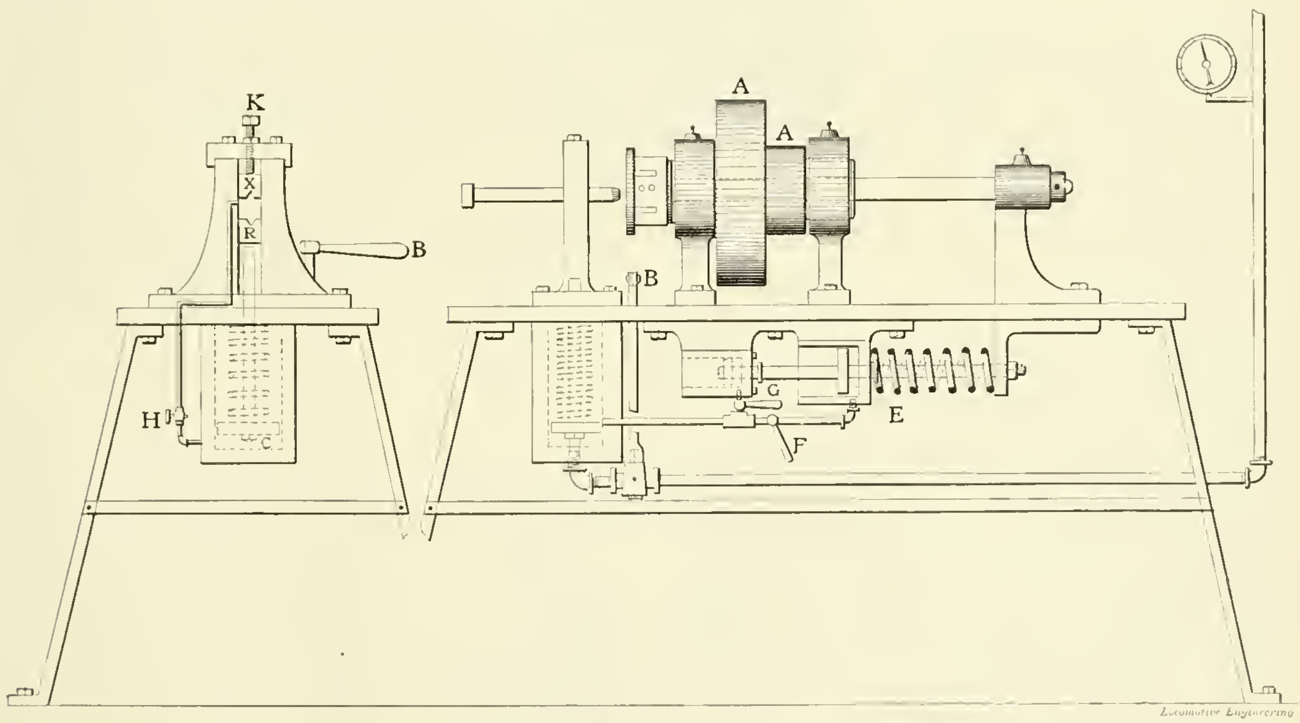
A New Bolt Pointer.

Editors:

I inclose to you a sketch of a machine I devised for pointing bolts of different sizes. It is easily operated, not expensive to build, and has given excellent results in the four months of its use.

The cone *A A*, which drives the cutters, is run by a belt; all the other parts are actuated by air. By moving handle *B* forward, air is admitted in cylinder *C*, moving up the piston, and with it the clamp *R*, holding the bolt firmly and central with the cutter spindle. Admitting air at the same time to the small cylinder, *D* moves its piston forward, thus pulling the spindle and cutters against the bolt and pointing the same. Releasing the air, the springs force the pistons to their first positions—that is, the cutters and clamp *R* recede from the bolt and all is released.

The operator has only to place the bolt between the clamps with his left hand, and manipulate the air valve with his right; the whole operation consists of those two moves only. There is a somewhat larger cylinder *E*, which is used for large-sized bolts where more pressure is needed. In this case the cylinder *E* is opened by moving handle *F*, and cylinder *D* is shut by the handle *G*. The cylinder *E* is also used when, for any reason, the air pressure falls to 40 pounds or less; it will then do the same work as could be done on cylinder *D* with 80 pounds pressure. *K* is the adjusting screw. The upper die *X* need only be let up or down, as the size of the bolt may require, to bring same in line with the cutting spindle.



A NEW BOLT POINTER.

This machine was built at the Northern Central Railway shop at Elmira, N. Y. It is in use every day, and we have pointed 5,000 ½-inch bolts with it; notwithstanding the fact that not a drop of oil was used, the cutters are still in good condition. The spindle makes about 480 revolutions per minute.

For rusty bolts, the cooler *H*, which is a jet of air, is turned on; this blows off all rust and dirt and helps out the cutters wonderfully.

J. A. Eisenaker.

Elmira, N. Y.

Alleged Metamorphosis.

Editors:

An engineer had occasion to put in new balance spring (short one) on right side. Next day engine went to shop and left steam chest was taken up, and the spring that was put in on right side was found over on left side. Do you think such a thing possible?

A. Molis.

Muscatine, Ia.

[The change alleged to have taken place was just as likely as it would be for a man to discover in the morning that his right thumb had changed during the night to his left hand.—Eds.]

Locomotive Inspectors.

Editors:

In your August issue I notice that you say: "In the British Isles a division master mechanic is called locomotive inspector." Whoever gave you that information misled you. A locomotive inspector in England is the same as a traveling engineer or road foreman of engines in America. The position that nearest approaches our master mechanic is the outdoor assistant to the locomotive superintendent, who has charge of the various engine houses and shops on his division, and to whom all engine house and shop foremen make their reports. The locomotive inspector is generally an old engineman, and is paid about $65 per month; he is also allowed his expenses while out on the road.

H. T. Bentley,
Late of L. & N. W. Ry. of Eng.

Belle Plaine, Ia.

Tender Steps and Handholds.

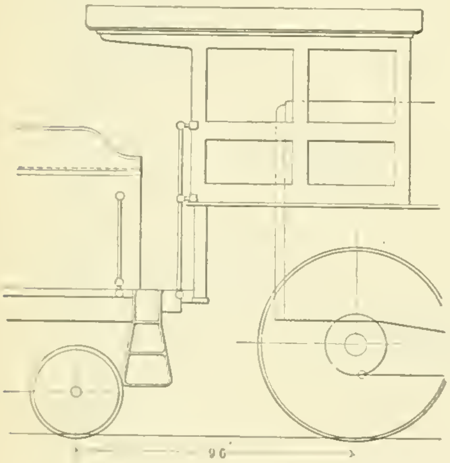
Editors:

The question of safe and convenient tender steps and handholds is brought more to the front by the recommendation of the Master Mechanics' Association at their latest convention, and when the people most concerned in this matter find the difference between poor and good steps and handholds, a general improvement in this direction is sure to take place.

Our Engine No. 1101, equipped with steps and handholds as shown on blueprint sent you, has been in service about three months, and everybody who has boarded her (and they are a good many) admits that the steps and handholds are good.

The five ten-wheeled engines Brooks are now building for our road will be equipped with similar steps and handholds, and as soon as practicable, old engines will also be improved in this respect.

You will notice on the blueprints that



the deadwood is carried under the extended top of step, thereby increasing the width at end sill and forming a better landing than before.

The hand-rail columns for cab and tender are made of malleable iron, to avoid the more or less treacherous cast iron. $1\frac{1}{4}$-inch wrought-iron pipe used for the hand rails, same as for sides of engine. Ends of cab hand column left long, and without holes to make suit different cabs.

Believing a description with illustrations of the Chicago, Rock Island & Pacific standard tender steps and handholds in your paper would be appreciated by its numerous readers, prompted us to this communication.

Chicago, Ill. G. A. AKERLIND, Chief Draftsman.

Pitch of Gears and Screw Threads.

Editors:

I saw an article on pitch of gears, etc., in the July number of "Locomotive Engineering," on page 613, and would say the explanation you gave differs somewhat from the International Correspondence Schools. They say the pitch of a gear is the distance from the edge of one tooth to the corresponding edge of the next tooth, and on a screw the distance from the edge of one thread to the corresponding edge of the next thread, etc.

Grant, Pa. J. A. BRITH.

Curious Case of Water Thrown from Stack.

A correspondent in Altoona, Wis., writes us:

"Can you give a remedy for the following trouble in locomotive? While hauling a light passenger train at rate of about thirty miles per hour and working light throttle, at intervals of about fifteen to twenty miles, a pint or two of dirty water is thrown out of stack, which covers engine from sandbox to cab with dirty spots. This happens with only one gage of water in boiler, and no water shows at cylinder cocks; with blower shut off tight, also air pump shut off. The dry pipes have been tested; holes $1\frac{1}{4}$ inches have been drilled in exhaust channels, midway between cylinder and nozzles; but the water does not show there. While engine is working hard continuously and running faster, less water is thrown off. The water seems to be carried up by exhaust to top of stack and drips off the edge. Nozzles have been changed, but does no good. Stack is made of stack steel size 15 inches diameter straight, except a slight flare-out at the top. No casting at top. Temperature of atmosphere, 90 degrees in shade. Cylinders and chests are cased, but none on stack."

This appears to be a curious case, and in absence of more particulars we cannot suggest the cause of the trouble. If any of our readers can do so, we shall be glad to hear from them.

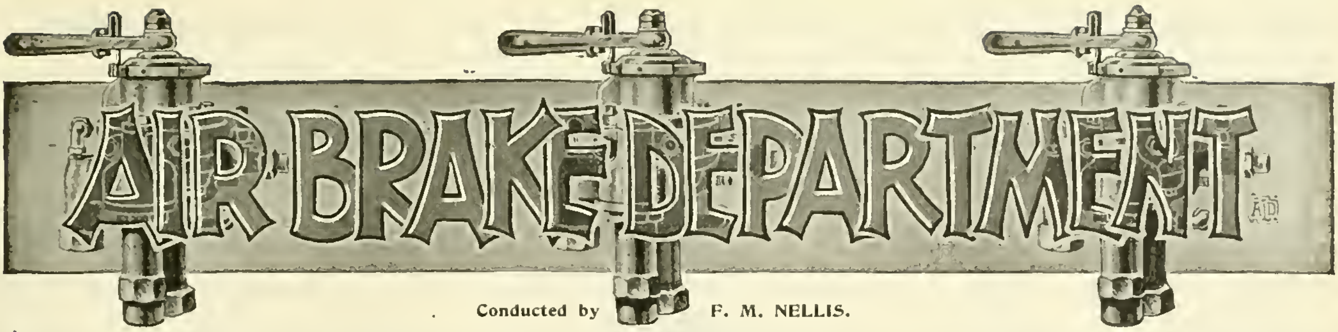
Common Sense Methods.

There are a few freaks belonging to the railroad stock species to be seen waiting for the patronage of the railroad companies, but there are very few in use at present. The hard times which railroads have been enduring for the last three years are a very good preventative of wild experiments, and railroad managers are proving themselves very hard-hearted towards the inventor who has offered to save 50 per cent. of the operating expenses by the use of some patented device. Railroad companies have displayed great liberality in the past in trying inventions that were not by any means promising of improvement, but it is a very wonderful patentee who gets them to try anything at present.

In his address before the Master Mechanics' Association, President Blackall portrayed the present condition of affairs very well in the course of a short paragraph:

"The past year marks an era in common-sense methods; in providing suitable counterbalance, reduction of the weight of reciprocating parts, rating of locomotives on tonnage basis, or more accurate methods of accounting for coal consumed, considerations for dead weight and method of reducing same, and a general relegation to the rear of such methods as figure a little and then guess at it. We are living in a day of marvelous progress, and we must be progressive; how to accomplish the most with the least expense is the great question of the day; economy is the word, but the utmost caution is needed on our part that we shall not be 'penny wise and pound foolish.' We are at once deeply interested in anything of improvement to machinery or rolling stock, but if we would strike the true key-note of economy, will it not be found in bettering the condition of the men in our charge? It is not always higher wages that does this, but that which tends to lift up and elevate them to a higher standard of manhood. Shall we not remember then the men under us, and do all in our power to throw around them influences to better their conditions, and aid them in resisting temptation? How can economies be made in shop practices, better tools, rearrangement of shops and an intelligent executive force are all problems requiring careful consideration. The use of modern tools will necessarily reduce cost. The advent of air and hydraulic lifts and cranes has aided greatly in bringing out the desired economies."

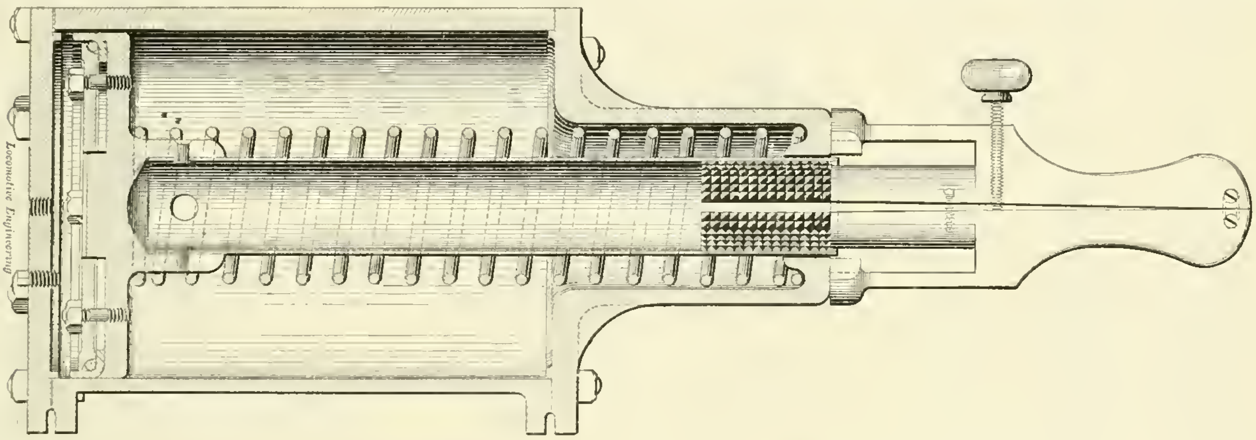
Some locomotives recently built by the Northeastern Railway of England, at their works at Gateshead, are said to be making wonderfully good performances with fast, heavy trains. The engines are of the two-cylinder compound type, with two pairs of coupled driving wheels 91 inches in diameter. Fifteen of these engines have been built, and it was expected that they would have a great deal to do in making the East Coast system of railways triumphant in beating the speed record of the West Coast during this summer. The racing is said to be "off" on account of an accident on the London & Northwestern, but the Northeastern engines are expected to beat the British record for speed on heavy trains. A peculiarity of these engines is that they have American cabs which cover the entire foot-plate. An engineer, writing about Northeastern engines which were equipped with American cabs two years ago, said, that during the severe winters of 1894 and 1895 not a single engine driver or fireman employed upon those engines was incapacitated from work owing to the cold, whereas on engines with the old-fashioned cab great difficulty was experienced in keeping up the ranks owing to the number of men who were taken ill.



Conducted by F. M. NELLIS.

Clamping Device for Cleaning Air-Brake Cylinders.

Mr. C. E. Sherwood, formerly traveling engineer on the Northern Pacific Railroad, sends us the following cuts of a device which he has patented for clamp-



ing the cylinder head onto the piston rod while cleaning. The cuts are self-explanatory to air-brake men, who will recognize in the device a handy tool for use in removing and replacing the parts when cleaning the air-brake cylinder.

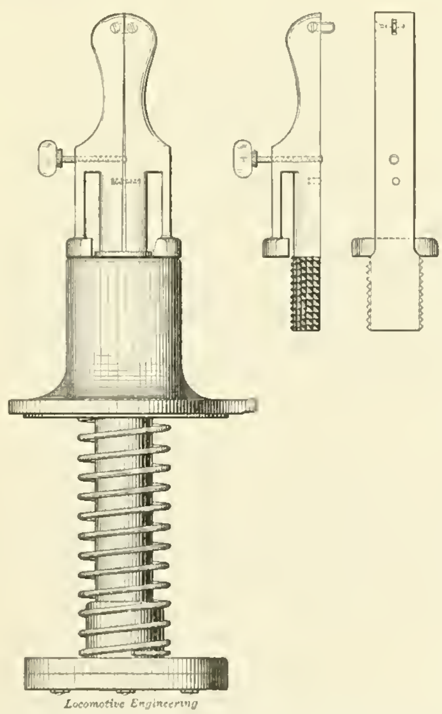
Air Brakes in Germany.

The Prussian State Railroads have adopted altogether the Westinghouse quick-action brake in place of the Carpenter, formerly used on those roads. The South German roads never used the Carpenter brake. The Carpenter is now only retained by some of the small companies which fit all of their new work with the Westinghouse.—Ex.

Brake Power Increased by Cars Losing Weight.

During the discussion which followed the reading of the paper on "Foundation Brakes" at the St. Louis Convention of Air-Brake Men, Secretary P. M. Kilroy made the somewhat surprising statement that a new car would, on account of drying-out of poorly seasoned timber, decrease in weight from 500 to 1,000 pounds, and thereby raise the braking power considerably above the amount originally calculated.

Mr. Kilroy has been borne out in his statement by a recent experiment made on the Pennsylvania Railroad, in which the average weight of five hundred 60,000 pounds capacity freight cars was found to have decreased nearly 1,600 pounds in thirteen months, thus increasing the brake



power by the drying-out process from 70 per cent. to 74 per cent.

A full air-braked train of seventy-nine cars, all loaded with wheat, was recently hauled over the Pennsylvania lines from Erie to Baltimore. This is said to be the longest air-braked train ever hauled.

The Air-Brake Men's Proceedings.

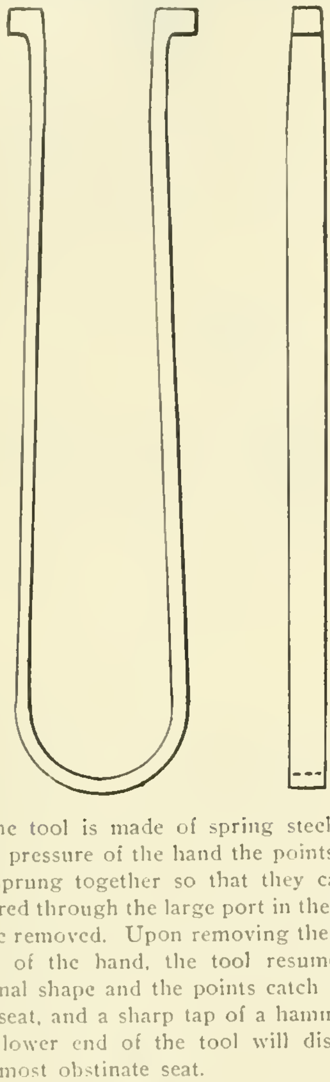
The interest now being taken in air brake matters could not be more forcibly illustrated, perhaps, than by the unusual demand for the Proceedings of the Air-Brake Men's Third Annual Convention. In two months the first edition of four thousand copies has been exhausted. A second edition has just come from the press of "Locomotive Engineering," and copies of this up-to-date instruction book may be had by remitting to P. M. Kilroy, Secretary Air-Brake Association, Pine Bluff, Ark. The prices are as follows: Paper bound copies, 50 cents; leather bound, 75 cents, and seal bound copies, $1.

As the margin is so narrow between the cost of getting up the book and the selling price, it has been found impossible to allow any commissions, even to newsdealers. The cost of the book is the same in quantities as single copies.

A passenger leaving his seat and proceeding down the aisle, preparing to alight before the train is brought to a standstill, shows that he is accustomed to riding on trains where stops are made without shock. The passenger who clings to his seat until the last moment thus advertises the fact that he is accustomed to the shock, and that he proposes to wait until he gets it. And the passenger who proceeds down the aisle with all the independence of a pig on ice, and is thrown through the door, or is bent over the back of the seat by the shock, shows that his confidence has been misplaced, and that brakes are not handled on this road like they are "at home."

Tool for Dislodging the Emergency Valve Seat.

A simple and effective tool which has been used on the Delaware, Lackawanna & Western Rairoad for some time past, for removing the emergency valve seat from a quick-action triple without bruising the seat, is illustrated in the accompanying cut.



The tool is made of spring steel, and by a pressure of the hand the points may be sprung together so that they can be entered through the large port in the piece to be removed. Upon removing the pressure of the hand, the tool resumes its normal shape and the points catch above the seat, and a sharp tap of a hammer in the lower end of the tool will dislodge the most obstinate seat.

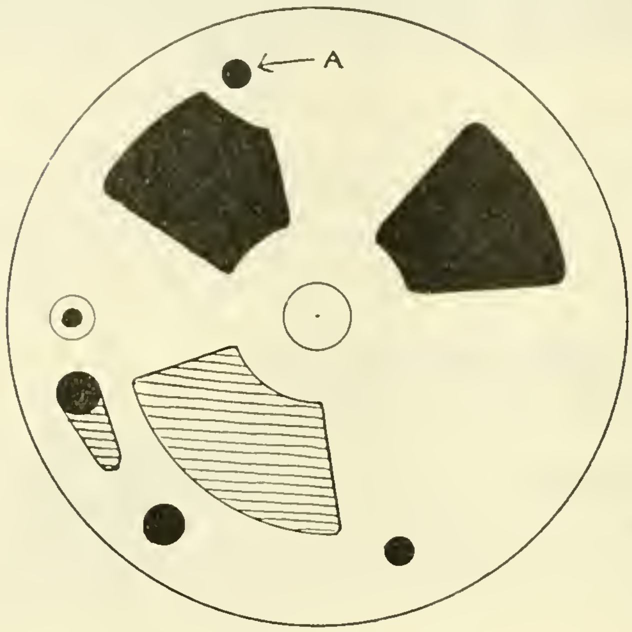
Not a single flat wheel taken from under the "Empire State Express" and "Congressional Limited" during the two years the high-speed brake has been in service on those fast trains, is the remarkable record given by this powerful safety appliance which reduces the length of an emergency stop 25 per cent. under that made by the ordinary quick-action brake.

"I consider this one of the best treatises on air brakes that has ever been published, and I think it would be well for all of our engineers and firemen who are interested in this matter to procure a copy," is what one of the leading superintendents of motive power of the country has to say for the Proceedings of the Air-Brake Men's Third Annual Convention.

What is Port "A" For?

Editors:

Inclosed please find a fac-simile of a rotary valve seat in a brake valve on an engine running on the N. Y., C. & H. R. R.R. If possible, please produce it in "Locomotive Engineering" as a favor to a great many of your readers here, and let the air-brake doctors tell what the port "A" is for.



JOHN J. PLUNKETT,
Eng. N. Y. C. & H. R. R.R.
Syracuse, N. Y.

The automatic slack adjuster seems to be making steady progress. The fast mail running between Chicago and Denver on the C., B. & Q. Ry., Trains Nos. 5 and 6 on the Rock Island road, and the "Chicago & Northwestern Limited," running between Chicago and St. Paul, have recently been equipped with the McKee adjuster. The Pennsylvania Railroad has several McKee adjusters on trial on some fast freight cars.

The Big Four Railroad has recently launched a new air-brake instruction car which is well equipped with all necessary apparatus, and is in charge of W. J. Hartman, the air-brake inspector and instructor of that system.

The cord which once stretched through all passenger equipment cars for operating the conductor's valve is fast disappearing and is now seldom seen. In equipping with the signaling apparatus and the Pintsch gas it has been crowded out.

Air pumps are not the only things that heat during this torrid weather.

QUESTIONS AND ANSWERS

On Air-Brake Subjects.

(55) K. B., Jersey City, N. J., asks:

What sized pipes should be used on the standard 8-inch air pump? A.—¾-inch steam pipe, 1-inch exhaust pipe and ¾-inch discharge pipe.

(56) D. B. R., Boston, Mass., asks:

Is there any difference in the principle of the D-5 and E-6 equalizing brake valves? I do not understand why these valves are so named, and where the difference lies if there is any. A.—There is practically no difference in these two valves. For some little time after the D-5 valve came out, it was described in the catalog as D-5. Later, when a new catalog was made up and sent out, the same valve appeared under the head of E-6. There is virtually no difference except in the catalog number.

(57) G. C. C., Lowell, Mass., asks:

With an 8-inch brake cylinder, 10 x 24 auxiliary reservoir plain triple, 70 pounds train-line pressure, then make 20 pounds service reduction, what would be the cylinder pressure had with 1, 2, 3, 4, 5, 6, 7 and 8-inch piston travels, respectively? A.—The pressures will differ with the amount of piping used; but the following figures are about what would be obtained ordinarily: 1-inch, 64 pounds; 2-inch, 61 pounds; 3-inch, 59 pounds; 4-inch, 57 pounds; 5-inch, 55 pounds; 6-inch, 52 pounds; 7-inch, 50 pounds; 8-inch, 49 pounds; 9-inch, 47 pounds, and 10-inch, 44 pounds.

(58) J. S., Quincy, Ill., writes:

1. The Westinghouse Instruction Book gives ⅛ inch lift for the receiving valve of the 6-inch pump, and 1-16 inch for the discharge valve. Should not the lift of discharge valve be the greatest? 2. What lift would you recommend for the valves of the 8-inch pump. A.—1. The lift of the valves as prescribed in the book is right. 2. On the same page of the instruction book you will find the lift for the receiving and discharge valves of the 8-inch pump given, which is ⅛ inch and 3-32 inch respectively. This is also correct, but may be increased to 5-32 inch and ⅛ inch, respectively, on pumps which supply very long trains.

(59) M. C. M. H. asks:

Which gives the best results in service, the feed valve or the excess pressure valve on the D-5 engineer's brake valve? A.—The feed valve attachment gives the best results. The excess pressure valve found on some of the earlier D-5 brake valves was intended to do but temporary service, and is not a permanent fixture. When the D-5 valve was first issued it had a feed attachment that was not entirely satisfactory, and was therefore recalled by the Westinghouse Air-Brake Company, who furnished the excess pressure attachment to do service until such time as the feed attachment should be perfected and replaced. If there are any of these special excess pressure valves still out they should be exchanged for the regular feed-valve attachment which has been perfected.

(60) J. S., Medicine Hat, N. W. T., writes:

When making an emergency application of the brakes, and pressures have become equalized and the non-return check valve 15 has seated, will the emergency valve 10 seat, or does it remain off its seat until the pressure in the train pipe has been restored to release the brakes? A.—In venting train-pipe pressure into the brake cylinder in an emergency application of the brake the non-return check valve 15 remains open but a small fraction of a second, and then reseats. The emergency piston 8 and emergency valve 10 are held down by the auxiliary reservoir pressure on top of the piston until such time as the pressures in the brake cylinder and auxiliary reservoir have become equalized; then the spring 12 will gradually overcome the weight of the emergency piston and emergency valve, and force them up to their normal positions.

(61) T. S., Jersey City, N. J., writes:

1. Why is it that, in changing a four-wheeled engine from cam brake to outside-equalized form, that 16-inch shoes are substituted for the 24-inch shoes with the cam type? 2. Question 235 in Air Brake Men's Proceedings for 1896 states that the handle of the engineer's brake valve should be on lap position when coupling to the train for charging purposes. Why is this necessary? A.—1. The brake heads and shoes used on the outside-equalized form of driver brake are necessarily shorter on account of the limited space offered for attaching brakes on mogul and consolidated engines. Heads and shoes of this same pattern are frequently used on low eight-wheeled passenger engines from which a cam brake with longer shoes have been displaced. An eight-wheeled passenger engine with high wheels is usually given the same length shoes as are used on the cam-brake type. 2. In framing this answer, the committee has endeavored to include both the D-8 and E-6 brake valves. With the D-8 valve a higher pressure may be accumulated in the main reservoir by placing the handle on lap than elsewhere. With the E-6 valve nothing is gained in this respect, but nothing is lost.

(62) C. H. R., Louisville, Ky., writes:

1. What is expected of the graduating spring in the Westinghouse quick-action triple? 2. How would the triple work if the graduating spring was weak or broken? 3. On several occasions I have noticed that a brake would not apply with a service reduction of about 5 or 7 pounds when all of the other ones would apply, but after making a second application this particular brake would go on in the emergency. Please explain the cause of this triple working in that manner. I understand that a broken graduating pin is one cause of this. 4. What effect would this brake going on in quick action have on the other cars? A.—1. To prevent the triple piston from going into the emergency position with a service application on a short train. 2. It would go into the emergency when a service application was made on a short train, but if it were placed in a train with fifteen or twenty other brakes it would work all right. 3. The slide valve and triple piston are probably in need of oil, and have so much friction that 5 or 7 pounds will not start it; but after it is once dislodged, the preponderance of pressure in the auxiliary reservoir pushes the triple piston to the full emergency position. 4. It would have a tendency to throw the other brakes into quick action.

(63) G. L. L., Smith's Falls, writes:

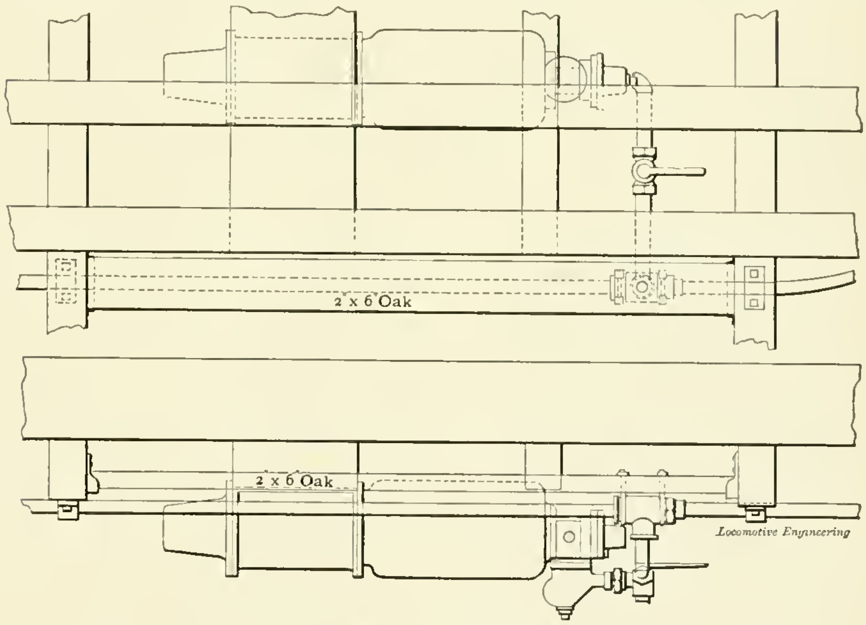
With two engines double-heading on a train, the brake valve on the head engine and the pump on the second engine give out. What would have to be done to get 90 pounds main reservoir pressure on the second engine and 70 pounds in the train line so that the brakes on the train could be worked, without changing any pipes. The only way I can see it could be done would be to have the brakes applied at the conductor's valve, and then pump the brakes off. A.—It would depend entirely upon what parts of the first engine's brake valve and second engine's pump had given out, whether anything could be done at all. Possibly an exchange of parts could be made that would allow one engine to do both the pumping and braking; but this question is framed with a view of making the head engine do the pumping and the second engine do the braking. The answer is to take the "works" out of both pressure-reducing valves and have the head engine supply the second engine's main reservoir with pressure. There are several combinations, however, that could be made that would not permit this scheme being worked. This question is a half-brother to Question No. 52 in August number of "Locomotive Engineering," and while affording good food for thought, its usefulness ends there. Its application to practice would be disappointing and unsatisfactory.

(64) J. W. C., Waco, Tex., writes:

I have studied out a plan whereby I can recharge auxiliary reservoirs while brakes are applied, without the use of an extra pipe or hose. The device can be used in connection with the Westinghouse quick-action triple, and would cost but little. Please inform me whether the necessity for such a device would justify the railroads in going to this additional cost. I have been informed that such improvements have been invented by others, but I do not understand why they have not been adopted. A.—Triple valves that would recharge the auxiliary reservoirs while brakes were set were first thought of quite some time ago, and patents were issued to George Boyden and several others; but there are substantial reasons why it would not do to embody in the triple valve a device for doing this work. These reasons will be best comprehended by thoroughly considering the varying conditions and many classes of service in which the air brake must work unerringly. The lifelong work of the inventor of the triple valve has been on lines that would insure the movement of the piston in either direction by differential pressures, without help or interference, and experience has decreed that the recharging device shall be separate and distinct from the triple-valve mechanisms; hence, the use of the pressure-retaining valve and the rejection of devices contained in or attached to the triple-valve mechanism.

(65) J. S., Quincy, Ill., writes:

1. What is the matter with a D-8 brake valve that will not set the brakes in the service application, the valve being all right? 2. What pressure is had in the brake cylinder with an emergency application? I know it is claimed that 10 per cent. of the train-line pressure goes in, but what is the total pressure? 3. In a three-car train, the first car having a 10-inch cylinder with 10-inch travel, the second car having an 8-inch cylinder with 8-inch travel, and the third car with a 10-inch cylinder with a 5½-inch piston travel, flat wheels are continually had on the third car. Is this not caused by the short travel on that car? 4. Will 8-inch cylinders and 10-inch cylinders work all right mixed together in same train? 5. With train-line pressure at 50 pounds, and a reduction of 20 pounds is made, what will be the pressure in the cylinder? 6. Cannot wheels be slid with 50 pounds train-line pressure and 20 pounds reduction as easily as with 70 pounds train-line pressure and 20 pounds reduction? A.—1. If the brake valve is all right it will set the brakes in the service application, unless the train pipe has been temporarily overcharged, as is frequently the case with a second application. 2. It varies with different piston travel and condition of triple valve, and ranges from 54 to 63 pounds. 3. Yes; most likely. 4. They may work fairly well, but, to get best results, passenger brakes should not be used on freight trains, and freight brakes should not be used on passenger trains. 5. With a 7 or 8 inch travel it will amount to about 35 pounds. 6. No.



ST. P., M. & O. PIPE CLAMP.

No fast passenger train should be without the high-speed brake and the engine-truck brake.

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A PRACTICAL JOURNAL of RAILWAY MOTIVE POWER AND ROLLING STOCK.

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Investigations of Train Resistances.

There appears to be something very strange, if not mysterious, about the diversity in the extent of train resistance as noted by the various engineers and investigators who have experimented to see how much power per ton was required to move trains at different speeds.

As the original purpose of railroads was to avoid the wheel and axle resistances due to the yielding character of common roads, it was natural that those who first employed iron rails for wheels to run upon should have experimented to find out the decrease in resistance due to the change. Investigations of this subject had made considerable progress before the railroad proper came into existence.

Toward the end of the last century, a Mr. Grimshaw, of Sunderland, England, made a great many experiments to find out the friction of wheel carriages running on iron rails. He found that a loaded carriage of a total weight of 8,522 pounds was moved with a pull of 50 pounds, or about $\frac{1}{170}$ of its weight. An empty car weighing 2,586 pounds, gave a resistance of 10 pounds.

About twenty years afterwards, in 1818, George Stephenson and Nicholas Wood made a series of experiments on the Killingworth Railway to ascertain the resistance of cars. Several dynamometers were made to record the resistance of the cars, and one, which proved the most successful, was a somewhat ingenious instrument. A special car was made, consisting principally of a triangular upright frame, from which was suspended a heavy leaden weight secured at the end of an iron rod. A quadrant was fulcrumed near the top of the rod, and by actual measurement the pull required to move the weight away from the perpendicular was marked upon the quadrant. By means of this instrument, and by descending grades of known steepness, numerous experiments were made, the purpose evidently being to find out what kind of wheels and axles produced the least resistance. The element of speed seemed to be ignored, and it is presumed that the tests were made at the ordinary car speed of the day, which was 4.5 miles an hour. The resistance varied from 10 to 15 pounds per short ton. From that time to the present day, there seems to have been always some engineer or scientist experimenting on the resistance of railway cars or locomotives.

In 1836, Pambour, author of a treatise on locomotive engines, designed a special form of dynamometer to determine the pull on the drawbar of a locomotive, and he made a great many experiments with it, but could demonstrate nothing with accuracy. The index of the balance, which constituted the principal part of the dynamometer, fluctuated so much that he could not strike a satisfactory average of the resistance. He supposed that he found out enough, however, to establish a mathematical formula for finding the extent of train resistance; but his formula was declared by subsequent experimenters to be inaccurate, and new formulas were several times established, the best known being that of D. K. Clark, which is still used by the engineering world and does not come near the truth. The early experimenters seemed to decide quite accurately on the various elements of train resistances, if they did not find out their extent.

In Wood's "Treatise on Locomotives," published in 1832, he says: "The resistance of wheel cars is referable to two separate causes, arising from the pressure or attrition upon the axles and the obstructions to the rolling of the wheels upon the rails. In the case of a body dragging along the surface of a plane, the whole weight of the body is subjected to the action of attrition over the whole surface of the plane, the parts subjected to attrition sliding over each other with the same velocity as the progressive motion of the body on the plane. On the contrary, if a body be cylindical and rolled upon a plane, no part of it is subjected to the action of attrition, the only resistence being that produced by the rolling of the periphery upon the plane. We have, therefore, two distinct species of friction—the friction of attrition acting upon the axles, and that of rolling acting upon the periphery of the wheel. Whenever two surfaces are brought into contact with each other and subjected to a determinate pressure, it requires a certain force to cause them to slide over each other; and the obstruction to the free motion of the car arising from this cause is called the friction of or resistance by attrition, and the retardation by the action of the periphery of the wheels rolling upon the rails, the rolling friction or resistance. As, in general, in all wheel carriages the two species are in motion at the same time, the friction of attrition commences when the bodies slide over each other." These facts being settled, the author of the first treatise on railroads proceeded mathematically to demonstrate that it was good practice to make car wheels as large in diameter as possible and journals as small.

The rules which D. K. Clark established for finding train resistance made out that at 25 miles an hour the resistance per long ton was about 10 pounds. This may not be far from the truth in regard to trains in Great Britain, because the lubricant used is of a pasty character, which increases the axial resistance somewhat, and the manner of coupling the cars at the sides increases the passenger train resistance on curves very much; but it has been well demonstrated in this country that train resistance at 25 miles an hour is seldom more than 7 or 8 pounds per ton.

The use of dynamometer cars by railroad companies has provided a means of ascertaining with fair accuracy the extent of train resistance, and it is very desirable that the result of the discoveries made should be given to the public. The Pennsylvania Railroad Company and the Chicago, Burlington & Quincy Railroad Company have had dynamometer cars in use for many years. The light which the officers in charge could throw upon the uncertainty of train resistance would be of great value to the railroad world. In view of what the Chicago, Burlington & Quincy people have found out about the resistance of trains, we are surprised to find in the Proceedings of the Western Railway Club a statement from Mr. William Forsyth, mechanical engineer of the Chicago, Burlington & Quincy, which says:

"We found on a level at 25 miles an hour the resistance of 59 empty box cars was 20 pounds per ton, and of 30 empty box cars 24 pounds to the ton; of 18 loaded stock cars the resistance was 13 pounds per ton, when one-third loaded it was 19 pounds per ton, and of these same cars, empty, the resistance was 21 pounds per ton. These figures," he continued, "are very nearly correct, and this shows that the ordinary figure which is assumed for train resistance must be largely increased for long trains and for trains which exceed 25 miles per hour."

This is a very extraordinary statement. The Clark formula, as has already been said, only makes a train resistance of about 10 pounds per ton at a speed of 25 miles an hour, and it is unquestionably too high for American trains.

On November 17, 1888, the "Engineering News" published a report on engine trials made the preceding winter on the Chicago, Burlington & Quincy, in which the results found by indicator and dynamometer car are given. Tests made with eight trains are published. The first train consisted of 327 tons; the weather was clear, without wind, and the record taken over 32 miles gave an average train resistance of 12.4 pounds at an average speed of 50 miles an hour. The second train of 344 tons, pulled over the same distance on the same day, gave an average train resistance of 9.5 pounds at an average speed of 44 miles an hour. On a clear day, with strong head wind, a train of 267 tons was run 25 miles at an average of 39.8 miles per hour, the resistance being 10 pounds per ton. A train of 289 tons on the same day was run 32 miles at an average speed of 44 miles an hour, the train resistance being 8 pounds per ton. Another day, a train of 317 tons was run 32 miles at an average speed of 41 miles an hour, the resistance recorded being 8.4 pounds per ton. On the same day, over the same distance, a train of 412 tons was run at 44 miles an hour, the resistance recorded being 9.3 pounds per ton. On a clear day, with strong side wind, a train was run 25 miles at an average speed of 43 miles per hour, the resistance being 18.5 pounds per ton. On the same day, another train of 329 tons was run 25 miles at an average speed of 39.5 miles per hour, the resistance being 13 pounds per ton. These runs were made on a fairly straight and level track.

The writer was present on the Chicago, Burlington & Quincy dynamometer car, seven or eight years ago, when tests were being made of various trains to ascertain the resistances. With one train of 36 loaded box cars and dynamometer car, a total of 940 tons, in the course of four readings the speed was 21.5 and the resistance 5.5 pounds per ton. With a train of 24 loaded cars and dynamometer car, a total of 615½ tons, which had an average speed of 26 miles per hour, the resistance recorded was 6.3 pounds per ton. With a train of 20 empty cars and dynamometer car, a total of 227 tons, an average of six readings at 20.5 miles per hour gave a train resistance of 7.7 pounds per ton, an average of 4 readings at 30 miles per hour gave the train resistance as 9.2 pounds per ton, an average of three readings at 48.8 miles per hour gave the train resistance as 11.35 per ton.

We have on several occasions enjoyed the privilege of examining the dynamometer car belonging to the Pennsylvania Railroad Company, and the train resistance agreed substantially with that given by the Chicago, Burlington & Quincy. If the figures of train resistance given by Mr. Forsyth were correct, the company does not have an engine that could pull 59 empty box cars at a speed of 25 miles an hour while cutting off at half stroke.

The Latest Grade Crossing Collision.

A terribly disastrous accident happened on July 30th at a level crossing on the Pennsylvania and Philadelphia & Reading railroads near Atlantic City, N J., whereby forty-seven persons were killed and many others seriously wounded, several of the latter having died from the injuries sustained. The tracks of these railroads cross each other diagonally on the level at an angle of about twenty degrees, and the crossing is protected on both railroads by interlocking signals. There are no derailing switches, which were evidently left off owing to the acute angle at which the tracks cross; otherwise every precaution that mechanical ingenuity has devised was taken to make the crossings perfectly safe.

The accident presents a melancholy proof of the fact, that no matter how highly perfected mechanical applications may be introduced to prevent railroad accidents, the human equation must be depended on to a very great extent. When a man running an engine, or a man in charge of a signal tower, blunders, there are liable to be accidents, no matter what great skill and expense have been incurred to make train-operating safe. In this particular case, the signalman, who was almost new to the job, found that two trains were approaching the crossing at the same time, and he had to decide which one should have the right of way. On the Pennsylvania railroad was an excursion train, and on the Philadelphia & Reading a fast express was approaching. Good judgment would have said, "Give the express the right of way," and the rules of the company required that that should be done; but the day in question the signalman lowered the signal for the Pennsylvania train and raised it against the express. From the testimony given at the coroner's inquest, the engineer of the express train applied the air brakes on seeing the signal against him; but he was running at such a high rate of speed that he was not able to stop before reaching the crossing, and crashed through the passenger train, which had not cleared the Philadelphia & Reading track. The engineer of the express train was killed, and therefore was unable to testify for himself; but the fireman, who escaped, gave evidence to the effect that the brakes were applied before the distant signal was reached. The blame of the accident has been put upon the dead engineer, and it is difficult to see how he could be exonerated from blame; but still there are circumstances connected with the accident which lead us to believe that any of the engineers running these express trains would probably have acted the same as the man on whom the responsibility for the accident is said to rest.

In the course of the inquest, evidence was given that the signalman stopped the express train a few nights before and it went over the crossing before being able to stop. The rules of the company require that the crossing should be approached with the train under control; but the pressure to make time with the fast train is so great that engineers get into the way of taking chances and approach crossings at too high a rate of speed. The evidence would seem to indicate that this was habitually the case at the Atlantic City crossing. It appears to us that this is another example of permitting rules to be ignored while everything goes well, and then bringing them up when an accident happens. It was the duty of some official of the Philadelphia & Reading Railroad to see that express trains did not approach this crossing at a dangerously high rate of speed. If it could be shown that this order was habitually neglected, the official in question ought to bear some of the responsibility of the accident.

The accident was a most deplorable one, and has caused great grief and suffering. Its principal lesson is, that all grade crossings ought to be abolished, for human ingenuity and the best of human care will not always be sufficient to prevent accidents where trains have to cross on the same spot. New England has been leading the rest of the country in abolishing grade crossings, with the result that accidents to trains in New England have been greatly diminished of late years. Railroad companies owe it to themselves and to the public to abolish grade crossings as quickly as possible. It is often a very expensive method of safety; but one severe accident will cost a great deal more than what it does to raise one track over the other.

Since the system of interlocking signals for grade crossings was thoroughly perfected, the practice of requiring a train to stop on approaching a crossing has been abolished in a great many States and on many railroads. It seemed to be a reflection on mechanical appliances that a train must stop at a crossing as a means of preventing accidents. It was a pretty sure means, however, and we do not know but what it would be better for railroad companies to go back to the old practice until they are able to effect the greater improvement of running one track above the other. The most improved forms of grade crossings require the use of derailing switches, which throw a train off the track if an attempt is made to cross while the signals are against it. That practice greatly increases the safety of a crossing, and a rule ought certainly to be made that, where derailing switches are not in use, trains should be compelled to stop at crossings, no matter what kind of signaling system is in use.

Small Profits from Railroad Property.

The demagogues of the country who are constantly howling about how the public is robbed by soulless railroad corporations will not find much comfort in the Annual Report of the Interstate Commerce Commission. A careful study of that report would show that railroad property is about the least productive of revenue of any kind of property that money has been invested in.

The report says that on June 30, 1895, 169 roads were reported in the hands of receivers, showing a net decrease of 23 during the year. The roads under receivers operated 37,855.80 miles of line, which shows a decrease of 2,963.01 as compared with 1894. The railway capital represented by these roads was nearly $2,500,000,000, or about 22.20 per cent. of the total railway capital in the United States.

The amount of railway capital on June 30, 1895, is shown to be $10,985,203,125, or $63,330 per mile of line. The increase during the year was $188,729,312. Railway capital was distributed as follows: The amount of capital stock was $4,961,258,656, of which $4,201,697,351 was common stock, and $759,561,305 preferred stock; the funded debt was $5,407,114,313, classified as bonds $4,659,873,548, miscellaneous obligations $445,221,472, income bonds $246,103,966, and equipment trust obligations $55,915,327; the current liabilities amounted to $616,830,156. Of the capital stock outstanding, $1,169,071,178, or 23.57 per cent., was owned by the railway corporations, as well as $437,508,841, or 9.39 per cent. of bonds outstanding. These figures show an increase in the corporate ownership of securities, probably rather due to railway consolidation than to the strengthening of reserve funds.

Stock to the amount of $3,475,640,203, or 70.05 per cent. of the total outstanding, paid no dividend, and $904,436,200, or 16.90 per cent. of funded debt, exclusive of equipment trust obligations, paid no interest during the year covered by the report. In no other year since the organization of the Division of Statistics has so large a percentage of stock passed its dividends, or, except in 1894, has so large a percentage of funded debt defaulted its interest. Of the stock paying dividends, 6.89 per cent of the total stock outstanding paid from 4 to 5 per cent., 5.39 per cent. of this stock paid from 5 to 6 per cent., 4.41 per cent. paid from 6 to 7 per cent., and 3.99 per cent. paid from 7 to 8 per cent. The total amount of dividends was $85,287,543, which would be produced by an average rate of 5.74 per cent. on the amount of stock on which some dividend was declared. The amount of bonds paying no interest was $624,702,293, or 13.41 per cent.; of miscellaneous obligations, $54,498,288, or 12.24 per cent.; of income bonds, $225,235,619, or 91.52 per cent.

Fixed charges for the year amounted to $425,966,921. In 1894 they were $3,041,389 greater. The deduction of fixed charges leaves $56,116,259 as net income from which to pay dividends. The amount of dividends, including $673,957 other payments from net income, was $85,961,500, from which it appears that the railways of the United States closed the year with a deficit from the year's operations of $29,845,241, which was met by a decrease in accumulated surplus, or by the creation of current liabilities. The corresponding deficit for the year ending June 30, 1894, was $45,851,294.

The Dangerous Engine Step.

We would direct the attention of people interested in the safety of enginemen, to the engine step used on the new locomotives of the Chicago, Rock Island & Pacific Railway, and illustrated in another part of this paper. The engine step is not a very conspicuous part of a locomotive, and that is probably why it has received so little attention, and why there are so many defective and awkward ones in use. American locomotives have been notorious for the awkward and defective arrangement of steps and handholds, which has led to many serious accidents through men falling when they were attempting to get up on the engine while in motion. The conditons of railroad services requires that men should frequently mount or get off the locomotive while in motion, and that being the case, the most convenient means ought to be provided to enable them to get up and down without accident.

Until three or four years ago there was very little said or done to improve engine steps, but we are pleased to notice that the subject is receiving considerable attention at present. The excellent report on "Steps and Handholds" presented by a committee of the Master Mechanics' Association, of which Mr. John Medway was chairman, has brought the subject prominently before railroad men, and it is to be hoped that within a very short time the awkward step, which is so common, will soon be a thing of the past.

Three years ago, a report submitted to the Master Mechanics' Association recommended that steps with risers, such as those used on the Rock Island engine referred to, should be introduced on all locomotives. Mr. J. Davis Barnett, who submitted that report, said while discussing it: "I see no reason why steps should be put up so very high, except it be to clear snow and other obstructions, and it seems to me a very poor reason to give, so that they might save a dollar a year. I think the practice exposes men to very great risk in jumping on engines when they are in motion. I think it would be better, even if we did lose an occasional step, that we put them so low down as to lessen that risk. I can see no justification for the additional risk we expose our men to by putting the steps so high. This, of course, is not an important subject, like that of tests of locomotives and the compound locomotive, but it is the first subject for a long time that did aim at a consideration for the comfort and convenience of the men daily employed on the engine." It was to the credit of the other speakers that they thoroughly indorsed the proposal to improve the arrangement of engine steps, and the general sentiment was that it was the most important subject which had been up for some time. Sentiment in favor of better steps has been developing ever since, and has received considerable discussion, which might yet be carried on with advantage. We commend the subject to the attention of railroad clubs, and hope they will bring it before the members to such an extent that no master mechanic will leave defective steps upon his engines for want of having his attention directed to this source of danger.

BOOK REVIEWS.

"A History of the Monetary Legislation and the Currency System of the United States." Embracing Rare and Valuable Documents. By the Honorable Robert E. Preston. John J. McVeigh, Philadelphia.

This is a book of 128 pages, replete with information which is of the very greatest value and interest to the people of the United States at the present day. It has been issued on behalf of no political party, but is a contribution to the cause of the sound and stable currency in which all American citizens, rich and poor alike, are interested. We have been hearing a great deal in the last few years about the dollar of our fathers, and the ratio on which gold and silver were originally coined in the United States, and at what ratio they ought to be coined to-day. Many people who talk glibly on the subject know very little about it, and we know of no method by which full information can be so readily obtained as by reading the book which we are writing about. It contains full particulars of the views held by Robert Morris, Thomas Jefferson, Alexander Hamilton, and the monetary principles held by other Fathers of the Republic. Those who are honestly desirous of understanding the money question of to-day ought to send for this book and study it carefully. Apart from its political aspect, the book is very interesting from a historical view, and contains facts about the development of our monetary system which every citizen ought to be acquainted with.

"Les Locomotives Suisses." Par Camille Barbey. Ouvrage Illustre de 80 Phototypies et de 81 Planches hors Texte. Avec une Carte des Chemins de Fer Suisses. Geneve: Ch. Eggimann & Cie, Libraires-Editeurs, 1896.

This book, which the author has dedicated to his wife, is one of the handsomest engineering publications we have ever examined. It is $11\frac{1}{2} \times 15$ inches and gives ample size for good illustrations. Although the text is in the French language, the greater part of the book consists of the universal language of drawings and engravings. In the introduction the author says: "The study which we present to the reader is intended specially for the engineers of the rolling-stock department. It has no pretensions at being scientific or didactic; it is a simple treatise which has no other end except to make known the divers types of locomotives employed on the railways of a country, in a great part mountainous, where the traction service presents peculiar conditions. The railways of Switzerland were developed so rapidly that, in spite of the Alps and the glaciers, which cover a great part of the territory of the Confederation, the railway mileage covers a third in length per kilometer to the number of inhabitants." The book contains illustrations of the greatest variety of types of locomotives of any work we are acquainted with. The 80 "phototypies"—so called in the description—are very handsome engravings, similar to a halftone, but much more distinct. Besides that, there are 81 pages of line engravings, giving elaborate details of locomotives and their attachments. One thing which strikes the reader in going over the book, is the strong influence which American designs have exercised on the designing of locomotives for the Swiss railways. The conditions are, to a great extent, similar to those found in the mountainous parts of this country, and the same conditions naturally call for similar designs. The "mogul" seems to be a favorite with Swiss engineers, and quite a number of this type of engines have been illustrated. In the description of the first one shown the author says: "We have here one of the most interesting types of locomotives, and which has met, in all countries, great favor of late years. It is the machine which the Americans have baptized by the name of 'mogul type,' that designation following the name of the first machine of the kind constructed. It is certain that these machines of the diverse varieties in use form a locomotive which has given excellent results on Western lines. It is admirably adapted to the needs of traction in Switzerland, be it for passenger service or for that of freight, and is in use on a great many lines. It is greatly used in the United States, the country where it originated. The Orleans Company, of France, had a locomotive of this type at the Paris Exposition in 1889; the company of the North showed the same machine of the Sauvage type, with three cylinders. In Belgium, this powerful locomotive pulled express trains of 110 tons at a velocity of sixty kilometers [37 miles] an hour, on grades of 16 millimeters [10 feet to the mile]. The railways of Prussia possess a series of 'mogul' locomotives. With us, four or five car companies have machines of this type." Engines of the eight-wheel American type are very common, evidently, from the number of illustrations shown, and there are a few ten-wheelers, similar to those used in America. For the heavier types of mountain engines, they have eight-wheel connected engines without a pony truck. There are peculiarities of construction in some of the engines that are very interesting to examine, and will be found a useful study for those having to design locomotives; to such men we warmly advocate a careful study of the work. We have not learned what the price of the book is, but we will engage to procure it for anyone wanting it.

The telegraph operators on the line of the Union Pacific have filed a suit in the Federal Courts, alleging that the receivers have reduced wages in violation of Judge Caldwell's order of 1894, wherein the Court ruled that no cut in wages could be enforced without an order of the Court. They specify where wages have been cut, and ask to have them restored. It is further alleged in the complaint that officials of the company have showed themselves hostile to organized labor, particularly to the order of Railway Telegraphers, and that a systematic effort has been made to weed out leaders of the order by summary dismissal without excuse.

EQUIPMENT NOTES.

W. R. Grace & Co. are building twenty-three cars for the Chili State Railways.

Dardanelle & Russell are having one locomotive built by H. K. Porter & Co.

The Baldwin Locomotive Works are building one locomotive for the Dry Fork Railway.

The Georgia Railroad has ordered 325 freight cars built by the Ohio Falls Car Company.

The Georgia Railroad are having four locomotives built by the Baldwin Locomotive Works.

The Alton Terminal Company is having eight freight cars built by the St. Charles Car Co.

The Denver & Rio Grande are about to build or purchase some passenger locomotives of a new type.

The Baltimore & Ohio Railway is having fourteen engines built at the Baldwin Locomotive Works.

The Baltimore & Ohio Railroad is having six locomotives built at the Baldwin Locomotive Works.

Nelson Morris & Co. are having fifty-seven freight cars built by the United States Car Company.

The Pittsburgh Locomotive Works are building twenty locomotives for the Baltimore & Ohio Railroad.

The Terre Haute Car Company is building fifty freight cars for the Terre Haute & Indianapolis Railway.

The Rogers Locomotive Works are building two locomotives for the Atlanta & West Point Railroad.

The Peninsula Car Company is building 100 freight cars for the Chicago, Rock Island & Pacific Railway.

The Lehigh Valley Railroad is having six passenger coaches built by the Pullman Palace Car Company.

The Baldwin Locomotive Works are building five locomotives for the Philadelphia & Reading Railroad.

The Midland Georgia & Atlantic Railway is having one locomotive built at the Baldwin Locomotive Works.

The Haskell & Barker Company is building 1,000 freight cars for the Chicago & Northwestern Railway.

The Denver & Rio Grande Railway Company is having two locomotives built by the Baldwin Locomotive Works.

The Berwind White Coal & Mining Company is having seventy-five freight cars built by the Middletown Car Works.

The Lake Manitoba Railway Company is having two locomotives built by the Canada Locomotive & Engine Company.

The Lancaster Railway Construction Company is building two passenger coaches for the Santa Anna Railway Company.

The Alabama Great Southern Railway is having four locomotives built by the Richmond Locomotive & Machine Company.

The Pullman Palace Car Company is building two passenger coaches for the Santa Fé, Prescott & Phoenix Railway Company.

The Denver & Rio Grande people are going to build a dynamometer car for the purpose of testing the tractive power of the various locomotives while working on mountain grades.

The Grand Trunk Railway Company has, we understand, arranged to consolidate all its car-building and car-repairing shops west of Toronto, at London, Ont., the road to receive from the latter city a bonus of $100,000 for the transfer. Plans for the new plant are now under way. The shops are to be equipped with the best line of wood-working machinery to be had.

A circular, issued by Mr. John W. Cloud, secretary of the Master Car-Builders' Association, calls attention to page 23 of the Revised Rules of Interchange for 1896, which go into effect September 1st. The circular reads: "The credit for the second item in the table is 80 cents, the same as the credit for the fourth item. The character after the dollar mark in the credit for the second item is not a figure, but is a defect in printing, and may not appear in all the copies of the rules."

Our English cousins are waking up to the fact that cast-steel wheels are a good thing for locomotives, and they are scrapping the wrought-iron wheels and replacing them with cast-steel. The four-wheeled or American type of truck is being introduced on all lines where the curvature will allow of it. This is evidence that the crust of conservatism is growing thinner and beautifully less. They are using for journal bearings a solid block of babbitt under cars, and it is said that they give highly satisfactory service.

The Association of Railway Superintendents of Bridges and Buildings will hold a meeting at the Leland Hotel, Chicago, on October 20th. They are going to discuss a variety of important subjects connected with their business, one of which is, mechanical action and resultant effects of motive power at high speed on bridges. It would be a good plan for them to invite railroad mechanical men to take part in the discussion of this subject.

The Master Car and Locomotive Painters' Association will meet in convention at the Park Avenue Hotel, New York, on September 9th. A variety of important subjects, connected with their business, will be reported upon.

PERSONAL.

Mr. C. H. Cannon, superintendent of car service of the Great Northern, has had his title changed to car accountant.

Mr. W. A. Walden, master mechanic at the Charlotte, N. C., shops of the Southern Railway, has been transferred to Burlington, N. C.

Mr. T. S. Inge, for some time master mechanic of the Southern Railway shops at Burlington, N. C., has been transferred to Columbia, S. C.

Mr. S. R. Tuggle has been appointed superintendent of motive power and machinery of the Galveston, La Porte & Houston Railway.

President Hill, of the Great Northern Railway, has appointed his former secretary, F. E. Ward, to the position of assistant to the president.

Mr. J. R. Herndon, car foreman of the Texas & Pacific Railroad at Longview, Tex., will succeed Mr. Coffin as foreman of the Texas & Pacific shops.

Mr. D. W. McLean, master car builder of the Kansas City, Fort Scott & Memphis Railroad at Fort Scott, Kan., died at Grand Rapids, Mich., July 27th.

Mr. J. N. Scrogin has been appointed master mechanic of the St. Louis Southwestern and of the Texas & Tyler Southeastern, with headquarters at Tyler, Texas.

Mr. J. R. King has been appointed trainmaster of the Interoceanic Railway of Mexico. He has been for some years a passenger conductor on the Mexican Central Railway.

Mr. J. T. Slatten has been appointed general freight and passenger agent and auditor of the Chattanooga Southern Railway, to take the place of Mr. H. P. Eagar, resigned.

Mr. William S. McGowan, jr., has been elected treasurer of the Hancock Inspirator Company, *vice* Mr. Edward P. Noyes, resigned, the appointment taking effect August 1st.

Mr. B. F. Yoakum was tendered a farewell banquet by his friends at Galveston, Tex., July 31st, on his retiring from the office of general manager of the Gulf, Colorado & Santa Fé Railway.

Mr. Jos. McWilliams has been appointed superintendent of the Marietta & North Georgia, with headquarters at Marietta, Ga. He was formerly general superintendent of the Texas Central.

Mr. W. J. Harrahan has been appointed superintendent of the Chesapeake & Ohio Southwestern divisions of the Illinois Central, with headquarters at Louisville, Ky. He is the son of Vice-President Harrahan.

Mr. W. E. Coffin, formerly foreman of the Texas & Pacific car shops at Marshall, Tex., has resigned that office to accept the position of traveling agent for the Cleveland Malleable Iron Company, of Cleveland, O.

Mr. Wm. Sinnott, formerly general foreman of the Baltimore & Ohio shops at Philadelphia, has been promoted to be division master mechanic of the Second and Third divisions, with headquarters at Cumberland, Md.

Miss Mary Powers has been appointed purchasing agent of the Rio Grande & Eagle Pass Railroad, with headquarters at Laredo, Texas. This is the first case that has come to our knowledge of a lady being appointed purchasing agent.

Mr. A. C. Shands, assistant engineer of the Pennsylvania Railroad at Altoona, Pa., has tendered his resignation. A partnership has been entered into between Mr. Shands and Mr. D. F. O'Rourke with Wm. E. Howley, of Pittsburgh.

Mr. W. H. Kellogg, for several years connected with the Southern Railway at Birmingham, Ala., as air-brake inspector, has accepted the position of air-brake instructor for the Chicago & Eastern Illinois, with headquarters at Daville.

Mr. Wm. Pratt, formerly division engineer of the Baltimore & Ohio Railroad, with jurisdiction between Washington and Philadelphia, has been appointed to the professorship of mechanical and electrical engineering at Delaware College.

Mr. James Gaston has been appointed master car builder of the Louisville, Evansville & St. Louis Railroad, with headquarters at Princeton, Ind. He was formerly with the Ohio Southern, and takes the place of Mr. W. E. Looney, resigned.

Mr. Edward S. Washburn, vice-president of the Kansas City, Fort Scott & Memphis Railroad, and who has been acting president since the death of Mr. George H. Nettleton, has been elected president at a meeting of the board of directors.

Mr. A. S. J. Holt, general agent in Cincinnati of the Grand Rapids & Indiana Railroad, has been appointed general agent of the Star Union Line, to succeed Mr. H. Wilson Browne, who has been general agent of the Star Union Line for more than thirty-two years.

Mr. John Evans, an old-time master mechanic of the Northern Pacific Railroad, has been appointed master mechanic of the Washington & Columbia River Railway at Wallula Junction, succeeding Mr. Wm. Saxton, who has held the above position for the past few years.

Mr. H. A. Wilson, district passenger agent of the Columbus, Hocking Valley & Toledo Railroad, with headquarters at Toledo, has resigned, and Mr. A. J. Richter, who was formerly city passenger agent of the Pennsylvania lines at Cincinnati, has been appointed to succeed him.

Mr. W. H. Hill, late chief clerk to Vice-President Finley, of the Great Northern, has received the appointment of assistant general freight agent of that road, by which he succeeds Mr. W. J. Evans, now general agent at St. Louis. Mr. Hill is a nephew of Mr. J. J. Hill, president of the Great Northern.

Mr. A. G. Wright has been appointed division master mechanic of the Chicago, St. Paul, Minneapolis & Omaha Railroad, with headquarters at Altoona, Wisconsin. He takes the place of Mr. W. E. Amann, who has gone with the Galena Oil Company to represent their interests on the Southern Pacific.

Mr. Wm. White, for a long time superintendent of the Texas Trunk Railroad, has been appointed receiver of that property, his appointment dating from August 13th and his duties beginning September 1st. Mr. White succeeds Mr. Geo. T. Atkins, who has had charge of the road for the past three years.

An order from the office of the general manager of the Norfolk & Western Railway abolishes the office of general superintendent, held by the late A. C. Hippey. The offices of division superintendents of motive power are also abolished, the officers holding these positions now filling the duties of assistants to the superintendent of motive power.

Mr. George Flanders, formerly city ticket agent of the Northern Pacific at St. Paul, Minn., has resigned that office to be a newspaper man. He is now railroad editor on the St. Paul "Globe"—a position where he can use his well-known hustling qualities to the best advantage. He has been succeeded on the Northern Pacific by Mr. C. C. Trott.

Mr. A. C. Hippey, late superintendent of the Norfolk & Western, who died in Roanoke, Va., on August 10th, was interred in that city last Wednesday. The funeral services were held at his residence and were attended by an immense concourse of people, in which all branches of the service of the road over which he formerly presided, were represented.

Mr. Henry Kistner has been appointed general foreman of motive power and car department of the Monterey & Mexican Gulf Railroad, with headquarters at Monterey, Mex. Mr. Kistner had been in the employ of the above company for a number of years in the capacity of locomotive engineer, and had been roundhouse foreman at Monterey for one year previous to this appointment.

Mr. Frederick Harrison, general manager of the London & Northwestern Railway, and Mr. Robert Turnbull, superintendent of the same line, are expected to arrive in New York on the "Lucania."

The probabilities are that they will remain in New York a few days only and then depart for the Pacific Coast. They are expected to return to New York by way of Canada late in the fall.

S. D. Worden, the Southern Pacific striker who was convicted of murder in connection with a wreck which he caused during the railway strike of two years ago, has managed so far to escape the death penalty to which he was sentenced; but his case was appealed to the Supreme Court, and a decision was rendered last month to the effect that Worden must die for the crime committed.

Mr. F. C. Day, at one time general freight agent of the South California, has received the appointment of general freight agent of the Atchison, Topeka & Santa Fé at Topeka. This is the second incumbency of the same office by Mr. Day. he having been transferred to the South California in January, 1895, the office of general freight agent on the Atchison, Topeka & Santa Fé having been vacant since that time.

Mr. J. B. Flanders has been promoted from superintendent to be general superintendent of the Cincinnati, Jackson & Mackinaw Railway. Mr. Flanders began railroading on the Ohio & Mississippi, and rose through the train service, in which he was engaged till about ten years ago, when he was appointed trainmaster of the Missouri Pacific Railway. He left that position to become superintendent of the road which he now serves.

When the Illinois Central secured control of the Chesapeake & Ohio Southwestern lines, they transferred Mr. M. Gilleas, assistant superintendent of the Illinois Southern lines at Memphis, to take charge of the new property at Louisville. The people of Memphis, however, made such a vigorous protest against the removal of officers of the Illinois Central from their city, that the railroad company have consented to let Mr. Gilleas remain at Memphis.

Mr. M. N. Forney has opened an office as consulting engineer at 41 Cortlandt street, New York City. He is prepared to furnish designs, drawings and specifications for all sorts of railroad equipments and shops. He will also make investigations concerning the efficiency of railway machinery of all sorts. Mr. Forney expresses himself as being heartily tired of journalism, and looks forward to a life of ease in following the profession of mechanical engineer.

Mr. James Dredge, editor of "Engineering," of London, has been appointed commissioner general of Great Britain to the International Exposition, to be held at Brussels. Mr. Dredge is author of the famous book, "The Pennsylvania Railroad, Its Organization, Construction and Management," which is the most extensive work concerning a single railroad ever published, and he is probably the most eminent editor of an engineering paper in the world.

Mr. George B. Hazlehurst, who was for many years connected with the Baltimore & Ohio Railway, and was during the latter part of his employment general superintendent of motive power, has become a partner in the construction firm of Jones, Pollard & Co., of Baltimore. Mr. Hazlehurst is a civil engineer, with a great deal of experience in bridge construction, and this knowledge will be utilized in his connection with the new firm, where he will superintend the construction of bridges and buildings.

Mr. John D. Campbell has been appointed superintendent of the Dickson Locomotive Works, at Scranton, Pa. Mr. Campbell has had a great deal of experience as a railroad mechanic, and was for several years assistant to Mr. Wm. Buchanan, of the New York Central, and had charge in putting in the equipment of the large shops at Depew. It is understood that he will be engaged reorganizing the Dickson Locomotive Works, in order to put them on a more modern basis for doing locomotive work in competition with other locomotive builders.

In the course of an address delivered to the students of Wisconsin University, Mr. L. F. Loree, general manager of the Pennsylvania lines, attributed the lessened destructiveness of train accidents, which is every year becoming more apparent, to improvements in roadbed, bridges and track; in the construction of locomotives and cars; in the adoption of the Miller platform, couplers of the Master Car-Builders' type, the Westinghouse air brake, interlocking apparatus and signaling devices. He expressed the opinion that there is a tendency at present to overdo the work of block signaling.

Mr. John A. Jackman died at his home in Bloomington, Ill., July 29th, at the age of eighty years. Mr. Jackman was superintendent of machinery of the Chicago & Alton Railroad from 1864 to 1879, and at that time was regarded as a high railroad authority in motive-power matters. He began his railroad career in 1837 on the Boston & Worcester, remaining there until 1852, when he went to the Toledo & Cleveland in the capacity of superintendent. He returned to the Boston & Worcester in 1859 as superintendent of machinery, and remained with that road until he accepted the above position on the Chicago & Alton.

Mr. Walter N. Hoag has been appointed car accountant of the West Shore Railroad, succeeding Mr. W. W. Wheatley, who resigned that position to take charge of the Brooklyn Heights Street Railway as superintendent. Mr. Hoag's connection with the West Shore dates from the time its rails were laid, as train dispatcher of the Hudson division. While he is a comparatively young man, he has been in railroad service since 1876. Prior to his connection with the West Shore, he was in the service of the New York division of the Pennsylvania, and still prior to that he was on the Newburgh, Dutchess & Columbia as station agent.

Engineer Claud Ayers, of the Fort Worth & Denver City Railroad, recently made a delay report for his train that is a little out of the common in this day and age. A delay of fifteen minutes was reported between Amorilla and Goodnight, in Texas, on account of buffaloes on the track. Master Mechanic E. W. Hayes notifies us, however, that the buffaloes were tame and belonged to a ranchman who has a herd of them, which is the only one known of outside of the Yellowstone Park. Many of the old engineers in Texas remember the days when delays on account of buffaloes were not uncommon, but it is a long time since a case of the kind has been reported.

Mr. James W. Wood, one of the oldest engineers in the service of the New York Central Railroad, has been retired on a pension. He began work on the Syracuse & Auburn Railroad, over forty-five years ago, as fireman. Two years afterwards he was running a locomotive, and has continued to do so to the present time. He was a very careful and prudent engineer, and was known on the New York Central as "Commodore Vanderbilt's engineer." In March, 1876, he made a run with Commodore Vanderbilt from Buffalo to Syracuse, a distance of 158 miles, in two hours and forty-five minutes, which was considered a very extraordinary run in those days, and was only twenty minutes longer than the time made by the special train which ran from New York to Buffalo last year as a record breaker.

General Manager Hallstead, of the Delaware, Lackawanna & Western is something of a joker in a grim fashion, but he sometimes gets the art turned upon himself. He also entertains decided views against giving passes to people not in the employ of the company. It is told that one day a well-known resident of Scranton walked into Mr. Hallstead's office and asked for a pass to New York and back. "Why should this company give you a free ride?" demanded the G. M. "Because I have been a good friend of the road," replied the would-be dead-head. Then Mr. Hallstead took out his pocketbook and counted out enough money to pay for a ticket to New York and back, and pushed it towards the well-known resident. The bluff did not work. The money was coolly gathered up, and the last seen of the man was his being pushed off the New York train by the conductor because he had no ticket and was trying to work another free ride on his cheek.

The Allen Valve.

Ever since steam engineers came to realize that the economical use of steam in the cylinders of a steam engine depended, to a great extent, upon reduction of pressure due to performance of work, unceasing efforts have been made to secure the highest possible initial and the lowest practical terminal pressure of steam. With engines having slow moving pistons, inventors have devoted themselves principally to the designing of valve mechanism that would produce quick openings for admission and exhaust, combined with a prompt cut-off. This line of development was perfectly efficient for the class of engines referred to, but there were certain types of high-speed engines which required the exercise of great ingenuity in order to make the admission opening sufficiently large to secure good results while cutting off short. The difficulty of doing this satisfactorily was particularly pronounced in high-speed reversing engines, such as the locomotive. With such engines, a liberal port opening, a short cut-off and a prompt release do not go harmoniously together, and great ingenuity has been exercised to perform these three important functions in a satisfactory manner.

In the early days of locomotive engineering, numerous attempts were made to obtain quick admission, prompt cut-off and prolonged exhaust opening by means of auxiliary mechanism, such as independent cut-off valves, but the complication was so great that the cost of maintenance overbalanced the saving produced by the superior steam distribution. It seemed for a time that the plain slide valve, actuated by a link motion, was destined to be the only practical form of valve gear for locomotives; but the contest among inventors of high-speed stationary engines brought forth an invention which has materially added to the efficiency of the locomotive slide valve for high-speed purposes.

This invention is the Allen valve, which has a supplementary port through the body of the valve, by which steam passes from one side of the valve to the other, and gives practically a double steam opening. Locomotive men in this country have been rather slow to acknowledge the advantage of the Allen port, but it is slowly forcing its way into favor, and every demand for high speed of railway trains is likely to make it more popular with the men who are responsible for getting trains over the road at the speed demanded by the operating departments.

With a valve having the Allen port, the steam port is opened sooner, remains open longer and is closed more quickly than with the simple slide. The effect of this is, that where the Allen valve is employed, steam is got into the cylinder at a higher initial pressure, has less initial expansion than with the common slide, and when the valve is properly set has the exhaust opening delayed. The practical effect of this improvement is, that engines in service do much better work than those with the common valve. They save steam and coal, and can take a train over a road on better time than those that have not got this improvement.

Someone using engines with this valve, reported to a committee of the Master Mechanics' Association that the engines were good for one or two more cars than the engines with the plain valve. The general testimony of those who have used the Allen valve is so decidedly in its favor that we are surprised it is not making more rapid headway into favor than it is doing. Indicator diagrams, taken by a committee of the Master Mechanics' Association, which investigated the subject of slide valves and reported at last convention, would seem to prove that the claims of the friends of this valve are well founded. Where the piston speed was high, it could be seen very plainly by the indicator diagram that the distribution of steam was much better when regulated by the Allen valve than with the others—at least, there was a higher ratio of expansion for doing a given amount of work, and consequently the steam would be used more economically. The steam was admitted at a higher pressure and released at a lower pressure than it was when the plain slide valve was employed under the same conditions. It was not demonstrated by the tests that the valve saved any fuel; but the ordinary reasoning concerning the operation of a steam engine would lead those familiar with the subject to expect that a considerable saving of fuel would result from the use of the valve for high-speed engines when the diagrams indicated less steam used per horse-power developed. We have known of several cases where engines using the Allen valve were able to run farther without taking water than those using the plain valve, which seems to be the best kind of evidence in favor of the resulting economy. The Allen valve does not offer any advantages with a freight engine or other locomotive, where the piston speed is rarely above 800 feet per minute; consequently, for that kind of service it is no doubt just as well to use the plain slide valve.

The Czar Patent Examiner.

It is difficult to find anyone who has had much business to do with the United States Patent Office who does not hold a very strong opinion regarding necessity for radical reforms in the way of doing business in that government department. As long ago as 1872 a Commissioner of Patents remarked: "There being no authoritative review of the work of the examiners, there is no protection against hasty and careless examinations, and, what is still worse, the door is thrown wide open to incessant importunings and to corrupt influences of every kind." Since that authoritative opinion was expressed, the methods of doing business have been growing worse every year, and the opinion concerning the business of the bureau, of those best acquainted with its work, is that there is practically no check against carelessness, ignorance and fraud.

A remarkably strong case against the existing methods in the Patent Office has recently been made out by Mr. James A. Whitney, and published in a pamphlet named "The Patent Office and the Problem of Reform." Concerning examiners, this pamphlet says:

"The Akhoond of Swat is not more absolute within his renowned dominion than is a Primary Examiner in control of a division who chooses to place his notions ahead of his official duty. There is, in fact, no functionary anywhere (with one solitary exception, that exception being an 'Assistant Examiner-in-charge') who is liable to be afflicted with so altitudinous a consciousness of personal exaltation, or through whom this weakness of human nature may do more harm. He may reject an application upon an alleged reference which has nothing to do with the case, and when the applicant has carefully demonstrated this, he may repeat his action, with the result of compelling an appeal, with additional expense, to the Board of Examiners-in-chief. If overruled by the latter, he may 'discover' a new reference which has been 'accidentally overlooked,' and reject the case again, thus placing before the applicant the alternative of further appeal and additional outlay, or of abandoning his application altogether. He may embarrass an application by absurd verbal criticisms, which the applicant or his representative is expected to meet with an aspect of submissive deference and grave respect, or may make requirements not expected or required by other examiners, and which may be futile upon their face, and may be irremediable in their results, and which cause annoyance and delay.

"Cases are not unknown where applications that, with proper regard to the rights of the inventor, could have been passed to issue in two or three months, have been kept dangling before the Patent Office for as many years, and this by the manifestly intentional perversity of an examiner.

"An examiner may do all this, and there is practically no remedy for it. He may do even worse than this, and equally without reparation. He may allow the application, when, in fact, there is an available reference which should defeat it, and which renders the patent invalid if granted. The time devoted to technicalities by an examiner is, of course, just so much abstracted from that available for legitimate work, and an official who devotes his energies to obstructing the just claims of inventors is commonly of too small a caliber to be able to do much else.

Under the present system, therefore, an ill-disposed examiner not only has it in his power to deny rights to those who are entitled to them, but is also likely to accord rights to those who have no lawful claim to them. It is no benefit to an inventor to receive a patent which is clearly anticipated in the prior state of the art. Such a patent is a delusion and a snare, a trap to the patentee, and a wrong to the public."

Rolling Stock Equipment.

The increase in number of locomotives in service during the last year, says the Interstate Commerce Report, was 207, the total number on June 30, 1895, being 35,699. Of this number, 9,999 were passenger locomotives, 20,012 were freight locomotives, 5,100 were switching locomotives, and 588 were unclassified. The number of cars of all classes reported, being those owned by railways, was 1,270,561, which indicates a decrease of 7,517 as compared with the previous year. Of the total cars reported, 33,112 were in passenger service, 1,196,119 were in freight service, and the remainder, 41,330, were cars used by the reporting companies in their own service. There was an increase of 94 in the number of passenger cars, and an increase of 1,439 in cars assigned to company's service, but cars in freight service decreased 9,050.

The explanation of this decrease is not wholly to be found in an effort on the part of the railway companies to economize in equipment, but rather in the increased use made of private cars. From the summaries given it appears that there was a decreased efficiency in passenger service, and an increased efficiency in freight service during the year covered by the report. The number of passengers carried per passenger locomotive was 50,747, or 3,907 less than in 1894.

The number of passenger miles per passenger locomotive was 1,218,967, or 225,433 less than in 1894, while the number of passenger cars per 1,000,000 passengers carried was 65, or 12 greater than the preceding year. This is probably largely due to decreased travel on account of business depression, but it also suggests that passenger traffic has returned to its normal condition previous to the World's Columbian Exposition.

The number of tons of freight carried per freight locomotive in 1895 was 34,817, showing an increase of 2,908 when compared with the corresponding figures for 1894 The number of ton-miles per freight locomotive was 4,258,821, the increase over the previous year being 242,066. These figures indicate increased economy in transportation of freight. The same result is shown by the fact that 1,888 freight cars were required to move 1,000,000 tons of freight in 1894, and 1,717 in 1895. These figures, however, are not satisfactory, because the basis of the computations does not include cars not owned by railway companies, in which a large proportion of freight is transported.

Out of a total equipment of 1,306,260 locomotives and cars, only 362,498 were fitted with train brakes, and 408,856 with automatic couplers on June 30, 1895. The increase in equipment fitted with train brakes was 31,506, with automatic couplers, 51,235. The summaries presented show that almost all passenger locomotives are fitted with train brakes, and 16,712, out of 20,012 freight locomotives have them. The number of passenger locomotives fitted with automatic couplers on June 30, 1895, was 3,893, the increase during the year being 414. It appears that 6,106 passenger locomotives were without automatic couplers. The number of freight locomotives fitted with automatic couplers was 2,039, the increase during the year being 731; but as there were 20,012 locomotives in freight service, the deficiency in respect to automatic couplers is marked. On June 30, 1895, the number of passenger cars in service was 33,112, of which 32,384 were fitted with train brakes, and 31,971 with automatic couplers. The number of freight cars in service was 1,196,119, of which 295,073 were fitted with train brakes, and 366,985 with automatic couplers. It appears that the passenger service is well equipped with automatic safety appliances, but that the freight service is greatly deficient in this respect.

Rails Bent by Action of Driving Wheels.

During a discussion on the counterbalancing of driving wheels, Mr. Pulaski Leeds, of the Louisville & Nashville, gave some interesting particulars about the bending of rails on his road by the driving wheels of certain consolidation locomotives. The attention of Mr. Leeds was directed by the track department to the bending of rails, and he proceeded systematically to investigate the cause. A peculiarity about the bending was, that the rails bent sidewise and not vertically, as is usually the case when the counterbalance is too heavy. There seemed to be no bending action produced by the driving wheels until the speed was over 48 miles an hour. The bends were produced first at one side and then at the other, evidently by alternate blows from the sides of driving wheels.

They found, on investigation, that the main driving wheels were about 600 pounds short of the correct weight for counterbalance, and this weight was distributed between the back and front wheels of the engine. On account of this excessive counterbalance, which gave an oscillating motion to the engine, the driving wheels rocked from side to side. By using lead, they managed to get the proper weight into the main drivers. They then took the extra weight out of the other wheels, and it put an end to the trouble from the bending of rails.

As it is very difficult to get the full counterbalance weight into the drivers of small-wheeled consolidation engines, it is a common practice to distribute the surplus weight among the other wheels. On railroads where this practice is followed, it would be well to watch the track to see if results similar to those discovered on the Louisville & Nashville are not produced from the same cause on other roads. Lateral bending of rails might very likely be attributed to some other cause than that of the effect of improper counterbalance of locomotives, and it is therefore the more important to make a case of this kind public when the real cause of the trouble is discovered.

Japan and its Railways.

American manufacturers have supplied much goods to Japanese railways, and there is likely to be so much increase of trade between the two countries that a few facts about Japan and its railways may be of interest to our readers.

The Japanese Empire comprises a number of islands, the four principal ones making an aggregate of nearly 150,000 square miles. All the islands are long and narrow, the principal one being 870 miles in length and only 90 miles broad. The first railway was opened in 1872; at the present time there are nearly 2,500 miles in operation or about to be opened. Most of the railways are single-track, and are operated by the staff system, which divides a road up into sections that trains pass over under the protection of a staff and tickets.

When railroad building was first begun in Japan, all the leading officials were European or American; but the natives have learned the business of railroading very rapidly, and there are now very few foreigners employed on any of the lines. Railways in Japan have got to contend with a difficulty which is rarely experienced in other parts of the world, *i. e.*, recurring earthquake shocks, which shake down bridges and buildings and twist the tracks into very awkward positions.

The rolling-stock equipment of the Japanese railways is of a somewhat diverse character: the greater part of the cars and locomotives are English make, but American builders come in as a good second, with a tendency to take the greater part of new orders. The cars are of the English compartment style, and the freight cars are also made after the English type. Most of the locomotives are of the eight-wheel type, and weigh from 30 to 50 tons. All the passenger equipment has air brakes. All the work of repairing the rolling stock is done by native workmen, and they are said to be very skillful in their different trades.

Efficiency of Boilers.

About fifteen years ago a committee of the American Society of Mechanical Engineers was appointed to formulate a system of testing boilers to show their efficiency, and what was considered at the time as a very able report was brought in, and a system of testing boilers established which has been in use ever since and is followed by nearly all engineers on this continent who have boilers to test. We notice within the last year or two that the standard method of testing boilers has been receiving hard knocks at the hands of the steam engineers, and some of them go to the extent of saying that the practices followed are utterly worthless when the efficiency of the boiler is established merely by the amount of water evaporated per pound of combustible.

In a paper read by Mr. Wm Kent at the last meeting of the American Society of Mechanical Engineers, he gave an instance whereby the record of efficiency of a certain boiler might be from 56.66 to 85.83 per cent., depending upon how the results are calculated and whose calorimeter is used. He said that if an engineer believes that "efficiency" is the proper standard for boilers to be governed by, to guarantee this he should state in his specifications what kind of coal will be used in the test, what percentage of efficiency is required, and how the efficiency is to be determined. If by analysis, by what chemist; and if by calorimeter, whose calorimeter. The efficiency may conveniently be regarded in the result of the test as an addition to the time-honored evaporation per pound of coal per pound of combustible, but he was opposed to substituting it for these results, and he was against its adoption as a commercial standard to be specified in contracts or guarantees.

As boilers are purchased subject to tests of efficiency, the mere specification of evaporating so many pounds of water per pounds of combustible is a very loose way of arriving at the efficiency of a boiler and throws a door wide open for fraud. Those interested in making out the efficiency of a boiler to be as high as possible might insist on using the very best grades of coal, while those interested in making out that the boiler was short of its reputed efficiency might prove their case by using the most inferior coal they could find.

The standard method of testing boilers certainly needs to be revised if justice is to be done between boiler users and boiler maker. The present condition of affairs is similar to what it would be among dealers of wheat if the sellers used a bushel measure of one capacity and the buyer a measure that was larger.

It is a strange thing that the sensible men constituting the American Society of Mechanical Engineers did not perceive the shortcomings of their method of testing boilers when it was recommended. A committee is wrestling with the subject again, and the indications are that it will be very difficult to establish a method suitable to all the interests concerned.

Hardship of Carrying Bicycles.

Some of the railroad papers have been exciting themselves very much over the hardships imposed upon railroad companies by certain States passing laws that compel the companies to carry bicycles free of charge. We believe that the railroad companies which have instituted the practice of charging for the transportation of bicycles when passengers are along with them, stand very much in their own light and fail to perceive what is really their best interests. The great mass of bicyclists who travel on railroads with their wheels make the journey for the purpose of riding back, and if it were not that they use the wheel the railroad company would not get the fares. Some of those who have insisted on making extra charges for wheels are beginning to find that the policy is militating against them. We know of two large railroads running through the same territory, which have received a few very good object lessons in regard to the practice of charging and not charging for bicycles. One company makes a charge and the other does not. The result is that nearly all wheelmen going out to have a long ride patronize the railroad that does not charge anything for the wheel. Besides that, which causes direct loss of business to the company, they are beginning to find that many business men who ride wheels patronize the company that shows them the greatest courtesy when they go to travel on business. The result is that the company which thought it was fair to charge for wheels are said to be seriously considering the advisability of dropping the charge.

We find that railroads in other countries, which are generally tied down by tradition which induces them to get everything possible out of passengers, have been shrewd enough to do all in their power to encourage and develop the practice of wheel riders going on their trains to points where they wish to use the wheel. In France, for instance, the railway companies offer every facility to induce bicyclists to take their trains out of the city instead of undergoing the inconvenience of riding through the streets and suburban roads which are heavy with traffic; they regard the bicycle as baggage and it is carried accordingly. A voucher for the wheel is all that is necessary, and that costs two cents. This liberal practice has brought a great deal of business to French railways, and thousands of Parisians go to the country with their wheels on holidays instead of remaining in the city. The same practice is spreading through the large cities in Germany, where similar privileges are accorded to people with bicycles.

Railroad Heroism.

"You may talk of it being a brave and heroic deed for two men to grab a rail and throw it into place as a fast train was approaching," remarked a bronzed, gray and nomadic railroader, who had experiences to tell of what he had gone through on railroads all over this continent.

"I do not want to underrate the coolness of men who grab a rail and throw it into place, but I once saw something done when I was rear brakeman for Daddy Slocum in the early days of the Canadian Pacific.

"We had left Rat Portage early in the morning with a train, and just when we were nearing the Winnipeg River bridge, going at a good speed, the driver noticed a man walking on the bridge. The train was almost upon the man before he saw it; and as the bridge is very high and has no parapets, it seemed certain death to the tie walker, for he had no means of getting clear of the track, and to jump was certain death. The only thing was to hang by the outer tie rail, and hang until the train passed. This he did, and the train came thundering on, unable to stop.

"Daddy Slocum happened to see the man's predicament, and recollecting that that the low steps of the Pullman might catch the poor fellow's arms, he pulled the coupling lever and had the Pullman stopped before it reached the man. That was before air brakes were applied, you must understand.

"The Pullman car was now standing on the middle of the bridge, and it had not been there but a few minutes when a freight train came backing around the curve at the approach to the bridge, and the trainmen did not see the Pullman car blocking the way. The passengers in the Pullman car were terribly frightened, for there was no means of getting out, and it seemed certain that the car would be dashed off the bridge into the river below, but Conductor Slocum was equal to the emergency. He signaled the engineer of his own train to back up, and this was done promptly. The Pullman was coupled up without an instant's delay, and the train pulled ahead just as the freight came thundering down upon the bridge. One minute more and Pullman car and passengers would have been dashed into the Winnipeg River, but Slocum looked as unconcerned as if he had performed an everyday feat that was not worthy of mention."

The Senior Philosopher sailed "awa'" for Scotland, home and mother on the 22d, and left the editorial work of the paper to the Junior Philosopher and his aides. Any improvement seen in the next two issues should be credited to the J. P., and all shortcomings charged to the absence of the S. P.

M. C. B. Committees for 1897.

Mr. Jno. W. Cloud, secretary of the Master Car-Builders' Association, has sent out the list of committees for the convention in June, 1897. List will be found below, together with the subjects:

STANDING COMMITTEES.

On Arbitration—G. W. Rhodes, chairman; John Mackenzie, M. M. Martin, G. L. Potter, J. N. Barr.

On Supervision of the Standards and Recommended Practice of the Association—R. H. Soule, chairman; G. L. Potter, A. M. Waitt.

On Triple-Valve Tests—G. W. Rhodes, chairman; A. W. Gibbs, W. S. Morris.

On Standard Wheel and Track Gages—To confer with the American Railway Association—J. N. Barr, chairman; G. W. Rhodes, R. E. Marshall.

On Brake-Shoe Tests—S. P. Bush, chairman; D. L. Barnes, J. W. Cloud.

SUBJECTS AND COMMITTEES.

1. Automatic Couplers (continued)—To advise what changes may be desirable in the standard size of Master Car-Builders' automatic coupler shank, and to recommend a standard yoke or pocket strap for rear attachment to car. C. M. Mendenhall, A. E. Mitchell, J. T. Chamberlain, W. H. Thomas, Wm. Garstang, T. G. Duncan, J. Macbeth.

2. Uncoupling Arrangements for Master Car-Builders' Automatic Couplers (continued)—To consider whether a standard uncoupling device is practicable, and the details thereof, and to recommend a device which would be applicable to the greatest number of couplers possible. G. L. Potter, C. E. Turner, R. C. Blackall, R. M. Galbraith, G. W. West, G. B. Sollers.

3. Loading Logs, Poles, Bark and Long Structural Material on Cars—To suggest modifications of or additions to recommended practice, if found desirable. P. Leeds, W. H. Day, P. H. Peck, S. P. Bush, F. H. Stark, J. R. Petrie, W. H. Lewis, B. Haskell, C. Coller.

4. Trains Parting—To consider the extent and causes of break-in-twos with automatic couplers, and to suggest remedies. A. M. Waitt, W. Lavery, F. H. Soule, D. Hawksworth, B. E. Thompson.

5. Passenger Car Pedestal and Journal Box for Journal 4¼ by 8 inches—To suggest designs. G. W. West, T. B. Purves, Jr.; E. A. Benson, F. W. Chaffee, J. W. Marden.

6. Specifications and Guarantee for Cast-Iron Wheels—To propose a revision of the recommended practice of the association, and to consider therewith the form of wheel. J. N. Barr, J. H. McConnell, S. P. Bush, J. Hodge, W. McWood.

7. Air-Brake and Signal Instructions—To confer with a committee from the American Railway Master Mechanics' Association and to propose a revision of the code adopted in 1892. E. W. Grieves, E. D. Bronner, S. Higgins, H. McCarty.

8. Freight Car Buffers—To follow up and report upon experiments about to be made with improved buffers. Wm. Forsyth, A. E. Mitchell, F. W. Brazier, Thos. Fildes, J. Player.

9. Box-Car Side and End Doors—To submit designs for side and end doors, including fixtures, for adoption. J. J. Hennessey, G. N. Dow, C. A. Schroyer, Robt. Gunn, F. B. Griffith.

10. Arch Bars and Column Bolts for Diamond Trucks—To recommend forms in detail, for cars of 60,000 pounds capacity, and to submit designs for same for cars of 80,000 pounds capacity. E. D. Nelson, T. Lyon, G. Gibbs, J. H. Rankin, J. E. Simons.

11. Independent Committee of Five to present individual report on Designs for Steel Car Frames—J. N. Barr, C. M. Mendenhall, R. P. C. Sanderson, S. A. Charpiot, G. R. Joughins.

12. Subjects for 1898—J. T. Chamberlain, A. M. Waitt, C. A. Schroyer.

Engineering Tools at Pompeii.

Under the title of "Things of Engineering Interest Found at Pompeii," Professor Goodman gave his inaugural lecture in the engineering department of the Yorkshire College, Leeds. The lecturer remarked that he had recently visited Pompeii, and was not only charmed by the great beauty of the works of the ancient Romans, but also by their extreme ingenuity as mechanics—in fact, it was a marvel how some of the instruments and tools they were in the habit of using could possibly have been made without such machinery as we now possess. After explaining the situation and destruction of Pompeii by showers of ashes and mud, not lava, as is usually supposed, in the year 79 A.D., Professor Goodman showed a series of about fifty lantern slides, prepared from photographs taken by himself in Pompeii last Easter. The streets, he explained, were used as waterways to carry off the surface water, and probably sewage, from the houses. The pavements were raised about a foot above the streets, and stepping stones were provided at intervals for foot passengers. The horses and chariots had to pass between, and in many places deep ruts had been worn by the chariot wheels in the stone paved streets. The water supply of Pompeii was distributed by means of lead pipes laid under the streets. There were many public drinking fountains, and most of the large houses were provided with fountains, many of most beautiful design. The amphitheater, although a fine structure, capable of seating 15,500 people, was small compared with many in Italy. The bronzes found at Pompeii revealed great skill and artistic talent. The bronze brazier and kitchener were provided with boilers at the side and taps for running off the hot water. Ewers and urns have been discovered with internal tubes and furnaces precisely similar to the arrangement now in modern steam boilers. Several very strong metal safes provided with substantial locks have been found. The locks and keys are most ingenious and some very complex. On looking at the iron tools found in Pompeii one could almost imagine he was gazing into a modern tool shop, except for the fact that the ancient representatives have suffered severely from rust. Sickles, bill-hooks, rakes, forks, axes, spades, blacksmiths' tongs, hammers, soldering irons, planes, shovels, etc., are remarkably like those used to-day; but certainly the most marvelous instruments found are the surgical instruments, beautifully executed, and of design exactly similar to some recently patented and reinvented. Incredible as it may appear, yet it is a fact that the Pompeiians had wire ropes of perfect construction.—"Age of Steel."

A somewhat ambitious form of draft-regulating appliance for the locomotive has been patented by Joseph C. Canby, of West Pittston, Pa. The invention consists of a series of petticoat or lift pipes extending from the base of the stack to the exhaust nozzle, the middle pipe being movable and secured to a rod which goes through the smokebox and can be operated from the cab. By means of this rod the middle petticoat section can be raised and lowered.

The following suggestive hint is from the "Railroad Employés' Gazette," and is given under the heading of "Pennsylvania Railroad Notes": "When Big Jack left, he took the pledge, also an oil suit and a suit of overalls. Jack can keep the pledge, but if he don't return the oil suit and overalls he may get himself in trouble, even if he is a temperance man."

A new and somewhat ingenious automatic brake-slack adjuster has been patented by Alexander Pitkethly, of Boston. The weak feature, in our opinion, of the invention is that there is too much to it. It is described as a combination of a brake beam, a lever-supporting frame secured to the beam and provided with longitudinally extended slots at right angles to each other, the brake lever extended through one of these slots, a fulcrum for the lever movable in the other slots, a rack bar carried by frame, a pawl movable with the fulcrum of the lever and co-operating with the rack bar, a second rack bar operatively connected to the brake lever, a housing or support for the second rack bar carried by the brake beam, and a pawl carried by the brake beam and co-operating with the second rack bar.

A Railroad Mystery.

A short time ago the following article appeared in the Wilmington (N. C.) "Messenger":

"Between the 49th and 55th mile-posts on the Carolina Central Railroad there is a piece of track for a distance of nearly six miles that presents a singular condition that so far amounts to an inexplicable mystery. All trains, going and coming, go to grinding and start a terrible squeaking when they get on this six miles of track. The noise comes from not only one car, but every locomotive, every coach and every car of whatever kind sets up a grinding as if turning a curve. The noise is something like the screeching of an ox-cart that has no grease on it, and is made by every truck in a train. The track is perfectly straight, and there is no curve at all; the cause of the grinding and squeaking has mystified the railroad people. Every effort has been made to ascertain the cause of the difficulty. The locomotives have been examined, the coaches and cars have been scrutinized, every cross-tie and every rail has been inspected, every joint has been looked at, and every foot of the track has been re-gaged, but no explanation could be found. The section master has almost crawled over the six miles on his knees in search of the cause. The roadmaster has tried his best to ferret out the matter, and the superintendent has been over the track and inspected it, all of them making repeated efforts time and time again to find out what is the matter, but they have given it up as a bad job. They have not only not been able to discover the cause of the noise, but have been unable to discover any theory to explain the mystery. It is one of the railroad mysteries of the age and has been going on for twenty years. During that time the cross-ties and rails have been replaced several times with new ones, but without effect. Who can explain the mystery?"

The editor of the "Railway Review" having seen the article quoted, wrote to Mr St. John, vice-president and general manager of the railroad referred to, and received a letter intimating that the screeching noise made by wheels on the Carolina Central Railroad between the 49th and 55th mile-posts was caused by the section master's gage being an inch too long, leaving the track too much open, and when the track was spiked to gage the noise discontinued at once.

Railway Accidents.

According to the Interstate Commerce Report, the number of railway employés killed during the year ending June 30, 1895, was 1,811, and the number injured was 25,696. These figures, compared with those of the previous year, show a decrease of 12 in number killed, and an increase of 2,274 in the number injured. The number of passengers killed was 170, the number injured 2,375. These figures give for the year a decrease of 154 in the number killed, and 659 in the number injured. The number of passengers killed is remarkably small. The smallest number killed in any of the preceding seven years was 286, in 1890. One employé was killed for each 433 employed, and one employé was injured for each 31 employed.

Of the class of employés known as trainmen—that is, engineers, firemen, conductors, and other employés whose service is upon trains—it appears that one was killed for each 155 in service, and one injured for each 11 in service. The number of passengers carried for each passenger killed during the year was 2,984,832, and the number carried for each passenger injured was 213,651. The liability of passengers to accidents is better shown in the fact that 71,696,743 passenger-miles were accomplished for every passenger killed, and 5,131,977 passenger-miles for every passenger injured. It is suggested that beneficial results were derived from the fitting of equipment with automatic appliances, as well as from the raising of the character of railway service and grade of railway equipment, first noted in the last report.

Scholarships for Sons of Railroad Men.

Several years ago the Railway Master Mechanics' Association paid $5,000 for four scholarships in the Stevens Institute of Technology. These scholarships were open only to the sons of members of the association, and, to be eligible, a young man was required to have worked a year in a machine shop before going to the examination. The entrance examination is very difficult, and it has been found that young men who have been away from school a year or more, working in a machine shop, have been unable to pass the examination without passing through a special course of preparatory study.

At the last convention a committee was appointed to have the rules concerning the scholarship broadened, so that more candidates would be available. They propose doing away with the year's work in the machine shop, and in case the scholarships are not all filled up by sons of members, sons of any railroad men will be eligible. The course at the Stevens Institute gives a young man a splendid engineering education, and it is a great pity that anything should be thrown in the way to prevent sons of railroad men from enjoying the opportunity thus afforded.

Although the change making sons of any railroad men eligible to enjoy the Master Mechanics' scholarships at the Stevens Institute has not been definitely settled, we believe that the Executive Committee would now favor the application of the son of any railroad man to enter the institute under the scholarships. If any railroad man has a son who is ambitious to obtain a first-class engineering education, we should advise him to apply to the secretary of the Master Mechanics' Association for the privilege of taking one of the scholarships.

Otto Lilienthal, a German mechanic and builder of steam engines, got the idea into his head that he could make a practical flying machine. He devoted all his spare time to experimenting with flying machines, and he made several which he was able to force into the air by means of artificial wings. His machines were made almost entirely of closely woven muslin, washed with collodion to render them impervious to air, and stretched upon a ribbed frame of split willow, which was found to be the lightest and strongest material for the purpose. He used the vapor of carbonic acid as a motive power. A great deal of intelligent research and scientific labor had been devoted by this devotee of science to flying machines. One day last month he started with one of his machines from a hill-top near Berlin. The apparatus worked all right for a few minutes, and flew quite a distance, when suddenly the machinery of the apparatus got out of order, and man and machine fell to the ground. Lilienthal was so badly injured that he died in the hospital to which he was removed. Thus has passed away another devotee to scientific progress.

A singular accident happened to a tower man in a block tower belonging to the Long Island Railroad at Laurel Hill, L. I., one day last month. Incoming trains found the blocks all set against them; no amount of blowing whistles or other signals elicited a response from the tower; then the place was entered and the tower man was found lying unconscious. When he recovered, he said that he was changing the signals, when he was suddenly knocked senseless by what he believed to be an electric current. Investigation showed that several men, employed on an electric-light line some distance away, had permitted a live wire to cross the wires that led to the signal tower. This was what nearly killed the tower man. The telegraph instrument was found to be destroyed by the strong electric current that passed over the wire.

They have been making experiments on the South Jersey Railroad with the Holman friction-gear locomotive, which is the three-story monstrosity which we have referred to several times in these columns. The engine was able to run at considerable speed with a couple of cars, and the people interested in the patents feel sure that they are going to make a great success by multiplying the parts away beyond those of the ordinary locomotive.

Relations Between Boilers, Cylinders and Weight on Driving Wheels of Locomotives.*

BY MAURICE DEMOULIN.

There exist mutual relations between the principal elements of the locomotive—namely, the adhesive weight, the volume of the cylinders and the power of the boiler. These relations, which well deserve investigation, are subject between limits to important variations, depending on the working conditions or local circumstances, which make it difficult to establish exact co-efficients and comparative figures.

Thus, the heating surfaces and grate areas are settled chiefly by comparison with more or less satisfactory results given by similar engines of previous types. It is impossible that it should be otherwise with engines whose power cannot be worked out in horse-power or any other unit which could be easily converted into a definite steam consumption.

In engines of similar types belonging to different companies, considerable differences are to be found in the relations between grate area, heating surface and volume of cylinders, and, again, between the steaming power of the boilers, due either to the quality of the fuel used or to the limits allowed for the thermal efficiency, depending on industrial and commercial considerations and on the life of the locomotive.

The steaming power depends on the absolute dimensions of the boiler, on the heating surface, and especially on the grate area, the quality of fuel burnt, and the quantity of the fuel which is burnt per unit of grate area. Also, when one compares the proportions of boilers belonging to locomotives working in different countries, it must not be forgotten that the absolute size of the boilers is only a general indication, and that according to custom or the quality of the fuel used, a grate of given area may be capable of developing very different powers, according to the rate of working, which is in different places considered to be forcing. If it were not so, the grate area would be the most suitable basis on which to make a comparison of different locomotives from the point of view of power; but it is not the grate area, but the quantity of coal burnt on it per unit of time which must be taken as the unit. Thus, the grate of an English engine with 17.2 square feet, on which Welsh or Derbyshire coal is burnt in a thick bed, will be practically equal to a grate of 22.6 to 24.7 square feet with a thinner layer of low-grade fuel. In other words, the important point is not the area of the grate, but the volume of the fuel which can be usefully carried at any time in the firebox.

The volume of the cylinders varies with the boiler pressure, the diameter of the wheels, and the tractive force which is possible with the given adhesive weight; but the formula used for calculating it contains a variable co-efficient, depending on the loss of pressure allowed between the boiler and the inside of the cylinder, or on the normal point of cut-off used at full speed.

Finally, there will be found in the accompanying table for certain known types of express engines the ratios between grate area and heating surfaces, the volume swept by the pistons per the admission stroke, and the ratios of the theoretical tractive force of the adhesive weights.

It will be seen how variable these co-efficients are, even for engines which seem to be made for the same service, burning similar fuel, and worked in a similar way. These differences are much greater when locomotives belonging to different countries and burning fuel of different qualities are compared. Thus, English locomotives which burn good coal in thick beds with a strong draft (see columns 7 to 9) have in the three examples chosen 2.22—2.29 square feet of grate per cubic foot of volume swept through by the pistons. In the American locomotives in column 11, intended to burn anthracite, the grate is very large, and has 5.32 square feet per cubic foot of volume in the cylinders.

The express engine of the Belgian State Railway, column 6, intended to burn small coal of poor quality, has a grate area of 6.1 square feet per cubic foot of cylinder, the largest that we have noted in express engines. The French engines occupy an intermediate position, as do the qualities of fuel they burn, with a grate area of from 2.47 to 3.93 square feet per cubic foot of cylinder, the companies which use the smallest coal having the largest grates.

The variations in the ratio between the grate area and the adhesive weight in locomotives intended for similar services, at least in point of including speed, are strikingly shown in the last line of the table. At one end of the scale we find an English engine with 0.535 square feet of grate per ton of adhesive weight, and at the other end an American engine having the Wootten firebox with 1.105 square feet, and above all the Belgian State Railway locomotive with 2.06 square feet. Between these extremes come the French locomotives with a minimum of 0.70 square feet for the Western Railway, and a maximum of 0.918 square feet for the Northern Railway.

The grate area per unit of adhesive weight is thus nearly four times as great in the Belgian State locomotive as in the Northeastern locomotive.

The heating surface varies less than the grate area. In the English engines, which have small grates, the ratio $\frac{S'}{S}$ is as high as 72, while it falls to 26.4 for the Belgian State locomotive, and to 30.9 for the American locomotive with the Wootten firebox. In the old French engines with very long tubes this ratio was even

		Northern, of France. (Type Outrance 1878.) 1	Western, of France. (Bogie Engine.) 2	Eastern, of France. (Bogie Engine.) 3	Paris-Orleans. (1889.) 4	Paris-Lyons-Mediterranean. (1882 Modified.) 5	Belgian State. (1889.) 6	Great Northern. (Single Drivers.) 7	Midland. (Bogie Engine.) 8	North-Eastern. (1894.) 9	New York Central. (Engine 999.) 10	Erie Railroad. (Wootten Fire box) 6-coupled. 11
Boiler pressure	Lb. per sq. in.	124	156	171	185	156	145	171	160	160	190	160
Diameter of cylinders	Inches.	17	18.1	18.5	17.3	19.7	19 7	18.1	18.1	19	19	21
Stroke of pistons	Inches.	24	26	26	27.5	24 4	23 6	28	26	26	24	26
Volume swept by the pistons per stroke.	Cubic feet.	3.15 x 2	3.87 x 2	4.04 x 2	3.76 x 2	4.3 x 2	4.16 x 2	4.17 x 2	3.88 x 2	4.27 x 2	3.95 x 2	5.2 x 2
Diameter of driving wheels	Inches.	82.7	80.3	82.7	82.7	78 7	82.7	98.4	84	84	85	65
Grate area S.	Square feet.	24.8	19	26	24 2	24.1	50.6	17.7	17.4	19 6	30.7	55.4
Heating surface S'	Square feet.	1,076	1,310	1,813	1,662	1,555	1,342	1,034	1,262	1,340	1,930	1,714
Ratio S to S'	1 to	43.3	68.3	69.5	68.5	63.1	26.4	58.8	72.3	68.5	62 9	30.9
Theoretical tractive force, $\frac{Pd^2l}{D}$	Lb.	11,810	16.500	18,300	13,400	18,800	15,650	14,550	16,300	17,600	19,200	28,200
Adhesive weight	Lb.	60,000	60,600	73,600	65.800	67,200	64,000	40,300	63,000	76,500	84,000	111,500
Square feet of grate per cubic foot of volume of stroke	Sq. ft. per cu. ft.	3.93	2.47	3.22	3.22	2.80	6.10	2.22	2.24	2.29	3.88	5.32
Square feet of heating surface per cubic foot of volume of stroke	Sq. ft. per cu. ft.	170.5	169	223.5	220.5	177	161	125.2	163	157	246	165
Ratio of theoretical tractive force to adhesive weight.		0.19	0.27	0.25	0.24	0.28	0.28	0.36	0.26	0.23	0 23	0 25
Square feet of grate per ton of adhesive weight	Sq. ft. per ton.	918	0.70	0.777	0.82	0 798	2.06	0.985	1.05	0.535	0.81	1.105

NOTE.—All these engines are four-coupled except that in column 11, which is six-coupled, and that in column 7, which has single drivers.

* From the Bulletin of the International Railway Congress, published in the "Mechanical World."

greater than in the English engines, which have always had short tubes; but the tendency at present in France is to shorten the tubes and increase the area of the grate, which reduces the ratio $\frac{S}{S'}$. In the new French locomotives the ratio of the heating surface to grate area varies from 69.5 (Eastern of France Railway locomotive with Flaman boiler and great heating surface) to 43.3 (Northern of France Railway locomotive with short tubes and large grate).

Finally, the heating surface above a certain minimum cannot be taken as a criterion of the power of the locomotive. The engine in column 7 has only 1,034 square feet of heating surface, and develops in work practically the same power as the locomotive of column 6, which has 1,342 square feet. Even when the grates had a smaller area the heating surface was made as large as the conditions of the design permitted, and when later the grate was increased, the heating surface could not usually be increased in the same proportion.

As to the ratio of the theoretical tractive force (calculated without reducing the boiler pressure by the reduction co-efficient) to the adhesive weight, it is found not to vary much for engines of the same class—viz., from 0.23 to 0.28 for locomotives with four wheels coupled; for the engine with single driving axle in column 7 the ratio reaches 0.36; it falls exceptionally low to 0.19 for the engine in column 1, which has smaller cylinders than most modern locomotives. The volume of these cylinders appears to be sufficient to use the adhesion under normal circumstances; but nowadays one prefers to increase the volume of the cylinders, partly to make use at starting of a momentary increase in the co-efficient of friction, due to accidental circumstances or to the use of sand, and partly to be able to cut off earlier in running.

As to the single engine in column 7, it has a very high ratio, because the cylinders are large and the effective weight is not great. This engine always slips on starting if the driver is not careful. This is, moreover, the case with all engines which have not coupled wheels, but for which the volume of the cylinders, apparently excessive compared with the effective weight, is determined, not with a view to starting, but in order to develop at full speed practically the same power as the engines with four wheels coupled, which have a greater effective weight. Besides, one can remedy this defect of the single engines by the judicious use of the steam sand jet, which re-establishes equilibrium by increasing the friction.

The work which the locomotive has to do is itself very variable, not only because the loads it has to draw vary, but also, with a train of given weight, because of the irregularity of the gradients and the alternate slowing down or acceleration required by the working conditions, or the passage of special points on the line. The variations of the steam production, which has to change from the maximum to the minimum and back again sometimes very rapidly, are provided for by the corresponding variations of the blast.

Since the boiler of a locomotive only works with forced draft, and the natural draft only produces sufficient intensity of combustion to just balance the loss of heat by radiation, it is sufficient to stop the jet of exhaust steam into the chimney on which the draft depends, in order to stop all steam production. Again, by regulating the speed of flow of this steam, or what comes to the same thing when the blast pipe is of constant size, the weight of steam ejected per unit of time, one obtains all the intermediate degrees of steam production. But this regulation occurs automatically, because the weight of the steam exhausted through the blast in a given time is proportional to the work done. This arrangement, at once so simple and so perfect, to which the locomotive owes its existence, automatically proportions the production to the consumption, and the power developed to the work required, in a more perfect manner than the most complex apparatus could do. Each stroke of the piston, so to speak, prepares for the following one. The system is only at fault in one case, for reasons independent of its principle: When a locomotive has to stop at the top of a long and steep bank, the intensity of the fire, urged by the violent blast due to the vigor of the exhaust whilst running up the bank, cannot stop when the regulator is closed. The equilibrium existing till then between the requirements and the production is violently disturbed, and as the steam produced is not being used any longer, the safety valves come into play.

The same thing always tends to happen, even apart from difficult gradients, with locomotives working normally with a strong draft, like the American engines, or with those which hold at all times a large weight of fuel in their fireboxes, like English engines, which burn a thick bed of fuel. The use, in place of coal, of petroleum or other liquid fuel injected into the firebox as required, and which presents no large mass of incandescent fuel when the regulator is closed, is, as is well known, a complete remedy for this state of affairs.

Production and consumption are thus intimately connected in the locomotive; so much so that if in a given engine, one increases very largely the steam admission, and consequently reduces its efficiency, one will nevertheless increase the maximum power which the boiler is capable of supplying, because as the pressure at the exhaust is increased the draft will be more violent. The total efficiency of the system may diminish, but the total power will increase. Having boilers of smaller proportions compared with the weight of steam delivered per unit of time, the American engines have a much larger production per square foot of heating surface than the European engines, so that they can work at all speeds with the cut-off at 40 to 50 per cent. These engines thus burn as much as 225 pounds of coal per square foot of grate (1,100 kilograms per square meter) per hour, and for the same total weight are able to develop continuously a greater power than other engines. In other words, their tractive force diminishes more slowly than their speed increases. The constancy of their tractive force at all speeds depends simply on the power of producing steam when the steam pipes are capable of carrying off all the steam made. On the other hand, these engines, for known reasons, are decidedly less economical than the European engines, both because the expansion of steam is too small and because the high speed with which the products of combustion pass through the tubes does not allow them to be cooled sufficiently before they reach the smokebox. In Europe, especially in those countries where the price of fuel is high, preference is given to a higher efficiency. In the United States, power of producing steam is placed before everything, no matter how poor the economy may be.

A Traveling Repair Shop.

We are indebted to Mr. W. H. Robinson, of Cleveland, O., for the loan of an old book called "Engineers' and Mechanics' Companion," printed in New York in 1853. There are several pages and chapters devoted to locomotives and engines of the old class. One chapter relates to instructions for running and managing locomotives; and to show one of the ideas of the times, we quote the following as a list of the necessary articles to carry on an engine:

"Several articles should be constantly carried on the tender, as either being frequently required in the working of the engine, or occasionally in cases of derangement or accident. The following may be taken as a list:

"One large can of oil, and one or two small oiling cans and an oiling tube, a box of tallow, a quantity of cotton waste, hemp and gasken, a hand brush, keys fitted to all the principal bolts, and one large and one small monkey wrench; a number of iron or wooden plugs, an iron plug holder and a 7-pound maul, two cold chisels, a hammer and a file, spare washers, and duplicates of the principal nuts, bolts, pins, gibs and keys, etc.; a quantity of thick and thin cord, and some tarred line, a fire bucket, two long crow-bars, a spare coupling chain, with shackle and hook complete, several wooden wedges about two feet long, four or five inches wide, and three inches thick; and, if running long journeys, two spare ball clacks, and a screw-jack."

Street Cars Operated by Compressed Air.

A representative of "Locomotive Engineering" enjoyed the privilege last month of making several trips on a compressed-air motor running in place of a cable car on One Hundred and Twenty-fifth street, New York. On entering upon the platform where the motorman does his work, the visitor sees apparatus very similar to that found on electric motors for operating the cars. This is a very shrewd idea of Mr. Robert Hardie, the inventor of the compressed air apparatus, and makes the work of handling the car very easy to any motorman. The car is handled as easily as a sewing machine, can be started very readily, displays a high speed capacity and rides with remarkable smoothness.

In a building near the north end of One Hundred and Twenty-fifth street we found the power house, where a Norwalk double compound air compressor compresses the air used in operating the cars which belong to the American Air Power Co. We have received no figures to give a comparison of the cost of compressed air with that of other power, but we have been told that it is decidedly cheaper than electrical or cable traction.

The air is compressed in three stages and cooled between each stage. It also passes through a final cooler, then a separator, and goes either directly to the car or into the storage, where it is kept on tap. The separator traps off the condensed moisture of the air, which goes to form dew, and Mr. Hardie jocularly calls it "condensed dew." Nearly half a gallon is entrapped from one charging of the car, the air in which, by the way, is over a quarter of a ton in weight. Few people know that air weighs anything.

The air in the motor, being dried by the amount of this entrapped moisture, is passed through hot water, which is carried on the motor, and the volume nearly doubled by the added hot vapor, which this dry air readily absorbs. During expansion in the cylinders, the consequent cooling of the air condenses this vapor and causes it to deliver its latent heat to the air. As the specific heat of air is very low, this heat increases the volume to a wonderful extent.

The water is reheated by a jet of steam at the same time that the air reservoirs are recharged, and the whole operation is done as quickly as a locomotive takes coal and water. A very beautiful feature of this reheating is, that the latent heat is all utilized.

For the benefit of those who do not understand this we will explain that the latent heat of steam is that heat which is expended in merely evaporating the water, without producing any pressure of steam. Suppose we take ice-cold water and apply heat to it until it is all evaporated into steam: The heat units per pound required to boil the water will be from 32° to 212° = 180°, but the temperature will remain at 212° during evaporation and 966 heat units per pound more will have been absorbed. It should be explained that a heat unit is the quantity of heat which will raise the temperature of one pound of water one degree. A few more heat units added, after evaporation is complete, will produce a pressure of steam which will move a piston, and it is these few heat units only which can be and are turned into useful work. It will therefore be seen that a steam engine is not and cannot be an economical machine.

It will now be seen how efficient this motor is, when it is remembered that all the latent heat of the steam used to reheat the water is turned into useful work in reheating the compressed air.

Some of the mechanical contrivances on this motor are interesting:

THE STARTER.

In order to utilize the stored energy to the utmost, it is necessary to use the air expansively. This is desirable on the score of economy. It is also expedient to have the motor run as long a distance as possible on one charging. It is also desirable to reduce, or in fact entirely eliminate, the puffing noise of exhaust. The range of cut-off is therefore fixed between one-tenth and one-fifth. This range of cut-off, together with a range of variation of working pressure, referred to further on under the head of "Accelerator," places within command of the motorman a considerable range of power for grades, loads, quick starting, etc. But a new difficulty presented itself—how to start the engine from a state of rest. It will be seen that, even with cranks on the quarter and the latest cut-off at one-fifth, the engine will rarely stop in a position where it will start on opening the throttle. This was quite a serious matter, because if the engine had to be frequently reversed before it would start ahead, the motor would not make time, and there would even be positions where the engine would neither start backward nor forward, and a pinch bar would have to be used on the wheels. An independent by-pass is provided for this starting, which is somewhat ingenious. It consists of a small independent port on the valve seat of the cylinder, opposite each admission port, with small pipes leading thereto from the brake valve, and by putting the brake-valve handle in a certain position, air is admitted through this port underneath the cut-off valve, and the motor starts readily in any position.

THE ACCELERATOR.

It has been said that a great variation of power is placed within command of the motorman, partly by variation of cut-off and partly by variation of working pressure. The device for causing variation of working pressure is called the "accelerator," because it enables the motorman to get up speed quickly from a state of rest.

There is a reducing valve for regulating the working pressure which operates on a similar principle to a safety valve, the only difference being that, instead of opening when the full pressure is reached and blowing off the surplus, it closes a valve against the storage pressure. This is adjustable by a spring, just as a safety valve is adjustable. Attached to this valve is a small piston which ordinarily has working pressure on both sides of it. By moving the brake-valve handle to the opposite extreme of where it applies the brake, the air pressure is bled from the under side of this piston, so that the working pressure on the other side assists the spring to hold the valve open. It now requires a higher pressure to close the valve against the combined effort of spring and piston, and the amount is fixed by the diameter of the piston.

THE AIR BRAKE.

This is one of the most beautiful features of the motor. The piston and rod are cast in one, and the area of the rod is more than half that of the cylinder. The whole is cast hollow. Air pressure is admitted to the annular space to apply the brake, while at the same time the other end is open to the atmosphere. To release the brake, the same air is made to equalize on both sides of the piston, which it does instantly, and the bleeding takes place after release, by passing noiselessly into the hollow piston and rod through a hole in piston head 1-16 inch diameter; thence it passes to the atmosphere. By moving the brake handle quickly to the applied position, and back to the neutral or half way position, any degree of braking effect is obtained and held.

THE ENGINES.

The engines consist of two reciprocating pistons and cylinders, bolted to the framing, and connected to the crank pins by rocker arms and rods. The top bar of the frame serves as the guide for the crosshead. Case-hardened liners are riveted on for wear. The valve gear is peculiar: There are a pair of Stephenson links and a pair of fixed cut-off valves. The variation of cut-off is effected by the reverse lever, but in the opposite way to that of a locomotive. The earliest grade of cut-off is when the reverse lever is "down in the corner." This would be the position when running fast, and gives a free exhaust.

Training of the Apprentice.

We have heard very decided expressions of disappointment with the position taken by the committee of the Master Mechanics' Association which reported to last convention on "The Apprentice Boy." The gist of that report was:

"With the passing of the small shop with a few boys, bound under written agreements and bonds signed with legal formality, there must be a new era for the apprentice.

"We see with the modern corporations a breaking-down of the old method of shop organization, suitable for the fathers and grandfathers, but no longer suitable for progressive organization. While in the past it may have been possible to hold a boy bound under agreements, such methods do not answer with great corporations such as our railroads are fast becoming, extending through several States, with their aggregation of shop employés gathered from the heart of great cities, from the suburban districts, and sometimes from small villages which are almost dependent on the corporation for their existence. The bond gives way to comity. The boy is taught fidelity, and is given examples in the principles of loyalty, and the time is fast approaching when the man will feel a loyalty to the corporation second only to the State or Church. To bring about this is the duty of men handling large bodies of workmen."

The report then proceeds to find out what ought to be the best ratio of apprentices to mechanics, and gives a somewhat improvised plan for a system of technical instruction for apprentices.

We believe that the expressions concerning the passing of the small shop, and the breaking-down of the old method of shop organization, exaggerate the existing condition of the apprentice system. There are quite as many small shops in the country as there ever were, and it is possible to train apprentices in the larger establishments, which are becoming so numerous, if a little intelligent care and attention are bestowed upon the problem. The condition of apprentices in many shops deserves the serious consideration of people having the interests of mechanics at heart, with a view to securing reforms that are highly necessary.

It appears to be the average practice to take a boy into the shop without finding out whether he is adapted for the business or not, and then to let him work out his own acquirements as a mechanic. A very common practice is to put a boy upon a nut-tapping or other simple machine that requires practically no skill, and to leave him there until he secures an advance by persistent complaint to the foreman. Every other step is dependent on the persistency of the lad in looking after his own interests. If he has no persistence in this direction himself, and has no one in the shop to plead his cause, he is likely to be no more of a mechanic at the end of four years than any of the laborers doing helping work about the shop.

We consider that the committee having this subject in charge ought to have investigated the various methods pursued in railroad and other shops for the training of apprentices. We know of a variety of railroad and other shops where apprentices are engaged and trained under rules very well calculated to produce first-class mechanics. Under these rules the boy is on probation for a certain time, and if he does not display a capacity for machine work by the time the probation ends, he is permitted to go and find a vocation better suited to his talents. All through the course of the apprenticeship the boys are gradually advanced in work that calls for increasing manipulative skill, and at the end of the apprenticeship if the boy is not a mechanic he has himself to blame, for he has been given every opportunity to acquire skill and insight into the trade.

In shops where a different policy prevails, the proprietors have the best reason to complain of the apprenticeship system being a failure. The lad is kept at laborer's work during the whole of his apprenticeship, and when he asks for journeyman's wages his employer finds that the earning capacity of the youth does not justify increasing his wages to those of the ordinary journeyman. If the errors made in the training of the apprentice were urgently pressed upon this class of employer, it is very likely that the necessary reforms would be carried out. What the Master Mechanics' committee ought to do is to make public the best forms of the apprenticeship system in use, and urge their adoption upon those who now use apprentices merely as cheap laborers.

In regard to technical instruction for apprentices, we think that everything should be done to forward the organization of night classes where drawing and the principles of applied mechanics might be learned. Institutions like the Cooper Institute, of New York, and the Armour Institute, of Chicago, form good models for the instruction of young mechanics, and agitation should be carried on to have similar establishments, on a smaller scale, organized in the smaller cities or industrial centers.

While investigating the best methods of technical instruction for apprentices, the committee should not overlook the advantages of correspondence schools similar to the International Correspondence Schools, of Scranton, and the Correspondence School of Technology, of Cleveland. In the report referred to, no mention whatever was made to correspondence schools, although we are inclined to believe that these are doing more for the education of the apprentice and railroad shop mechanics than all other forms of auxiliary education put together. Railroad shops are very often to be found in small communities where it is difficult to establish a regular night school, the consequence being that night schools where technical education is imparted are very rare in places where railroad apprentices might obtain the benefit.

The average apprentice, like the average man, does not have self-denial sufficient to compel himself to attend evening schools or to pursue private studies for the sake of improving his education. By far the majority of people are inflicted with mental laziness, and this prevents all except a few from following up the elementary or other education which they have received; but there is in every shop and in every community a small percentage inspired with mental activity and industry, who are ready to labor during leisure hours for mental and professional improvement. From this class is drawn the greater part of the officials who carry on the industrial and commercial enterprises of the country. The few young men in every shop or factory who possess this elevating faculty ought to be provided with the means of making the best of it, and it is for them that night schools and correspondence schools do perform, and will perform, the greatest work. What the railroad companies and the country needs is the extension of these methods of instruction, which are calculated to arm the best of its employés and its citizens with the kind of weapons that make them mighty among their fellows.

The New "Northwestern Limited."

The "Northwestern Limited," running between Minneapolis, St. Paul and Chicago, on the Chicago & Northwestern Railway, is one of the most superb rolling stock outfits ever seen.

It comprises a buffet car, baggage car, three Wagner cars, a first-class coach and smoking car, all having the wide vestibule, and the train made up in the order named; that is, the smoking car is at the rear. In the way of finish and solidly magnificent appointments, this train probably stands at the head of all previous achievements in reaching after the goal of all progressive roads, namely, comfort combined with splendor.

The engines hauling these trains are Schenectady 19 x 24 eight-wheelers, with steel driving wheels 73 inches diameter outside of tires. Boiler 61½ inches diameter at small ring. Weight on drivers, 81,000 pounds. Total weight of engine, 126,100 pounds. Heating surface of flues (inside), 1,494 square feet. Heating surface of firebox, 171 square feet. Area of grate surface, 26½ square feet. Air brake on every wheel of engine and tender. Single exhaust nozzle 5½ inches diameter, and an increase talked of. These few items of dimensions show that what the train is to ordinary rolling stock, so is the engine to the better class of power.

The Hilles & Jones Company, of Wilmington, Del., have issued their Catalog M, which is produced in the usual artistic way adopted by this company in telling the story of their machine tools. The story is entirely told by the use of excellent half-tone engravings, which give those interested in the tools built by the company a very good idea of what the device is capable of doing.

Peculiarities of Iron.

In a lecture which Mr. W. F. Durfee delivered before the Franklin Institute recently, a number of interesting facts were given concerning "The Conditions Which Cause Wrought Iron to be Fibrous and Steel Low in Carbon to be Crystalline."

The opinion is common among users of wrought iron and soft steel that the former has no carbon associated with it, and the belief is also prevalent that the minute percentage of carbon, 0.10 to 0.15 of 1 per cent., is at once the cause and explanation of the structural dissimilarity of these metals. Like many other popular opinions and beliefs, these are not established upon those hard, unyielding, azoic rocks of knowledge—well-ascertained facts— on which all true science is founded; for it is well known to investigators that the best fibrous wrought iron contains as much carbon as the average crystalline soft steel.

He then gives a table showing the percentages of carbon in some varieties of iron and steel, from which we find that Lowmoor iron boiler plate has more carbon than extra soft Fagersta Bessemer steel; Staffordshire boiler plate has over twice as much carbon as the Fagersta steel; some samples of Russian and Swedish bar iron have over four times as much carbon as the Fagersta steel, and a sample of wrought iron made by the "Catalan" process (which produces exceptionally good wrought metal) had five times as much carbon as the Fagersta steel.

The term wrought iron is popularly supposed to designate a metal, but in reality it is the name of a mechanical admixture, which, at its best, consists of clusters of crystals of practically pure iron, separated from one another, as the result of the manipulative processes employed, by films or threads of unavoidable impurity, called "cinder."

When a properly heated "bloom" is subjected to the action of hammer or rolls, the contained cinder endeavors to escape from its entangled mechanical alliance with the crystals of the iron, and in so doing, each particle is driven into some line of least resistance, which is always in a plane at right angles to the direction of the force acting upon the metal. The direct consequence of the elongation of metal crystals in rolling, and the effort of the intervening cinder to escape, is the establishment of that structural peculiarity in the resulting bar known as "fiber." Whenever a bloom is subjected to a force of compression, as when it is rolled into a sheet or plate, these crystals and accompanying cinder are each flattened and extended parallel, and the resulting sheet or plate has more of a laminated than of a fibrous structure, being built up of a number of leaves or strata of iron, separated from each other by films of cinder, which, when unduly thick at any point, cause defects in the plate, which are called "blisters."

The question is often asked: Will a given sample of wrought iron, having a decidedly fibrous texture, become crystalline under the continued repetition of violent strains or shocks? Many persons of varied experience in the use of iron and steel will answer this question in the affirmative. The sailor who sees his cable snap short has no doubt about the metal having become crystalline owing to lapse of time and usage. The railway passenger who has escaped serious injury from an accident caused by a broken axle is usually ready, even anxious, to testify, with emphatic confidence, that "the iron of the axle was crystalline and entirely unfit for the purpose for which it was used." When the leading member of an iron bridge gives way, causing disaster to the passing train, among the various theories devised to disguise the utter want of sufficient intelligently distributed material in the structure, is sure to be that of crystallization of the iron employed.

A bar of wrought iron of a pronounced fibrous structure can be ruptured in two ways so as to exhibit a crystalline fracture: (1) By sudden application of a force of extension, commonly called a "jerk." (2) By prolonged repetition of a force of compression, sometimes called a "jar."

In the manufacture of iron rails, it is considered desirable that they should be of a hard and crystalline texture in the heads, but soft and fibrous in the flanges. However perfectly this distribution of metal is made, it is always possible to break a rail so as to show a crystalline fracture in its flange. This is accomplished by making a slight nick across the flange, and placing the rail in the straightening press on supports placed a short distance on either side of the nick, and then putting in the "gag" just over it—the result is almost always a crystalline fracture of the flange. But if the points supporting the rail were placed farther apart and the rail given an opportunity to yield considerably between them, then, if the gag was put in light a number of times in succession, the flange would be sure to exhibit a fibrous texture, due to the fact that there had been sufficient time to break up the films of cinder between the flanks of the compound crystals and destroy their transverse cohesion, thus permitting them to slide apart and exhibit the appearance of disrupted fibers.

Various illustrations were given, showing the effect of breaking iron, which seem to prove positively that the crystalline and the fibrous appearance depended more upon the method of breaking than upon the structure or character of the metal. The crystalline appearance of iron broken by compression was illustrated by cases of broken steam hammer bars.

The mechanical action which takes place as the result of shock in the films of cinder which separate the compound crystals in a bar of wrought iron, is believed to be somewhat as follows: Each individual jerk of extension or jar of compression slightly disarranges the molecules of the thickest film of cinder in the immediate vicinity of that part of the bar in which the shock is the most powerful, and, as the result of this disarrangement, the crystals of iron cannot be brought as closely together under the operation of cohesive attraction as they were before the disturbing shock, and as shock after shock is experienced by the bar, these crystals of iron become further and further separated and their cohesive attraction enfeebled, until finally it is not sufficient to resist the shock which ruptures the bar.

The belief in the so-called crystallization of fibrous wrought iron as the result of long use is altogether a mistaken one. The crystallization observed in the case of any particular fracture existed, just as we see it exposed in the break, at the time the metal was given the shape it had when ruptured. After a bar of distinctly fibrous wrought iron has been subjected to multitudes of sudden jerks of extension or jars of percussive compression, the cinder in some cross-section gets broken up, cohesion is destroyed, and the bar breaks with a crystalline fracture.

A Shop Manager on the Metric System.

There was a short discussion at the last Master Mechanics' Association Convention on the introduction of the metric system of measurement, but it appeared to find very little favor among the railroad men present. Mr. S. Higgins, of the Lehigh Valley, introduced a resolution to be sent to Congress in opposition to the proposed law which will make the metric system obligatory in this country in 1901, and it was agreed to almost unanimously. The only opposition offered was by Mr. G. R. Henderson, of the Norfolk & Western, who believed that if the resolution were adopted the association would be considered a lot of old fogies. He was strongly opposed to the motion. Then Mr. S. M. Vauclain, superintendent of the Baldwin Locomotive Works, said:

"I am not opposed to it; I am in favor of it. So far as being considered an old fogy is concerned, I do not think that anyone who favors holding on to the yard is an old fogy.

"Before we adopt the metric system it is wise to consider what it would cost the railroad companies and the manufacturing establishments of this country. It would mean an entire revision of all the drawings that we have; they would all have to be figured according to that system. Some of our mechanics, and we have a great many good ones, are rather old and it is hard to teach old dogs new tricks, and these men would have to be taught the metric system, how to work to it, how to caliper to it and everything of that sort. In our establishment we have over 2,000 plans of locomotives, and all the necessary detail drawings, blacksmiths' sketches, etc., would have to be gone over. I can imagine a blacksmith measuring a sketch and figuring up to the metric system—it would require a foreman for each man, who would have to stay right with him; and the trouble would be to get foremen who understand the metric system. It is said that some foreign countries favor the metric system over the English yard. We work to foreign drawings quite frequently, but in all cases the measurements are transformed into inches, so that our shopmen will have no difficulty in measuring, and that is a thing that can be done by the draftsman, an educated man, who has plenty of time to do it, so that others can follow. But it would be a difficult thing for our men to follow if we turned these drawings into the shop—we would not get an engine built in five years.

"Another thing confronts us, that in looking over these drawings we very often find the old-fashioned foot and the old-fashioned inch come into play. On drawings that are worked up to the metric system, in some places the metric measurement is used and in other places we have feet and inches. I think that very much the same thing would result here. We would have two sets of measurements clashing all the time; that would be a needless expense added to our present manufacturing expense, and somebody has got to pay for that. No manufacturing establishment can keep on throwing work away and sell their product at the same price they are selling it at now. They would have to go out of business, and we cannot afford to have them go out of business. We have got to keep on or else the country will stand still. We do not want to go abroad and buy our articles that we use; we want to make them here. It seems to me that we had better stay right where we are, and if the English-speaking people will stay right where they are, those who have an ideal measurement—which is wrong and proven to be wrong, which is not correct to start with—they will come to our measurement too. Mr. Henderson has said that we know the value of the metric system of money, and that when we undertake to count up in pounds, shillings and pence, we find great difficulty. But there is a vast difference between the foot for measurements and pounds, shillings and pence for money, and we must not forget it when we come to make comparisons."

The Manhattan Elevated Railroad Company are building in their shops in New York an electric motor which they intend to put into service on the Thirty-fourth street branch. This is intended as an experiment to give guidance for the extension of electricity to the whole system.

Grates and Ash-Pans.

In the course of his highly practical and sensible inaugural address at the opening of the last Master Mechanics' Convention, President Blackall, while discussing the subject of fuel economy, urged renewed attention to the character of the grate openings, and to the making of the ash-pans of such design as will control the admission of air necessary for combustion.

Grate openings and the design of ash-pans are like the sheep that are always getting lost, while the shepherds in charge do not consider them of sufficient importance to be searched for; yet they represent losses that materially reduce the value of the flock.

There is too much tendency toward uniformity in the designing of grates. Uniformity is a good thing in its way, but, like many other good things, it can be misused. In a general way, uniformity has greatly reduced the cost of repairing railroad rolling stock; but while following the practice of maintaining parts uniform, it is well to remember that different conditions demand diversity of forms. Because a grate of certain form and size of opening has bee 1 found satisfactory for coal having 80 per cent. carbon, it does not follow that the same grate is suitable for coal that has only 50 per cent. of fixed carbon. Uniformity of this kind is bad practice, yet it is very prevalent among our railroad companies. There is good reason for believing that the size of grates might be reduced advantageously if the proportion of grate opening was increased to an extent that could readily be done by careful designing.

In the firebox of the larger size of engines the grate is too large to be fired properly, and the heat losses from uneven distribution of coal are often serious. Any improvement in design that would make it practicable to shorten the grate would certainly be a step in the direction of economy if the grate openings were sufficient to admit the required volume of air.

The designing of grates may seem a petty subject to discuss, but the petty losses, when worked up into a whole, very often make serious leakage. But grate designing is by no means petty work, although it has not received so much serious attention as it deserves.

We know of a case where the improved design of locomotive grates acted as the principal leverage in elevating a general manager of a small road to the head of one of the transcontinental lines. When the general manager referred to took charge of the minor Northwestern road he found that the fuel account for locomotives was abnormally high. The master mechanic in charge admitted that the fuel account was high, but he alleged that, owing to the cold region traversed by the road, engines would not steam unless the best Hocking Valley coal was employed; attempts had been made to burn Illinois coal without success. A new master mechanic was employed, and he began his duties by trying to find out why the engines could not burn Illinois coal successfully. On examining the grates he found that the percentage of air opening was very small, so he designed a new form with the opening greatly increased. This was tried in one of the locomotives, and there was no difficulty in burning Illinois coal. After that engine had run for a month and demonstrated that it would steam satisfactorily, the grates of all the other engines were changed, and Illinois coal was used exclusively. The result of this change, and a few others in the line of saving, was that the operating expenses of the locomotive department was reduced about $100,000 a year, and the general manager got entire credit for what was done. His reputation as a good manager was established, and on account of that he was soon chosen to fill one of the highest railroad positions in the country.

The humble ash-pan is even a more important factor than the form of grates in the saving or wasting of fuel. A well-designed ash-pan is so constructed that the openings can be employed to restrain the admission of air, and by that means act as a damper upon the fire. Through a humorous misnomer the doors of the ash-pan are called "dampers," but, as usually constructed, they do not dampen anything except the ardor of the fireman who is trying to make a fuel-saving record, and who hates to hear the safety valves screaming all the time the engine is not working steam. We do not know of anything which illustrates so well the apathy towards small savings as the loose construction of ash-pans and the dampers supposed to close the openings. Between that defect and the miserable practice of leading the air-pump exhaust into the smokestack, many engines use nearly as much fuel when standing at stations as they do when pulling trains.

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We would call attention to a little trick in locomotive wrecking which is shown in the engraving on the first page of this paper, from our sister Republic, the Argentine, in South America. This engine was on her side in a ditch, and before straightening her up, for pulling on the track, they lashed a rail to her driving wheels and truck wheels, so that when she stood on her feet she would be on a rail, ready to be pulled up a temporary track to the main line. We do not know of any such practice in this country, it being pretty generally the custom to pull a turned-over engine up on her wheels, jack her up and put rails under her. We do not see why the South American practice isn't a good one, and about the quickest way to accomplish the desired result.

WHAT YOU WANT TO KNOW.

Questions and Answers.

Correspondents wishing to have questions answered in these columns should send in their names and addresses, not for publication, but for evidence of good faith. We throw all anonymous letters into the waste basket.

(68) H. J. S., Chadron, Neb., writes:

Will you please let me know the best way to make hard solder for brazing brass? What I want to know is the best way to get it in small pieces. The way I have been making it is to first melt it together and then pour it out in a pail of water; but this does not make it as fine as I would like to have it. A.—You can pulverize the spelter to any degree of fineness by breaking it up in an iron mortar; but it may be cheaper for you to purchase the commercial article already prepared.

(69) J. A. B., Grant, Pa., writes:

I would like to know which of the wheels on an engine slips in going around a curve; is it the inner or the outer one? A.—If the wheels are coned so as to allow the outer wheel to travel around its path in the same time that the inner one measures off its circumference on the rail, there will be no slip in either wheel; but this ideal condition is never found in practice, and slip does occur, for the reason that the outer wheel has a greater distance to cover than its mate on the same axle, and the slip of the wheels will therefore be measured by the difference in the distance they will travel in rounding the curve. We believe it has never yet been clearly defined where this slip actually occurs.

(70) N. R. K., Rutland, Vt., writes:

Will you please inform me how many points of support a common eight-wheel engine has? A certain catechism on the locomotive says there are three points, namely, the two fulcrums of the equalizers and the one bearing of the truck-center casting. Do not the back-spring hanger of the back spring and the forward-spring hanger of the front spring hold some of the weight, or does the strain on them revert back to the equalizer fulcrum? A.—All of the load sustained by the springs is transmitted through the hangers to the equalizers and is deposited at the gib in the equalizer post. All that part of the load not carried by the springs is sustained by the center casting, making a tripod or three-pointed support for the engine.

(71) S. A., Duluth, Minn., writes:

1. Can you, through the columns of your valuable journal, tell what action valve oil has on the pins and brasses of a locomotive when used in rod cups as a lubricant? Our master mechanic has issued a bulletin forbidding the use of valve oil, claiming that it wears the pins out and must not be used on that account. A.—The mechanical effect of lard oil as a lubricant has been found to be of a soothing character on a hot pin, because of its body or viscosity, although it gives a slightly higher co-efficient of friction than some of the lighter mineral oils. We never have heard of any harm ensuing to pins or brasses from chemical causes when lard oil was used. Perhaps a too free use of this lubricant is responsible for the bulletin you speak of. 2. Will ammonia used in the oil affect pins? A.—We have never heard of ammonia used in lubricants, and cannot say what the effect would be.

(72) J. E. P., Independence, Mo., writes:

1. Being a subscriber to your paper, I should very much like to know, through its columns, what are some of the chief reasons for abandoning the use of stoves in cars. A.—The great loss of life by fire in case of wrecks furnished the principal incentive to doing away with stoves for car heating, and public opinion was not slow in making a vigorous demand for its discontinuance. Little heed was given to this cry for a safer heater by the railroads, however, until legislative enactment in many States made it compulsory for them to place a heating system in their cars that would give immunity from a horrible death to passengers that had the good fortune to escape mangling in a wreck. 2. Is heating by steam safer, cheaper or better? A.—It is certainly safer, and while we cannot give relative cost of steam and stoves, the fact that it is safer should outweigh all other considerations; human life is paramount. It is better, for the reason that it gives a more equable distribution of heat. 3. If stoves could be used with safety, would they have been abandoned? A.—There is a strong probability that they would not, since it was the danger element that forced their retirement.

(73) T. L. S., Temple, Tex., writes:

We have five ten-wheel Baldwin engines here that have been in service for two years. These engines carry a boiler pressure of 180 pounds of steam and are equipped with two No. 8 monitor injectors. With 150 or 160 pounds of steam these injectors work well, but when they are worked under full boiler pressure they will not take up the water. The injector checks and pipes are in good condition, and the same injectors placed on another engine carrying 145 or 150 pounds of steam work all right. I have never heard of any other high-pressure engines having the same trouble; can you name a cause for it? A.—This is a common fault with injectors having fixed tubes and which are designed for a certain range of pressures. The reason for the failure to work properly, lies in the fact that at the higher pressure there is more heat in the steam than at the lower pressures, and the water does not have time to take up that heat and condense the steam. The remedy is to increase the distance the steam must travel to reach the combining tube, thus giving more time for the water to condense the steam. All makers of injectors furnish tubes suitable for desired pressures, and if applied to will arrange to make an injector work under any given condition.

(74) W. H. R., Tacoma, Wash., writes:

It is claimed that an engine which can haul fifteen 20-ton cars fully loaded, with a given amount of steam, can haul with very little additional steam fifteen 40-ton fully loaded cars. Is this correct, or approximately so? A.—The claim noted above cannot be borne out by the facts, since there is a constant amount of work done by a cubic foot of steam at a given pressure, while overcoming a resistance through a given space. If the claim made were true there would be no need of the large power that has been designed to haul our heavy freight equipment. 2. Why can an engine haul twice as many tons, if placed in large cars, as it can in small cars, without nearly doubling the amount of steam used? A.—It is not established that an engine can haul twice as many tons when carried in large cars, but it is well known that more tons can be hauled when the load is in large cars than is possible with a train made up of smaller cars, and the reason why this can be done is because there is less resistance to overcome. The large cars, making a shorter train, present less area to the wind, and also have less flange friction because of the smaller number of wheels. These two causes furnish the most resistance to the motion of a train, and it is plain that if they are reduced the hauling capacity of the engine will be increased.

(75) J. S., Quincy, Ill., writes:

1. I want to take the animal acid out of tallow; what degree of heat will it take, and how will I fix up to do it? Please say how much steam I will require on the boiler, and what size steam pipes will it be necessary to use. A.—This question is not in our line, and involves points in chemistry and also manufacturers' trade secrets not easily obtained. 2. I have an engine with 17 x 24-inch cylinders and 60-inch wheels; smokebox, half extension; single nozzle, 4½ inches diameter; straight stack, 15¾ inches diameter inside, 64 inches long; from top of nozzle to top of arch, 18 inches. There is no lifting pipe, and stack and nozzles are plumb. The diaphragm is 5½ inches from the flue sheet at the top, and abuts against the crotch pipe; the bottom of the diaphragm is 12¾ inches out from the flue sheet, and stands at the fifth row of flues from the bottom of the arch. The engine will not steam, and if we put in a smaller nozzle it will take the ash-pan, grates and all. I thought of putting in a lifting pipe; what size would you use, or what would you suggest doing? A.—Your nozzle is of correct diameter for 17-inch cylinders. The faulty conditions are in the arrangement of the diaphragm, but just what they are it is difficult for us to say at this distance. A lifting pipe might possibly help the situation, but the opening and angle of the diaphragm would have a greater influence on the steaming of the engine, and it is at that point that we would recommend changes to be made. It is a question of experiment.

(76) J. E. O., Lake City, Ia., writes:

Would you kindly furnish me the rules for figuring arithmetically the cubical contents of a drum having concave or convex heads? A.—For an example we may take a drum with a body 24 inches diameter and 24 inches long, having convex heads with a height of 6 inches at the center. We then first compute the volume of the cylindrical portion, to which must be added the volume of the ends, which are segments of a sphere. The volume of a cylinder is equal to its area multiplied by its length, and in this case it will be $0.7854 \times 24^2 \times 24 = 452.39 \times 24 = 10,857.36$ cubic inches. To find the volume of the segments at the ends, square the radius of the base of the segment, and multiply this square by 3; to this product add the square of the height at the center of the segment; multiply this sum by the height; and multiply this product by 0.5236. To express the rule in figures we have 12 inches for the radius of the base, since 24 inches is the diameter of the drum; the height at the center we have taken to be 6 inches. Then $(12^2 \times 3) + 6^2) \times 6 \times 0.5236 = 1,470.27$ cubic inches, and multiplying this by 2 we have 2,940.54 cubic inches in both segments, and adding this to the volume of the drum, 10,857.36 cubic inches, we have 13,797.9 cubic inches in the drum under consideration. If the ends were concave instead of convex, it would, of course, be necessary to subtract their volume from that of the cylindrical portion of the drum. If the ends were hemispheres their volume would be easier calculated by the rule for spheres, which is diameter cubed $\times$ 0.5236.

The first horseless carriage ever used in England was made and run on common roads in Great Britain as early as 1827. The conservative tendencies of the British people appear to have been the only obstacle to developing the horseless carriage for common roads about the time that railroads were coming into existence, but our English friends hated innovations, and laws were passed, prohibiting the running of horseless carriages on the public highways. It remained for the French, seventy years later, to begin demonstrating the usefulness of horseless carriages, and now the English people are becoming aware of the race they have lost by their conservative tendencies. A new Act of Parliament has been passed, giving horseless carriages some privileges on the public highways, and the horseless carriage is beginning to make its way in England. With the splendid roads they have got over there, it is likely enough that within a few years, carriages driven by petroleum, by gas, or by light steam engines, will be second only in popularity to the bicycle. So far, the most successful horseless carriages have been driven by steam and petroleum, but the prospects for electricity as a motive power seem to be very fair. It suffers from the drawback of requiring storage batteries, and this makes the load too heavy. Most of the carriages hitherto tried have been merely horse carriages equipped with power. The likelihood is that, in developing this form of vehicle, people will depart as far from the ordinary horse carriage as they have done in making vehicles for railroad use.

The "Scientific American" has celebrated its fiftieth anniversary number by a special issue, showing the progress of the world in science and art during the past half century. The number contains 116 pages and is very profusely illustrated. The illustrations show the development of the locomotive within the period stated; also progress in ship-building, bridge-building, steam-engine design, telegraphy, bicycles, electric motors, agricultural machinery, etc. Numerous illustrations are given of the men who have taken the lead in the world's progress during the fifty years past.

One of the officers of the Pennsylvania Railroad at Altoona writes us: "In the August number of your journal appears an article about 'The Pennsylvania Compounds.' A very serious error has been made by the writer of that article which has led him to draw somewhat erroneous conclusions. The heating surface of the consolidation engines referred to is given as 1,258 square feet. As a matter of fact, it is 1,498 square feet, or very nearly 20 per cent. greater than the figure given. Furthermore, the classification letter of the consolidation engine is 'R,' not 'P.' "

INDEX TO ADVERTISEMENTS.

Buyers' Finding List.

Air Brake Fittings.
Crane Co., Chicago, Ill.

Air Brake Hose.
Boston Belting Co., Boston, Mass.
N. Y. Belting & Packing Co., New York.

Air Brakes.
Westinghouse Air Brake Co., Pittsburg, Pa.

Air Brake Gage.
Utica Steam Gage Co., Utica, N. Y.

Air-Brake Pump Governors.
Foster Engineering Co., Newark, N. J.

Air Compressors.
Clayton Air Compressor Works, New York.
Ingersoll-Sergeant Drill Co., N. Y. City.
Norwalk Iron Works Co., South Norwalk, Ct.
Pedrick & Ayer Co., Philadelphia, Pa.
Rand Drill Co., New York.
St. Louis Steam Engine Co., St. Louis, Mo.

Air Drilling Machine.
C. H. Haeseler & Co., Philadelphia, Pa.

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Pedrick & Ayer Co., Philadelphia, Pa.
Whiting Foundry Equipment Co., Chicago, Ill.

(Continued on page 790.)

BUYERS' FINDING LIST—*Continued.*

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Cambria Iron Co., Philadelphia, Pa.

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N. Y. Belting & Packing Co., New York.

Boiler and Firebox Steel.
Shoenberger Steel Co., Pittsburg, Pa.

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Philadelphia Book Co., Philadelphia, Pa.
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Trojan Car Coupler Co., Troy, N. Y.

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Safety Car Heating & Lighting Co., New York.

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Safety Car Heating & Lighting Co., New York.

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Lima Locomotive & Machine Co., Lima, O.
Ramapo Wheel & Foundry Co., Ramapo, N. Y.
Standard Steel Works, Philadelphia, Pa.
Washburn Car Wheel Co., Hartford, Conn.

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Q. & C. Co., Chicago, Ill.

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Moore Mfg. & Fdy. Co., Milwaukee, Wis.

Chime Whistles.
Crosby Steam Gage & Valve Co., Boston, Mass.
Star Brass Mfg. Co., Boston, Mass.

(*Continued on page 791.*)

BUYERS' FINDING LIST—*Continued.*

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Richmond Loco. & Mch. Wks., Richmond, Va.
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Schenectady Loco. Wks., Schenectady, N. Y.

(*Continued on page 792.*)

BUYERS' FINDING LIST—*Continued.*

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(Continued on page 793.)

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Ashton Valve Co., Boston, Mass.
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A. French Spring Co., Pittsburg, Pa.

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Falls Hollow Stay-Bolt Co., Cuyahoga Falls, O.
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Crosby Steam Gage & Valve Co., Boston.
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The Egan Co., Cincinnati, O.
J. A. Fay & Co., Cincinnati, O.

Wrought Iron Pipe.
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Cash must accompany order. No books sent C. O. D. Give name of book and author, and we can furnish any book wanted. The list below is especially recommended for mechanical readers. All books sent by mail free for price named, unless otherwise stated.

A Library of Steam Engineering. Fehrenbatch. 1895. The latest and the best book on Steam Engineering. Illustrates and explains every kind of steam engineering, stationary, locomotive and marine. Has chapters on the mathematics of steam engineering, covering all possible points, but in plain figures. No "higher" mathematics used. Can be understood by any man with a common school education. A whole library of steam engineering. Highly recommended. 800 pages. Price.......................... **$5.00**

Air-Brake Catechism. Conger. 1895. This is Conger's "Air-Brake and Signal Instructions" rewritten and improved, containing the air-brake and signal instructions approved by the Master Car Builders' and Master Mechanics' Associations; also the standard list of questions for air-brake instruction. This is the latest and best book on air brakes. Issued November 1, 1895. Price... **25c.**

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Diseases of the Air-Brake System. Synnestvedt. 1894. Tells how to find and repair every defect that the air-brake system is liable to have.......................... **$1.00**

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Enginemen's Pocket Companion. Booth. 1895. Contains pages arranged for time-keeping. Has Traveling Engineers' Examination for Enginemen, articles on brakes, valve setting, combustion, and much valuable information for enginemen **$1.00**

Evolution of the Air Brake. Synnestvedt. 1895. A brief but comprehensive history of the development of the modern railroad brake, from the earliest conception contained in the simple lever, up to, and including, the most approved forms of the present day.......................... **$1.00**

Haswell's Engineer's Pocket-Book. 1892. Probably the best authority in engineering matters. Rules for almost everything. **$4.00**

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Key to Steam Engineering. Williams. 1892. More especially for stationary engines, but good information for anyone. Boiler, engine, combustion, evaporation, etc., explained in a common-sense way.......................... **50c.**

Link and Valve Motions. Auchincloss. 13th Edition. Just Revised. 1895. The principal authority on the subject **$2.00**

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Locomotive Engine-Running and Management. Illustrated. Sinclair. 1893. Enlarged. Best work on running and care of locomotives. Plain facts plainly stated.......................... **$2.00**

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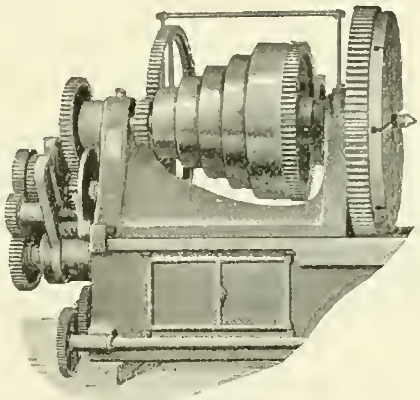

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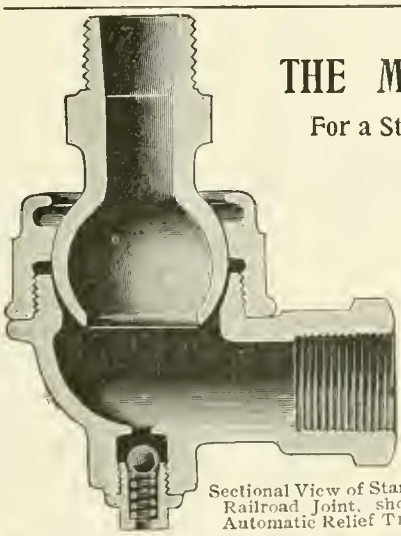

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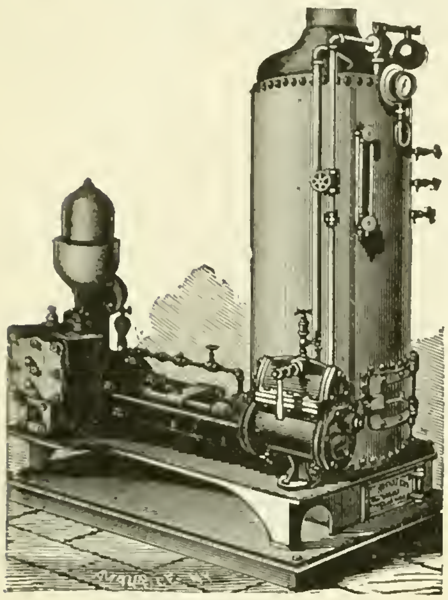

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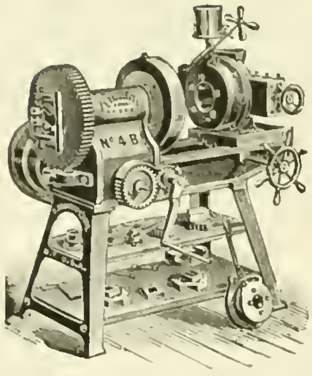

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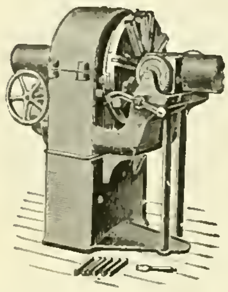

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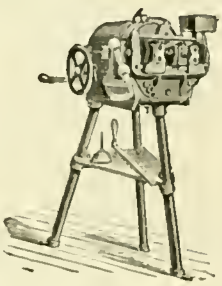

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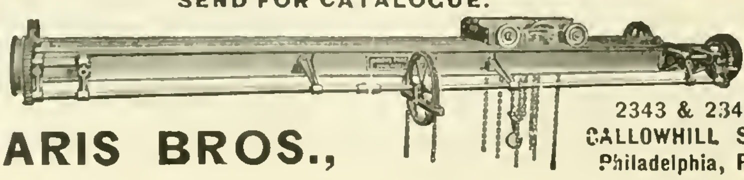

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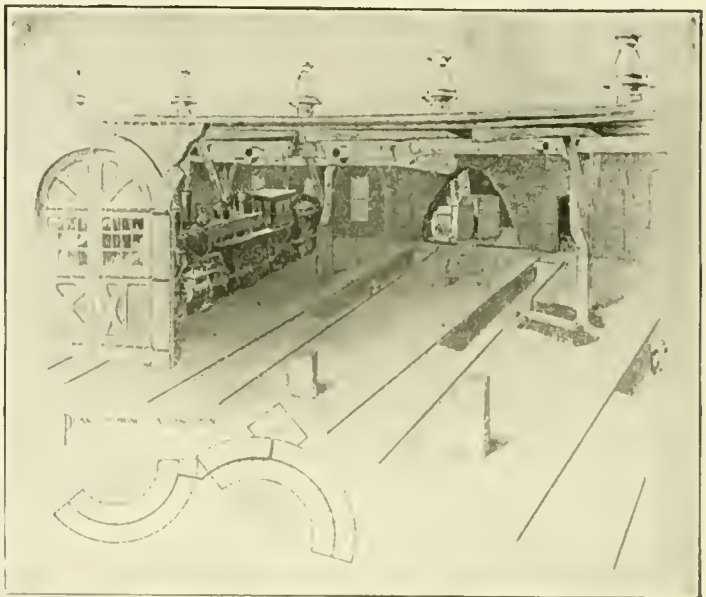

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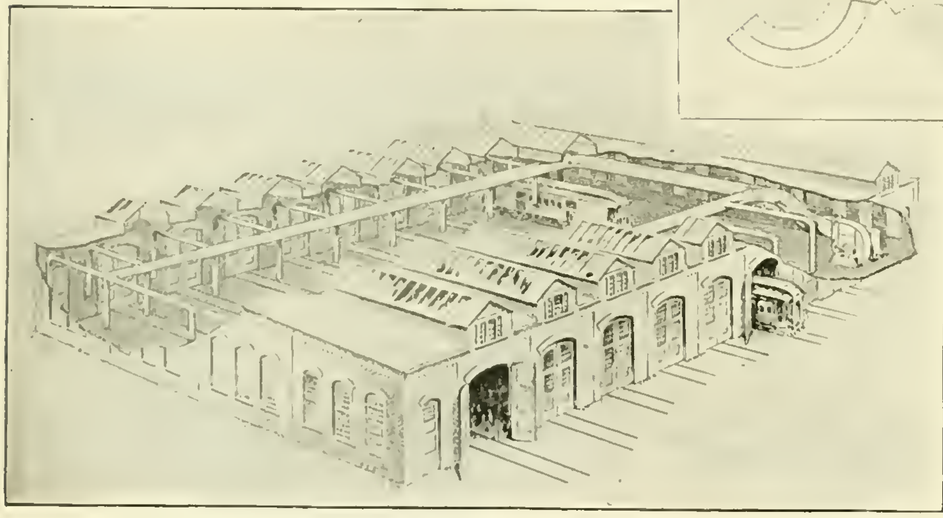

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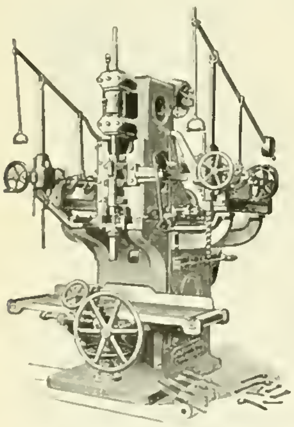

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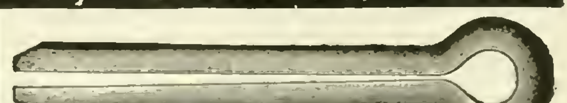

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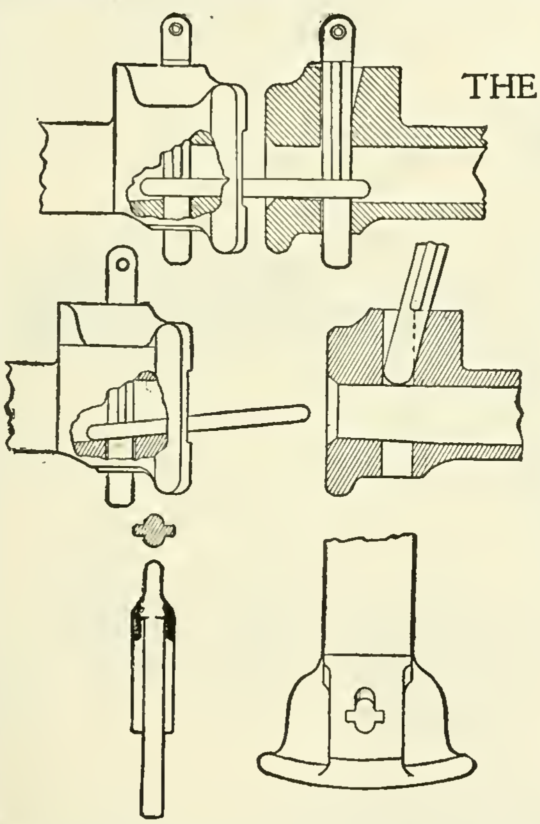

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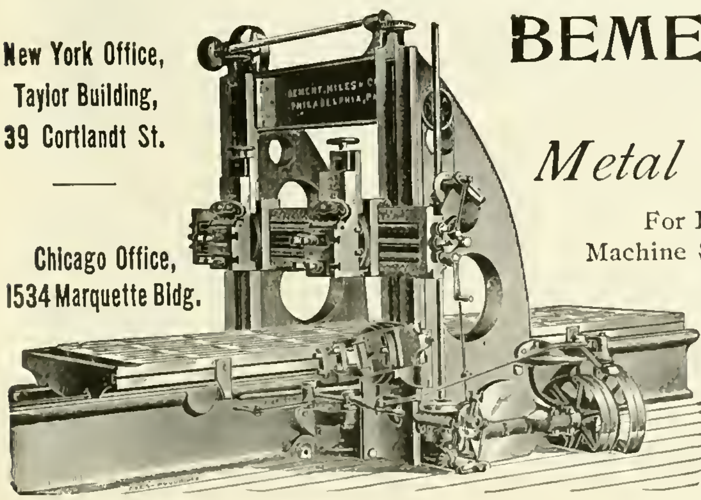

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LOCOMOTIVE ENGINEERING
A PRACTICAL JOURNAL of RAILWAY MOTIVE POWER AND ROLLING STOCK.
[Trade-Mark Registered.]
Vol. IX. NEW YORK, OCTOBER, 1896. No. 10.

One Way to Do Things.

Sam Hutchins, of the Westinghouse Instruction Car, tells a story of a resourceful engineer who had to disconnect his engine one bitter cold night.

The engine had metallic valve-stem packing, and the tool box was minus the keeper to fasten it.

The valve rod went through a hole in the yoke, however, and the engineer put some wedges around it, took a wisp of hemp, wrapped it around the fracture and poured a pail of water on the job: in two minutes it was frozen solid—and they got in "O. K."

Another old-timer adds that another fellow, who heard the M. M. compliment the ice artist as a genius, waited to be towed in one night the next July because he couldn't make the water freeze. He was one of those helpless mortals who always imitate and never originate.

Baldy Wooten used to tell a story of an old-timer who cautioned his newly-promoted son to "allus use taller when you git anythin' hot." The first thing that heated was the fire door—the liner came off—and the trustful son gave it a dose of "stewed mule" to cool it off—" 'cause dad said so."

FOUR-TRACK VIEW, CANADIAN PACIFIC RAILROAD, SELKIRK MOUNTAINS.

Jim Skeevers' Object Lessons.

Oil Economy and the Hereafter--Pints or Cents, Tons or Dollars--The Performance Sheet.

BY JOHN ALEXANDER.

Jim Skeevers has had a rest for a couple of months—no vacation, of course; they only come in higher official circles—but the "Sphinx," who is president, and the "Old Man," who is general manager, went to Europe in June. Besides that, Sullivan, the general superintendent, let a livery horse run away with him and break his leg; the chairman of the Grief Committee was elected sheriff and quit the road; Sarah has a new Skeevers baby, and in many forms things have "been comin' his way."

Before "goin' foreign" the "Old Man" ordered Skeevers to suspend all new work, reduce the shop hours, and to "choke things" until after election.

"When we get this sixteen to one business settled we'll do something," wrote the "Old Man."

Skeevers knows to a dead certainty that in his secret heart the "Old Man" is for silver, and he also knows that the "Sphinx" is gold to the gizzard, so he keeps wondering which side must win to get that mysterious "something" started. He is strongly of the opinion that "something" will be done if there is freight to haul this fall, regardless of who is elected.

The "38" is still standing in the back shop, the "pinch" stopping work on her, and the new form of cylinder fastening and frame fit, and all that, will have to wait for trial until "this sixteen to one business is settled."

Skeevers knew he would get no vacation, and that it was absolutely useless for him to ask vacations for his division men, but he sent them on trips to look up certain matters in certain shops and take notes of anything worth imitating. It might not have been all accident that he sent each of them into the neighborhood of his old home, and it was certainly intentional when he told each to "take it easy." He got passes for the wives, too, and told each man to put in a bill for expense while away.

Some railroad officials would object to the expense, but, now that the last one is home and has made his report, Skeevers figures out that the information gained is going to save the road over four hundred dollars this year alone.

Just before the "Old Man" went away he called Skeevers into the office, gave him a cigar and a seat, and then pulled out a roll of blueprints.

"Skeevers," said he, solemnly, "I want to jest call your attention to these performance sheets of the six roads that touch ours. I am not satisfied with this oil service—not by a darned sight."

"Neither am I," said Skeevers.

"Well, why don't you stop it?"

"I don't think it would pay."

"Oh, say, Skeevers, I'm in earnest."

"So am I, sir, and if you will listen I think I can turn some light on the subject for you!"

"An object lesson?"

"No; just a plain statement of facts. Mr. Wider, you know that your wish, my policy and the only way to conduct business is for the head of each department to mind his own business"——

"Yes; you just bet."

"Therefore I have no criticism to make, although I may appear to do so. My department uses all the oil; who orders it?"

"Well, I do; you know it's a sort of hobby with me."

"All well and good. I don't want to order it; but if I did, I should cut the amount down at once."

"Is this a conundrum or the string you pull the 'O. L.' out with, Skeevers?"

"No; neither one nor the other. I think your standard of measurement is wrong. I should change the measure at the oil house."

"One of them fool sixteen to one jokes coming now," said the "Old Man," half to himself.

"You buy three grades of oil and mix them at the oil house—a formula you bought. Our engine oil costs about eight cents a gallon, and cylinder oil, say, twelve-and-a-half. Is that about right?"

"Yes; just about."

"You change the measure at the oil house and we will come up somewhere near the other roads."

"False bottoms in the measures?"

"False measure altogether."

"I'm listening, Skeevers."

"You throw away the pint cans and measure by a dollar bill, and see where the Great Air Line would be."

Mr. Wider consulted the blueprints.

"It's in pints on 'em all."

"So it is. But take the Midland; they oil by contract with the Galena Oil Company; their oil is worth three or four times as much per gallon as ours, but a dollar's worth of it will run farther with safety than a dollar's worth of ours."

"I never had any use for that scheme for oiling by contract—seems like callin' in an outsider to attend to your work; but blamed if I don't believe if they'd a' put it to me that way I'd a' listened. If you say you will run farther on a dollar's worth of their oil I'll buy some; we don't want no contract, though."

"Mr. Wider, the men have been educated on this poor oil; they must make up in quantity what it lacks in quality, and they use more than they should if the oil was good. When the new oil comes they will waste a lot of it, and we will have six months of work and worry. You want results, and the best results could be had by giving the contract outright for engine and car miles. Your economy commences at once then; they will send men well up in 'oilogy' to train the men. Their plan will knock the pints on the performance sheet into the figures you want to see, and the road will be ahead on the dollar bill measurement."

"By ginger spruce, I believe you're more'n half right."

"I know that is right, Mr. Wider. If all performance sheets were figured on the dollar standard instead of pints and pounds, some of the record breakers would be sick, and people might see why it is possible for some of our roads to pay dividends and yet have a bad oil record. Oil is only the blossom on the vine—the potatoes are under ground and out of sight."

"Here comes another," chuckled the "Old Man"; "have another cigar, Skeevers."

"Thanks! If you want some net results to show the president when he gets back, give me authority to do as I want to in the matter of fuel and I will agree to save you a dollar bill for every postage stamp you can save in the oil business—do what you will."

"Say, Skeevers, who's givin' this lecture and who's the audience? I called you down here to set out your packin', and blast me if you ain't doin' all the talkin'—but go ahead; I'm a' enjoyin' it."

"You perhaps haven't thought of it in that light, but there are a great many ifs to the oil economy scheme. It's economy if no damage is done, no cylinders cut, or valves and seats scored, or axles hot and brasses ruined, with their resultant delays and loss for repairs, and the engine being out of service. You remember the Bible question: 'What profiteth it a man if he gain the whole world and lose his own soul?' Railroad managers should not look alone on the few cents saved in the first place, and not also look ahead into the hereafter—there is a red-hot sizzling hereafter to some of the oil economy. Not so in coal economy; a dollar saved there is a good, clean, clear dollar made—and no fear of a hell to follow."

"Say, if my wife gets hold of you there will be a man about your size teaching Sunday school in Dr. Parker's church."

"When you come back I will have a new performance sheet that measures oil in dollars and cents—you said you'd contract the oiling or buy better oil?"

"Yes, and I'll abolish the fuel department and put it under you."

"No, I don't want it; let the fuel agent buy and distribute the fuel, but order him to buy *one kind* for my department and not to change the kind or quality without my consent. Now he will change for ten cents a ton, and we are burning four or five distinct kinds of fuel; an engine drafted properly for one kind will not burn the other at all with economy. With one kind I'll put them all in shape, and then we will ask the boys to be careful. We will labor with 'em, instruct 'em, interest 'em in the work and encourage 'em to save coal. The new performance sheet figured in dollars and cents will interest them more than pints and tons. Let promotion, preference for runs and standing depend on how many cents a man can haul a ton of freight a mile or a hundred miles for—then you will get results. If you let me do this my way I'll consult the boys. I'll say to 'em: 'Here, boys, we have been giving you oil that cost seven cents a gallon; we are going to give you some that costs twenty cents and will go five times as far—be careful of it.' I'll let 'em vote for the kind of coal they want, and tell 'em we don't care a continental how much it costs, we want the best results; we know we have the best men in the country and we propose to give 'em the best fuel to work with. Every mother's son of 'em will vote for Frost Creek coal—it costs—lemme see ——"

"Two seventy a ton," said the G. M.

"Two seventy as against one ninety for Eldorado——"

"Good deal of difference there, Jim."

"Yes, sir, *in tons;* but a dollar's worth of Frost Creek coal will haul a ton of freight more miles than a dollar's worth of Eldorado—you don't care for tons; it's dollars, remember. The Frost Creek dollar does more work for you than the Eldorado dollar, and we can't maintain 'em at parity any longer."

"James Skeevers," said the "Old Man," as he shook "Skinny" by the hand, "if our party wins this fall I'll be tempted to make a trip to Washington to get ye appointed Secretary of the Treasury—there's only one thing that stands in the way, and that is, that I want you right here. When we get back I want that dollar performance sheet and some results. When the 'Sphinx' comes out to the annual meeting I'll put him into a trance, or else this here hypnotism of yours is a joke and I'm a jay from Jaytown."

Skeevers and the boys have been wrestling with the fuel problem all summer; the "Old Man" has just returned, and Skeevers tells me that he's getting some figures on coal that will interest people—perhaps he'll tell his wife as a secret; my wife and Sarah are friends, and if he breathes it I'll let you know right away.

Hardening Steel.

Chemical analyses and other methods of investigating the properties of steel have poured so much new light upon the subject that we supposed there was no longer any difficulty about uniform hardening of steel. Mr. W. F. Durfee, C. E., in a lecture delivered before the Franklin Institute, indicates that knowledge about the hardening of steel is still in an elementary condition. He says:

"In this matter of hardening steel, the value of the 'personal equation' of the workman is very important. It is not uncommon to find a practical mechanic who usually has good success in the use of a certain kind of steel with which his neighbors, equally skillful perhaps in other matters, can do nothing. So often have I encountered this fact, that I am inclined to believe that if a person in pursuit of information as to the proper quality of steel to use for any given article should travel through this land and obtain the honest opinions of all who were making the article in question, 'the last state of that man would be worse than the first;' for the chances are that every person consulted would have an opinion differing from those of his fellow-craftsmen; and, although when our traveler started on his search for technical wisdom he was positive that he knew nothing, he could not rejoice in even that negative certainty when he returned. In the present state of our knowledge, there is no recognized uniform, scientific method of hardening and tempering steel; all we have is a tentative art, as crude in its development as it is obscure in its origin."

The Greatest Railroad.

One of our friends, familiar with the railroads of Russia, was moved on the occasion of our illustrating railway terminals in Siberia to tell some things about the railroads of the Russian Empire. When the great Siberian Railroad is finished, it will be twice as long as the lines from New York to San Francisco. For many years the development of railways in Russia went on very slowly, having been controlled to a great extent by private companies. The present vigorous policy of pushing railways to the farthest limits of the Russian Empire has originated principally since 1892, and has been the work of the Minister of Finance, M. Witte, who adopted the policy of putting the railroads entirely under government direction. His policy met with great opposition from different interests at first, but he was backed by the Czar, and that influence has enabled him to successfully surmount all opposition. Great reductions have been made in freight and passenger traffic, and the number and speed of the express trains has been largely increased. The farther one travels in Russia, under the revised system, the cheaper the fare becomes—a rapidly decreasing rate of mileage being adopted for long distances. The Trans-Siberian Railroad is already completed for about 2,500 miles from Moscow.

A HANDSOME RAILWAY BRIDGE IN AUSTRALIA.

Fast Passenger Locomotive for the Black Diamond Express, Lehigh Valley Railroad.

We present in this paper engravings of the latest fast passenger engine, recently turned out by the Baldwin Locomotive Works for the Lehigh Valley Railroad.

The photographic reproduction will show the general appearance of the engine, and the numerous detailed engravings will give most of the information desired by railroad men.

This engine was designed by Mr. Samuel Higgins, superintendent of motive power, and shows the line of improvement now being made in most fast locomotives of this company. This is particularly noticeable in larger driving wheels, longer stroke, lighter reciprocating parts, and the use of steel in place of cast iron and forgings.

The use of extra large fireboxes, either of Wootten type, or a form which is narrower, yet wider than the frames, located entirely back of the driving wheels and supported on trailing wheels, is becoming more common, and this is a good specimen of a Wootten firebox on a high-wheeled engine.

There isn't a thing on this engine in the way of unnecessary finish—unless it may be the polishing of the cylinder heads. Everything is black—even the steel jacket is painted—but it will be noticed that more care than usual is taken with the protection of the boiler and the cylinders, in the use of magnesia coverings.

There appears to be nothing in the make-up of this engine that could be criticised as being used "because it was cheap." The driving and trailing wheels are of cast steel; the engine-truck and tender wheels are of steel. The tires are held on by shrinkage and the additional safeguards of retaining rings. I-section rods are used to get strength without unnecessary weight. All the rod cups are forged on, the eccentric straps are of phosphor bronze, and open-hearth steel is used for axles.

Particular attention has been paid to the construction of the boiler, which is made entirely of carbon steel, and the most expensive kind of iron is used in the stays and an effort made to have the stays enter the firebox sheets at right angles.

Particular attention has been paid to convenience for the engineer in the cab. Both injectors are on the engineer's side, and all the drivers can be oiled from the foot board. Lubrication of the cylinders and air pump is taken care of by the triple-feed cup, and metallic packing is used everywhere. The engine is fitted throughout with Westinghouse brakes of the most approved pattern.

On the tender, National hollow beams are used, with Collin spring head and shoe. Tender-box covers are of the Davis pressed-steel pattern, and all the small accessories are the best to be found in the market.

These engines have been in service for the past few weeks on the fastest train of the Lehigh Valley, and have given excellent satisfaction.

The following are the general dimensions of the engine:

Tractive power, 22,230 pounds.

Weight in Working Order—
On drivers, 81,800 pounds; truck, 29,100 pounds; engine total, 140,950 pounds; tender, 85,000 pounds.

Wheel Base—
Driving, 13 feet; total, 24 feet.

Driving Wheels—
Cast steel; diameter center, 70 inches; number, 4. Driving axles—Length, 69¼ inches. Journal—Diameter, 8½ inches; length, 11 inches. Material, open hearth steel. Wheel fit—Diameter, 8½ inches; length, 8 inches. Driving wheel tires—Number flanged, 4.

Cylinder—
Size, 19 x 26 inches; half saddle; packing, snap ring; size of exhaust pipe opening in cylinder casting, 8 inches. Steam ports—Length, 19 inches; width, 1⅜ inches; bridges, 18 inches. Exhaust ports—Length, 19 inches; width, 3¼ inches.

Valves—
Kind, Richardson balance, with vacuum valves to turn up. Travel, 5¾ inches, front of valve line and line; outside lap, 1⅛ inches; inside lap, $\frac{1}{16}$ inch neg. on back; lead, $\frac{1}{32}$ inch.

Boiler—
Material, carbon steel; working steam pressure, 180 pounds; 1st ring, outside diameter, 61 inches; thickness, $\frac{9}{16}$, ½ and $\frac{7}{16}$ inch. Dome—diameter, 30 inches; height, 22 inches.

Tubes—
Number, 265; length, 15 feet; diameter, 2 inches; thickness, No. 11, W. G.; distance between centers, 2⅝ inches.

Fire Box—
Material, carbon steel; radial stays, 1⅛ inches diameter; length, 114 inches; width, 80 inches; depth front end, 46¼ inches; back end, 46¼ inches. Water space—front, 4 inches; sides, 3½ inches; back, 3½ inches. Sheet thickness—Crown, ⅜ inch; sides, $\frac{5}{16}$ inch; flue, ½ inch; door, ⅜ inch; grate area, 63.97 square feet; class, shaking. Heating surface — Tubes, 2081.24 square feet; fire box, 148.98 square feet. Total, 2230.22 square feet.

Boiler Fixtures—
Throttle—Kind, balance; area opening, 57.9 square inches. Safety valves—Number, 2; size, 3 inches. Injectors—Number, 2; kind, Metropolitan No. 10. Lubricator—Number, 1; kind, Nathan triple.

Engine Truck—
Class, swing center. Wheels—Number, 4; diameter, 36 inches; wheel base, 74 inches.

General Dimensions Running Gear—
Distance between center engine truck and first pair of drivers, 95 inches; length 2d rod, 79 inches.

Tender—
Tank capacity, 4,000 gallons; material, steel. Sheet thickness—Sides, $\frac{3}{16}$ inch; top and bottom, ¼ inch. Number of trucks, 2. Frame—Kind, steel. Trucks—Class, rigid center, McKee, Fuller & Co.; wheels, No. 8; kind, plate; diameter, 36 inches; wheel base of one truck, 60 inches; total wheel base, 189 inches; kind of coupler at back end, Gould.

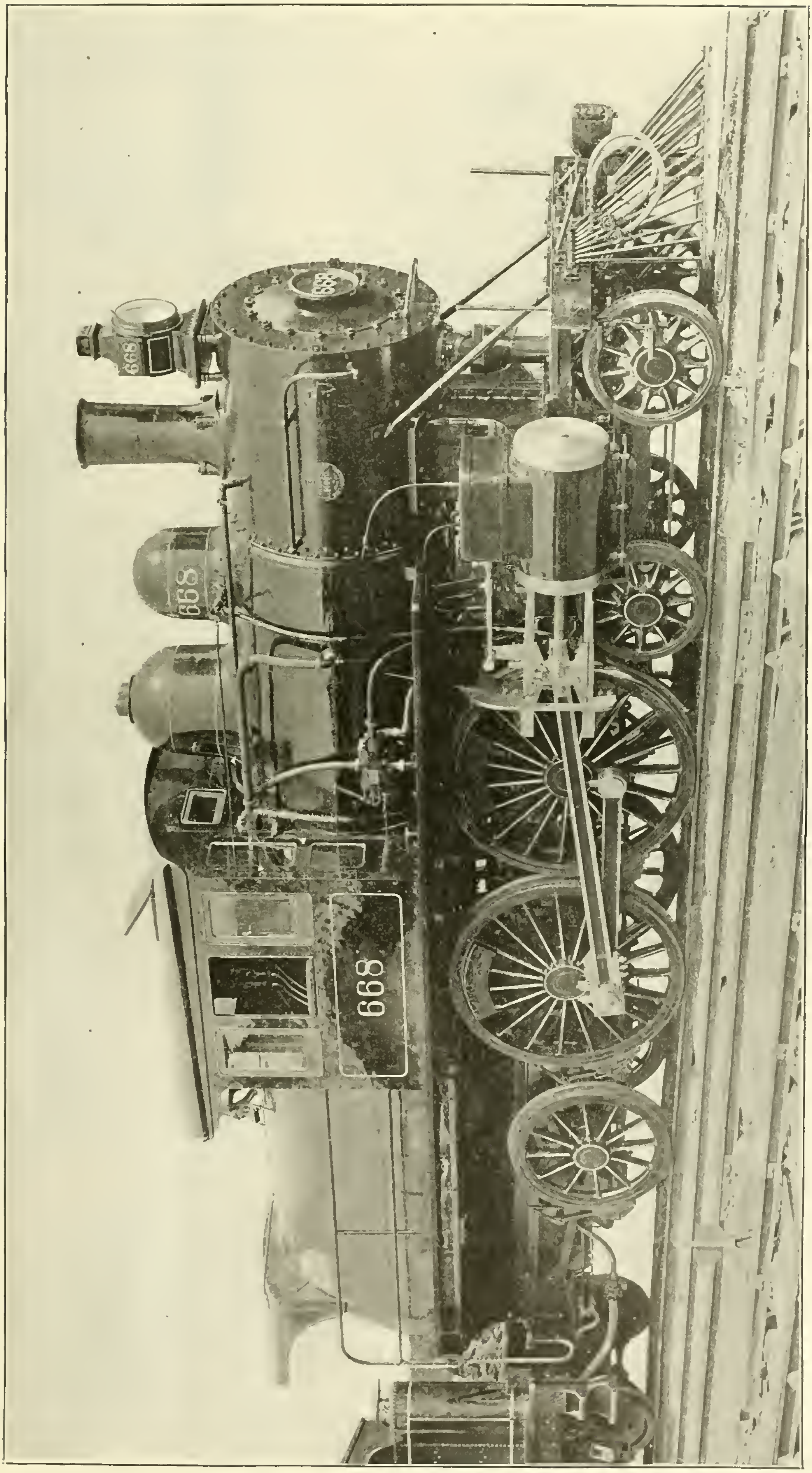
Brake—
Tram. Sch. X. M., class, driver brake. Drivers—Number of wheels braked, 4.
Train signal, Sch. J.
Steam heat, Consolidated.
Stack—Kind, cast iron; style, taper; height above rail, 14 feet 10 inches.
Extension smoke box, 22 inches; kind, L. V., standard.
Fuel, hard coal.
Latrobe tires.
Leach sanding device.
Air bell ringer, Snow.
Ashcroft gages.
Consolidated muffler safety valves.
U. S. metallic packing.
Cast steel wheel centers.
Iron tender frame, L. V. standard.
Magnesia boiler covering.
Taylor iron in staybolts.

Designing Link Motion That Cannot be Squared.

There have been some very curious things done in connection with what has been called, improving the valve motion of locomotives. A man needs to devote a great deal of study to link motion before he can get an intelligent idea of what the effects of any change will be; yet there are men who are ready to make radical changes on dimensions without the least hesitation.

A good illustration of this reckless way of doing things was mentioned by a speaker at a railroad club a few months ago. He said: "I know of a superintendent of motive power upon one of the roads in this country, who had some switching engines designed; it was at the time when standards were just beginning to come in, and he had a standard link upon a heavy passenger engine with eccentric rods some 7½ feet long. His switching engine had eccentric rods about 3 feet 6 inches long. After he had arranged for the big link, when his draftsman was laying out his valve motion he interfered with him, and said he would like this length of link, and an order came to put it on the switching engine as well as the others. This was done, but it was found with his rocker on, the length it was necessary to make it, his links would be dragging along on the ties loosely. The order was then given to cut off the end of the links, and the engine was put into service in that way. It was utterly impossible to get the engine squared, but it was running in this condition for a long time."

One dollar's worth of ordinary commercial gold leaf will, it is said, cover 900 square inches; but this material is thick compared with the gold leaf that is now made by depositing the yellow metal by electricity in a bath upon a highly polished sheet of copper. In this manner a film only one four-millionth of an inch in thickness is produced. Mounted on glass it is transparent.

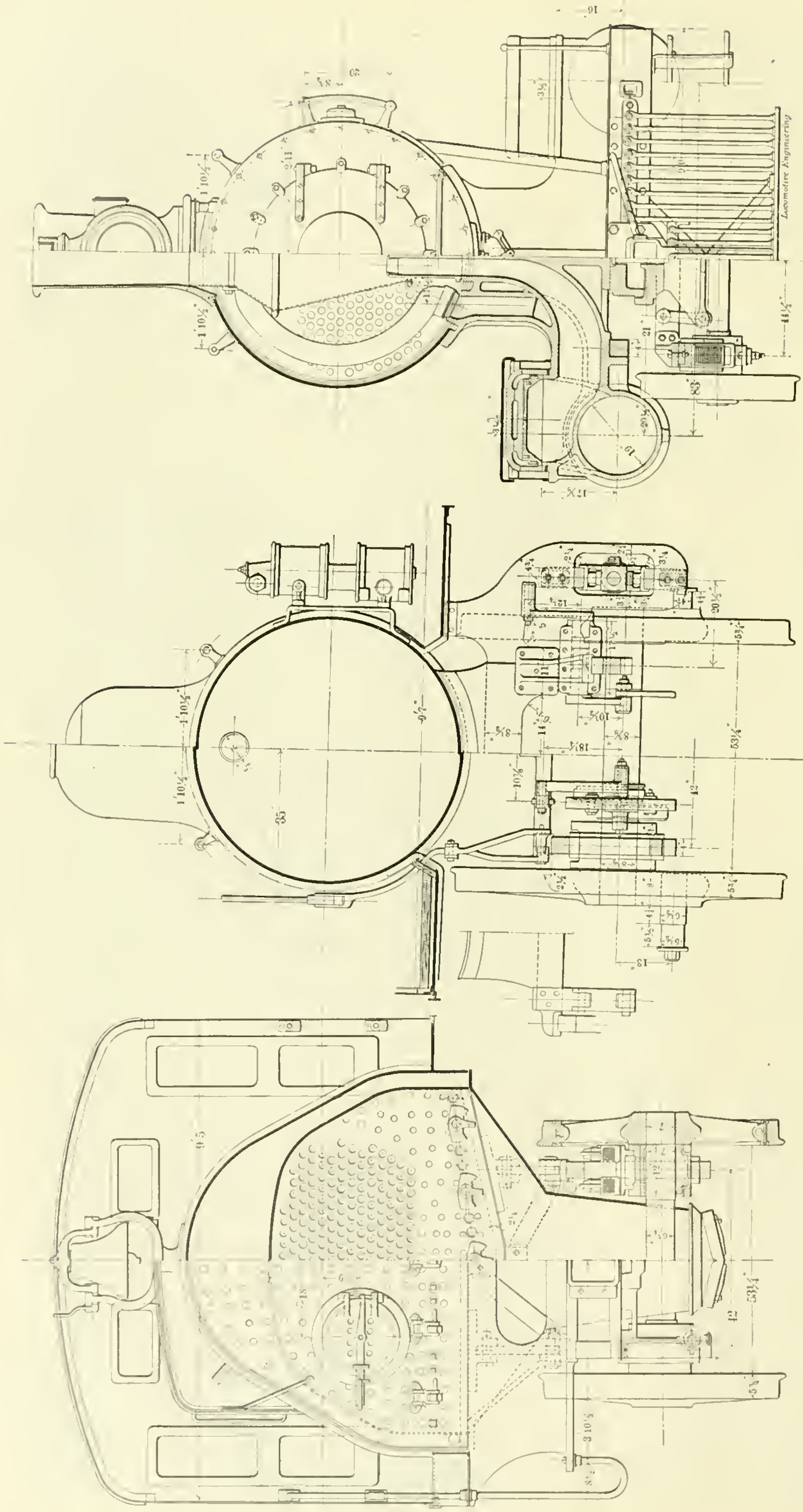


LOCOMOTIVE FOR THE BLACK DIAMOND EXPRESS.

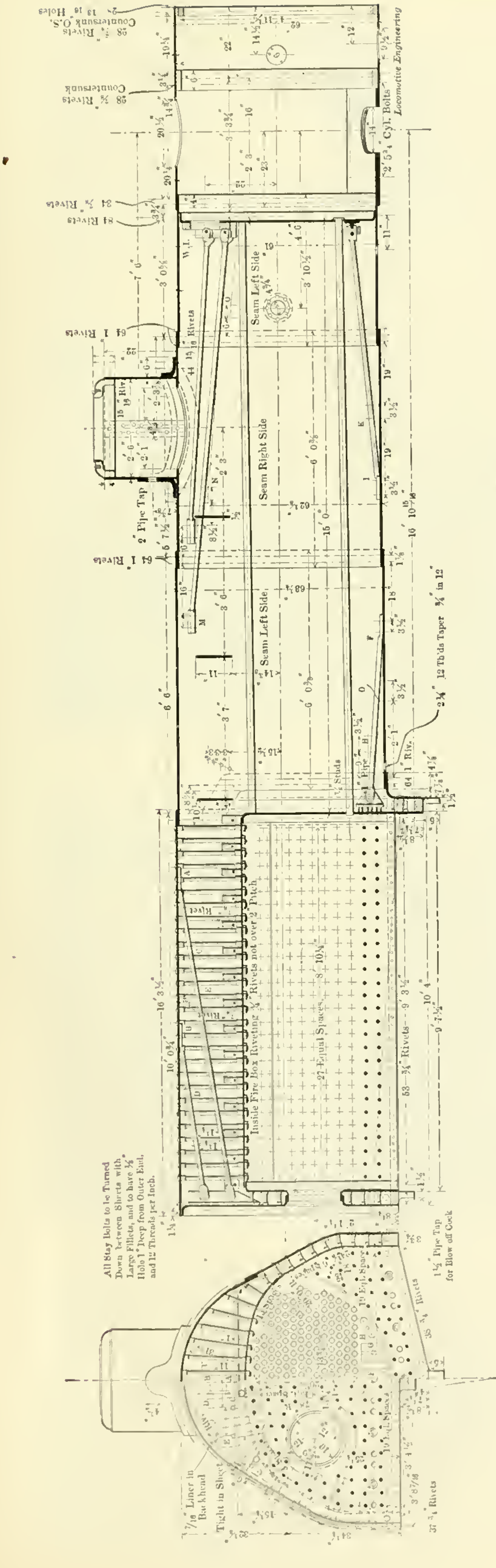
Cylinder, 19 x 26 inches. 76-inch drivers. 2,230 square feet of heating surface.
Total weight, 140,950 pounds.

Designed by Samuel Higgins, Supt. M. P., Lehigh Valley R.R.

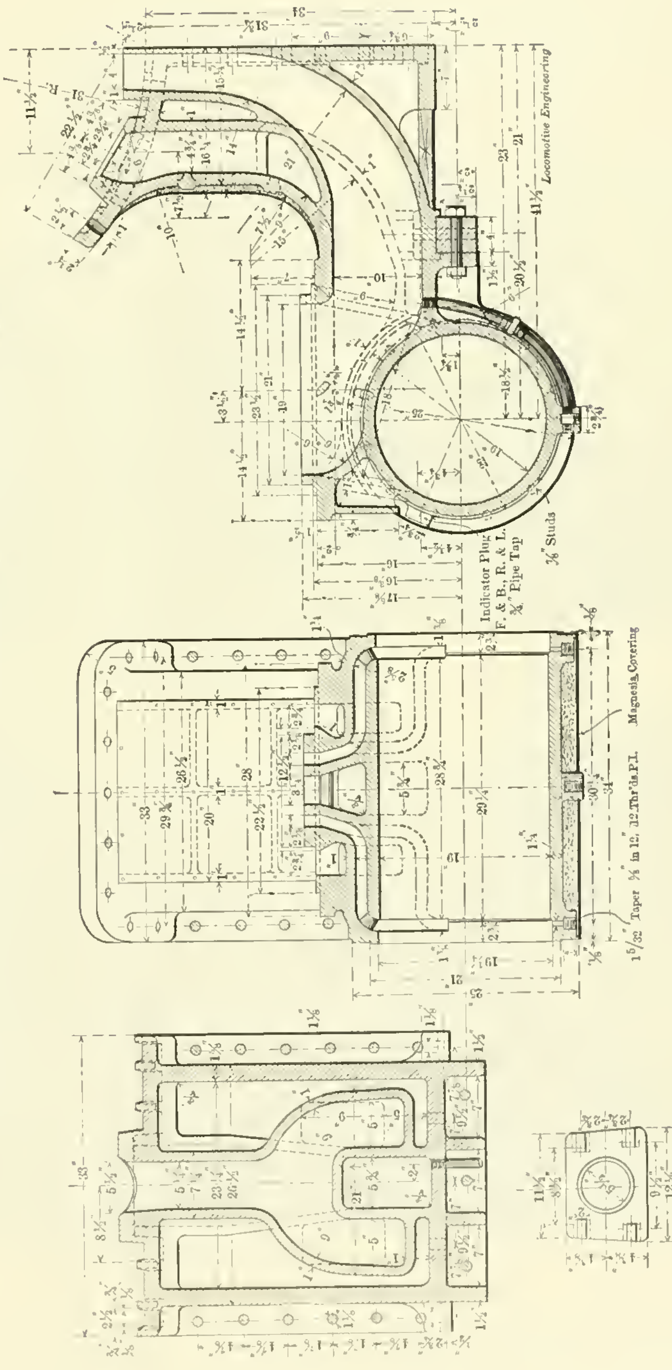
Built by Baldwin Loco. Works, July, 1896.



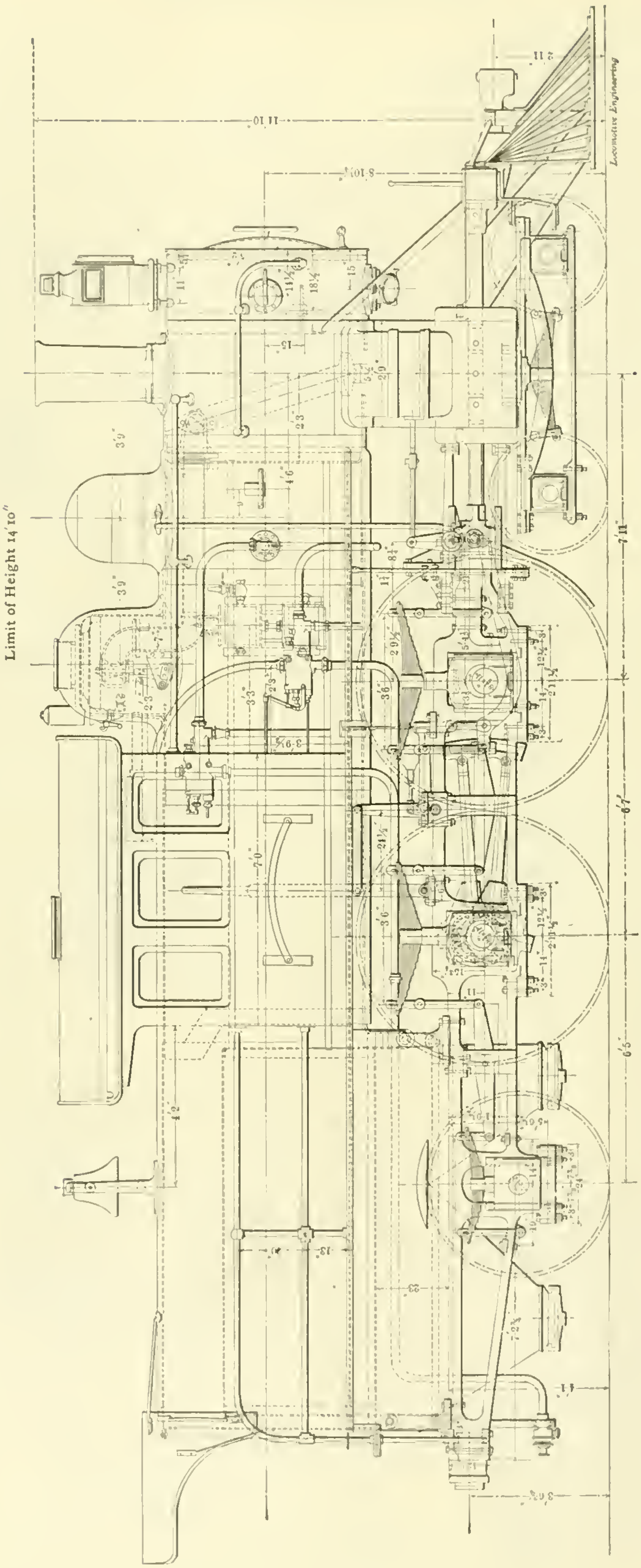
DETAILS OF CONSTRUCTION, BLACK DIAMOND EXPRESS LOCOMOTIVE.



DETAILS OF BOILER CONSTRUCTION, BLACK DIAMOND EXPRESS LOCOMOTIVE.



DETAILS OF CYLINDER CONSTRUCTION, BLACK DIAMOND EXPRESS LOCOMOTIVE.



SIDE ELEVATION, BLACK DIAMOND EXPRESS LOCOMOTIVE, LEHIGH VALLEY R. R.

New Ten-Wheeler for the Erie Railroad.

Our illustration shows one of five new engines recently turned out by the Brooks Locomotive Works for the Erie Railroad.

This is the Erie standard ten-wheeler, with the following dimensions:

Gage—4 feet 8½ inches.

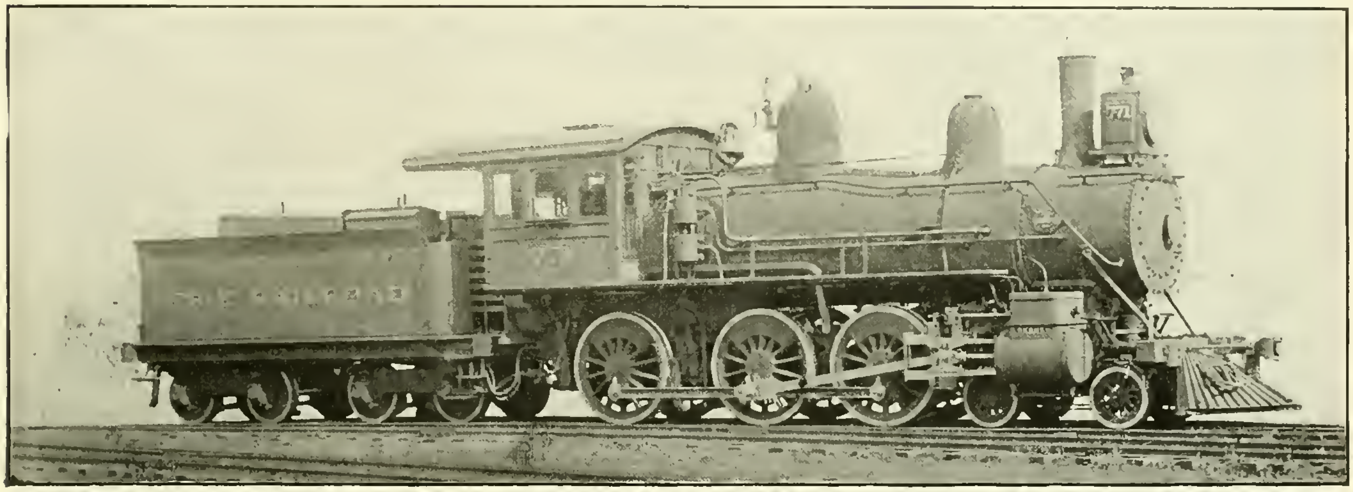
Boiler pressure—180 pounds.

Fuel—Bituminous coal.

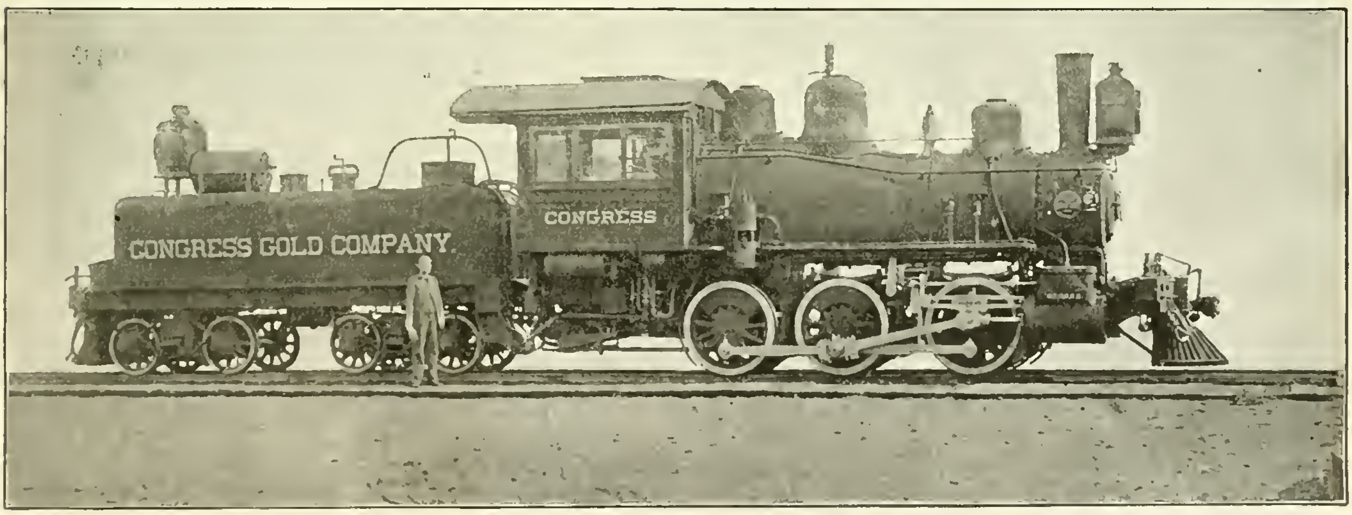
Type—Ten-wheel passenger.

Cylinders—20 inches diameter, 26 inches stroke.

Driving wheels—62 inches diameter.



STANDARD ERIE TEN-WHEELER.



OIL-BURNING LOCOMOTIVE.

Boiler—64 inches diameter.

Firebox—107⅛ inches long by 40¼ inches wide.

Flues—282 2-inch flues, 13 feet 2 inches long.

Wheel base—Driving wheels, 13 feet 6 inches; total engine, 24 feet 2 inches; engine and tender, 50 feet 6 inches.

Weight in working order—Tender, 85,000 pounds; on drivers, 108,000 pounds; front truck, 36,750 pounds; total weight of engine, 144,750 pounds; total weight of engine and tender, 252,750 pounds.

An Oil-Burning Engine.

The Brooks Locomotive Works have just turned out from their shops the engine shown in our illustration, which is built for the Congress Gold Mining Company, and is designed to burn crude petroleum on a new plan, which we expect to describe at no distant date.

At the present time the inventor has not completed his patents, and will not allow the details to be shown.

The picture tells about all the railroad man cares to know of an engine of this character.

The engine's dimensions are as follows:

Gage—4 feet 8½ inches.

Boiler pressure—180 pounds.

Fuel—Crude petroleum.

Type—Six-wheel (oil-burning).

Cylinders—17 inches diameter, 24 inches stroke.

Driving wheels—51 inches diameter.

Boiler—56 inches diameter.

Firebox—78 inches long by 32 inches wide.

Flues—226 2-inch flues, 11 feet 1 inch long.

Wheel base—Driving wheels, 11 feet; engine and tender, 40 feet 6 inches.

Weight in working order—Tender, 86,000 pounds; weight of engine, 112,000 pounds; total weight of engine and tender, 198,000 pounds.

It is not generally known that a famous singer made the first move towards the establishing of private cars. In 1851, when the famous Jenny Lind got married in this country, she was very much annoyed during her honeymoon by the intrusion of impertinent interviewers, and to escape from the infliction she had a passenger car cleared of its seats and fitted up as a drawing-room. In this she was able to stop off at secluded points or go from place to place without molestation. The idea was quite original with the great singer, and directed so much attention that other people of luxurious tastes wanted to imitate that method of travel. The fashion did not spread very rapidly, but it got a start then and has gone on slowly into the development of the palace car and dining car.

American Railway Master Mechanics' Committees for 1897.

Mr. John W. Cloud, secretary of the Master Mechanics' Association, has furnished a list of the committees and subjects for discussion for the next convention. The new topics will be found of great interest, especially that referring to ratios of grate area, heating surface and cylinder volume, into which is sandwiched the question of ratio between the diameter of cylinder and length of steam port. This is a subject that will engage the attention of the association's best talent. The list is given below:

1. Exhaust Nozzles and Steam Passages (continued)—The discussion of report for 1896 was made the first order of business for 1897. Members who can do so are requested to co-operate with the committee by experimenting upon its conclusions and reporting to the committee, which will report further to the convention of 1897 as introductory to the discussion: Robert Quayle, Jas. McNaughton, D. L. Barnes, William Forsyth, W. S. Morris, W. F. M. Goss.

2. Counterbalancing Locomotives (continued)—To designate a number of roads to confirm or disprove its recommendations in the report of 1896, and to report the results to the convention of 1897. E. M. Herr, C. H. Quereau, S. P. Bush, W. H. Lewis (C., B. & N.).

3. Truck Swing Hangers (continued)—To advise the proper angle for swing beam hangers in locomotive trucks: G. L. Potter, Wm. Garstang, M. N. Forney, W. Lavery, John Mackenzie.

4. Locomotive Grates (continued)—What kind of grate is most suitable for burning anthracite coal, the cast-iron shaking or the water bar? H. Wade Hibbard, B. Clark, E. L. Coster, Geo. W. West, David Brown.

5. The Apprentice Boy (continued)—To recommend a course of shop training for apprentices in the locomotive shops, and to make recommendations in regard to the technical education of shop apprentices: W. F. Bradley, G. R. Joughins, H. P. Robinson, W. H. Harrison, A. E. Manchester.

6. Best Metal for Cylinders, Valves and Valve Seats (New)—What kind of metal, hard, medium or soft, should be used in locomotive cylinders, valve seats and valves? Should the metal for valve seats and valves be the same, or different? J. N. Barr, G. F. Wilson, G. W. Stevens, F. W. Morse.

7. Boiler Jackets (New)—Which is the most economical, a boiler jacket of planished iron, or a boiler jacket of common sheet iron or sheet steel, painted? The general appearance, first cost and cost of maintenance to be considered. A. E. Mitchell, C. G. Turner, T. B. Purves, Jr.; J. E. Sague, E. L. Coster.

8. Ratios of Grate Area, Heating Area and Cylinder Volume (New)—For engines in both passenger service and freight service, and whether burning anthacite coal or bituminous coal, what should be the ratio of grate area to heating surface and to cylinder volume? What should be the ratio between diameter of cylinder and length of steam port? G. R. Henderson, A. S. Vogt, R. Wells, S. M. Vauclain, C. J. Mellin.

9. Piecework in Locomotive Repair Shops (New)—Is it practicable and advisable to apply the piecework system in connection with locomotive repairs? What is the best method of arriving at the prices for the different operations? P. Leeds, Wm. Swanston, R. P. C. Sanderson, J. G. Neuffer, J. B. Michael.

10. Motors: Steam, Air and Electricity (New)—In a locomotive repair shop, what class of work can best be performed by air motors, and what is the relative convenience and economy of air motors, electric motors and steam motors for such work? When such motors are used, should the shape of the cutting edges of the drills, reamers, etc., be different from the shapes used in ordinary practice? J. H. McConnell, John Player, W. C. Arp, W. Renshaw, V. B. Lang.

11. Revision of Air-Brake and Signal Instructions (New)—G. W. Rhodes, B. Haskell, A. W. Ball, A. M. Waitt, C. H. Cory.

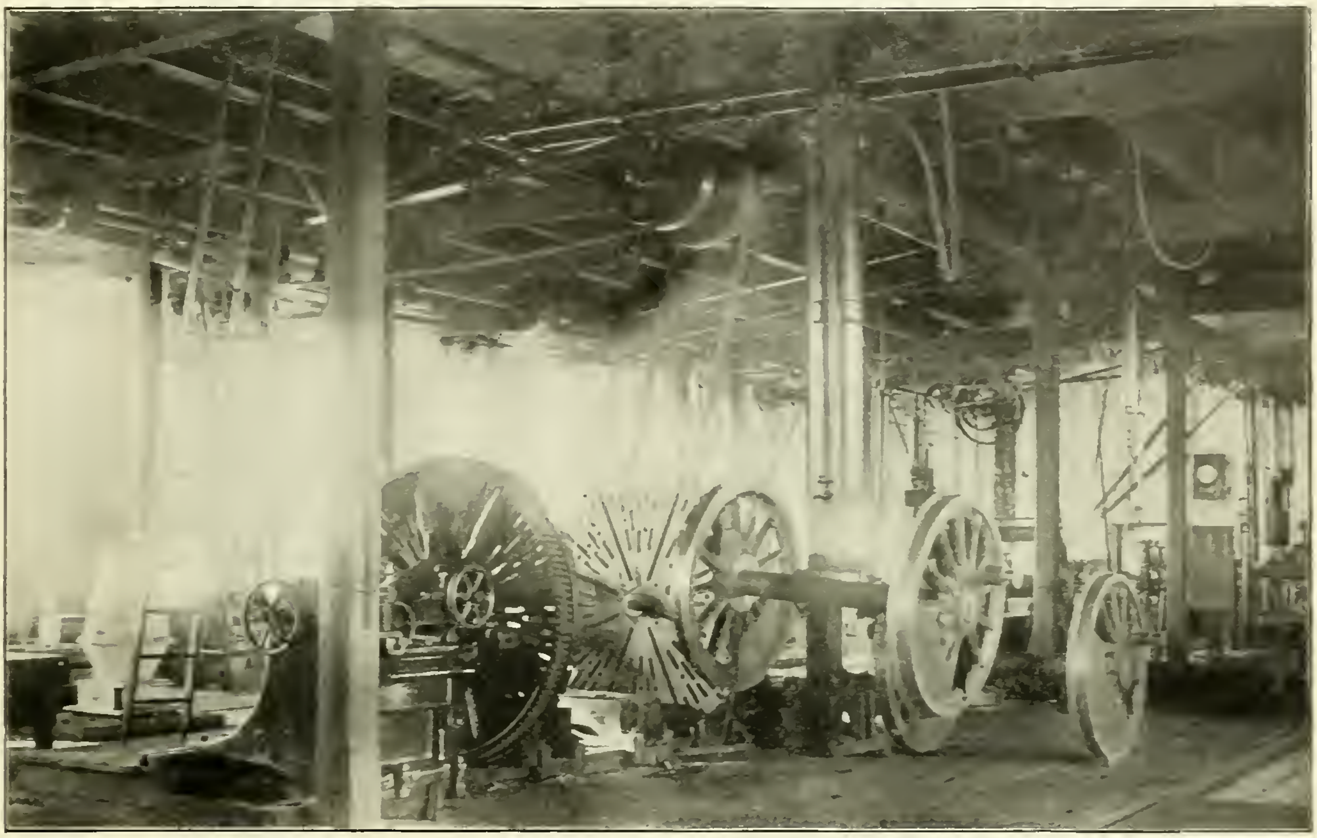
12. Subjects for Convention of 1898—W. H. Lewis (C., B. & N.), Tracy Lyon, C. H. Quereau.

ARKANSAS CITY, KANSAS, HEADQUARTERS SOUTHERN DIVISION A., T. & S. F. RY.

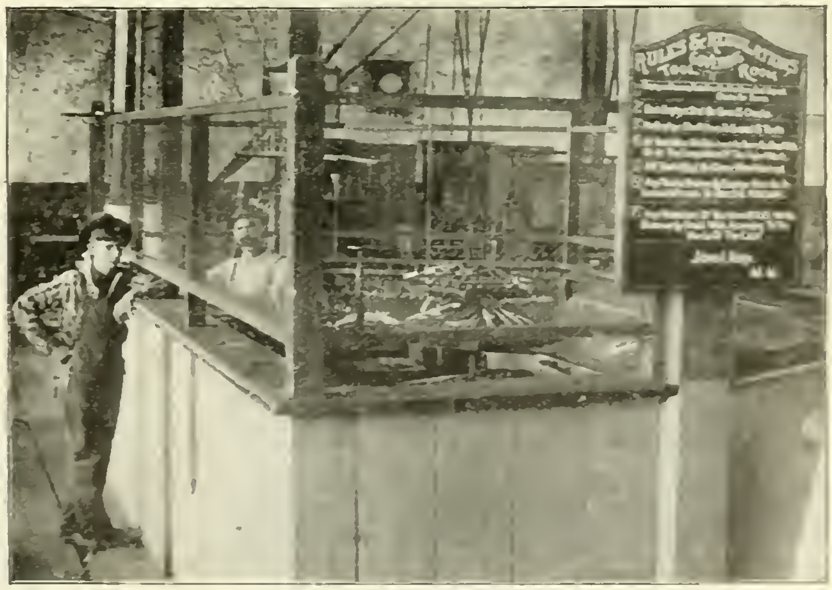
The engineers and firemen who are running the new Schenectady engines on the New York, New Haven & Hartford are the best-pleased men in New England. One of them remarked to the "Locomotive Engineering" man that "this is the first real, made-a-purpose engine I ever got hold of."

Freight Electric Locomotives.

The first electric locomotive of any considerable size built in this country, and the first practical electrical locomotive in the world, exhibited by the General Electric Company, at the Chicago Exposition, 1893, having a rated drawbar pull of 7,000 pounds, has been purchased by the Manufacturers' Street Railway Company of New Haven, Conn. It is equipped with air brake and is being prepared for shipment from the Schenectady Works within a very few weeks. Its total weight is 30 tons, and it will be utilized to haul freight cars from the junction of the New York & New Haven Railway at Cedar Hill, which is about one mile from the New Haven passenger depot, to the works of the Bigelow Company, manufacturers of boilers, the National Pipe Bending Company, the Quinnipiac Brewing Company, the New Haven Rolling Mills and other manufacturing establishments located along the water front at some distance from the freight yards of the Consolidated road. The freight cars will be hauled directly into the yards of the manufacturers, and the loads will be collected by the electric locomotive and hauled to the main line of the New York, New Haven & Hartford Railroad, where they will be taken up by the steam locomotive for transportation to their destination. The length of the line along which this locomotive will run is nearly two miles, the maximum grade against the load being about 2½ per cent. The guaranteed speed of this locomotive on this grade will be seven miles an hour with a heavy load behind it, but judging by its performance at the Lynn Works of the General Electric Company, it will probably be able to largely exceed the guarantee. All the locomotives which the General Electric Company have built will be, when this one is delivered at New Haven, in service. The 40-ton locomotive is used as a switch engine at the Taftville Cotton Mills, at Taftville, while the three 96-ton locomotives are engaged in hauling the freight trains through the Belt Line tunnel of the Baltimore & Ohio Railroad; indeed, no freight train is hauled through the Belt Line tunnel of Baltimore except by the electric locomotives. —"Iron Age."

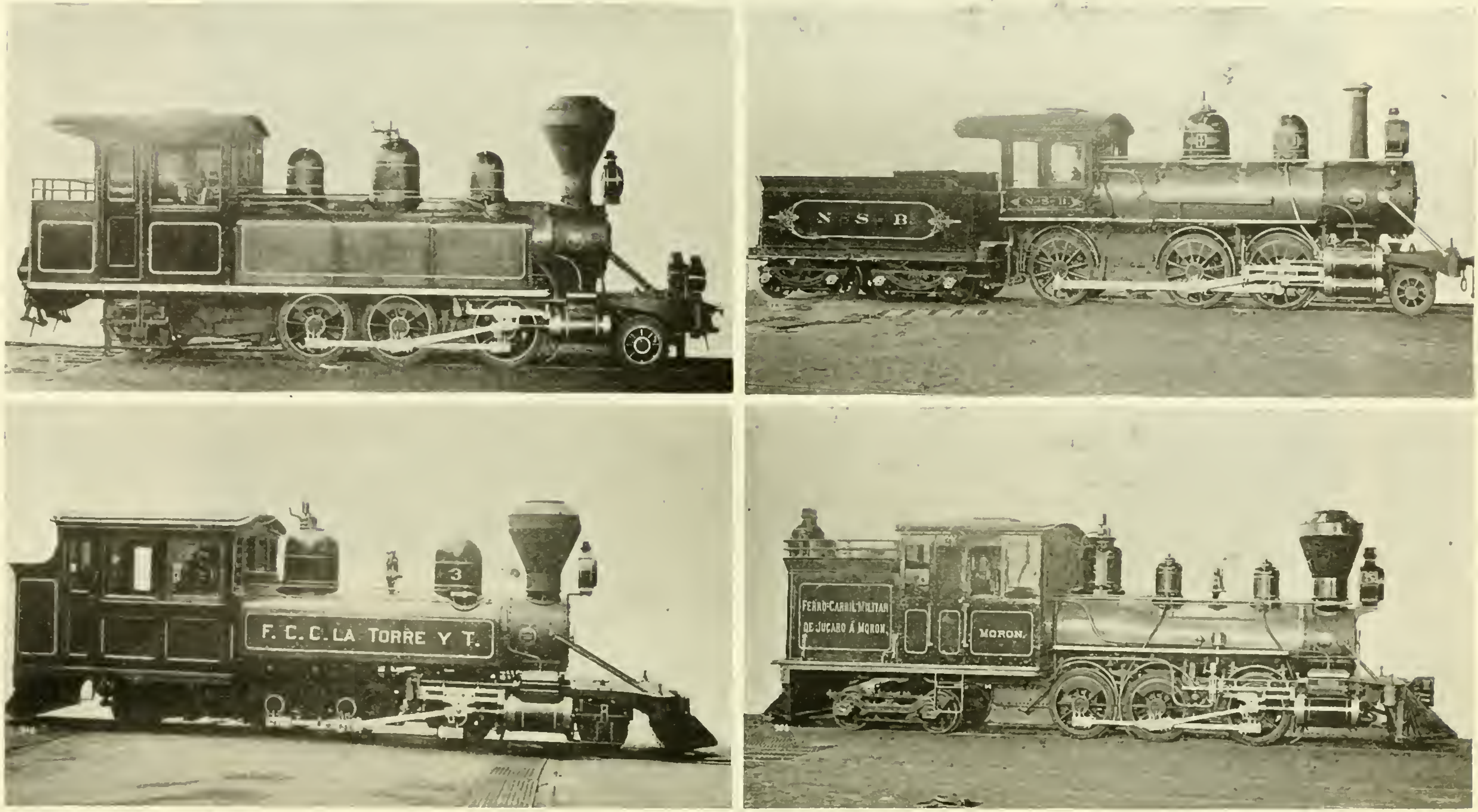


TRAVERSING AIR HOISTS, ARKANSAS CITY SHOPS, A., T. & S. F. RY.



TOOL ROOM, ARKANSAS CITY SHOPS, A., T. & S. F. RY.

Bound volumes of 1894, postage free, for $2—good thing.



SOME ODD LOCOMOTIVES RECENTLY TURNED OUT BY BALDWIN'S.

Narrow Gage, Russian.
Two-Foot Gage, for Mexico

Compound, Norwegian State Railways.
Iron Clad, for Cuba.

Some Odd Locomotives Recently Turned Out by the Baldwin Locomotive Works.

We present herewith pictures of some very odd locomotives, that show the diversity of work done at the Baldwin Locomotive Works.

In addition to a number of heavy express engines for the Lehigh Valley, some standard eight-wheelers for Canada, and compressed-air locomotives for coal mines, within the last month they have turned out a number of these peculiar engines, details of which are as follows:

A double-ender locomotive, built for the Krotovka-Sergievsk line in Russia:

Gage of road—3 feet 3⅜ inches.

Cylinders—10 inches diameter, 16 inches stroke.

Driving wheels—36¼ inches diameter; journals, 4½ x 6 inches.

Total wheel base—19 feet 9 inches.

Driving wheel base—7 feet 8 inches.

Total weight—47,160 pounds.

Weight on drivers—33,010 pounds.

Boiler—34 inches diameter.

Tubes—70 in number; 1¾ inches diameter, 10 feet 1 inch long.

Firebox—46½ inches long, 21½ inches wide, 43 inches deep.

Truck wheels—24¼ inches diameter; journals, 3½ x 6 inches.

Tank capacity—600 gallons, carried on sides of boiler.

Double-ender locomotive, No. 3, built for the E. G. de Cazadero a Tepetong, Mexico:

Gage—2 feet.

Cylinders—11 inches diameter by 16 inches stroke.

Driving wheels—33 inches diameter; journals, 5 x 6 inches.

Total wheel base—19 feet 10 inches.

Driving wheel base—7 feet 6 inches.

Weight on drivers—31,910 pounds.

Total weight—43,410 pounds.

Boiler—34 inches diameter.

Tubes—62 in number; 2 inches diameter, 10 feet 11 inches long.

Firebox—37 3-16 inches long, 30⅝ inches wide, 40½ inches deep.

Two-wheel truck, front and back—Wheels, 22 inches diameter; journals, 3½ x 6 inches.

Tank—550 gallons capacity, on sides of boiler.

Mogul compound locomotive, No. 33, built for the Norwegian State Railways:

Gage of road—3 feet 6 inches.

Cylinders — High-pressure, 9 inches diameter by 18 inches stroke; low-pressure, 15 inches diameter by 18 inches stroke.

Driving wheels—46½ inches diameter; journals, 5½ x 7 inches.

Total wheel base—18 feet 7 inches.

Driving wheel base—12 feet.

Total weight—51,844 pounds.

Weight on drivers—42,244 pounds.

Boiler diameter—44 inches.

Tubes—157 in number; 1½ inches diameter, 8 feet 1 inch long.

Firebox—52 7-16 inches long, 30¼ inches wide, 49⅛ inches deep.

Truck wheels—26 inches diameter; journals, 4 x 6 inches.

Tender tank capacity—1,400 gallons.

Tender wheels—26 inches diameter; journals, 3½ x 6 inches.

The above was the 15,000th locomotive built by the Baldwin Locomotive Works.

Locomotive "Moron." — A double-ender having three pairs of coupled wheels and a four-wheeled rear truck, built for the Spanish military engineers, Havana:

Gage—4 feet 8½ inches.

Cylinders—12 inches diameter, 18 inches stroke.

Driving wheels—38 inches diameter; journals, 5 x 7½ inches.

Total wheel base—19 feet 5 inches.

Driving wheel base—8 feet 1 inch.

Weight on drivers—45,560 pounds.

Total weight—71,960 pounds.

Boiler diameter—36 inches.

Tubes—94 in number; 1¾ inches diameter, 11 feet long.

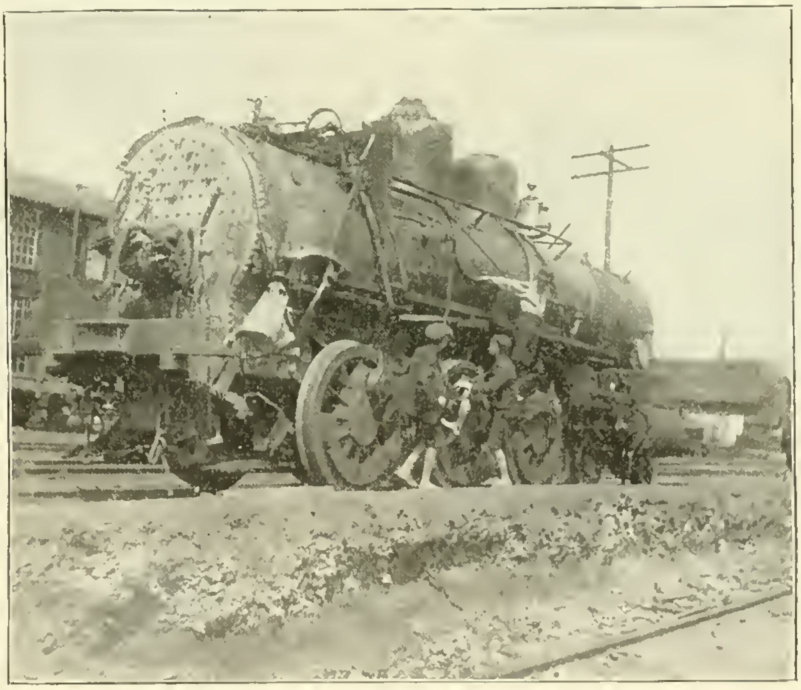
Firebox—38 15/16 inches long, 38 7/8 inches wide, 46½ inches deep.

Truck wheels—24 inches diameter.

Journals—3¾ x 7 inches.

Tank—1,600 gallons capacity, located over rear truck.

The cab of this locomotive was armor clad with ⅜-inch steel plates on sides and front, lined with ash. The doors and windows were provided with ⅜-inch steel shutters to slide over the glass pane when required, the shutters being provided with loopholes in center to allow of firing in case of attack.



SOMETHING WAS NOT IN TO CLEAR.

West Shore Air Hoists.

Handling of work about a shop by means of air is nothing new at this day, but there are many new schemes coming to the surface in new applications of it. The West Shore shops at Frankfort, N. Y., have a very extensive installation of tools of this character, there being no less than twenty-two hoists of all sizes in operation. There is one located between the large planer and radial drill, carried on a semicircular track overhead, connecting both tools, which for convenience, and therefore a money-saver, can hardly be surpassed. Car wheels and other materials are loaded on cars in the quickest and easiest manner, by running the wheels or a loaded truck, as the case may be, on a platform which rests on a pair of air pistons placed below the track level. The load is rolled on the platform and raised by air pressure to the level of the car floor with an expedition and ease that puts to shame the barbarous skids and labored efforts of the old main-strength style of loading, particularly of wheels.

The latest purpose for which compressed air is going to be applied is in the locking of freight-car doors. A patent has been granted to Frederick C. Conrad and Charles W. Goodspeed, of Elyria, O., for a patent pneumatic door lock which will not only keep the car door closed, but is designed to give an alarm to the trainmen in case the door is opened.

Correspondents writing for information should not endeavor to abbreviate their letters. Let all communications be full and complete, and if any cutting-down is necessary we will do it.

Linstrom's Improved Eccentric.

The subject of "Eccentric Fastening Devices" has been repeatedly debated in almost all technical journals by skilled mechanics. Some have advocated the use of two set screws and one key to be the best method of securing an eccentric to its axle, while others opined that the key could be done away with; nevertheless, delays on account of slipping eccentrics have not discontinued to be of almost daily occurrence.

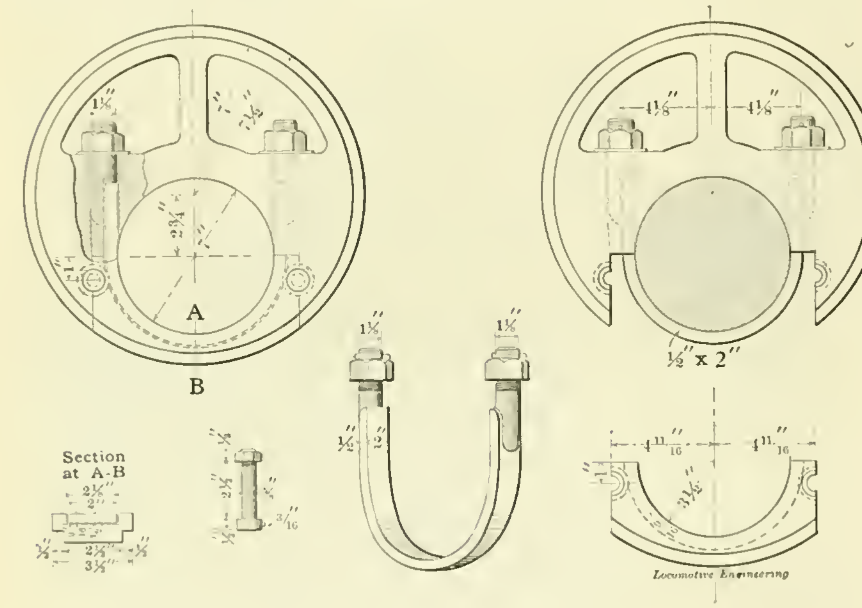
The accompanying drawing illustrates one of the most simple and effective devices for securing an eccentric to an axle yet invented, of which Mr. Charles Linstrom, master mechanic of the Yazoo & Mississippi Valley Railroad (I. C. System), is the patentee. The chief object of the invention is to provide a new and improved eccentric which can be rigidly secured to an axle shaft without liability of the sections becoming disconnected from their correct operative positions on a driving axle of a locomotive, or any other axle or shaft which is to be provided with an eccentric for converting motion.

Referring to the drawing, it will be seen that the eccentric proper is in the form of a disk, composed of a main section with two abutting jaws adapted to receive a complementary section. Two passages are cored in the main section to receive the threaded ends of a U-shaped yoke clamp, in such a manner that by tightening the nuts the yoke is bound upon the shaft and the main section of the eccentric is thereby rigidly clamped in position.

The complementary section, which has no strain whatever to sustain, may more or less accurately fit the driving axle, and is retained in operative position with the main section, through the medium of two small transverse bolts which extend through bolt holes formed partially in the abutting jaws and partially in the ends of the complementary section. The bolt holes are counterbored at their extremities so as to receive the heads and nuts of the bolts.

It will be obvious that by this arrangement the main section of the eccentric adheres its full bearing surface on the driving axle, and thus making sure of its being at right angles with the center of the latter, instead of its being forced from its position, as is invariably the case with eccentrics fastened with set screws and keys.

This arrangement commends itself by its general construction, cheapness, and many other advantages that practical men will consider. Its construction is the simplest of all sectional eccentrics now in service, and it can be finished at about 50 per cent. less than the old-style eccentric, notwithstanding the fact that its circumferential form will not be rendered elliptical by the tightening of the set screws.



LINSTROM'S IMPROVED ECCENTRIC.

Fractures in Steel.

At a recent meeting of the Sheffield Society of Engineers and Metallurgists, a lecture was delivered by Mr W. T. Andrews, F.R.S., M. Inst. C.E., on "Microscopic Internal Flaws Inducing Fracture in Steel." For many years past the lecturer had been engaged upon researches respecting deterioration by fatigue in metals, and he communicated last week some of the results of his investigation. Mr. Andrews is of opinion that if it were possible to produce a perfect metal, theoretically there should be no deterioration by fatigue. During his remarks he dwelt with the causes of the many so-called mysterious fractures of steel engineering structures, such as steel locomotive and other railway axles, rails, tires, steamship propeller shafts, crank shafts, artillery guns, ship plates, bridge girder plates, and boiler plates. It was shown, by approximate actual micrometer measurements made by Mr. Andrews, that an ordinary railway axle is composed of about 2,313,178,300 primary crystals, the latter often being again subdivided into a still larger number of secondary crystals. He pointed out that many fractures in steel are due to the presence of innumerable internal micro-flaws in the metal, caused by the presence of very minute quantities of sulphur and other impurities. Sulphur was shown to be the most dangerous element in producing these micro-flaws, owing to the formation, during the solidification of large masses of steel, of sulphide of iron, which, on the final crystallization of the metal, located itself between the ultimate crystals of the steel. The deleterious influence of other impurities, such as phosphorus and silicon, was dealt with. Mr. Andrews spoke highly of the standard of education at the Sheffield Technical School, and stated, in conclusion, that one of the highest objects of engineers and metallurgists should be to promote the interests of the public safety in the designing and making of engineering structures for railway, marine and other purposes.—"Machinery," London.

We frequently have cases in this country where railroad companies are sued for excessive damages on account of extensions near the property of adjoining land owners and property owners, but we do not remember of ever hearing such a bad case as was recently settled in one of the English courts. In 1887 the London & Northwestern obtained power from Parliament for widening their line on land belonging to Lord Gerard. According to the regular course, the railroad company sent notice to Lord Gerard that they needed 18 acres of land, with the underlying sand, stone, clay and gravel. The owner of the land claimed that the property to be taken away was worth $46,000, and he claimed in addition close on $900,000 for damages to the estate. The company was not willing to consider this sum, and in the disputes that ensued, Lord Gerard raised his claim to $1,800,000. The case then went into the courts. A decision has recently been rendered, giving the lordly land owner $31,225 to cover all his claims, and he is required to pay the costs incurred by seven years of litigation, which amounts to about $50,000.

The Government of New South Wales is anxious to have a steel-making plant established in the colony. As a help to this end, they offer to make a contract for 150,000 tons of steel rails and the necessary quantity of fish-plates, fish-bolts and spikes. The steel must be manufactured in the colony of New South Wales, out of iron ore and other necessary minerals, the product of, and, with coal, coke or other fuel, smelted, gotten and raised within the said colony.

Cattle Guard Machine.

A machine designed to form cattle guard plates by pressure, is shown in our illustration, Fig. 1. It is the joint invention of Mr. Jas. McNaughton, superintendent of motive power and cars, of the Wisconsin Central Railroad, and Mr. S. G. Smith, foreman boiler maker of the same road. Fig. 2 shows the machine in section and conveys a clearer idea of its functions to the practical man, perhaps, than the perspective illustration.

This machine is the result of an order to furnish cattle guard plates as shown in Fig. 3 where the guard is seen complete, and realizing that hand work, by which method they had been bent before, would make the cost prohibitive, brains were put in motion with the result shown, producing a machine that will corrugate the heaviest plate satisfactorily. These plates are rectangular in shape when going to the machine, and are bent in a matrix having the desired form; this die having a longitudinal motion on the frame of the machine, by means of its connection with the piston of a cylinder shown at the side.

An inclined cylinder having the outer end of its piston fitted with a die, forces the sheet operated on into the matrix. A vertical cylinder also having a die on its piston, is located near the forming die, to clamp the sheet, and prevent any tendency to buckle under the bending process. Fig. 2 shows the relative positions of these dies as raised free from the matrix, which is advanced to present a new portion of the sheet to the die as fast as one depression is finished. The matrix during the process of bending of a sheet, is locked in position immovably, by hand levers actuating locking pins.

This is a special tool designed to do a special job, in a way to save dollars to the company ordering the work, and the fact that it does all this, and also that the job does not come within the general scope of motive power work, is evidence that the inventive faculty is not dormant, or at least does not need cultivation on the Wisconsin Central.

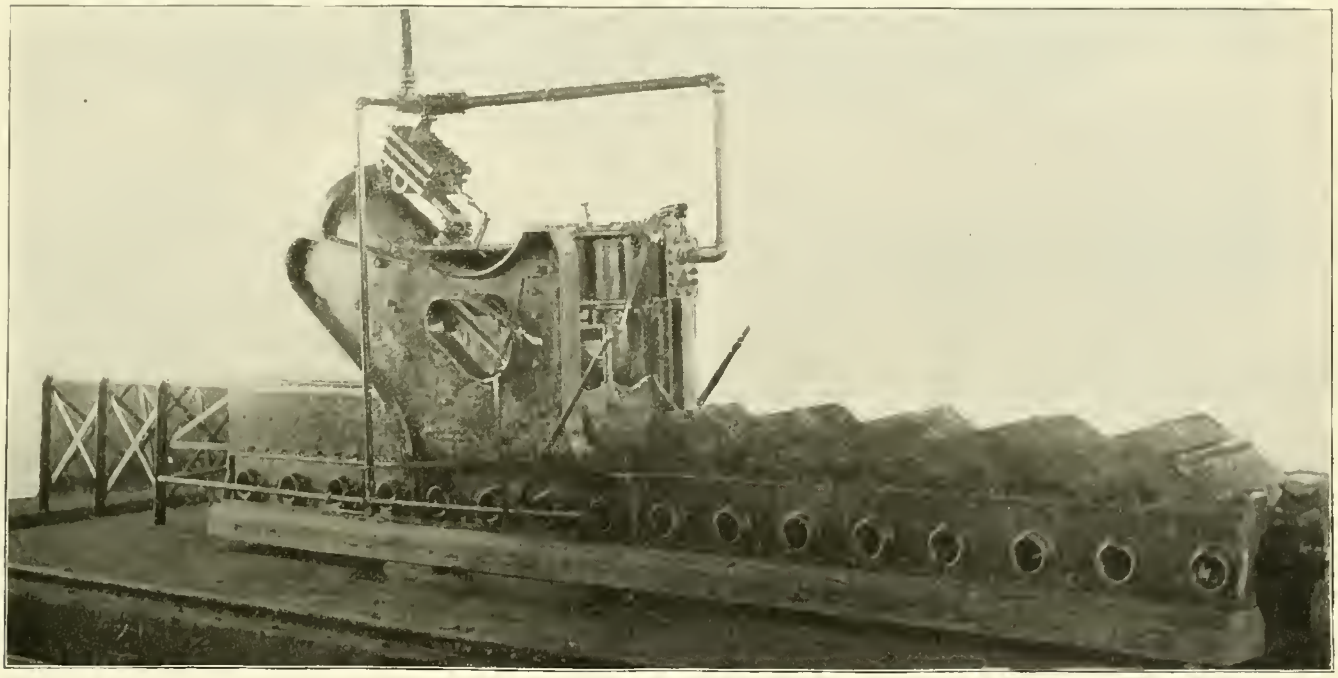


Fig. 1. CATTLE GUARD MACHINE.

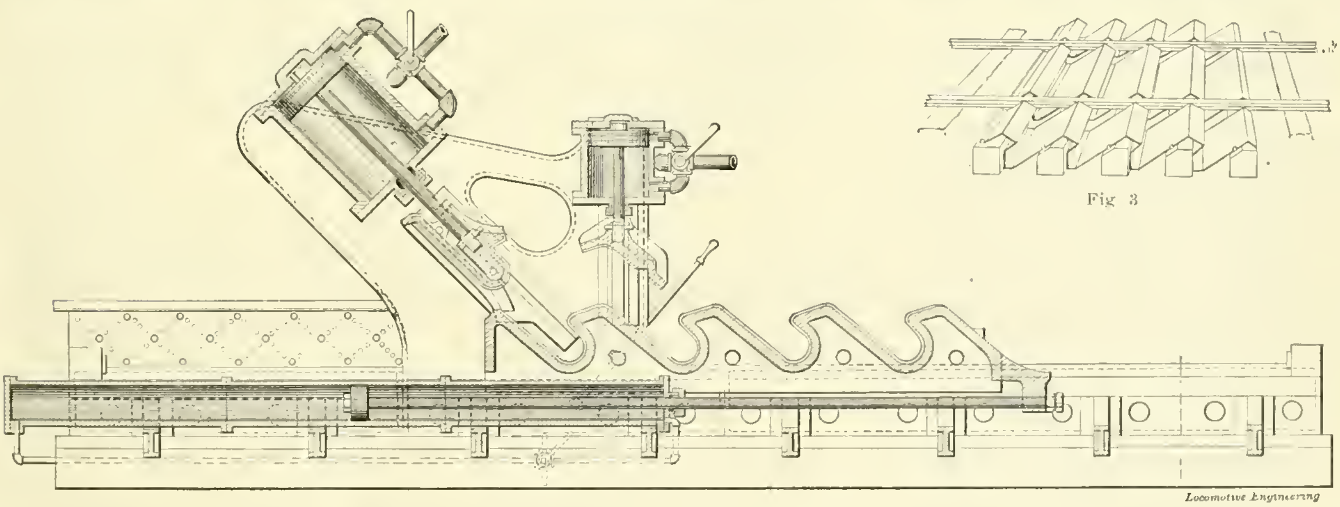


Fig. 2. CATTLE GUARD MACHINE.

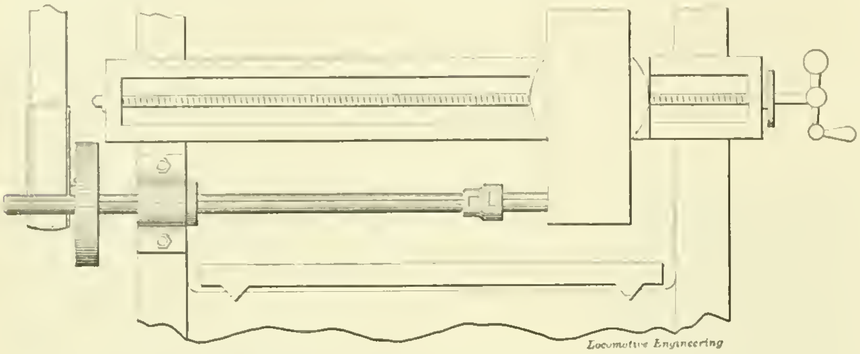
Fig 3

We have just received from the Directory Publishing Co. (Ltd.), of London, England, the 1896 edition of the "Universal Directory of Railway Officials." This book is very complete for the larger roads, and is perhaps the only reliable directory of the officials on foreign roads. We notice, however, that many of the minor roads in North America are omitted entirely. They only account for 121,214 miles, in round numbers, in the United States, and do not give mileage on two or three roads. As a matter of fact, the mileage of the United States was, on December 31, 1895, 180,955.37 miles. This leaves out of account entirely 59,741 miles, considerable of a system in itself.

A Planer Made Into a Horizontal Borer.

An old planer over in the corner of the shop, long past its usefulness as a means to an end (or, in other words, no good in that shop, because it had been replaced by a better tool), covered with dust and occupying floor space worth money, has been transformed into an indispensable machine by the wizard touch of Foreman Kline, of the Meadows shops.

It was desirable that some arrangement should be made to bore the bearing ends of solid rods, both the rod and brasses, and face off the latter. The tools available for this purpose were entirely too few to meet the pressing needs, and the old planer was fitted up as shown in the engraving—not for temporary use, but harnessed with the intention of getting a record out of the old scrap that would make partial compensation for past idleness.



PLANER CONVERTED TO HORIZONTAL BORER.

The platen serves admirably for a stationary table, and the other parts used lent themselves readily to the new order of things. The tool head was lowered and bored out on one side for a boring bar, leaving the bar free to revolve, and a bearing for the latter was bolted to one of the housings. On the bar was bolted a cutter head for boring, having a separate attachment for facing. A pulley driven from the old countershaft, and having on its shaft a pinion which meshed into a gear on the boring bar, furnished the motive power. The old feed arrangement was made to move the tool head, and with it the boring bar, which was splined through the driving gear, thus allowing the cutter head to traverse the full width of the platen if necessary, and making a boring machine equal to the best.

It is but a step from this boring-bar attachment to a heavy milling cutter, for planers of the kind under consideration, and there can be no doubt of the utility of such changes as these when a shop is long on planers and short on horizontal borers or milling machines.

The articles on signals have been rewritten and published in book form.

Great Northern Railway, England.

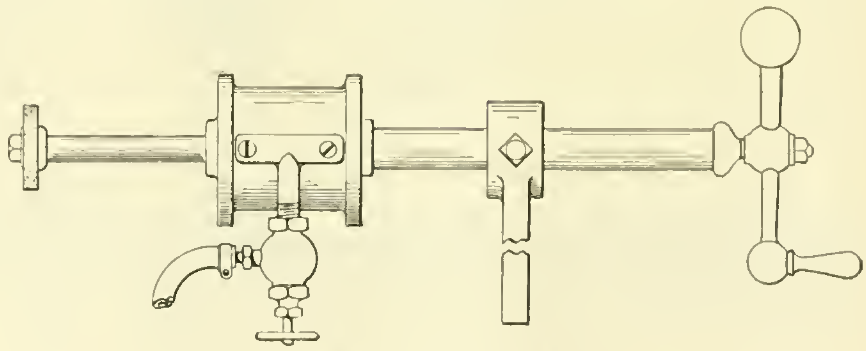
The Great Northern Railway Company is proceeding with the reconstruction of its main line with heavier rails. The traffic passing over this main line is continually increasing in weight and magnitude, and the rails which are now being laid down weigh 92 pounds to the yard, while the rails removed weigh 82 pounds to the yard. The work, which will involve a considerable expenditure, will be carried on as quickly as circumstances will permit. The whole cost will be charged to revenue, and will be spread over a term of years, the balance uncharged each half-year remaining in suspense until cleared off. Larger and more powerful engines are also being substituted on the Great Northern for locomotives of earlier types; the capacity of the passenger carriages is also being increased. At the present time twenty engines are in course of construction at the cost of revenue. The cost of locomotive power per train-mile was reduced in the past half-year to 11.18d, as compared with 11.55d in the corresponding period of 1895. An additional up line is being laid between Huntingdon and St. Neot's, and additional down lines are being constructed between Huntingdon and Abbots Ripton and between Wrenthorpe and Lofthouse South. In spite, however, of the efforts of the board to maintain a thoroughly efficient train service, the company was unfortunate last half-year in the matter of compensation claims, having paid £29,066 under this head during the six months, as compared with £8,404 in the corresponding period of 1895.—"Engineering."

Pneumatic Center Grinder.

A center grinder is one of the needfuls of every well-regulated machine shop, and the tool of this character with the fewest complications, that is quickly placed in position, and that will grind the lathe center true with the least sacrifice of time, is the one that gets the approval of the party who has to use it.

Our illustration shows such a tool, designed and built by Mr. J. W. Porter, the chief of the tool department at the Wisconsin Central shops, Waukesha. It is nothing more nor less than a rotary air motor with a cylinder 2 inches in diameter, in which revolves a two-wing piston, set with ¼-inch eccentricity. The emery wheel at the end of the spindle is 1½ inches diameter and ¼ inch thick. The spindle has a longitudinal motion by means of a handle which actuates a screw to which the spindle is connected. A throttle valve having an air hose attached is fastened to the cylinder, and the whole thing is mounted in the lathe by means of a shank made to clamp on the screw tube.

In operation, the shank is held in the tool post, and the compound rest is turned so that the traverse of the grinding wheel will coincide with the required taper of the lathe center; air is turned on, and the center trued without any unnecessary waste of time. One of these tools will keep the centers in shape in any railroad shop, from the wheel lathe down to the smallest bolt lathe. Having such an extended range of usefulness, there are few tools in a shop that can give a better return for its cost.


PNEUMATIC CENTER GRINDER.

The Vulcan shipyard at Bredon, Germany, are building for the Hamburg-American Line what will be the largest steamship in the world. The vessel is intended for the American trade, and has a length of 625 feet on the water line, which makes her about 25 feet longer than the largest vessel afloat. The engines will have 27,000 horse-power, and it is expected that the vessel will make a speed of 22 knots (equal to 25.3 miles) an hour.

Boston Binder for three 2-cent stamps.

CAR DEPARTMENT.

Conducted by ORVILLE H. REYNOLDS, M. E.

A Confusing Standard.

The height from top of rail to the center of drawbar, as furnished by the Interstate Commerce Commission, has seemingly not been clearly understood by the builders of vertical plane couplers, who have placed the knuckles so that the openings in same bear no definite relation to the center of draft. This is plainly wrong if a standard is ever to be obtained, for the reason that one road may set the center of the drawbar shank in accordance with the height established by law, while another road may set the knuckle opening to the same standard height. This could not work harm to the standard, provided the knuckle openings were on the center-line of draft, or, in fact, in any other center line that would bring the two opposing couplers in the same horizontal plane when coupled—a state of affairs which, if found at all, is one of chance, since coupler builders turn out their product without any regard whatever to the output of their competitors, with reference to vertical position of knuckle opening.

Mr. John McKenzie, superintendent of motive power of the "Nickel Plate," sounded a warning note at the last Master Car-Builders' Convention when he invited the members present to note the difference between the center of drawbar to the knuckle opening—which in some cases amounted to 1¼ inches—on the couplers then on exhibition.

Car department heads can work a reformation in this matter, only by laying down lines for the proper relation of knuckle opening to the center line of draft, and giving them the prestige of the backing of the association, as was done in naming a contour for the working face of knuckles. While taking this action, we suggest that a standard be adopted for the depth of the knuckle, and bring some uniformity to that dimension; there is too much latitude permitted in that detail. Action of this character is what is needed to reduce expense of raising and lowering cars to the new standard of height. Any other course will only tend to perpetuate this confusion, and further help to deplete treasuries that are already too weak to stand alone.

Remodeling of 40,000-Pound Cars.

Among the best things accomplished in car work, that has come to our attention up to the present time, is the remodeling of 40,000-pound box cars into 50,000 pounds capacity. Increasing the capacity of these cars 10,000 pounds at a merely nominal expenditure, constitutes a feat worthy of more than passing mention. This work was started only a few weeks since by Mr. John Hickey, superintendent of motive power, machinery and rolling stock of the Northern Pacific Railway, by whose courtesy we are enabled to present to our readers some data and figures concerning the methods by which results were reached by one of our representative machinery department managers.

The cars under consideration are several years old, but in a first-class state of preservation, the woodwork showing no signs of deterioration, and therefore in the best condition for permanent improvement. They were 33 feet 8 inches long, and 8 feet wide, outside of sills, of a type in general use, and had body bolsters of two plates of wrought iron, with all the weak characteristics of that type of bolster when made too shallow and not provided with stiffeners, being only 6 inches between the plates. The truss-rod posts were only 6 inches long, giving a total truss of 21½ inches, a depth sufficient to carry the load without imposing too great a fibre stress on the rods, but not deep enough for the newly decreed capacity.

With these weak points for a base, operations were at once begun and a bolster designed that would carry the load with safety. This was done by taking the ⅞ x 8 inch plates of the old bolster and increasing the drop at the center to 8 inches, also introducing a pressed steel filling between the bolster plates, from side bearing to side bearing; the flanges of the steel filler being riveted to the bolster members with ¾-inch rivets. At the immediate center, and at the ends of the steel filler, are also filling pieces of malleable iron. The blacksmithing required to fit these old bolsters to the new conditions, consisted in bending the lower plates to the new angle made necessary by the greater distance between the plates, and drawing out the same members at the ends to remedy the shortage occasioned by the cause just mentioned. Fig. 1 shows this new arrangement in elevation, plan and section.

Attention was next given to the truss rods, which were left the original diameter of 1⅛ inches, but dropped at the cross-tie timbers to 26 inches, by making the height of truss-rod posts 10½ inches, thus providing for increased load, while keeping the fibre stress per unit of area of the rods within a safe limit. The truss rods, by the new order of things, are run in a straight line from their crossing at the bolster, through the end sills; this makes less work for the smith shop and keeps the strain in line with the axis of the rod, which is not the case when they are made to pass horizontally through the end sills. An angle washer is provided on the outside face of sill for the nut to bear against. It is gratifying to find a case where truss rods are properly designed to do their work. Higher grain doors, and grain lines, and stenciling for the new capacity, completed the work on the car body. Fig. 2 shows the grain doors in section, and how they are fastened in the up position.

The truck to carry this rejuvenated body next claimed consideration. Trussing was resorted to in connection with a 9 x 11⅞-inch solid oak bolster; the truss rods are made of 1¼-inch iron with enlarged ends; the truss-rod washers are a combination of malleable iron forming a washer and side bearing, having a liberal bearing on the wood to distribute the strains over as large a surface as possible, and are secured through the end flange by two ⅝-inch bolts through the bolster. The rods have 14½ inches drop, making a strong construction, which is shown in Fig. 3. A reinforcement of the truck arch bars was made by placing a piece of the same dimensions as the bars (1⅛ x 3 inches) on the upper bar, of a length sufficient to receive the four column bolts.

A test of the strength of the bolsters for both body and truck was made, which bore out the calculations most satisfactorily. The method of testing the reinforced body bolster is shown in Fig. 4, together with

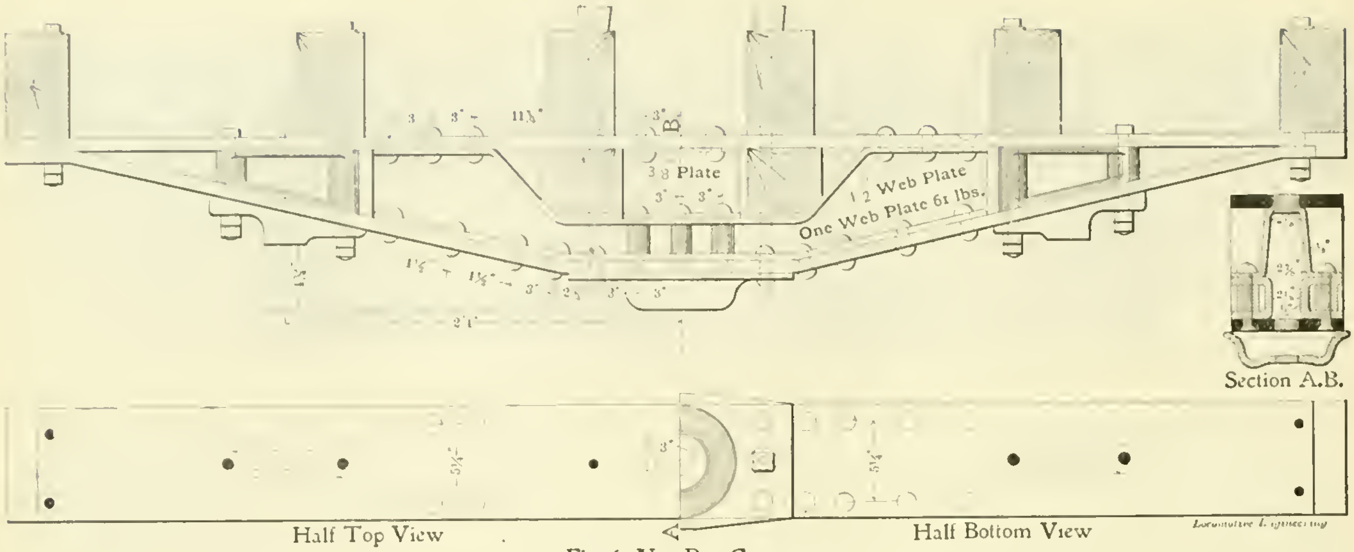


Fig. 1 Nor. Pac. Car.

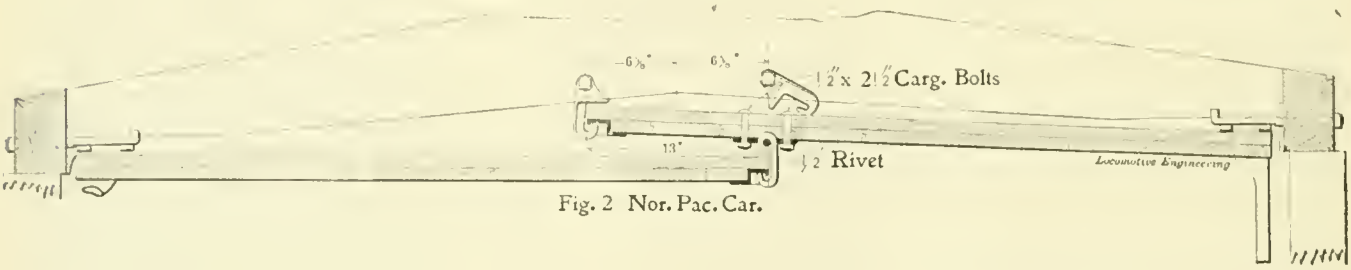


Fig. 2 Nor. Pac. Car.

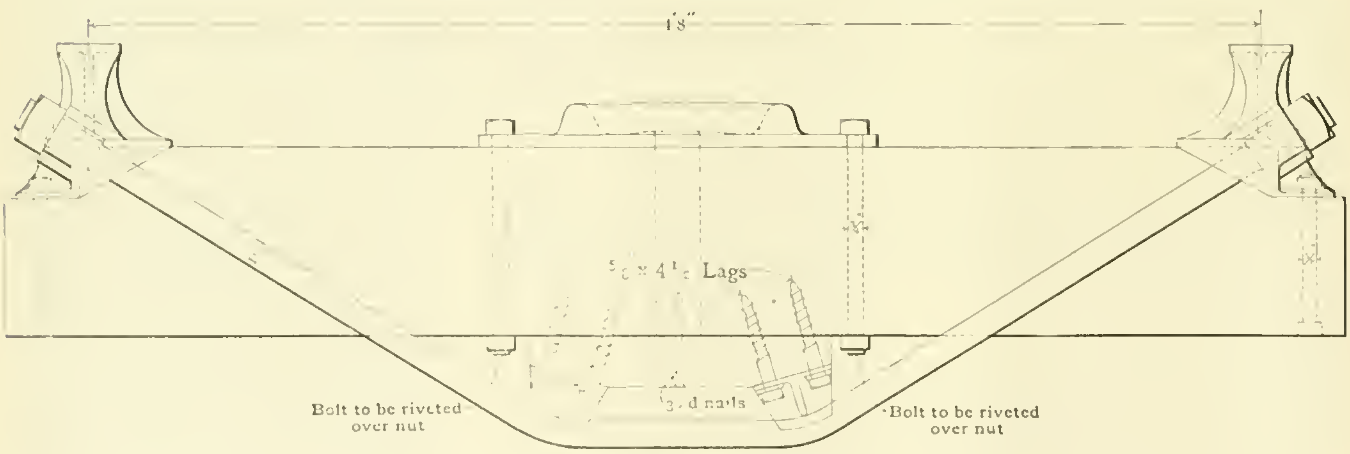
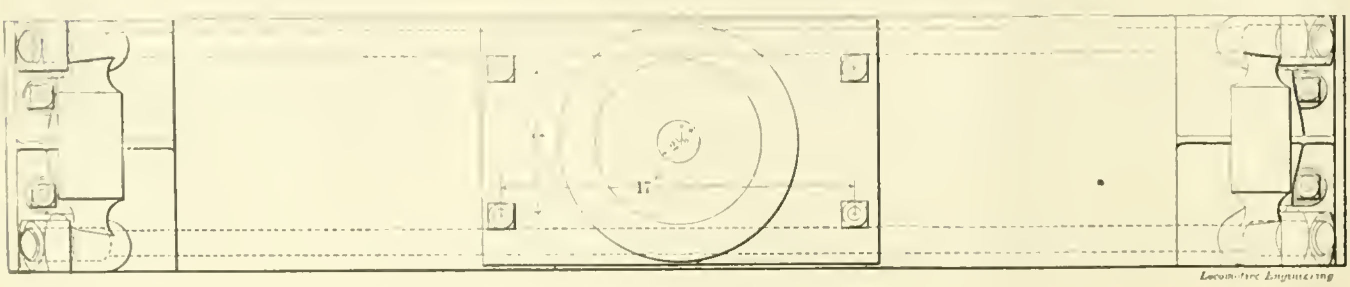


Fig. 3. NOR. PAC. CAR

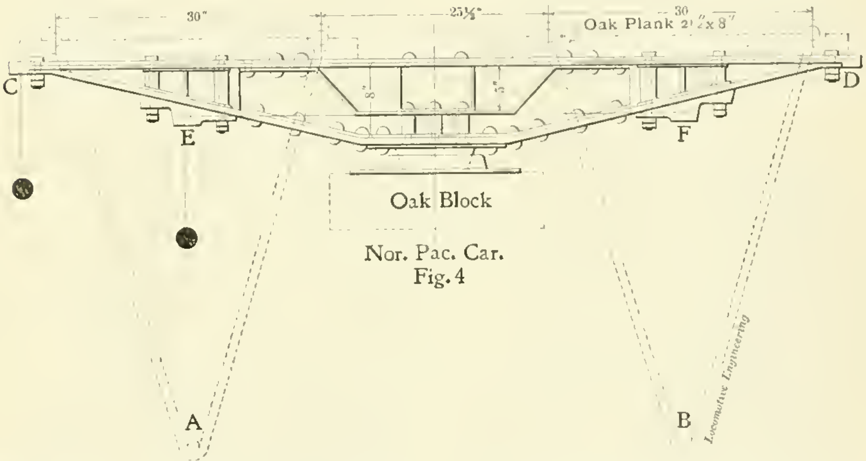


a tabulated statement of loads and deflections. The bolster is seen to rest on its center plates as in service. Stirrups were placed on the bolster so as to bring the load in the same place as it would be when deposited there by the truss rods, and the force was then applied at *A* and *B*. From this it is seen that the stresses were as nearly as possible those due to static service conditions. The deflections were taken at the ends at *C* and *D*, and also at the side bearings at *E* and *F*. As the table shows, there was little deflection and no permanent set.

The old body bolster was tested in the same manner, and the results are also given in tabular form, as a matter of record for that build of bolster. It was then tested to destruction by a load of 45,288 pounds. This load sent the side bearings down $\frac{21}{32}$ inch, and showed a permanent set at those points of $\frac{9}{32}$ inch; the plates were found badly distorted generally, and bent upward at the center when the load was removed.

A test of the new truck bolster, Fig. 3, showed up equally as well as that for the reinforced body bolster. The illustration of the bolster will explain why these results were obtained, better than any written description.

The care taken to know positively what the outcome was to be in the matter of expense involved in the change of about 5,000 cars, will richly repay the projector of this move. The adage, "He is a bene factor to his race who causes two blades of grass to grow where one grew before," has, it seems to us, an application to the case in hand.



Nor. Pac. Car.
Fig. 4

TEST OF BODY BOLSTER WHICH WAS TAKEN FROM OLD 40,000 CAP. CAR BEFORE BEING REINFORCED.

Pressure.	Deflection at End.	Deflection at Side Bearing.	Pressure.	Deflection at Ends.	Deflection at Side Bearings.
1,258 lbs.	$\frac{1}{32}$ inch.	$\frac{1}{32}$ inch.	32,708 lbs.	$\frac{3}{8}$ inch.	$\frac{13}{32}$ inch.
6,290 "	$\frac{3}{32}$ "	$\frac{1}{16}$ "	Off.	$\frac{3}{16}$ perm't set.	$\frac{1}{8}$ perm't set.
12,580 "	$\frac{6}{32}$ "	$\frac{1}{8}$ "	40,256 "	$\frac{1}{2}$ inch.	$\frac{1}{2}$ inch.
18,870 "	$\frac{7}{32}$ "	$\frac{3}{16}$ "	45,288 "	$\frac{5}{8}$ "	$\frac{21}{32}$ "
25,160 "	$\frac{9}{32}$ "	$\frac{9}{32}$ "	Off.	$\frac{13}{32}$ perm't set.	$\frac{9}{32}$ perm't set.

TEST OF REINFORCED BODY BOLSTER.

Pressure.	Deflection at End.	Deflection at Side Bearings.	Pressure.	Deflection at Ends.	Deflection at Side Bearings.
6,290 lbs.	0 inch.	0 inch.	33,740 lbs.	$\frac{3}{64}$ inch.	$\frac{1}{32}$ inch.
12,580 "	$\frac{1}{64}$ "	0 "	Off.	No perm't set.	No perm't set.
18,870 "	$\frac{1}{32}$ "	0 "	40,256 "	$\frac{3}{32}$ inch.	$\frac{3}{64}$ inch.
25,160 "	$\frac{3}{64}$ "	$\frac{1}{64}$ "	50,320 "	$\frac{5}{32}$ "	$\frac{1}{16}$ "
31,450 "	$\frac{1}{16}$ "	$\frac{1}{64}$ "	Off.	No perm't set.	No perm't set.

TEST OF REINFORCED TRUCK BOLSTER.

Pressure.	Deflection.	Pressure.	Deflection.
6,290 lbs.	0 inch.	33,960 lbs.	$\frac{7}{64}$ inch
12,580 "	$\frac{1}{64}$ "	Off.	No perm't set.
18,870 "	$\frac{3}{64}$ "	40,256 "	$\frac{1}{8}$ inch.
25,160 "	$\frac{1}{16}$ "	Off.	No perm't set.
31,450 "	$\frac{3}{32}$ "	50,320 "	$\frac{3}{16}$ inch.
		Off.	$\frac{1}{32}$ "

A Model Railroad Paint Shop.

The Long Island Railroad has an up-to-date plant at Morris Park Station, Long Island; the shops comprising the whole having been arranged with the idea of having room enough to start with, and introducing extensions if necessary.

With such a favorable outlook, it is perhaps not an act of justice to the whole to particularize; but we will say a few words about the paint-shop, which, by reason of its neatness and general air of business, would catch the eye of a railroader at once, and for that reason our stay was limited to that shop.

It is floored with concrete, and has an abundant water supply to thirteen tracks, which are drained in the most approved manner. Electric light bulbs are strewn thickly over the space, so that there can always be an abundance of light. The stock room is one of the features of the shop, and is an example of what can be done in the way of keeping stock down to a hard-times limit and still have sufficient material on hand to provide for the demands of the present.

A long step in advance of the ordinary methods used to denude a car of its old paint, is in vogue here. Pintsch gas is used with a Bunsen burner, to "burn off" all passenger-train cars. There are six tanks, 20 inches diameter and 9 feet 6 inches long, in use for this purpose exclusively, four of which are in commission in the shop while two are on the road being filled; they are loaded at a pressure of ten atmospheres, practically 145 pounds per square inch.

Two tanks of gas are required to one 60-foot car, which two men use up in from 16 to 20 hours, the time required to completely remove all vestiges of the old pigment. This is done at an expense for labor of $4.50, a pretty low figure as compared with the old hand torch, or even with the gasoline carburetters.

Mr. R. J. Kelly, the foreman painter, is turning out an average of fifty coaches per month with complete work, or ninety with light repairs—this with a roster of forty names all told. Superintendent of Motive Power Prince has authorized experiments to be made with electricity to drive a brick disk for rubbing down surfaces. If the investigations under way are as fruitful of results as they expect, they will be able to smooth up the side of a car with greater expedition than is now done with the best appliances.

Aluminum goes on everything for ornamentation—coaches, cabs and tenders alike. It is the most satisfactory thing yet used here for striping and lettering—and cheap.

The Uncomfortable Suburban Car.

One of the best-posted experts on transportation problems mentioned in an article, lately, that it seemed certain that within a very few years all urban and suburban passenger traffic will be done by electric motors. It seems to us that there is a possibility for the compressed-air motor competing with electricity in a great many cases, but we are free to admit that the likelihood is that steam locomotives will become every year more sparingly used for short passenger trips. It seems to us that surface railroad companies have themselves to blame, to a great extent, for the passenger business that is passing out of their grasp. Where they might do so on equal terms, they do not attempt to give the same rates as trolley lines, and it is very difficult for them to get out of the beaten path and increase the privileges of the people they carry. We have been very much struck lately with petty inflictions put upon passengers of suburban roads, which a little bit of "broad gage" management would abolish. There is too much burning of soft coal by locomotives employed on suburban passenger service, and there is too little attention bestowed to keeping smoke and cinders and dust out of the cars. In the neighborhood of many cities, the railroads are ballasted with material that causes a great deal of dust when a train is in motion, and, between the dust and smoke, a ride in a surface car is an ordeal that many people will not endure twice if they can help it. These discomforts make people willing to sit a little longer in a trolley car to make the same distance, and are taking away revenue from railroads that might well be saved by intelligent attention to details and a desire displayed to promote the comfort of travelers.

The Compartment Car.

The compartment car and all the discomforts attendant on that style of vehicle abroad has long been a fruitful field for protest by travelers from this side, and now the English papers have taken up the subject. Some of the reasons for the modification of the present arrangement of these cars, and recommendations for additional safety to unprotected passengers, until the American type, or, as they put it, the corridor car, comes into general use there, are taken from "Transport," which shows the action in the case by the Board of Trade. It is given entire below:

"It is pointed out that, until corridor cars become general for long distance traffic, or at any rate on trains running considerable distances without stopping, the question of the improvement of the means of communication between the passengers and the servants of the company in charge of the train must remain an important subject for consideration, and the board would be glad to know whether the companies have recently made experiments with electrical or other means of communication, and, if so, with what results. The subject of separate accommodation for women traveling alone is also important, and upon this the department communicated with the railway companies by circular letter in 1888. From the replies received it was made clear that ladies do not care to make use of compartments specially designated and set apart for them. The experience of the companies showed that when compartments were set apart for ladies they were but seldom used, and that the obligation to provide such compartments would impose expense on the companies without any proportionate advantage to the public. On the other hand, some companies intimated that they had issued a regulation directing their servants to find special accommodation for any lady desiring it. Such an arrangement is probably still in force, but it may not be universal, and even where there is such a rule, the board doubt whether lady travelers are aware of its existence. The department is therefore disposed to think that it would be well for the companies to make such a regulation universal, and to take steps by advertisement and otherwise to give it full publicity, in order that a lady traveling alone may be given notice that she can always be accommodated with a seat in a carriage of the class desired to which women only will be admitted. As far back as 1864 the Board of Trade communicated with the railway companies on the subject of occurrences of a criminal nature in passenger trains, and in their circular letter of that date the department suggested *inter alia* that a window, provided with curtains, might be placed between the compartments of carriages. This suggestion was not accepted, and the board are not prepared to say that the balance of convenience to the public would be in favor of its adoption. They merely refer to the fact that it was made in order to show that for over thirty years some means of preventing the recurrence of these disgraceful cases has been sought in vain, and to add weight to their appeal to the Railway Association to use its best endeavors, by consideration and discussion, to devise a remedy for an evil which, from time to time, assumes in the public mind the proportions of a serious social scandal."

Viewed from our position on this side, the matter of personal comfort is of equal importance with that of safety from molestation while in transit. Hygienic reasons alone should force the introduction of lavatories and closets in those cars for women and children especially. The lack of these conveniences, or, more properly, necessaries, would not be tolerated on American roads; and this fact furnishes the strongest kind of an argument for corridor cars, since, from their construction, these improvements are possible, whereas in the type under consideration it is not easy to introduce them.

Laboratory Tests of Brake Shoes.

The Committee of the Master Car-Builders' Association on Laboratory Brake Shoe Tests, found a very close agreement to results obtained the year before, when testing the same shoes under similar conditions this year, except in case of the steel shoes, both hard and soft, which gave a higher friction co-efficient; this was accounted for by the surface of the wheel tread being rougher last year than when making the later test.

These findings go to show how variables can affect results, and change the complexion of a report. They also shake our faith in the old interlocking theory of surfaces in frictional contact, since the smoothest surface in this case gave the highest co-efficient of friction, which is contrary to our conception of the behavior of rubbing surfaces under pressure.

In the tests of shoes 17 inches long, however, and shoes covering the wheel flange as well as the tread, there were no results obtained that would indicate any greater frictional resistance than would be found with the 13-inch shoe. There was no advantage in the use of the long shoe, other than a reduced pressure per unit of area, due to its greater bearing surface. This restores our confidence in early teachings of the principles of friction. The same verdict is given in the case of the shoe with a flange; this latter will be likely to shock some theorists who have maintained that there was a certain pinching action on the flanged part of the shoe, that produced an increase of friction.

There is nothing that will show up a fallacy any better than a heartless unbiased practical test, and the good work is going on, for the gentlemen making these tests have been made a standing committee, and another committee has been appointed to make a series of practical tests.

Elizabethport Car Shops.

At the Elizabethport shops of the Central Railroad of New Jersey they are building two new 60-foot baggage cars with two doors at each side. There is very little metal entering into the make-up of these cars in the way of reinforcing features, that has marked recent new passenger-train equipment. All sills, girths and posts are made of yellow pine, except the door posts, which are of ash. The carlins are also of ash, and have six of the wrought-iron sandwiched type, secured according to usual practice for those details.

Mr. Hoffecker, the assistant superintendent of motive power, has built, from his own design, an air-crane for use about the yard and shops, that fills a want at those points, in loading car wheels and other materials, that were formerly handled in the old slow way. It is mounted on a short flat car, and comprises a short cast-iron mast at the center of the car, carrying a jib to which is secured a cylinder 12 inches in diameter and having a piston travel of 10 feet. A chain connection with the end of the piston passes over sheaves at the end of the jib. The machine is remarkably efficient in picking up heavy stuff, and is also frequently used to raise the ends of cars for light repairs.

The Master Car and Locomotive Painters' Association held their annual convention in New York City in September, closing on Friday the 11th, one of the most interesting and profitable sessions ever held by that body.

PRACTICAL LETTERS FROM PRACTICAL MEN

The Safety Steam Turret.

Editors:

The June number of "Locomotive Engineering" shows a safety device gotten up by Mr. John A. Hill, which perhaps I have not got a correct understanding of.

Suppose that we allow the boiler to attain the pressure of 140 pounds to the square inch before we try to open the fountain throttle: It would take a pressure of 30 pounds on the piston to open it, and as the pump throttle is tapped into the steam box we could not get the air. The resisting steam pressure on bottom of steam valve would be 831 pounds, which would stop any engineer.

Lake City, Ia. John E. Osmer.

[What our correspondent says would be practically true. It is to be supposed that the valve would be opened when the engine was fired up, or shortly after. It would be an easy matter to move the valve against a low pressure, say 25 to 40 pounds. The details are only suggestions; it would be an easy matter to put a lever arrangement on to open the valve easily at any pressure. To say that the valve might be left shut when firing up does not excuse leaving it so; one might as well say the blow-off cock or the throttle might be left open.—Eds.]

A Handy Tire Heater.

Editors:

By this mail I send you blueprint of tire removing and setting apparatus, that we are using with great success. I have never seen anything like it before, and thought perhaps it might be of interest to the readers of your valuable paper.

You will note that there is a casing made of 3-16-inch tank steel, to suit the different size wheels. This casing fits snugly on the tire at the sides, and stands off the periphery of the tire about 4 to 6 inches, according to the thickness of the tire. The tire is heated by the spraying apparatus that we use in firing up engines. Crude oil at three cents per gallon is used, and it requires about one to two gallons to remove a tire. You will note at the left of the apparatus we introduce an air jet to promote circulation, and after the spray has once become ignited, it whirls around the outside of the tire, completely enveloping it.

We have removed a 1¾-inch tire with this apparatus in six minutes, after the fire was lighted.

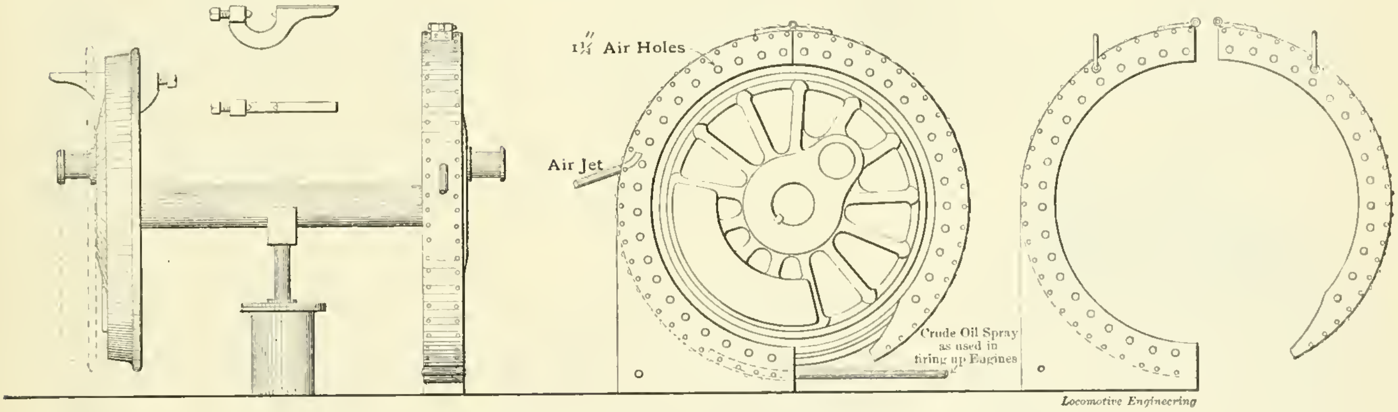
You will also note a clamp to be used in putting on tires. This clamp is fastened to the wheel center, and the tire hung on it, and the case applied to the tire, same as would be done in removing tires. When tire is sufficiently expanded, it can be pushed in place very readily.

We have a place fixed up in the yard for this kind of work, where wheels are lifted from the rail by an air cylinder, as shown. We also have an air crane that swings in a circle of 30 feet, with which we can handle tires, as well as the casing.

We find this a great labor-saving device, as two men can handle it, either applying or removing tires.

C. T. McElvaney,
M. M., M. K. & T. Ry.

Denison, Texas.



TIRE-REMOVING APPARATUS, M. K. & T. SHOPS, DENISON, TEXAS.

A Set of Metallic Packing that Ran For Thirteen Years.

Editors:

We recently had occasion to change the valve-stem packing on our shop engine, and it has made so good a record that we concluded to send you some data concerning it, knowing that such matters are of interest to you.

The packing is ordinary Jerome metallic packing. It was put on engine February 5, 1883, and was taken off August 20, 1896. The engine has been in service every working day between periods noted, and packing was never looked at until its removal. The valve stem is worn but $\frac{1}{64}$ smaller than original diameter. We send you the rings that were removed so you can see their condition.

David Brown,
Scranton, Pa. M. M.

[The packing rings sent us seem to be good for long service yet; the exterior is slightly pitted all over, but the bearing surface is bright and the rings maintain their original shape.—Eds.]

Prevention Versus Cure.

Editors:

I notice, on page 713 of August issue, that the Traveling Engineers' Association are investigating the subject of disciplining enginemen for infraction of orders. I would like to say to them: Put the orders on a file before enginemen's eyes and it will not be necessary to be making any investigations as to the best mode of punishment for any infraction of them. I don't mean to say there is no need of any change from the present mode or manner of discipline, as it is entirely too severe; as a man on the majority of roads is discharged outright and no extenuating circumstances taken into consideration at all. Most roads, on the other hand, will hire a man to take discharged man's place that has committed same offence on last road he worked for. If it does not unfit a man for service on one road, why should it on another?

Hoping this may meet the eyes of some of the traveling engineers and set them to work right, which is to provide a remedy against instead of a punishment for, I would respectfully invite their attention to Rule 516 in the Standard Code of Train Rules.

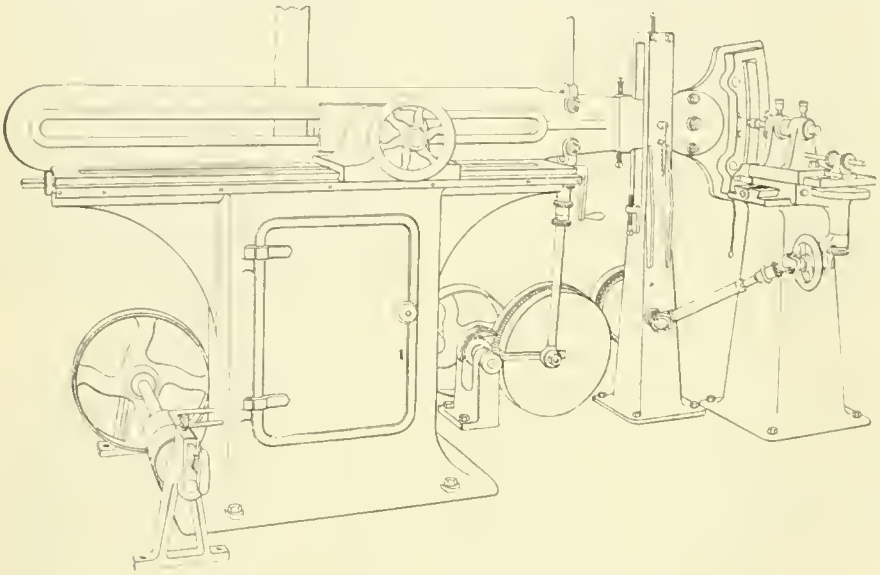
McCook, Neb. A. W. JENNINGS.

A Good Link Grinder.

Editors:

Am forwarding you photographs of link grinder designed by Mr. Aird, foreman of the machine shop, and myself. This machine has ground more than sixty pairs of links and blocks, and will grind any radius from 3′ 6″ up to 7′ 6″.

The radius is taken from center of slot



in plate where link is bolted, and the head is moved along frame of machine to the desired radius, which is indicated by a scale screwed on front of frame, made expressly by the Brown & Sharpe Manufacturing Co.

A stop pin is put through guide and radius bar, as in photo, to hold in position while head is being moved.

The hand wheel clamps bar firmly between flanges on end of pin, but allows pin to rotate freely in head.

The emery wheel makes 8,000 revolutions per minute, and has a reciprocating motion at right angles to radius bar which can be adjusted to any length of stroke, and made to stop at any desired point, so as to grind close up to flange when grinding link blocks.

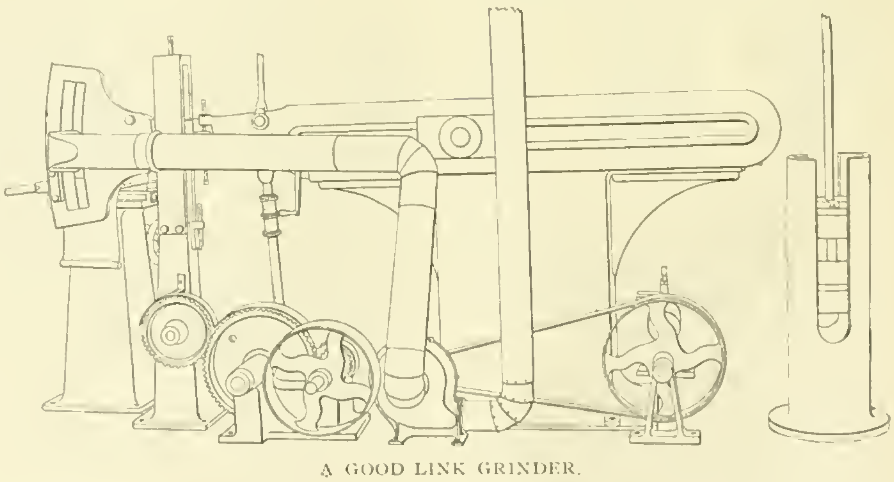
The rod attached to bar is connected to walking beam (which does not show in photo), at the opposite end of which is suspended another rod, with weights put at bottom end to balance overhanging weight of radius bar. The weights are inclosed in a sleeve to prevent them from swinging when moved up and down.

A Sturtevant exhaust fan carries away the dust, keeping the machine clean, and making it pleasanter for the operator.

A three-speed cone has been substituted for driving pulley shown in photo.

J. FARRAR,
Asst. Foreman G. T. Shops.

Montreal, Can.



A GOOD LINK GRINDER.

Interesting Data in the Old Books of the Mason Locomotive Works.

Editors:

Once having permission to look over the "Old Locomotive Book" of the late William Mason, and being allowed to take notes therefrom for my own personal satisfaction, I send a copy of them, thinking they will interest those whose pleasure it is and has been to look back into the past history of the rise of the "iron horse," and who are looking into the future with your admirable monthly as a great help.

As some of these notes may create heart-burnings, I wish to state frankly that my sole object is not to create a discussion as to whose ideas or inventions Mr. Mason may have thought best to use, and I am not aware that he claimed all that he introduced in his locomotives, but I do claim that no builder ever tried harder than he did to benefit and improve the work he undertook to do. I have given some of the prominent changes from time to time made by Mr. Mason, and of which he makes special mention in his book, and which I copy as written in his book by him:

Engine No. 1; Jeffersonville & Indiana Railroad; October 11, 1853—Indiana pattern; outside connection link motion; solid spoke; copper steam pipe; dome over firebox; copper flue sheet. (Note—Mr. Mason began to build before 1853, but no records appear to have been kept, for he built insiders and drop hooks.)

Engine No. 5; Hartford, Providence & Fishkill; named "Orion"; March 17, 1854—Hollow-spoke driving wheels. (Note first mentioned.)

Engine No. 13; Western Railroad; named "Olympus"; January 3, 1855—straight boiler; perforated steam pipe.

Engine No. 23; Toledo & Illinois Railroad; named "Ariel"; July 20, 1855—First engine of new pattern. (Note—This must have been at the time when he spread his truck wheels.)

Engine No. 68; Baltimore & Ohio; June 8, 1857—Crown sheet, Lowmoor iron; iron tubes; tires, chilled iron.

Engine No. 95; Lehigh Valley; April 30, 1860—Ten-wheeler; cylinders set on an incline. Weight on drivers, 41,400; weight on truck, 20,100; weight, 30 tons. (Note—A whale.)

Engine No. 105; Providence & Worcester; named "Paul Whiton"; April 1, 1861—"First engine to have gage cocks discharge into a dripper; made all so after this."

Engine No. 107; Dubuque & Sioux City; named "Vixen"; June 17, 1861—Pony engine; two 4-foot 6-inch drivers; two 33-inch lead trucks; baggage car and tender in one. "First engine to have elliptic spring balance."

Engine No. 113; "W. H. Whiton"; July 21, 1862; for the United States military roads—16 x 22; 5-foot driver. "First engine for the United States Government."

Engine No. 114; Boston, Lowell & Nashua Railroad; August 17, 1862—Driver, G. S. Griggs pattern.

Engine No. 117; United States Military Railroad; the "E. L. Wentz"; September 4, 1862—"Cast-iron lower rocker arm. The crosshead babbitted."

Engine No. 128; Philadelphia, Wilmington & Baltimore Railroad; named "New York City"; March 23, 1863—"No hand-rails."

Engine No. 136; Toledo & Wabash Railroad; June 29, 1863—"Pumps composition chambers."

Engine No. 139; Chicago, Burlington & Quincy Railroad; numbered 89; August 17, 1863—"New pattern crosshead; new pattern center-bearing lead truck; water leg in firebox."

Engine No. 145; Central Pacific Railroad of California; November 27, 1863—"Shipped on board vessel 'Volunteer.' for San Francisco, from Boston."

Engine No. 155; Grand Trunk Railroad of Canada; 5-foot 6-inch gage; numbered 231—"Had new saddle and steam chest."

Engine No. 177; Portland & Kennebeck Railroad; named "W. D. Sewal;" October 31, 1864—"New bell yoke, present style; new pattern boiler front, 42-inch."

Engine No. 191; Terre Haute & Richmond Railroad; named "Arctic," No. 5; 15 x 22—"New-style cab and cab stands; cast-iron foot board; new sandbox under boiler; new tender trucks."

Engine No. 209; Toledo, Wabash & Western Railroad; "J. K. Knox;" numbered 50; 16 x 22. August 25, 1865—"Had new equalizing lever."

Engine No. 218; Boston & Worcester Railroad; named "Vulcan;" November 30, 1865—"New-style tender jaw and brake; new-style valve strap and stem."

Engine No. 116; Louisville & Nashville Railroad; August 25, 1862—"First engine to have hollow-spoke drivers balanced with lead."

Engine No. 233; Toledo, Wabash & Western Railroad; named "Wabash," No. 144; June 26, 1866—"Had electrical apparatus in boiler to keep clear from scale."

Engine No. 237; Boston & Worcester Railroad; named "Atlas"; August 20, 1866—"Ash pan secured with angle iron."

Engine No. 242; Western Railroad (Boston & Albany); named "Greenbush"; October 16, 1864—"New arrangement parallel rods, double-keyed; no gibs on back end; new rocker."

Engine No. 256; Boston & Worcester Railroad; named "Hero"; April 29, 1867—First engine to have monogram between drivers.

Engine No. 291; Vermont Central and Vermont & Canada Railroad; named "Braintree"—Tender truck brakes embrace all wheels.

Engine No. 306; Central Railroad of New Jersey; March 30, 1869; named the "Empress"—First engine to have rack and pinion on throttle lever.

Engine No. 318; California Pacific Railroad; named the "T. M. Ryder," No. 9—Flag stands on lantern brackets.

Engine No. 301; South Side Railroad of Virginia; February 5, 1869—Curtain style of wheel guards

Engine No. 334; Lake Shore & Michigan Southern Railroad; November 15, 1869—Double sheets in boiler, under yoke.

Engine No. 351; Lehigh Valley Railroad; March 31, 1870—Nathan & Dreyfus oilers on rods and slides.

Engine No. 353; San Francisco & San José Railroad; named "Menlo Park," No. 11; April 16, 1870—Cylinders oiled from cab; glass water gages.

Engine No. 358; Lehigh Valley Railroad, May 30, 1870; named "Coplay," No. 152—"Used my new lantern bracket."

Engine No. 375; Milwaukee & St. Paul Railway; September 28, 1870—New front draw iron; hollow brass pump plungers.

Engine No. 382; Greenville & Columbia Railroad; 5-foot gage; named "Gov. R. K. Scott"—Frame jaws 18 inches long. "My new driving box; brakes hung on truck frames."

Engine No. 385; Norfolk & Petersburg Railroad; December 31, 1870; gage, 5 feet—Brass cylinders, dome, and sand box casings; brass hand rails and wheel guards; all brass work in cab and outside trimmings nickel-plated; black walnut cab; engine painted blue with gold striping.

Engine No. 387; Central Railroad of Iowa; named the "C. C. Gilman," No. 72; February 13, 1871—"My first 4-foot 8½-inch gage engine to have new arrangement of frame jaws and boxes."

Engine No. 403; Boston & Albany Railroad; named the "Natic," No. 174; May 10, 1871—"To be painted black as the devil."

All engines since this date are so modern that most railroad men will not require to be reminded of them.

HERBERT FISHER.

Taunton, Mass.

That Engine that Threw Water.

Editors:

In answer to your correspondent in Altoona, Wis., page 764, September number of "Locomotive Engineering," the cause of the water being thrown from stack while engine is working, I think you will find is the condensation of steam in blower pipe. The blower cock leaks a little, and the steam condenses in pipe until the pipe is nearly full; then the pressure gathers behind the water and forces it out of the blower nozzle, and the engine exhaust carries it out of top of stack. This accounts for the water not showing at cylinder or exhaust pipe cocks.

Another way this same thing could occur would be that the blower cock leaks some, and is so low on the boiler head that the water in boiler surges into it with the movement of the engine while running; or the condensation of steam in air-pump exhaust pipe when pump starts up after regulator has stopped it, would bring about this same result.

The reason the water does not fall back on the engine when working hard is because the exhaust is stronger, or comes out with greater force and scatters it up into the atmosphere.

I think this trouble can be overcome by placing a drip cock in both the air-pump exhaust and the blower pipes. Would be pleased to know if I am correct in this particular case.

C. J. MCMASTER.

Rutland, Vt.

A Curious Way to Cure Water Throwing.

Editors:

Concerning your curious case of water thrown from stack, in September issue, page 764, I will say that on the Sixth avenue line of the Manhattan Elevated we have some Baldwins that will almost invariably raise and throw water out of stack with one gage of water, but will not with two gages. Would say, let correspondent try running with two gages, and see if that will overcome it.

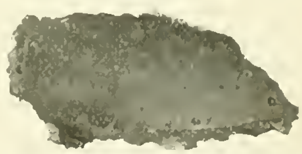
W. R. JOHNSTON.

New York City.

A Rod-Cup Explosion.

Editors:

There was a small explosion at this station last evening, that was so much out of the usual line, that I thought I would jot down the particulars and send them to you for publication in your valuable journal, as I think not many engineers have ever seen or heard of a thing of this kind. Engine 347, Pennsylvania Railroad, mogul type,



run by Mr. Thos. Dixon—Train 238, heavily laden with ore—was slowly pulling into Sharpsville, Pa., Station, when the oil cup on the back end of main rod exploded with a noise like a small cannon; the pieces flew in every direction, but fortunately without striking any person. I send you a piece of the broken cup, which had evidently struck a key or other sharp obstruction (as it is bruised as though it had received a blow with a chisel). I think this is unique in the line of explosions. The pin had been running hot for some time, but not so much so as to cause any uneasiness as to its safety. If any of your readers know of a similar circumstance, we would like to know it.

C. H. PETERS.

Sharpsville, Pa.

Tool-Room Kinks.

Editors:

Good tool-room management is not confined to keeping up repairs and renewals of broken tools. It also includes the proper checking-out of tools, and facilities for handling them quickly. While the metal check system is about the best, a great deal of time can be saved in the proper handling of the checks.

Upon my advent into my present position, I found check pegs alongside of or near each tool or duplicate tools, the idea being to hang a check on a peg when the tool was taken out, which is all very good in its way, but there is always the trouble of checks getting knocked down and lost. Being very much cramped for room in that part of the tool room where there were no racks or shelves, I divided the territory up into three parts, and fastened up a checkboard to cover the tools in each part. Fig. 1 shows the board and check pegs in rows. If there are a great many tools of a kind, say straight wrenches, I use one row of pegs, and have a painted tag or label fastened to the board. By this we are enabled to keep all checks on straight wrenches together without the fear of having them knocked down. Having eight die stocks, one row of pegs is devoted to die stocks, and a lozenge-shaped tag with the size alongside each peg; and to be sure the die stocks are returned to their proper place on the hooks, a tag to represent the size is fastened alongside the hook. When a certain tool is called for, if it is out, and the question is asked who has it, we have only to look at number on check, and refer to check list of all men having checks, and locate the man having the tool. Our twist drill ratchet has a special peg, away from the other ratchets, and is designated "taper socket ratchet."

Now, it very often happens that a man may want more tools than he has checks (5) for; to get around this, instead of taking his check for tap wrenches or wrenches for reamers, we hang the check Fig. 2 (having the letter *W* stamped on it) on the peg with his tool check. This shows that he has taken one or more tap wrenches out with the taps or reamers. These wrench checks remain in the tool room. Where an open-ended or other wrench of a given size is asked for, I have a set of galvanized iron gages with the size stamped on. (See Fig. 3.) These gages run from 1 to 4 inches by eighths, so, instead of using a rule to measure the wrench, one of the gages is used. They are hung up on pegs inside the tool-room door, where they are handy to get at.

We had a great deal of trouble from the breakage of handles in punches and chisels. To get rid of this trouble, when a punch or chisel was dressed I had the tool dresser rivet a piece of 1 1-16 round iron in the eye, and about 5 inches long; the end of this 1 1-16 iron was threaded, and a piece of ¾ gas pipe 2 feet long was screwed on. It makes a strong, serviceable handle. When the punch or chisel requires dressing, the pipe is unscrewed, the short piece of round iron not interfering with the repairs.

Immediately under the shelf over which the tools are passed through the door, are two small shelves, each holding a quantity of the different grades of emery cloth. Below these shelves are two iron hooks, on which we hang our cab rope (a rope for lifting cabs on and off).

Fig. 4 is a tool rack 66 inches high by 14 inches wide and 48 inches long. The shelves *A*, *B*, *C* are for reamers, twist drills, etc. The strips 1 and 2, line *D*, running lengthwise, are to lay staybolt taps on. The strips 3 and 4, line *E*, are for counterbores or pin drills. Shelf *F* is for small *S* and other wrenches. This rack holds over 250 tools; it is compact and handy, and most of the tools are indexed on the strips marked *X*. The figures 24 x 4 are the foot or base of the rack.

Who can suggest some good way for testing hydraulic jacks, without hunting a pair of driving wheels to test the lifting and sustaining qualities of the jack, when being repaired?

W. DE SANNO,
Tool Room F'man, Pan Handle Shop.
Indianapolis, Ind.

Fig. 1

Fig. 2

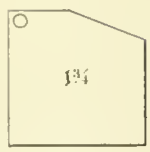


Fig. 3

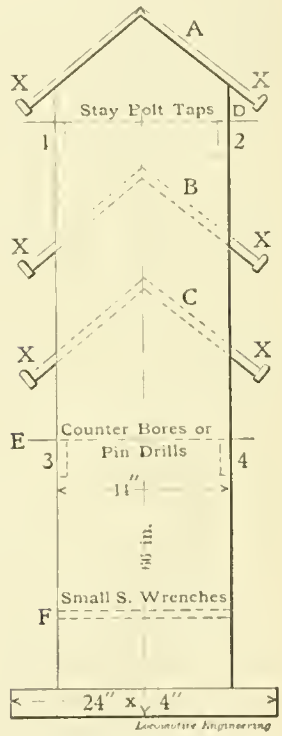


Fig. 4

Why a Locomotive Moves.

Editors:

An experiment of no small interest may be made by anyone who owns or who can obtain the use of a bicycle for a short time. The experimenter need not be an expert rider, and, indeed, does not even require to know how to mount. In making the experiment, it is necessary to place the bicycle upon a level floor, and to have it held in an upright position by someone who can be trusted not to vitiate the accuracy of the result by giving any motion to, or exerting any pressure upon, the machine. If the bicycle moves forward, the wheels will turn in a direction similar to the direction pursued by the hands of a clock, when viewed by a spectator standing on the right-hand side of and facing the bicycle. If the machine moves backward, the wheels will revolve in a contrary direction.

Let a string be attached to one of the spokes of the front wheel, at or near the point where the spoke joins the tire-rim, and let the spoke chosen be the only vertical one at the time, in the lower half of the wheel. We will then have an arrangement analogous to the position assumed by the main rod of a locomotive when the crank pin, on the right side, stands on the bottom quarter. Now, if the string be pulled forward—that is, in the direction in which the bicycle would move if proceeding forward—such a pull would impart a motion to the wheel which, if free to revolve in the air, would be, to the spectator, in a counter-clockwise direction. In other words, one wou'd expect the bicycle to back up. With the wheel upon the ground, however, the bicycle will not back up. The string pulled tight, will itself pull tighter, and the wheel will begin to revolve against the direction of the pull—clockwise—and the machine will advance exactly as if the string had been attached to the handle bar. The reason for this is obvious. The spoke in question is a lever with fulcrum on the ground; the power is applied through the string, between fulcrum and resistance, the resistance being at the hub of the wheel. If the wheel be now turned round so that the spoke to which the string is attached shall stand above the hub, and if the string be again pulled forward, the bicycle will move forward. We see, therefore, that if the string be pulled, the machine will advance in the direction of the pull, without reference to whether the point of application of the drawing force be above or below the hub.

Applying the results of this simple experiment to the consideration of the question why a locomotive moves, we will find that the method of procedure, and the reasoning employed, will not lead to exactly the same conclusion as that deduced from the experiment. A locomotive standing with its right-hand crank pin upon the bottom quarter, and, for sake of argument, supposed to be disconnected on the left side, can be backed up by the application of a pulling force similar to that which caused the bicycle to advance. The crank pin in question is here the object of a pulling force, produced by steam pressure, exerted through the main rod, and, as everyone knows, the resulting motion of a locomotive wheel under these conditions is in a counter-clockwise direction, to the eye of the spectator on the right side, and the engine backs up. Why is there this difference between bicycle and locomotive? A pull in a forward direction exerted upon a spoke of a bicycle wheel when below the hub will produce a forward motion. A pull upon a locomotive crank pin standing below the driving axle in the same forward direction will produce a backward motion. In each case the wheel is a lever, with fulcrum on the ground, the resistance at the axle, and the power applied between fulcrum and resistance. The wheel is in each case what mathematicians would call a lever of the third class. We have therefore an apparently similar pull exerted upon similar levers, producing opposite motions.

The difference between these two forces is found in the fact that the origin of the power is not by any means similar, and in reality the application of the power is very different in the case of bicycle and engine. If the crank pin of the locomotive had been pulled by a tail-rope attached to another engine standing ahead, the wheel would behave as the bicycle wheel did, and would move in the direction of the pull, and not contrary to it. The pull upon the bicycle was presumed to have been exerted by a man standing upon the ground. As he pulled, he transmitted, through his feet, to the ground, a force equal and opposite to the amount of his pull upon the wheel, which increased somewhat beyond the measure of equality when the bicycle began to move. The pull, through the main rod, upon the crank pin, when on the bottom quarter, was produced by the pressure of steam acting upon the piston, which latter moved from approximately the central position in the cylinder toward the front cover. While the steam was pressing upon the piston, it was simultaneously pressing with an equal force upon the back cylinder cover. This pressure was communicated, through the cylinder fastening, to the frame of the engine. The locomotive wheel was therefore acted upon by two forces; the one pulling the crank pin, the other pushing upon the axle box.

In order to produce motion, a force or forces must become unbalanced, or unopposed by equal and opposite forces. The pressure in the cylinder was equal upon both piston and back cover, but the points of application to the wheel are seen to be very different. The pull through the main rod, coming from the pressure upon the piston, seeks to move the wheel lever, with fulcrum at rail, power applied at crank-pin, and resistance at axle. The push upon the frame, coming from pressure upon the back cylinder head, endeavors to move the wheel lever, with fulcrum at rail, power applied at axle, and resistance, as it may be said, now at crank pin. In this case the word "power" is used to signify that force which produces motion, and the word "resistance" that force opposed to it.

When these two sets of actions are considered together, we find that the pull upon the crank pin tends to make the engine move forward, not to back up; and the pressure or push, through the frame, upon the axle box tends to make the engine move backward. The distance from the axle center to the rail being greater than from the crank-pin center to the rail, the axle-box push has the greater leverage at command; and the resistance to motion being overcome when sufficient steam pressure has been accumulated in the cylinder, the engine moves backward, and the wheel revolves in a counter-clockwise direction, before a spectator standing to the right. When the crank pin comes around and is above the axle, the pull upon the crank pin becomes a push; and though the frame pressure also reverses its direction, the effort of the crank pin is now to turn the wheel in the counter-clockwise direction, which accords with the motion of the whole machine. It succeeds because the advantage of leverage is with the crank-pin push, as the distance from crank pin to rail (with crank pin above) is greater than from axle to rail. The whole cycle of motion becomes complete, and repeating itself regularly, the engine continues to move backward so long as pressure is exerted upon piston and cylinder covers.

The same line of reasoning is found to hold good when applied to the consideration of the forward motion of the engine. The pressure upon the crank pin, when below the axle, is found to be, paradoxical as it may appear, an effort to move the engine in a direction contrary to that in which we may actually see the engine move, whether forward or backward.

In order to put the case in still more concrete form, let it be supposed that the diameter of the driving wheel is 6 feet and that the stroke of the piston is the regulation 24 inches. In the first position, with crank pin on the lower quarter, the case stands thus: The wheel lever has a pull applied to the crank pin 2 feet above the fulcrum, which is at the rail, and, for the sake of example, suppose the total pressure of steam on the piston to be 25,000 pounds. The amount of this force about the fulcrum at the rail will be the product of the pressure by the arm of the power; viz., $2 \times 25,000 = 50,000$. The pressure of 25,000 pounds also applied to the axle box through the frame has a lever 3 feet long to operate upon. The movement of this force about the fulcrum point at the rail is $3 \times 25,000 = 75,000$. It is, therefore, clear that the pressure exerted upon the wheel at the axle box is the more powerful of the two, and the engine will move in the direction of the greater force —it will back up.

When the crank pin comes above the axle, or on the top quarter, which is the second position to be considered, the case may be stated as follows: The push upon the crank pin of 25,000 pounds now acts upon a lever 4 feet long, measured up from the fulcrum at the rail, and the moment of this push becomes $4 \times 25,000 = 100,000$. The counter pressure upon the axle box is, as before, $3 \times 25,000 = 75,000$. The engine, still obedient to the greater force, continues to back up.

GEO. S. HODGINS,
Windsor, Can. Can. Pac. Ry.

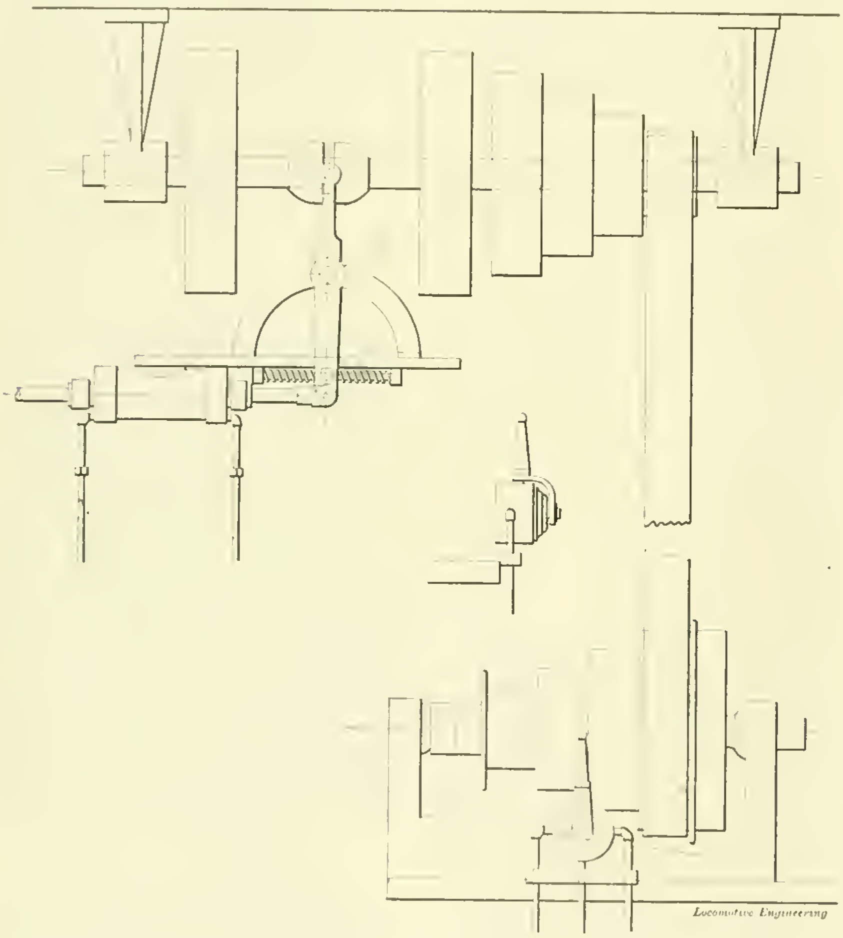
We offer the suggestion to railroad lamp makers, during these hard times, that they turn their attention to making a common-sense lamp to be used by riders of bicycles. There are a great many bicycle lamps on the market, most of them fearfully and wonderfully made. The aim of designers of bicycle lamps appears to have been the making of an article that would have as many pieces as possible, and which would call for the most skill in putting the parts together and keeping them adjusted. This, of course, gives an excuse for charging a fancy price, but it is rather hard upon those who purchase and take care of the lamps. If a bicycle lamp with as few parts as a hand lantern should be put upon the market, it would bring a rushing business to the maker.

We have received Volume II of the "Engineering Index" for the years 1892 to 1895, inclusive. To any man interested in engineering literature this is a particularly valuable book of reference, for it indicates where he can find articles on almost any subject connected with the entire science of engineering. It is published by the "Engineering Magazine," and is an extension of the work to be seen in that publication monthly, where the engineering index is given of all current literature likely to be of interest to engineers of all classes.

The Mason Regulator Co., of Boston, have issued a new and complete catalog of their regulating devices for steam and air pumps. We notice that the Safety Car Heating & Lighting Co. have adopted the Mason reducing valve as their standard for steam-heated trains. The catalog is free.

Pneumatic Clutch Shifter.

Our line engraving of a clutch shifter operated by compressed air, places on record one more device that makes the manipulation of a belted tool easier and safer for the operator; and it will not require a wearisome stretch of the mental organism to understand that a shop equipped with these and like schemes to accomplish results with the fewest moves, is in the front rank in economical performance. That is where the Waukesha shops have long been located, having earned the distinction of being one of the best-handled railroad plants in the West.



PNEUMATIC CLUTCH SHIFTER.

This device comprises an air cylinder placed near the countershaft of the machine it is to control; the cylinder has a piston with its head at mid-length of cylinder, the rod extending out far enough to engage with the lower end of a lever which has at its upper end the usual fork for a clutch, on the countershaft. A coiled spring holds the fork in its central position until air is used, and returns it to the same place when air is exhausted, so that the clutch is inoperative at all times except when air is used.

The *piece de resistance* of this whole arrangement is the valve which controls the air, shown on the lathe bed at the side of the cone. It is of the rotary type, with a finish to comport with that of the machine on which it is used. A handle extends upward from it, within easy reach of the operator, who has only to put out his hand a short distance with the certainty of finding what he is after. The old wooden shifter, and the blind gropings in empty air, above one's head, after the same, are replaced by these efficient little affairs, on the most important machine tools. It is at once apparent that any movement of the valve handle will either apply or release the air, and this is a particularly strong point when, from considerations of safety, a machine should be stopped instantly, and also when cutting screw threads up to or near a shoulder.

Mr. James McNaughton, superintendent of motive power and cars of the Wisconsin Central Lines, who kindly furnished the drawing of this device after we had seen it in operation some time ago, has left the impress of his individuality on a great many labor-saving devices that could, we believe, be profitably copied by many shop managers throughout the land.

The Healthy Train Service.

The British Board of Trade, which supervises the operation of railways in the same way as our Interstate Commerce Commission does, but exercises much greater authority, has been investigating the effect upon trainmen of high train speeds. There is an impression in many quarters that running the engines of high-speed trains soon degenerates the nervous system of engineers, and that after a few years it is necessary that they retire from the service or change to trains where the nervous strain is less intense. It is said that all trainmen are affected in the same way to a greater or less degree, and that all trainmen are more subject to kidney and inflammatory troubles than people engaged on other occupations.

We have never placed any faith in these assertions, because we have never known of an engineer having to give up a fast train because age had shattered his nerves, and our observation has been that trainmen in general are remarkably healthy. We are glad, then, to find that our conclusions on this question are supported by the report made to the British Board of Trade. The reports made to this board are always based on thorough investigation, and may be accepted as thoroughly reliable. This one makes out that engine drivers are among the most healthy people in Great Britain, and that age appears to have no influence in unfitting them for running the engines of fast trains. One of the best express train engine drivers in the British Isles has been on the footplate over fifty years. Sir Henry Oakley, general manager of the Great Northern, a line famous for its fast express trains, says that of sixty men who were driving express trains ten years ago, forty-three are still in the same service. The opinion is expressed that in no other responsible occupation could men be found who enjoyed such good health as the ordinary run of engine drivers. No evidence could be found to prove that the constant vibration of trains when in motion had a prejudicial effect upon the health of trainmen or of other people who have to spend a great deal of time in trains.

Bolt Cutter Operated by Compressed Air.

At the Pennsylvania Railroad shops, Jersey City, there is to be seen a thread-cutting machine that closely verges on the automatic in its action. The device, as illustrated, is shown applied to an old bolt cutter, and is as would, in fact, be applied to any machine, whether old or new. It comprises a revolving turret having sockets for six bolt heads, which holds the bolts in correct alignment with the center of thread-cutting dies.

This turret is made to turn automatically by means of compressed air, which is admitted to a small cylinder located under the turret, the admission also taking place automatically, being governed by the longitudinal movement of the turret while the thread is being cut; the tappets 10 and 11, in Fig. 1, being set so as to engage with the valve handle V^1 at the proper time to move the air piston, which, having an arm A reaching to the turret, forces the latter back to position ready for the next bolt. In the act of moving back,

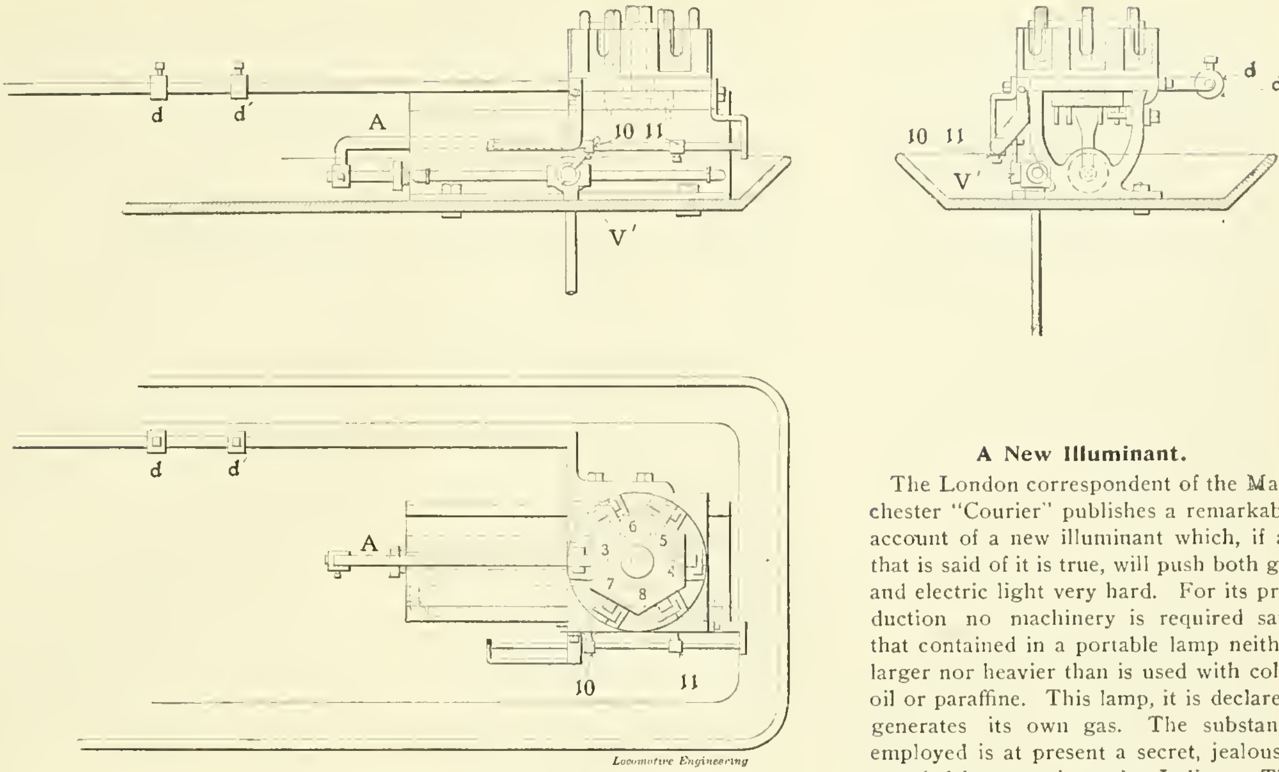


Fig. 1

BOLT CUTTER OPERATED BY COMPRESSED AIR.

the pins P^1, P^2, P^3, projecting from the under side of the turret, encounter a pawl *F*, Fig 2, which turns the turret one-sixth of a revolution and brings a new blank in line with the dies.

While the turret is revolving it carries the body of the bolt up an inclined plane (not shown in the illustration), which lifts the bolt head from its socket, and centrifugal force throws it out into a receptacle, where it is ready for use.

The function of the air attachment is, then, first, to force the turret with its bolt up to the die; second, to move the turret back to its first position after the thread is cut; third, to rotate the turret so as to bring a new blank into position for the dies to operate on; fourth, to eject the bolt after the thread is cut. The dies open and close by the familiar mechanism found on bolt cutters, by means of the tappets *d* and d^1.

Contrary to general practice in the case of a new mechanical idea, this one was not put on exhibition until it was perfected and had cut several hundred bolts. It is a rapid worker, reducing the time away under that required where it is necessary to clamp and unclamp a bolt by hand, since the whole duty of an operator in handling a machine with this attachment is merely to keep the turret supplied with blanks. The device is the invention of Mr. H. A. Ferguson, assistant master mechanic of the Meadows shops.

A New Illuminant.

The London correspondent of the Manchester "Courier" publishes a remarkable account of a new illuminant which, if all that is said of it is true, will push both gas and electric light very hard. For its production no machinery is required save that contained in a portable lamp neither larger nor heavier than is used with colza oil or paraffine. This lamp, it is declared, generates its own gas. The substance employed is at present a secret, jealously guarded by some inventive Italians. The cost is declared to be at most one-fifth of that of ordinary gas, and the resultant light is nearly as bright as the electric light and much whiter. A single lamp floods a large room with light. The apparatus can be carried about as easily as a candlestick and seems both clean and odorless.

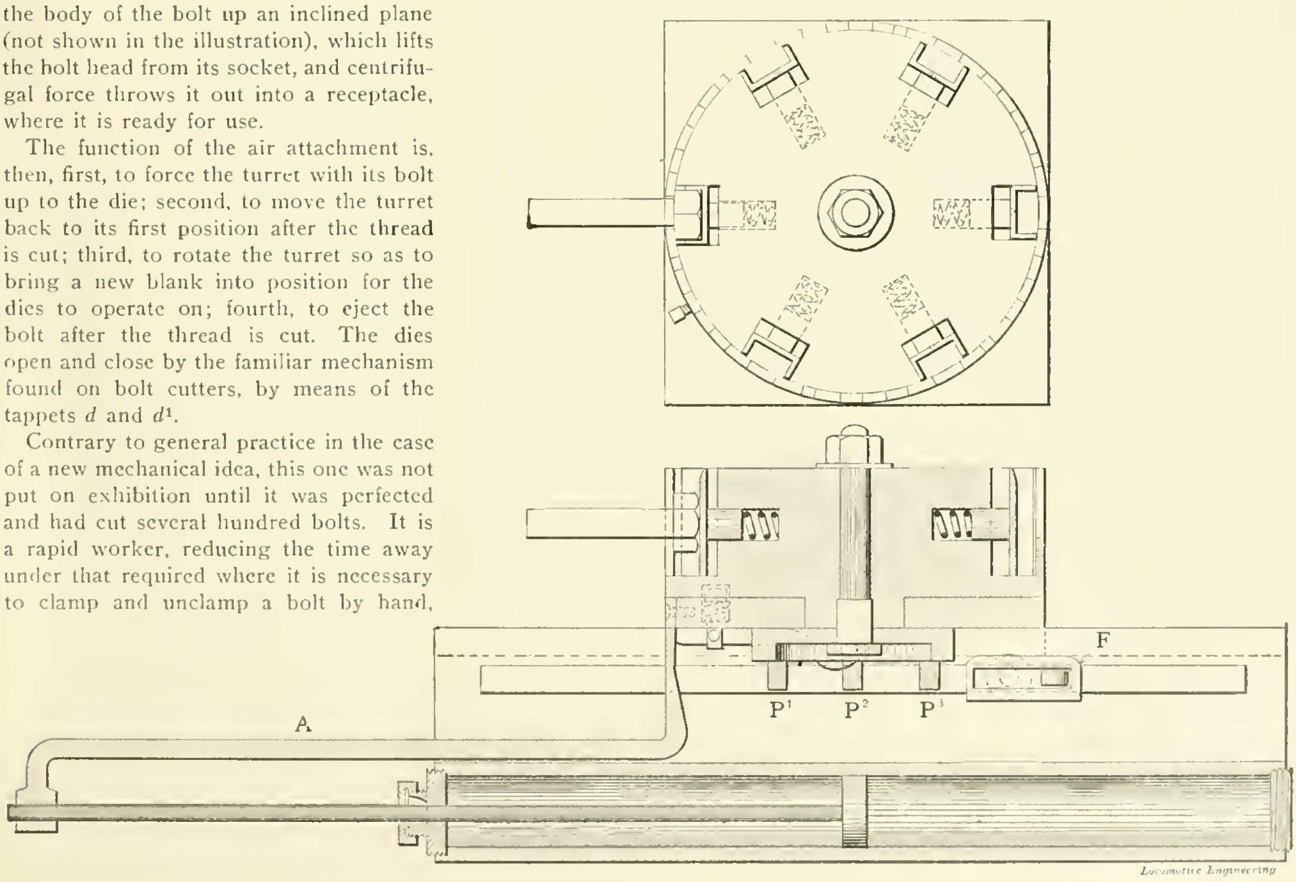


Fig. 2.

The Traveling Engineers' Convention.

The fourth annual meeting of the Traveling Engineers' Association, held at Minneapolis, Minn., beginning September 8, 1896, was called to order by President C. B. Conger. Mayor Pratt was introduced, and in a neat speech welcomed the Traveling Engineers to the city and tendered to them an invitation to visit the public schools, manual-training schools and universities of Minneapolis. President Conger replied in a happy vein, thanking the Mayor for his courteous invitation and kind words.

The president of the Commercial Club of Minneapolis, through Mr. Frank Dyer, representative of the Galena Oil Co., invited the members and ladies to visit the club's headquarters in the Kasota Building.

Secretary Thompson stated that letters had been received from numerous railway officials who expressed therein their regrets that the pressure of business prevented them from attending the convention.

THE PRESIDENT'S ADDRESS.

President Conger addressed the convention at considerable length. He said that when starting in at New York, the membership of the association numbered 42; at Chicago it was 107; at Denver it was 134; at Pittsburg last year it had increased to 151, and now the total membership was 162, of which 146 were active and 16 were associate members. No deaths had been reported during the past year.

He expressed a belief that a successful traveling engineer must study hard to acquire a store of information that could be drawn upon for any question that might come up in his daily work. He urged general reading and study, and thought every traveling engineer should join some one of the railroad clubs, and thereby get the reports of the proceedings of all the clubs, which would keep him up to date in railroad practice and management.

The depression in business about 18 months ago had cut off the traveling engineer on some roads along with other salaried officers, but he has been reinstated in nearly every instance. This is regarded as quite a flattering compliment to his usefulness.

The president, in conclusion, noted with gratification that many railways were changing from the old harsh method of punishment to the now famous and humane plan known as the Brown system.

SECRETARY'S REPORT.

The secretary's report showed that the receipts of the association were exceeded by the expenditures, and that there was a deficiency of ninety dollars in the treasury. Of the 1,500 copies of the proceedings of the third annual convention but 130 copies remained.

THE PROPER OPERATION OF, CARE AND INSTRUCTIONS CONCERNING SIGHT-FEED LUBRICATORS.

The report of the committee was read by Chairman M. W. Burke. As the history of the sight-feed lubricator had been given in previous papers, the committee plunged right into business and took up the care of the modern styles of double and triple feed lubricators.

PRECAUTIONARY POINTS.

Perfect performance of the lubricator was assured if the steam supply was sufficient and the passages were kept clear.

To secure best results it was recommended that the lubricator should be supported by a stiff bracket, strong enough to prevent loosening of pipes and joints from vibration, and should be located where the feeds could be seen by night and day. The steam pipe should be lower at all points than that where it connects to the cup. The delivery, or oil pipes, should have a good steady fall from the lubricator to the steam chest.

The cup should be blown out with steam occasionally and should be given a lye bath at frequent intervals. Oil should be strained before being put in lubricator, and care should be taken not to fill too full. Glasses may burst and cup body bulge out, due to expansion of the oil when heated, if the steam and water valves are not opened immediately after refilling. The steam valve should be kept wide open. Full directions were given to relieve distress from sight feeds stopping up, chokes, clogging, broken glasses, etc.

THE EQUALIZING FEATURE.

Regarding the equalizing feature, the report says:

"The successful working of the modern lubricator as applied to locomotives of to-day, is almost entirely dependent on the equalizing feature. It will be found that in the majority of cases of irregular action, this feature has been destroyed, either by insufficient opening from boiler to lubricator, equalizing pipes partially or wholly stopped up, or choke plug worn larger, or becoming loose. The opening in choke plug should bear a certain relation to the amount of steam delivered through the equalizing pipe, in order to hold up boiler pressure in upper feed arm, as one writer has said: 'On account of small opening in choke plug the steam is huddled up and not allowed to pass out freely into the oil pipe, whereby a pressure equal to the full boiler pressure is maintained on top of sight-feed glasses, irrespective of whatever pressure may or may not prevail on the opposite or cylinder side of the choke plug.' It will be apparent, from what has been said, that the feed will be regular, irrespective of pressure in oil pipes, as this equalization of pressures in lubricator is brought about by reducing the opening at point of oil delivery. This is especially true where full throttle and short cut-off is used.

"When throttle is opened wide when starting, the oil pipes fill up from steam chest end first. If engine is cut back, steam chest pressure is very nearly the same as lubricator pressure, and the current of oil and steam through chokes is very slow, no doubt being delayed some times several minutes, or until such time as throttle is eased off, reducing steam chest pressure below lubricator pressure, establishing a live steam current through oil pipe from lubricator to steam chest. Good and sufficient lubrication will always tide an engine over this difficulty.

SIPHONING.

Siphoning is treated as follows:

"Instances of siphoning from oil tank when feed valves were closed, steam and water valves open, and boiler allowed to cool off, are so rare that it can safely be said to not occur with the modern lubricator as constructed to-day. When cases of oil disappearance are met with, investigation will usually prove one or more mechanical defects present in the lubricator in question. The following are a few causes for loss of oil:

"1. Pipe leading from condenser to bottom of oil tank being split, or bad joint where screwed into water passage.

"2. Blowhole in casting, allowing oil to pass into condenser or upper feed arms.

"3. Imperfect joint made with plug in opening through which oil supply pipe was inserted in a 'Nathan,' was followed by loss of oil.

"4. Imperfect gasket at bottom of feed glasses of Detroit No. 2 will be accompanied by loss of oil through feed glasses."

MILEAGE.

Regarding the mileage made with one cup of oil, the committee thought the table given by one of the leading lubricator manufacturers was based on the most favorable conditions and was therefore, too high. Closing, it says:

"Your committee will not undertake to say what the maximum mileage should be as applied to railroads in general. The best possible mileage for each individual road or division can always be safely determined by a record of a portion of the men. In our opinion the best mileage can be made on switching or shifting engines by keeping oil feeds closed, and opening the feeds at intervals, when engineer thinks it necessary, and allowing 20 to 30 drops of oil to pass into oil pipe at once, then close feed again. The performance sheets of some roads show that when this plan is followed in yard service greater mileage is made with no damage to valves than is possible with the continuous set feed."

The report was accepted and the committee discharged.

DISCUSSION OF THE REPORT.

Mr. Hodges, of the Detroit Lubricator Company, was called upon by the president to open the discussion. He said in substance that the methods of lubrication in the modern lubricator were somewhat defective, and that recent experiments had proven that under certain conditions a portion of the oil goes into the boiler instead of the steam chest and cylinders. The Detroit people, he said, had invented a device for overcoming this trouble.

Mr. Geo. Royal, Sr., of the Nathan Mfg. Co., gave a talk of considerable length, in which he denied that this defect existed to any considerable extent. He substantiated his talk with data from recent experiments. Mr. Bryant, of the Detroit Lubricator Company, gave data obtained from tests showing that oil went from the lubricator to the steam chest imperfectly and irregularly. With the ordinary cup, 7 to 17 minutes elapsed before the oil reached the chest. With the new device, but one and a quarter minutes delay was had.

Mr. Hedendahl cited experiments made on the Union Pacific in which it was learned that the oil supply to the chest was intermittent, and when the throttle was closed the oil which had gathered in the pipe would flush into the chest. He thought this discrepancy was due to a higher pressure being had in the steam chest than in the lubricator and was aggravated when the reverse lever was cut back and very high steam pressure was carried. A small pipe, tapped into the steam passage of the cylinder and connected into the oil pipes at the lubricator, produced a circulating effect and caused the delivery of oil to the chest to be regular.

President Conger and J. H. Brown related experiences in which with lever cut back and throttle opened wide the oil would evidently not flow continuously to the chest, and the valves would work hard: but by slightly closing the throttle, or dropping the lever down a notch or two for a few moments, the trouble would disappear.

Mr. Burke said the oil no doubt reached the valves, but he believed it went in flushes and was largely wasted. He read an extract from a letter received from C. P. Cass, describing a test made to ascertain the difference in the pressures in the cup and the oil pipes. A duplex air gage was used. The lubricator pressure was shown by the red hand, and the oil pipe pressure by the black hand. It said: "Engine throttle full open would allow pressure to accumulate in oil pipes and tend to stop the feed. By a slight closing of the throttle the drop in pressure in the oil pipe was astonishing. The same effect was had by letting the reverse lever down. If the throttle valve was partly open and reverse lever at full stroke, by raising the lever up and making no change in the throttle, the pressure in the oil pipe would run up considerably." Discussion closed.

Afternoon Session.

WOULD THE RATING OF ENGINES BY TONS, INSTEAD OF BY CARS, DECREASE TRAIN DELAYS AND INCREASE THE EFFICIENCY OF THE POWER, AND WHAT IS THE BEST METHOD OF EQUALIZING THE DIFFERENCE BETWEEN EMPTIES AND LOADS?

In the absence of all members of the committee, the report was read by Mr. Hedendahl at the president's request.

The advantages of the tonnage system were generally admitted. As to the best method of equalizing the difference between the rating of empties and loads, the following extract seems to satisfactorily answer the question:

"With tonnage rating we would suggest the use of the manner suggested by Mr. I. E. Hass, Engineer Maintenance of Way, of the Toledo division, which was published in the "Railroad Gazette" about one year ago, and which is used on that division. The manner of preparing to use this arrangement is as follows: A trial train of all empty (of about what the average empties would be, stock, gondolas, box and flat) cars is run over the road; this trial train is run over the road until the maximum empty train load is found. A record of all cars and the number of them should be made. Example: 50 empty cars, average weight of each 13 tons; total weight of train (exclusive of engine, tender and caboose) 650 tons. The maximum train load where all loaded cars are used should now be found, care being taken to have a train made up of average loads, and record of, number of, and weight of cars should be made. Example: 30 loaded cars, average weight of cars and loads 25 tons; total weight of train, 750 tons. We have now found from the two trials (examples) that the same engine will haul 100 more tons, when cars are all loads than when they are all empties (750 tons all loads, minus 650 tons all empties, equal 100 tons). It will haul twenty more empty than loaded cars. The power of the engine in each case being the same, it is fair to assume that the difference in the number of tons hauled (100) is due to the resistance of the increased number of cars in the empty train, 20 cars. Therefore, if we divide the 100 tons by the 20 cars, we will get the resistance due to each car, whether loaded or empty, or, in this case, 5 tons. It will now be seen that the real load of the empty train is as follows: 50 cars, 13 tons each, plus 5 tons resistance due to each car, 18 tons, or 900 tons, load of empty train. The load of the loaded train will be 30 cars, 25 tons each, plus 5 tons resistance due to each car, 30 tons, or 900 tons, or the same as that of the empty train. This 900 tons is called the basis of the loading, and yardmasters should be instructed to load trains to 900 tons, including weight of load and car. Five tons also to be added for each car in the train so made up. It will be seen that this manner of loading not only allows for empty and loaded cars, but also allows for partially loaded ones. The basis of loading 900 tons, and the resistance per car, 5 tons, will vary on each division, and for this reason the above trial trains should be run. For instance, the resistance on this division is 8 tons per car, and the basis for loading is 1,100 tons. This changing is largely due to curves, grades and locations of stops. This arrangement works very well on this division, and has added to the train loads.

"Car system of loading: Where it is used, we would recommend that the above experiments for tonnage arrangement be made, and that the basis of loading 900 tons, or whatever it may be, and the resistance of the car, 5 tons, be arrived at. We would then pick out all the heavy kinds of freight, such as coal, coke, brick, wheat, corn, stock, etc., a car of each of these to be called one load. We would estimate what these cars average in tons per car and add to it the resistance due to each car. Example: Weight of car and load, plus 5 tons, equal 30 tons, weight of one load. Taking the average weight of empties at 13 tons plus 5 tons resistance, equal 18 tons; now, by proportion, 30:18::1:3-5. Therefore, 5 empties equal 3 loads. This same scheme should be carried out with the house or other light freight. Example: 13 tons, weight of car, plus 6 tons, weight of load, plus 5 tons, resistance, equal 24 tons. Now, by proportion, 30:24::1:4-5, or, in other words, 5 house or light loads will make 4 loads with this arrangement and in this example, the following instructions would be given to yardmasters: Thirty loads will be a train load. Each car of brick, coal, wheat, coke, stock or other heavy freight will be considered one load. In making up trains, 5 empties will be considered 3 loads, and 5 cars of house or light freight will be considered 4 loads. As all these figures will change in each division, the above are only given as convenient examples."

DISCUSSION OF THE REPORT.

Mr. Slayton and Mr. Gould reported the tonnage system in successful operation on their lines. Mr. McCullom stated that on his line the "time freights" were rated at 700 tons, the moderate speed freights at 800 tons, and slow freights at 900. These ratings were determined upon by dynamometer tests. Mr. Thompson believed that the most important question was the rating of empties as loads. I H. Brown thought enough allowance had not been made for empties. Mr. Wilson said that 800 tons were being hauled on freight trains on some divisions of the Denver & Rio Grande, but that its equivalent in empties, at the present system of rating, could not be hauled.

Mr. Farmer said that one of the Northwestern roads had increased the tonnage hauled by raising their cars off the side bearings. Mr. Risteen thought insufficient allowance had been made for empties, and that where the proportion of empties in the train was large, the caboose was too far from the engine. He said that the Northern Pacific practice was to weigh trains, and that engine failures were no more frequent than under the car system. Mr. Thompson mentioned cases where less doubling of hills was had under the tonnage system than happened with the car system. Discussion closed.

Invitation of Mr. Lowry, president of the Twin City Inter-urban Electric line to the members, to take a ride on Mr. S. E.

Olson's private illuminated car, was accepted.

Report of Auditing Committee was presented and accepted.

Convention adjourned.

MR. BARR'S ADDRESS.

Mr. J. N. Barr made a neat speech in which he expressed his belief that all technical railway associations were of great benefit to the railroads, and should be combined into one great association in which the Master Car Builders should form one section, the Master Mechanics another, the Traveling Engineers another, the Air-Brake Association another, etc.

He believed that a good traveling engineer was a valuable man to the railroads, and one that could "stop leaks" not visible to the higher official eye, and which would not show up on the performance sheet. The motive power department appreciated the good work of the association, and he believed that it depended entirely upon the Traveling Engineers just how successful their association would be.

IS NOT DISCIPLINE OF ENGINEERS BY FINES OR SUSPENSIONS DETRIMENTAL TO THE SERVICE?

In the absence of Chairman I. H. Brown, the report was read by M. M. Meehan. The Brown and similar systems were extolled. An extract says:

"The earnestness of the reports, as manifested by the great interest of those reporting, is most gratifying indeed. This subject has of late excited a vast deal of interest in the railroad world, and some of the ablest managers have given this matter great attention, and what they have said and written is no doubt familiar to the most of us. It indicates an era of better times, as the discussion on arbitration between nations heralds the time when there will be no more war; and it is indeed a hopeful sign that there is fast coming a time when between railroad corporations and their employés the most friendly feelings will exist—a knowledge on the part of the employé that his complaint will receive consideration and his faults mercy; to the officer, that the employé is as vitally interested in the successful operation of the road, in its success as a financial undertaking, as he is himself, or the president, directors or stockholders of the road."

Quoting from the paper, it says

"Every wreck, every accident, every mistake, every loss has taught its lesson, and these are of no less value to railroad men than the successes. I practice making every mishap a lesson to every man on the road."

Further on it says:

"It has often been charged that the enginemen have no interest in the company's affairs. This is not true, and if there are roads where it is true, it is the fault of the management and not of the employés. Our own experience is that the men do, as a rule, take a keen interest in this, not only from the point that a road doing a good business their own wages are thereby enhanced, but they keenly observe whether passenger trains are well filled, and whether freight trains are hauling a good tonnage of freight over the road.

"Our experience is that the record system is, and will have, a far more beneficial effect than can ever be had from suspension. A good man feels it more keenly than he would if he were suspended. It is the general feeling that where a man has been suspended for any offence, that in the suspension he has atoned for the fault and the record is clear; but where a record is kept he has a feeling that this is standing open against him, and he is only too anxious to have it erased, or perform some service that will atone for it.

"It is our opinion that the Brown system can as well be applied to a large road as to a small road, and we would say in conclusion, speed the day when it is generally adopted."

DISCUSSION OF THE REPORT.

Mr. Slayton said the Brown system had been in force two years on his line, and had given entire satisfaction. Mr. Barr said that his line had adopted the system of recording debits and credits with good results. Nearly all disciplining was done in that way. The men preferred ten days' suspension to a "black mark." President Conger stated that the debit and credit system had been in service on his line for one year. Mr. Hedendahl said it had been in experimental use on a certain division of his line with good results.

MR. WILLIAMS' SPEECH.

Mr. Williams, superintendent of motive power of the Soo line, was called upon, and spoke in a complimentary manner of the work done by the traveling engineers and their association.

The debit and credit system had been in use on his line for some time past, and has worked satisfactorily. A new man starting in is given 60 credit marks. One year's successful work entitles the man to 45 credit marks. Every three months the man having the best fuel record is given 20 credit marks; second best, 15 credit marks; and third best, 10 credit marks. Men are highly pleased with the system. But one engineer had been discharged in two years. Any special performance demanding recognition was paid in credit marks, five and ten credits being given for exercise of good judgment in emergency calls.

Mr. Barr thought all highly efficient services should be rewarded with credit marks, by which the ambitious, smart and loyal man might forge ahead of the ordinary man. Promotions should be made in accordance with credit marks and merit.

Mr. Slayton stated that the debit and credit mark system on his road extended to firemen, trainmen and wipers. This keeps all men in service, and in pinches suspended men never have to be used.

Mr. Bartlett thought a greater part of the trouble had with the old system was engendered by arbitrary and unjust rulings, which made schoolboys of men and withheld all opportunity for atonement. Discussion closed.

ON A FORM OF REPORT ON CONDITION OF ENGINE AND CHARACTER OF SERVICE RENDERED BY ENGINEER.

The report was quite short and contained a blank form for reporting the condition of the several parts of the locomotive, and for recording the ability of the engineer and fireman in their respective stations. It was read by Chairman Thompson.

DISCUSSION OF THE REPORT.

Mr. Burke thought the use of the card would be productive of better handling of air-brake trains. Mr. Beldon said the card had been in effective use on the Chesapeake & Ohio for two years. It also served as a check on parties neglecting to report work, and on those who did poor repair work. Mr. Barr thought its use would be a check on the traveling engineer, roundhouse foreman, engineer and machinist. Mr. Williams had used a similar kind of card on his line with good effect. Mr. Thompson said the card as designed by the committee was intended to assist the Brown system in keeping record. Paper accepted and discussion closed.

Thursday Morning Session.

IN WHAT WAY CAN THE ROUGH HANDLING OF TRAINS WITH THE AIR BRAKE BE REDUCED TO A MINIMUM?

In the absence of a regular report from the committee, letters bearing on the subject from F. W. Schraag and C. B. Conger, and a short paper by F. M. Nellis, were read.

The gist of the letters and the paper was to the effect that the shock so injurious to lading and equipment was caused by the slack of the train running in and out too quickly. Character of road and judgment of the engineer had much to do with the proper manipulation of slack.

SLACK.

The paper said: "The rough handling of air-braked trains causes a shock that is injurious to lading and equipment. The immediate cause of the shock is the slack being bunched or stretched too quickly. If a reduction of ten or fifteen pounds be made on the first application, the brakes set too hard on the head cars and the slack is gathered too quickly. When the last car runs up, the shock there is great. An initial reduction of five or six pounds should be made to gather the slack. When this is done, the engineer should wait for the crowding-ahead sensation which tells him that the slack is bunched, and that he may thereafter apply such additional brake power as the conditions of the case may require."

While not bearing directly upon the subject, it is quite important that the throttle valve of the engine should be opened slowly in starting, and the train be stretched before using a full head of steam. Sufficient time should be given the rear brakes to release before using steam to any considerable extent.

PISTON TRAVEL.

The piston travel should be uniform in all cases, else a surging and jerking will follow the application of the brakes.

USE ALL AVAILABLE BRAKES.

All brakes should be cut in and used. The cutting-out of each alternate brake should be discouraged as an unsafe practice. The use of a certain number of brakes is also dangerous, inasmuch that the train can be stopped in a shorter distance in emergency cases, and less shock will be had from slack bunching violently in ordinary stops. Engine and tender brakes should be kept cut in and in good working condition.

LEAKAGE.

Leakage in train pipes and brake cylinders should be eliminated as far as possible; for the former will increase the reduction made by the engineer, and the latter will reduce the holding power of that car. Both interfere with controlling the slack of the train.

WATER AND COAL CHUTE STOPS.

Where close, accurate stops are required on partially equipped freight trains, it is perhaps the better plan to cut off the engine, and thereby avoid to the train the usual numerous shocks had in "spotting" the engine.

HAND BRAKES.

When there are not enough air brakes to control the train, or assist in making stops, the hand brakes immediately behind the air brakes should be used. Hand brakes on the rear end of the train should be used only when backing up, and should be released before the engineer stretches the train.

RELEASING BRAKES.

Air brakes should not be released on a freight train at low speeds, or before coming to a full stop. Those on a passenger train should be released a sufficient distance from full stop in order that the trucks may adjust themselves and prevent shocks to passengers.

APPLICATIONS.

One application for regular stops, and two for water tanks, coal chutes and other close, accurate stops should be practiced. Numerous successive applications and releases should be avoided.

INSTRUCTIONS.

Besides the regular instructions given in air-brake plants and instruction cars, a practical demonstration by the traveling engineer should be given on the engine. Means should be taken to see that the proper instructions are carried out.

DISCUSSION OF REPORT.

The importance of preventing the rear end of train from colliding with the head end when break-in-twos occur was dwelt upon at considerable length. When the breakage was between air cars the throttle valve should be closed immediately if steam was being used, and allow the parts to come together as soon as possible, thus keeping the gap between the two sections as narrow as possible and preventing much damage when they struck. When the breakage was between non-air cars, the head end should be kept out of the way of the rear end.

President Conger and Mr. Burke thought shock to trains would be lessened if train crews gave better signals when switching. Mr. Meehan said it was the practice on his road to feel the wheels at foot of heavy grades, and tell by degree of heat how brakes were holding on certain cars. Mr. Gould approved of cutting engine from freight trains when taking water. Mr. Parker and Mr. Stalker agreed with him. Mr. Farmer indorsed Desoe's water-tank marker.

Mr. Hedendahl said that cutting off engine to take water was once ordered on his road, but that it was too much trouble, and the engineers "stole" the use of the brakes, and in doing so were obliged to be careful to avoid detection. President Conger thought all cars not air-braked should be piped. Mr. Farmer disagreed on the grounds that too many pipe cars might be collected in any one part of the train and cause trouble and damage. He also thought that trainmen's signals could not be relied upon.

Mr. Stalker said that splendid success was had on his road by cutting engine off to take water. Any engineer caught taking water without cutting off was suspended.

Mr. Hedendahl explained an "overcharged" train pipe for the benefit of a member.

Mr. Thompson and Mr. Stalker said that the wide manhole in tenders on their road allowed a range of 6 to 12 feet in making stops at water tanks. Mr. Risteen said that investigation proved that much damage done by switching cars in yards was unjustly blamed to rough handling of air brakes.

Mr. J. B. Johnson issued to the convention an invitation to go on an excursion to Minnehaha Falls and Fort Snelling, and to attend the theatre in the evening. Both invitations accepted.

Mr. James Root, the engineer hero of the Hinckley fire, was introduced, and made a short speech in which he said that he had made the famous run through the burning woods to save his own life as well as the lives of his passengers.

I. H. Brown objected to pipe cars. Believed all air-braked cars should be switched ahead. Mr. McKee said all air cars were switched ahead and used on his road. This, he stated, was a recent victory gained by giving a six-hour course of air-brake instructions to his higher officials, who were brought to appreciate the advantages of the practice. Engines on his road were not cut off to take water.

Mr. Nellis thought the cutting-off practice saved many shocks. He stated that the practice was necessary on locomotives having high-back coal boards and the main reservoir on top of rear end of the tender.

Secretary Thompson read a complimentary letter from Mr. Schlacks, of the Denver and Rio Grande Railroad. Mr. Farmer and Mr. Parker stated that the pressure recorder was bringing about smoother handling of trains on the St. Paul and Duluth Railroad. Discussion closed.

Friday Morning's Session.

ON STANDARD FORM OF EXAMINATION OF FIREMEN FOR PROMOTION AND NEW MEN FOR EMPLOYMENT.

The report was read by Chairman I. H. Brown. It was subdivided under the heads of Boiler, Boiler and Boiler-feeding Attachments, Machinery, Lubricators, and Air Brakes. The report consisted of about 350 questions, of which more than one-half were air-brake questions. The form of the report is almost identical with that of last year, but has been considerably enlarged upon.

J. O. Pattee, superintendent of motive power, Great Northern Railway, was called upon by President Conger for a speech and responded in a complimentary manner.

After a short discussion and slight modifications suggested by Mr. Burke, Mr. Hedendahl and Mr. Meehan, the report was adopted in sections.

The traveling engineers' ladies presented Mr. J. B. Johnson, chairman of the Committee on Arrangements, with a gold-headed cane.

WOULD NOT THE LOCOMOTIVE SERVICE BE IMPROVED IF COAL AND FEED-WATER BE IN THE HANDS OF THE MOTIVE POWER DEPARTMENT?

The report was read by Secretary Thompson, and after a short discussion in which it was believed that the motive power department should at least be consulted, the paper was accepted and the discussion closed.

Letter read by the secretary from the Denver Board of Trade, inviting the association to meet at Denver in 1897.

Balloting for next place of meeting resulted in the following: Chicago, 12; Boston, 7; Indianapolis, 5; and Denver, 2. Chicago was elected.

WHAT IS THE BEST INCENTIVE TO OFFER ENGINEMEN TO DECREASE THE COAL CONSUMPTION?

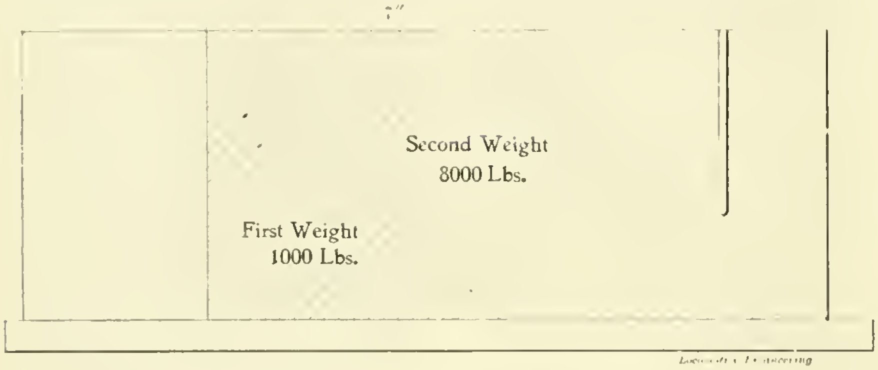
In the absence of the chairman and members of the committee the report was read by President Conger. It was full and complete, and showed that much care had been taken in its preparation. It proved that if incentive be given to the engineer and fireman, that great saving in fuel consumption could be had.

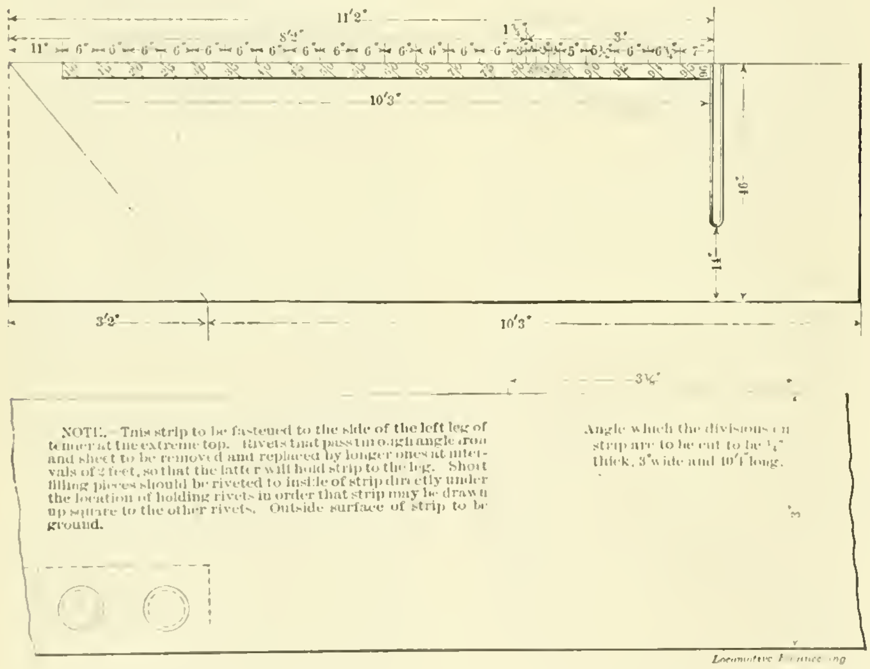
The accompanying cuts show the method recommended by the committee for measuring coal left in the tank.

METHOD OF ESTIMATING COAL LEFT ON TENDER AND CARRYING IT AS A CHARGE OR CREDIT ON COAL CHECKS.

"In order to make the results accurate and to avoid disputes, a scale similar to the one herewith shown should be fitted to the left side of coal space at the top by means of substantial bolts. In order to prevent its being broken by falling coal, the scale should be cast of bronze scrap. The figures should be raised and arranged so that a well-defined right line across the coal space is obtained, in order to determine the upper bounding of the slant of coal. Mark this point and slant of coal on the 3-foot scale, which, of course, will correspond with the total weight so far placed in the tender. Now subtract the first from the second weight, and the reminder will be the weight of coal to be subdivided into equal increments to correspond with the number of feet of coal space.

"An example and sketch will make this





in suitable multiples of 1,000 pounds, and the graduations should be cut into the scale 1-16 of an inch deep, and at an angle to correspond with the angle of repose of the average coal.

"The scale for each class of tenders having different coal capacities is, of course, different, and must be carefully calibrated, according to the following method: In the case of the coal spaces having parallel sides and straight back, place the coal boards in position, weigh and place in the coal pit enough coal to obtain a slant from the top to the bottom of coal space to correspond with the angle of repose of the coal. Note this first weight, weigh and place in the pit enough coal to fill the coal space when the lower or forward edge of the coal just touches the bottom of the coal boards. Be careful to level the coal clear. Let the first weight to obtain the slant equal 1,000 pounds and the second 8,000 pounds, the difference being 7,000 for a pit length of 7 feet. Each foot of the length will, therefore, equal 1,000 pounds, and any suitable subdivision can be made on the scale. The first graduation, however, must correspond with the first weight. Hence, in this case the first foot in the scale would be 2,000 pounds, the second foot 3,000 pounds, etc.

"Continuing, weigh out 200 pounds at a time, being careful to level and mark the slant of coal on the scale, in each case, until the remaining space is filled to the coal boards. The reason that 200 pounds is given is, that a smaller weight (except in the last two instances) will not fill the pit sufficiently to get an accurate measurement on the scale.

"In the case of coal pits with parallel sides and slanting backs, the same method is to be followed, except that there is no first weight to be taken. The total weight of coal up to where the lower edge touches the bottom of the coal boards is to be subdivided according to the length of coal pit up to that point, but the first graduation will be zero pounds.

"In the case of coal pits whose sides are not parallel, it is necessary first to decide upon what subdivisions are required, and then weigh out and lay off the coal on the scale to correspond with each one.

"When tenders, having only about a pitful of coal, approach a terminal, all of the remaining coal must be shoveled down into the pit so that it fills the space to the top and has the same slant as that shown by the graduations on the scale.

"The coal station keepers must note this weight of coal as indicated by the scale, place it upon the check for that trip as a credit, and tear off the same. He then must carry over the same amount on to the next check as a charge, weigh out the coal necessary to fill the tank, place that amount upon the check, and leave the book on the engine for the next man.

"In all cases where it is possible, this method should be followed, but there will be some runs that cannot be regulated so as to have less than a pit-full of coal when the tender arrives at a terminal. In these cases it is necessary for the coal keepers to have a table showing the total coal capacity of each class of tenders, when they will proceed as follows: First weigh the coal necessary to fill the tank, then subtract this weight from the total coal capacity of the tender. The weight added is what has been burnt, and the difference is what was left on tender as a credit.

"When necessary to make change of engines at other places on road than terminals, and in order to avoid disputes, both enginemen will make an estimate together of the coal in their respective engines. Should there be any difference in the amounts estimated, both will be added together and divided by two. The amount thus obtained will be entered upon the back of each stub or check, and so charged."

DISCUSSION OF REPORT.

Mr. Gould said he kept on the performance sheet a record of coal used. His engines are not "chain-ganged." Mr. Slayton's system of computing the amount of coal left on the tender was similar to that shown in the committee's report. Mr. Sullivan disapproved of the premium system, as he believed it encouraged dishonesty. The use of a No. 3 scoop resulted in a considerable saving of fuel, as he found that with a large shovel a fireman was apt to put in too much coal and smother the fire.

Mr. Munroe believed that considerable saving in fuel would be had by not loading tanks so heavily as to cause the coal to roll off and waste. Subject closed.

ELECTION OF OFFICERS.

Balloting for officers resulted in the following election: President, C. B. Conger; Secretary, W. O. Thompson; Treasurer, D. R. McBane; First Vice-President, J. B. Johnson; Second Vice-President, M. W. Burke. Executive Committee: Martin Munroe, T. H. Hedendahl, I. H. Brown.

After considerable discussion, Mr. Meehan made a motion, which was amended by Mr. Slayton and seconded by Mr. Risteen, that the Executive Committee be instructed to meet with the Executive Committee of the Air-Brake Men's Association and endeavor to make arrangements whereby the two associations could hold their meetings at the same place, one closely following the other—the Air-Brake Men to be allowed to meet first, but September should be decided upon as the time for the meeting. Carried.

The convention adjourned to meet in Chicago, Ill., in September, 1897.

Echoes of the Traveling Engineers' Convention.

C. B. Conger was re-elected president.

A large proportion of supply men attended.

Chicago was elected for the next meeting place.

About fifty members attended the Minneapolis meeting.

The committee's report on lubricators contains many valuable pointers.

The "Brown System" of discipline seemed to be popular where it has been tried.

The recommendation that pipes be placed on non-air-braked cars deserved the rebuke it received.

It looks as though the Traveling Engineers and Air-Brake Men may play in the same backyard next year.

In balloting for place for next meeting, Chicago received 12 votes, Boston 7, Indianapolis 5, and Denver 2.

Lubricator feeds should not be closed at stops of less than ten minutes—so says the report of the committee.

The equalizing feature of the sight-feed lubricator called forth a lively discussion and set a good many men thinking.

Insufficient allowance is made in rating empties as loads. The caboose is placed too far away from the engine.

Nearly half of the questions for examination of firemen for promotion and new men for employment were on air brakes.

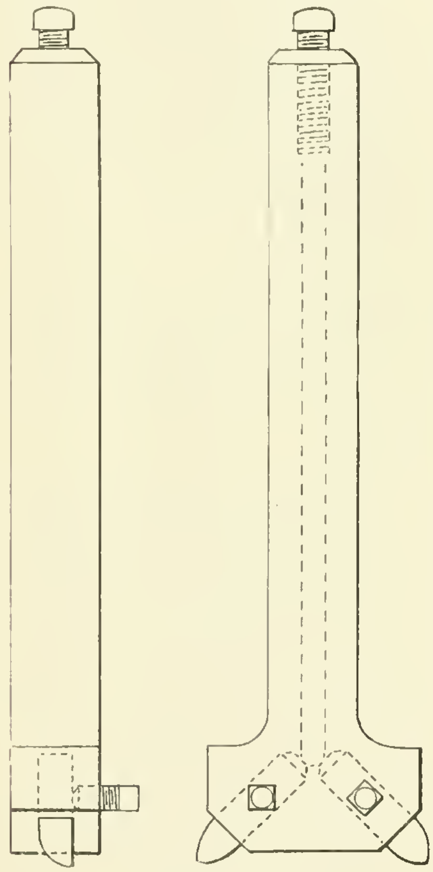
Under the tonnage system, one member recommended that an allowance of three tons be made in favor of a dirty stock car over a clean one.

Mr. F. B. Farmer said that the tonnage hauled on a certain Northwestern road had been increased by raising ore cars off the side bearings.

A Double-Head Planer Tool.

The tool holder we illustrate with two cutting tools, was got up by Mr. A. J. Kline, machine-shop foreman of the Meadows shops, Pennsylvania Railroad. This road uses bronze driving boxes on all locomotives, and the tool shown was designed to plane the inside face of flanges, and also the oil-cellar fit, which it does in practically one-half the time possible with a single cutting tool.

Steel, 2½ inches square in the shank, forms the body of the tool; the head is made 3 inches deep and 6 inches wide, to receive two tools 1 inch square, which are let in at an angle of 45 degrees and are secured by ¾-inch set screws. Adjustment for cut is made by means of a ⅞-inch screw, passing down through the shank and bearing on the ends of the cutters, which are set to the proverbial "hair" by forcing out the cutters to caliper sizes for finish cuts. This tool does fast work in roughing out when the planer is geared powerfully enough to overcome the resistance of two heavy cuts at one and the same time, and with the modern machine this is possible.



A DOUBLE-HEADER.

Something new and original developed lately in a question of rate-cutting by the Sea Board Air Line. It has generally been the case, when two railroad companies set to ruin themselves by rate-cutting and other methods of competition, that the public and their representatives, the courts and representatives of State and Federal authority look on and applaud the combatants. In the Sea Board Air Line case the attitude of those interested has been reversed. The Sea Board Air Line Company attempted to make a slashing reduction of rates, to prevent the Southern Railway Company from putting on a line of steamboats which would have been in competition with those of the Sea Board Air Line. The courts served an injunction on the Sea Board Air Line, restricting them from cutting rates without showing that it was fair and just, and not to prevent competition upon the ocean. If it was to prevent competition upon the ocean, the purpose was unlawful. The indications are that the injunction will be made permanent, and the United States Courts will prevent the railroads from injuring themselves and the public.

The Snow Steam Pump Works, of Buffalo, have sent out a beautifully illustrated catalog, which, besides giving fine half-tone illustrations of the various water-working machines made by the company, contains numerous scenes that have some direct or indirect relation to the moving of water. On the cover we find a pretty half-tone picture of the watering trough of bygone days found by the rustic wayside. Next we have "Ophelia" sitting, offering a slip of rosemary, which is intended to indicate that the catalog is given as a remembrance of the meeting of the American Water Works Association. Then comes the "old oaken bucket" and the well it is drawn from, followed by a variety of others with quaint description and reminiscence in which we seem to hear the voice of the late consulting engineer of the works, Mr. J. F. Holloway. The catalog is a triumph of the engraver's and printer's art, and is very well worth preserving for its own artistic merits alone.

A special form of safety valve has been invented and patented by Mr. Frank N. Winne, Evanston, Ill., and assigned to the Crane Co., Chicago, of which Mr. Winne is an official. The claim is: "A safety vent comprising a casing having its upper portion reduced and threaded, a ring adapted to be screwed onto the threaded portion of the casing, and a rupture plate secured between the screw ring and the casing and having a circumferential groove in its under surface only, the outer wall of the groove being in alignment with the inner wall of the said ring, whereby, when undue pressure is brought to bear on the plate, the lift or upward bulge thereof will cause the weakened portion to rupture and break away, the inner wall of the screw ring acting as an abutment or shearing edge against which the upper surface of the outer boundary of the weakened portion bears."

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Curiosities of Boiler Corrosion.

One of the troubles that seem always to be present with railroad men is the corrosion of boiler plates. The causes of the pitting and furrowing of plates, which are silent destructive agents working steadily on boilers, are exceedingly difficult to identify, but some of them have been found out and are worthy of mention. Others appear to be secrets which science fails to divulge.

In districts where the feed water is badly impregnated with alkaline or acid impurities, the men in charge are aware from experience that vigilant and unceasing inspection of boiler sheets is necessary to prevent accidents due to the weakening of the boiler from corrosion. Some of the impurities in the water display a strong affinity for the material in certain spots and lines of the boiler, and they form a soluble combination which melts out a pit or a groove in the sheet. A curious thing connected with the corrosive agents is that a piece of boiler sheet placed in a strong mixture of the impurity seldom corrodes rapidly, and frequently shows no signs of corrosion after being for a long time immersed in the mixture that proves rapidly fatal to the life of a boiler. There appears to be a combination of the heat and strain and movement ever present in a working boiler necessary to render the corrosive poisons active.

When boiler plates are found corroded, the natural inference is, that the phenomenon is due to the action of acid or alkali salts in the feed water, but this is not always correct. When the surface condenser first came into use for ocean steamers, which permits the same water to be used indefinitely in its rounds from boiler to cylinder and back to boiler, it was supposed that the pure water would put an end to troubles from corrosion of boiler sheets; but for a time they were worse than they were when sea water was used for the feed. Engineers and chemists were very much puzzled at first with the rapid corrosion of boilers on vessels that had surface condensers. The engineers soon discovered a remedy, which is to employ sufficient sea water to maintain a thin scale of lime on the boiler sheets. The chemists have not yet given a rational solution of why pure water rapidly corrodes boiler sheets.

If this action happened only with water that had been condensed over and over again, there might be good reason for believing that impurities from the lubrication of valves and cylinders passed through the cylinder into the boiler and acted as a corrosive agent upon the plates, but similar trouble from corrosion of boilers has been experienced in regions where the water is entirely free from mineral impurities. Boiler users in some parts of New England, Eastern Canada, the South and some mountainous parts of the West, where there are no lime rocks, frequently have their boilers badly pitted. Those who understand what the proper remedy is mix a small quantity of lime with the feed water.

The city of Glasgow, Scotland, used to be supplied with water taken from places where lime and magnesia abounded, consequently those who used the city water for boiler feeding had no end of trouble from scale forming over the heating surfaces. The city authorities decided to bring a supply of pure water from Loch Katrine, which is in the heart of a granite district of the Highlands, and is therefore free from mineral impurities. Many of the boiler owners made ready for the change of feed water by thoroughly cleaning off the scale that had formed in the boilers in use, while others discarded their old scaly boilers and put in new ones. The pure water was in use only a short time when pitting and seaming of plates began to cause accidents. Glasgow has always been famous for the number of its citizens who have devoted themselves to industrial science. Investigations were at once instituted to find out what was eating holes in the boilers. One of the first discoveries made was that the careless or too busy boiler owners who had not cleaned the scale from their boilers were the most fortunate, for their boilers were giving no trouble from corrosion. It was then an easy act of ratiocination to understand that the lime in the boiler was neutralizing some element which was exercising a destructive effect upon other boilers. Little science lore was necessary to reach that conclusion; but why pure water should eat holes in iron plate, was a question which science failed to answer.

Water is the most universal solvent in nature, but there is something mysterious about the way it acts on boiler plate. Nearly all acids and alkalies will dissolve some substances much more rapidly than water, but there are substances which the strongest nitric acid or a combination of nitric and sulphuric acids will not act upon in the smallest degree. But the clear, limpid water that sparkles in babbling brook or glistens in the rainbow's form—the water which the most fragile member of animated nature drinks with impunity—turns the hardest rocks into sand and tears apart the constituent elements of every known mineral if it is only given the necessary time. But it is passing strange that the same pure water should eat holes in boiler sheet as fast as if it were mixed with sulphuric acid.

Large Valves and Long Travel.

We have noticed in all the locomotives built on this continent within the last few years, that designers have settled on large steam ports and a long travel of valve, both proportions being considerably greater than what was considered good practice ten years ago. On general engineering principles the change may be regarded as a step in the right direction, but there is a possibility that, while all the theoretical arguments are in favor of the change, it may not produce a better engine. Like all other steam engines, the best locomotive is that from which the greatest amount of work can be obtained on a given consumption of fuel. If larger valves and greater travel of the same are calculated to make the locomotive more efficient, the movement is in the right direction; if the engine is not to be more efficient in the sense of doing the work with the same amount or less fuel than what was used by the older type of engines, it is a retrograde movement.

Gaged by the proportions of steam port openings adopted by the best forms of stationary engines, the locomotive even with the largest valves would not be considered an example of good designing. On this account it is natural that the highly educated draftsmen who are now leaders in the designing of locomotives, should favor proportions which have been found the most satisfactory in promoting the economical use of steam. The indicator diagram is also a solace and comfort to those who favor big ports and quick opening, for the combination tends to produce a diagram which approximates to that taken from a Corliss engine. The analogy of the proportions that have given the best results in stationary engine practice, which is much more susceptible of accurate measurement than work done by locomotives, and the testimony of the indicator diagram would be conclusive evidence that the later locomotive designers are on the right road, if the conditions of service of the locomotive and stationary engine were identical. But they are not, and the difference in operating may be sufficient to waste steam when saving might reasonably be expected. At least there are sufficient reasons for the belief held by many that unduly large steam ports and long valve travel increase the consumption of fuel, to justify a series of tests by those who are in the position to make accurate experiments.

It is a little difficult to get educated mechanical engineers to listen with patience to any argument which conflicts with the teaching of the stationary engine practice, or seems to question the testimony of the indicator diagram; but there is practical information available on the economical operation of locomotives which deserves as much consideration as the indicator diagram or stationary engine traditions. The testimony of good, experienced locomotive engineers, and of observing master mechanics is, that a long valve travel and large steam ports tend to make an engine smart but wasteful of fuel. Discussion on the subject is not new. It was a subject of hot discussion when the Railway Master Mechanics' Association was formed, twenty-eight years ago, and it has never ceased to be talked about by men familiar with locomotive operating. So long as the master mechanic familiar with locomotive engine running controlled the designing of locomotives, steam ports and valve travel were made to the proportions that had done the most work with small boiler capacity—a good test of efficiency.

There are important facts connected with the consumption of steam and fuel by locomotives which the indicator diagram makes no note of and on which the experience with stationary engine practice offers no guidance. In experiments made with the Schenectady locomotive at Purdue University and described in a paper prepared by Professor Goss, it was found that the consumption of steam was generally smaller with an eight-inch cut-off than it was when the cut-off was six inches; but that the consumption of fuel was generally smaller at the short cut-off. Here was apparently a decided contradiction. More fuel was seemingly necessary to evaporate 26 pounds of water per horse-power per hour than sufficed to evaporate 28 pounds of water per horse-power per hour. The cause of the difference was no doubt the effect of the exhaust upon the fire, a matter which receives too little attention from designers. We believe that the effect of slow or quick port opening upon the fire is a line of investigation that would produce as good a return as any problem of locomotive operation waiting to be solved.

Piston Speed and Large Driving Wheels.

In the early days of steam engineering there was a belief that a slow moving piston was conducive to the economical use of steam. It was owing to this belief that Watt and the class of engineers which he called into professional existence designed ponderous slow moving engines that took tons of iron and brass for every horse power developed. Oliver Evans in this country, a contemporary of Watt's, designed engines that had a high piston speed, but he and his followers did not favor high piston speed as a good thing in itself, but merely as an essential feature of a light engine. Early American marine engineers were as favorable to slow piston speed as Watt was, and some of the old river engines still in use bear striking testimony concerning the popularity of long stroke and slow piston speed.

It was very rational to believe that better use of the steam could be obtained in a slow working engine as there was likely to be time for good admission, extended expansion, a free release and absence of back pressure. It was only when Clark and others made discoveries concerning the action of condensation and re-evaporation of steam in the cylinder and its wasteful effects that the engineering world came properly to realize that the advantages of slow piston speed were offset by conditions that caused loss of heat. Then began the movement towards high piston speed which went to the opposite extreme.

Makers of stationary engines with their facilities for making accurate tests found out in course of time what piston speed was most conducive to economy; but railroad engineers have been longer in securing data on which to base similar conclusions concerning locomotives. The greatest diversity of practice prevails on railroads all over the world as to the piston speed of locomotives, and in fact little attention has been bestowed upon piston speed in itself, the size of driving wheels best adapted for certain service receiving the only consideration. It appears now that the combination of piston speed and size of drivers likely to produce the most harmonious results is destined to receive much more attention from locomotive designers than it has in the past. In the course of experiments made with the Schenectady locomotive at Purdue University, Professor Goss found out that there was what he calls a "critical speed" of rotation which could not be much exceeded without materially increasing the consumption of fuel for the power developed. He found the critical speed to be a little under 200 revolutions per minute, which represents about 800 feet of piston speed. In the report on the discovery referred to he says: "It is an interesting fact that the steam consumption per horse power per hour is lowest when the engine is running at its critical speed, and equally interesting is the fact that the coal consumption per horse power per hour is practically constant below the critical speed. These relationships are of such a character as to make it appear probable that they will be found true for all locomotives, in which case the critical speed becomes an important factor to be considered by the designer of locomotives."

That is certainly true. Railroad men have been slowly learning that the driving wheels of the ordinary locomotive are too small. The difference in cost of maintenance of locomotives with small driving wheels as compared with those having larger ones has become so apparent, since the acceleration of train speeds has become general, that the tendency for the last few years has been to increase the size of drivers. It was not so apparent that waste of fuel was a necessary effect from the use of small drivers, but since it has been so clearly demonstrated it is likely to exercise great influence on future designs. Professor Goss argues that the driving wheels of locomotives should be made large enough to maintain the critical speed when running at the highest train velocity. If such a thing were to be attempted, the driving wheels of our fast express locomotives would be about 9 feet diameter. A locomotive at the best is a compromise, so far as proportions are concerned, and railroad companies are not likely to employ driving wheels much larger than 7 feet in diameter, but if that size was made common on express trains it would effect considerable saving in fuel and repairs. Very large driving wheels might be employed without inconvenience on level roads where stops are not frequent; but efficiency in the use of steam must be sacrificed to utility on railways where stops are numerous and grades are heavy.

Iron Plate Pushing Out Steel.

It appeared to us at one time that the question of "what is the best material for fireboxes of locomotives and for furnaces of other boilers" was settled beyond dispute in favor of mild steel plate. Twenty years ago steel began to push out iron, which had previously been extensively used for fireboxes and furnaces that called for a high rate of combustion and evaporation, and in a remarkably short space of time good mild steel came into almost universal use. While this revolution was going on many of the men who were firm believers in iron and had no faith in steel insisted that the change in public sentiment which made steel popular was not due to any inherent defects of iron or to real merits of steel; but that the change was induced by the fact that the iron makers who had held the market so long fell into the habit of believing that customers would take that product no matter what its quality might be. They wanted to make all the profit they could, and to increase their net returns they imposed upon their customers material that was utterly unfitted for the hard service to which it was subjected. The steel makers of the day were wise in their generation and made plates that were as good as science, skill and careful labor could produce. The early steel plate for firebox purposes was not cheap, but it was exceptionally good. Its quality was an unanswerable argument in its favor, and mechanical men who tried steel under protest were forced to confess that the article had none of the defects which were constantly forcing locomotives with iron fireboxes prematurely out of service until tedious repairs could be done.

It appears to us that the causes which contributed to force iron so rapidly and ignominiously out of favor for firebox purposes, have been reversed in the last few years, and that they are working rapidly to make steel as unpopular as iron was when it met with general rejection. The disastrous and unwise demand for cheapness which has dominated railroad and other purchasers for the last few years has seduced the greater part of steel makers to bow their heads to the idol of "dear cheapness" and the market is flooded with steel offered for firebox purposes which is not good enough for the construction of tenders. The logical result is following this policy. The failures of firebox sheets are becoming so common that several of our largest railroad companies have turned their hopes back to good charcoal iron and some of them, such as the New York Central, are buying more iron than steel for firebox purposes. The charcoal iron men who have remained in the business have profited by the lesson of adversity and are supplying an article which is calculated to throw the cheap steel into disrepute.

We are inclined to think that some of the railroad companies which have made the change to iron have done so without proper consideration and investigation. Although most of the steel makers have yielded to the cheap demand and have made their product worth a little less than the low price paid for it, others have taken a higher minded stand and maintained the high quality of their product, but have naturally refused to quote current low prices which are below the cost of production. It is a melancholy reflection upon purchasers that most of them have refused to pay a cent or two a pound more for good steel and have preferred the cheap material with all its resulting expense and annoyance. When the trouble from blistered, cracked and corroded steel plates is inflicting its full annoyance, it is a natural thing to declare that "steel is not what it used to be" and give orders for iron. Even with the improved methods of production that have come into use during the last twenty years it is not to be expected that plate sold for two or three cents a pound will equal in quality the material that railroad companies used willingly to purchase for three or four times that price.

Steel nowadays is suffering from the malady which proved fatal to many iron makers in the days when they were earning that downfall. There is not enough care or labor devoted to its production.

A striking characteristic of nearly all our manufacturing establishments for years past has been the resorting to every possible means of augmenting production with the least possible increase of labor. In the struggle for supremacy, steel makers have manifested this tendency in an exaggerated form. The large steel makers have striven to undersell the small ones and with this end in view they have constructed huge furnaces and rushed the material through them too rapidly for good work. In all lines of industry where steel is largely used, complaints are heard about the inferior quality of the material and investigations are making to ascertain the cause of the defects complained of. Steel rails are not wearing as they used to wear, steel plate is in disrepute and other forms of the material are arousing prejudices which will act to favor the makers of good iron.

The belief used to be general that physical and analytical tests could demonstrate beyond question the quality of steel, and show what service the article was suitable for. This belief has been sorely shaken. It has been found that the analysis of a heat may be satisfactory and that the physical tests may seem all that could be desired, and yet that the plates made from it fail quickly when subjected to the ordeal of hard service. Huge furnaces and large ingots bring forth a product that is badly mixed. The Pennsylvania Railroad chemical department have been investigating this subject lately and their tests showed that there was great want of uniformity in different parts of the same plate or bar. Phosphorous was concentrated in spots, silicon in other places while the other hardeners or impurities were not evenly distributed. A high sounding name was given for the cause of this concentration of impurities in spots; but the workman's explanation is that the stuff was not properly mixed.

The leading steel makers are mostly to blame for the degradation of steel making. But railroad companies are by no means blameless for the poor steel they are getting. The ever-pressing demand for cheapness has brought down the quality of the product.

BOOK REVIEWS.

"Proceedings of the Master Car-Builders' Association." Volume XXX, 1896. Chicago, Ill. Printed by the Henry O. Shepard Company.

This report of the proceedings of the Thirtieth Annual Convention of the Master Car-Builders' Association comprises 531 pages, including the index and list of members, printed on paper 6 x 9 inches The cuts are clear and represent the best work in that line, while the text is fully up to any prior report in point of interesting work ably handled The usual charts of old standard practice, together with those of the new, are included, making quite a good sized volume, which is bound in cloth, half leather. It is worthy of a place in any technical library.

"One Thousand Pointers for Machinists and Engineers." Charles McShane (Practical Machinist). Illustrated. Price $1.50. Chicago: Griffin & Winters.

This is a work that contains an abundance of useful information for the engineer and shopman. It is a compilation of material that can be found in no other one book; credit being given to well-known authorities for contributed chapters, which, while they are not strictly new, are recognized as the best matter on the subjects treated. With the exception of some typographical errors, the work cannot be seriously criticised. It is neatly gotten up, has 342 pages, and is bound in cloth.

There has been a great deal of talk for several months back about a sextuple wheel which some enterprising riders were going to race the "Empire State Express" with. One morning a New York paper came out with a glaring cut, showing these men propelling a wheel with that number of seats, with the "Empire State Express" slightly in the rear. The men were set up with the usual humps that wheel riders display while they are doing their level best to beat the record, and everyone was armed with a mouth sponge to keep his breath from getting dry. The race was said to have taken place at Syracuse, and that the Delaware, Lackawanna & Western tracks, which run alongside the New York Central, were used as the racing ground. Wishing to find out if the thing had really taken place, we wrote to Mr. Hallstead, general manager of the Delaware, Lackawanna & Western, asking for particulars. He referred the matter to the superintendent of the Syracuse division, who wrote: "It is simply an advertising dodge. They did go between the New York Central and our tracks, west of Genesee street, and had themselves photographed just ahead of the 'Empire State Express,' as though racing with it. There was no track prepared for them. They asked no permission and were simply trespassers." Verily, the needs of advertising are very great, when six men are staked up on a wheel and photographed as though they were propelling it. It appears to us that the whole thing is senseless in the highest degree. If six men on a wheel were to beat a fast express train for a few yards, it would mean nothing against the capacity of the locomotive, and nothing in favor of the speed capacity of a bicycle.

The fastest schedule time made by any road in the world is that on the Reading Railroad's Camden & Atlantic City runs. The schedule time for $107\frac{1}{2}$ miles varies between $68\frac{3}{4}$ and $74\frac{1}{2}$ miles per hour. The fastest schedule time in Great Britain is made on the West Coast "Flyer," and is at the rate of $60\frac{1}{2}$ miles per hour.

PERSONAL.

Mr. C. W. Risley, superintendent of the Lima Northern, has tendered his resignation.

Mr. S. V. Smith, for many years superintendent of the Erie Railway shops at Kent, O., died September 4th.

Mr. C. O. Skidmore has resigned his position of master mechanic of the New York, Philadelphia & Norfolk Railroad.

Mr. J. G. Woodworth has been appointed assistant to President McNeill, of the Oregon Railway Navigation Company.

Mr. C. F. W. Phelps, resident engineer of the Gulf, Colorado & Santa Fé, has been appointed chief engineer, with headquarters at Galveston.

Mr. Wm. Alexander, foreman of the blacksmith department of the Chicago, Milwaukee & St. Paul shops at Milwaukee, Wis., died August 30th.

Mr. A. C. Martin, general agent of the Oregon Railway & Navigation Company and the Union Pacific Railroad at Seattle, has tendered his resignation.

Mr. G. W. Turner, of the St. Louis & San Francisco Railroad, has been appointed bridge master, with jurisdiction over all bridges and buildings.

Mr. F. M. Bisbee, superintendent of tracks, bridges and buildings of the Gulf, Colorado & Santa Fé, has resigned, and that position has been abolished.

Mr. John D. Cutter has been appointed traveling passenger agent of the Erie, to succeed Mr. F. A. Beatty. He will have headquarters at Youngstown, O.

Mr. D. K. Ford, who has been general claim agent of the Northern Pacific since 1883, has resigned that position, his resignation taking effect September 1st.

Mr. W. H. Hudson, master mechanic of the Southern Railway at Atlanta, Ga., has been transferred to the same position at the shops at Salisbury, N. C.

Mr. W. L. Tracy has been appointed master mechanic of the Seventh motive power division of the Southern Railway, *vice* Mr. W. H. Hudson, transferred.

Mr. A. G. Dunham has been appointed special master in the Baltimore & Ohio receivership. He was formerly general manager of the Ohio Southern Railway.

Mr. James P. Elmer, whose location is 114 Endicott Arcade, St. Paul, has been appointed agent for the Northwest for the Shickle, Harrison & Howard Iron Company.

Mr. W. A. Stone, who has held the position of master mechanic of the Southern Railway at Selma, Ala., has been transferred to a like position at Birmingham, Ala.

Mr. W. T. Smelten, of the St. Louis & San Francisco, has been appointed general road master in charge of all permanent way details, with headquarters at Springfield, Mo.

Mr. S. B. Hines, of La Porte, Ind., who was formerly superintendent of the California Southern Railway, has been appointed superintendent of the Los Angeles Terminal Company.

Mr. T. B. McNiel, an old engineer on the Colorado Midland, has been appointed traveling engineer for the entire road. Mr. McNiel is a good engineer, and well fitted for the position.

Mr. J. Hess, road master of the Gulf, Colorado & Santa Fé at Cleburne, has been appointed general road master, and B. W. Leahy, bridge master at Cleburne, has been appointed general bridge master.

Mr. S. D. Parkhurst, recently chief clerk of the St. Paul & Duluth freight department, has been appointed to the position of general freight agent of the Mason City & Fort Dodge Railroad, succeeding Mr. James Mahoney.

Sweeping reductions in the maintenance of way department of the St. Louis & San Francisco road have been recently made. Twenty road masters and division bridge masters are now without employment on that road.

Mr. F. L. Sheperd, superintendent of the Pennsylvania lines East, who has been away from his charge for the past five months, owing to ill health, has returned to his office at Altoona, greatly improved by his absence abroad.

Mr. C. H. Chappell, Jr., has been appointed soliciting freight agent of the railroads comprising the Seaboard Air Line. He is a son of Vice-President and General Manager Chappell, of the Chicago & Alton Railroad.

Mr. W. J. Miller, who has long been foreman of the Shawnee shops of the Columbus, Sandusky & Hocking Railroad at Columbus, O., has been appointed general foreman of the machinery department at Columbus, O., *vice* Mr. B. T. Bancroft, resigned.

Mr. Edward Chase, one of the New York Central's engineers, has been made traveling engineer of the middle division between Syracuse and Schenectady, N. Y., taking the place of Mr. Frank Case, who is appointed to the position of master mechanic at Utica, N. Y.

Mr. W. H. Newman, third vice-president and general traffic manager of the Chicago & Northwestern Railroad, has resigned and gone to the Great Northern as second vice-president, to succeed Mr. W. W. Finley, recently elected second vice-president of the Southern Railway.

Mr. John Ross has been appointed traveling engineer of the Western & New Mexican division of the Atchison, Topeka & Sante Fé Railway. Mr. Ross has been a passenger engineer between Las Vegas and Albuquerque, and has a reputation all over the road as a progressive up-to-date man.

Mr. Frank J. Sarnan, who has been master mechanic for several years on the Manitou Beach Railroad, has been appointed superintendent of the same road, succeeding Mr. George C. Mills. Mr. Charles Sarnan, brother of the above, has succeeded to the position of master mechanic.

Mr. James Henderson, who has been in the employ of the North British Railway for fifty years, is said to be the oldest locomotive engineer in Europe. During the fifty years of his service, Mr. Henderson has never had an accident. He is at the present time 78 years old, and still in the harness.

Another veteran has passed away—Mr. John Lightner died August 17th at Jamaica Plains, Boston. His first railroad work was on the Baltimore & Ohio Railroad at Baltimore; next he was on the Boston & Providence road, from 1834 to 1888, in charge of the car department of that company.

Mr. J. G. Thomas, assistant superintendent of motive power of the Central Railroad of New Jersey, having headquarters at Ashley, Pa., has recently been appointed superintendent of motive power of the Lehigh & Susquehanna division, which embraces Scranton, Pa., and Phillipsburg, N. J., as terminals.

The date of August 31st, when the receivership of the Northern Pacific terminated, retired the following officers: Frank G. Bigelow, receiver; Andrew F. Burleigh, receiver; G. W. Dickinson, general manager for Western receiver; James M. Ashton, general counsel for Western receiver; C. H. Prescott, Pacific Coast agent; W. O. Chapman, attorney on Pacific Coast; J. Q. Mason, assistant superintendent of telegraph at Tacoma, and General Manager Kingly, of the Northern Pacific Coal Company.

Mr. Wm. H. Baldwin, Jr., second vice-president of the Southern Railway, has resigned, taking effect September 15th, to accept the presidency of the Long Island Railroad. Prior to July, 1894, Mr. Baldwin was for three years general manager of the Flint & Pere Marquette Railroad. He was general manager of the Montana Union from September 30, 1889, to August, 1890, and afterwards made president of the same road. The new president of the Long Island Railroad will have his headquarters in New York.

The executive officers of the reorganized Oregon Railway & Navigation Company are: E. McNeill, president and general manager; W. W. Cotton, general attorney; E. S. Benson, general auditor; J. G. Woodworth, assistant to president; P. Campbell, traffic manager; D. C. O'Reilly, assistant general freight agent; W. H. Hulbert, general passenger agent; J. P. O'Brien, superintendent rail lines; E. J. Rathbone, superintendent water lines; Goodall, Perkins & Co., superintendents of the ocean division; W. H. Kennedy, chief engineer; J. F. Graham, master mechanic; F. G. Wheeler, purchasing agent; J. F. Meyer, car service agent; A. S. Watt, land and tax agent, and D. E. Hall, claim agent.

Mr. W. W. Finley, second vice-president of the Great Northern, has resigned that position to accept a like office on the Southern Railway, succeeding Mr. W. H. Baldwin, Jr., resigned. He is going back to his old road, where he was formerly third vice-president, which office he resigned, after a short term, to return to the Great Northern, where he had previously held the position of general traffic manager. Prior to Mr. Finley's connection with the Great Northern as general traffic manager, he was chairman of the Trans-Missouri Traffic Association, and after that he became commissioner of the Southern States Passenger Association, from which position he was made third vice-president of the Southern Railway.

Mr. J. F. Holloway, one of the best-known mechanical engineers of this century, died on September 2d, at his home in Cuyahoga Falls, O., at the age of 71 years. His career was an exceptional one, he rising from the shop to the highest positions of trust and honor in the manufacturing world and engineering fraternities—a record seldom earned by those not having a college education. Entering the service of the Cuyahoga Steam Furnace Company in his youth, he became successively its superintendent and president, his incumbency of the latter office dating from 1872. These works are historical in the field of American engineering, having been incoporated in the year 1834, and were among the earliest to take up the manufacture of locomotives. It is fitting that the illustrious name of the subject of this sketch should be linked with a concern that was helping to work out the development of the locomotive.

The Foster Engineering Co., of Newark, N. J., in addition to large previous shipments, have just received an order from Alex. Friedman, of Vienna, the largest railroad supply house on the Continent, for forty of their pressure regulators to be used as air-brake pump governors and for the steam-heating of trains on railroads in France. This fact is of special interest as indicating the increasing demand in Europe for superior devices of American manufacture.

We have word from Terrell, Tex., that many engineers and firemen are going there for work on the Texas Midland, and that it is useless, as all the places are more than filled.

EQUIPMENT NOTES.

The Chilian State railways have ordered five freight cars through W. R. Grace & Co.

The Erie Railroad has ordered 50 freight cars from the Michigan-Peninsular Car Company.

The Vandalia Line is having built 150 refrigerator cars by the Terre Haute Manufacturing Company.

At the Bloomington shops of the Chicago & Alton Railroad, they are building 100, 60,000-pound coal cars.

The Vanegas, Cedral & Rio Verde Railroad has ordered one engine built at the Baldwin Locomotive Works.

The West Shore Railway is having built 60 gondolas, 168 box and 22 stock cars by the Union Car Company.

The DesMoines & Kansas City Railway has ordered three locomotives from the Rogers Locomotive Works.

The Morning Mining Company has ordered one locomotive from the Lima Locomotive & Machine Company.

The Compania Minervia de Penol is having twelve freight cars built by the Missouri Car & Foundry Company.

The Keokuk & Western Railroad is having a number of passenger cars built by the Pullman Palace Car Company.

The Chicago, Rock Island & Pacific Railroad has ordered 100 box cars from the Michigan-Peninsular Car Company.

The Morning Mining Company has given the Lima Locomotive & Machine Company an order for six freight cars.

The Chilian railways are getting five passenger coaches from the American Manufacturing Exchange Association.

The Youngstown Car Manufacturing Company has received an order for 100 freight cars from the Georgia Railroad.

The St. Louis, Iron Mountain & Southern Railway has had three 60-foot postal cars built by the St. Charles Car Works.

The Hearne & Brazos Valley Railway has received one baggage car and two coaches from the St. Charles Car Company.

The Keokuk & Western Railroad has placed an order with the Rogers Locomotive Works for three 10-wheel locomotives.

The Galveston, La Porte & Houston Railroad is about to receive one locomotive from the Baldwin Locomotive Works.

The Georgia & Alabama Railroad has given the Richmond Locomotive & Machine Company an order for three locomotives.

The Florida East Coast Railway is having 50 flat cars and 300 ventilated box cars built by the Elliott Car Company at Gadsden, Ala.

The Des Moines & Kansas City Railway is about to receive two passenger-train cars from the Pullman Palace Car Company.

It is reported that the Baldwin Locomotive Works will equip with power the Tien-tsin & Pekin Railway, a part of the Imperial Railway of China.

Four new passenger coaches and two new engines have been ordered by the Midland Terminal of Colorado, to run between Cripple Creek and Gillett.

There are two 60-foot mail cars now under construction at the Toledo shops of the Wabash Railroad. All improvements known to the postal service will be embodied in these cars.

The Chicago, St. Paul, Minneapolis & Omaha Railway has completed and put in commission their late order for Hamilton refrigerator cars, and is now working on 50,000-pound box cars.

Nine new passenger coaches—six of which are equipped with the Gould vestibule platform and couplers, and three with the open platform—were put in service on the Central Vermont recently.

The Nanwa Railroad of Japan has ordered two narrow-gage saddle-tank standard type engines from the Brooks Locomotive Works. This is the first order that these works have received from Japan.

The Union Pacific, Denver & Gulf Railroad has received two new passenger cars for the Colorado Central division, which are the advance guard of an order for seven—the others to be delivered at once.

The Illinois Central Railroad has ordered for the Chicago, Ohio & Southwestern a new lot of locomotives, the order going, six to the Rogers Works, where the engines were already built, and four to the Brooks Locomotive Works.

The Northern Pacific shops at Tacoma are now making preparations for building 120 new 70,000-pound flat cars. These cars are to be in service in a few months. Reconstruction of the old 40,000-pound cars to 50,000 pounds capacity is going on rapidly at these shops.

This is the way the railway man heard the conundrum: "At what time shortly before noon is it three o'clock? At a quarter of twelve, because a quarter of twelve is three." And this is the way he worked it off on his friends: "At what time shortly before noon is it three o'clock? At 11:45, because 11.45 is three. It doesn't sound right, either, blame it, but that's the way I heard it."—"Chicago Record."

Wrought Iron Culvert Pipes.

An innovation in railroad shop work, and a job rarely found outside of a contract shop, is the building of wrought-iron culvert pipes. Mr. Jas. McNaughton, superintendent of motive power and cars of the Wisconsin Central, having an order for one million lineal feet of such pipe, ranging from 24 to 60 inches in diameter, in 30 feet lengths, has met the situation by methods that insure their production at a minimum cost.

The immensity of the order forbade anything but the most intelligent direction and manipulation to produce the above result, and not then without the best labor-saving devices that could be evolved to fit the case, if it was hoped to bring the expense account sufficiently low to compete with pipes of other material requiring no special appliances for their construction.

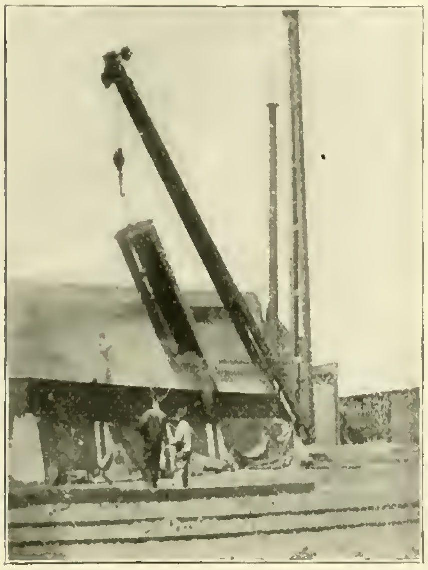


Fig. 2.

One general idea was followed out in all sizes of pipe made; that is, each complete length was made up of four sections; the ends had flanges formed of angle iron, and the parts were then riveted up into the lengths stated, by a Player air riveter.

Templets for each size of pipe were made for permanent use, from which the rivet holes were laid off on the sheets, and the latter were then punched and rolled to shape. The flanges were brought to circular shape in the plate rolls by means of the collars on the lower rolls in Fig. 1, in which the rolls are shown with one face of the collars coincident with the sides of a groove which was cut in the rolls to receive one flange of the angle iron: this scheme made a good job of the flanges, and did not impair the rolls for plate rolling.

After the pipes were completed, they were treated to a bath of asphaltum heated to a temperature of 300 degrees, for a period of 40 minutes, and then allowed to drip dry into the bath while suspended from the crane by which they were handled; Fig. 2 shows a section of pipe in this position. The bath tank is wrought iron, 68 inches wide, 69 inches deep, with a semi-circular bottom, and 35 feet long; it is enclosed in brick work and heated with oil. The crane is 60 feet high, and is handled by a small slide valve engine located near it.

This brief recounting of what was done to reach results does not convey any hint of the trials encountered and overcome, in devising means to bring the cost down to the lowest figure; they were simply the repeated history of almost every pioneer effort in strange lines; but it is a matter of record that these pipes are made cheaper than the cast-iron or tile article can be purchased for, and the record is a creditable one to the machinery department as emphasizing what good management can do on work entirely foreign to railroad shops.

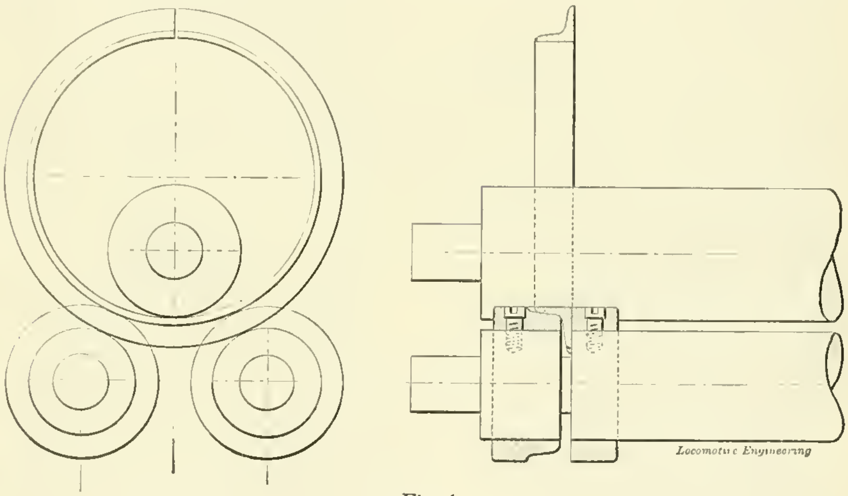


Fig. 1

WROUGHT IRON CULVERT PIPE.

Effect of Cold on Iron and Steel.

Nearly every man who has been accustomed to the handling of metal tools outside in cold meather, is a firm believer that extremely low temperature makes iron and steel brittle and more liable to break than when the temperature is normal or high. A great many scientific tests have been made to ascertain the truth of this popular belief, and the evidence brought out is to the effect that the limits of atmospheric temperature exercise little influence on the strength of metals. A committee of the Master Car-Builders' Association, appointed to report on the design of a new car axle, made a very thorough investigation of all the causes at work to shorten the life of axles, and among other things they considered the effect of varied temperature. Of this the report says:

"As to the effect of temperature, it seems to be pretty well established that the effect of ordinary atmospheric changes of temperature, say from 20 degrees below to 120 degrees Fahr. above zero upon the physical properties of iron and steel, are slight and unimportant when stresses are applied without shock. But the effect of a change of temperature upon the ability of these metals to resist shocks is not so definitely known.

"Mr. Thomas Andrews, in 1887, gave results of tests by impact under a drop hammer, of forty-two full-size iron axles, the axles having been heated and cooled to various degrees for the purpose of determining the effect of temperature upon strength. He found that at 100 degrees Fahr. the axles were 43 per cent. stronger than at 7 degrees, and concludes that low temperature materially reduces the power of resistance of railway axles to continued impact."

The committee doubted if these tests throw much light upon the effect of temperature upon axles as strained in service, since the shocks in his method of test were altogether more severe than those met with in service, from six to eight blows being sufficient in each case to break the axle. In fact, experience in this country shows that few, if any, more axles are broken in cold weather than in warm, and it is reasonable to assume that the greater rigidity of the road bed in winter would fully account for any greater percentage of breakage in that season than in summer. Carefully kept records of axles broken or bent on one of the largest railroad systems in this country show that no larger number of axles failed in the colder months than in the warmer ones.

"Locomotive Engineering" will give its readers something new and useful next year in the shape of educational charts. There will be one each month, and they will be part of the paper itself, but every one of them will be worthy of a frame, and the whole will be a graphic history of the locomotive from its inception right up to December, 1897. We will be ready with agents' outfits about October 20th.

AIR BRAKE DEPARTMENT

Conducted by F. M. NELLIS.

Air Brake Items.

Train crews would have to carry fewer chains if they were more careful in giving signals to engineers to start and stop.

There is no doubt that larger manholes on tenders would decrease shocks to trains at water tanks, for then a range of eight to twelve feet in which to stop would be had.

An extensive series of examinations, made to procure reliable data on the subject, prove that broken graduating pins are now so rare that they may be said to have practically disappeared.

Secretary Kilroy states that there is no abatement in the heavy demand for the Air-Brake Men's Proceedings, and that it is with difficulty that he can keep anywhere near up with his orders.

There seems to be a growing impression among air-brake men that there is a greater necessity for enforcing the instructions already given than for giving more. It is not a question of how full of air-brake knowledge a man can be crammed, but how much he uses.

The Norfolk & Western has, for some time past, adopted the practice of arranging early all foundation brake gear, with the exception of drilling the middle hole in the cylinder levers, which is deferred and decided upon after all furniture and equipments have been placed in the car. Thus the true weight of the car is determined and braked.

An engineer, when told the objections raised against the truck brake by men who found it difficult to remove truck springs because of its interference, wittily remarked: "Two weeks ago my engine truck brake saved my springs from being taken out. Met a Baldwin 'hog' on the main track, headed the opposite way. Stopped about a car length apart."

Objections to the engine-truck brake have been raised by a few roundhouse men who find it more difficult to replace truck springs now than before truck brakes were introduced; but when the advantages of the device are arrayed against the above complaint, the latter is so clearly outweighed that the objection is reduced to a feeble complaint or a mere "kick."

The report of the proceedings of the Air-Brake Men's first annual convention, now out of print, gives some interesting and valuable information to the effect that in making a service application on a fifty-car train, the pressure in the first car reduces five and a quarter pounds faster than that in the rear car; also, that in releasing, it takes from six to ten seconds for the pressure to reach the rear car.

No fast passenger train should be without the High Speed brake. Fast time is, of course, very important nowadays; however, it should not be given such exclusive attention that the ability to stop a train in a correspondingly short distance will be overlooked. Besides being able to reduce the length of stop twenty-five per cent. over that made by the standard quick-acting brake, the High Speed brake enjoys the exceptional record of never having made a flat wheel.

The practice of piping non-air cars, in order that air-braked cars may be distributed through the train, is no doubt well intended, but should be discouraged on the grounds that too many piped cars may be placed together, thus making a quick-action application impossible, for quick action will not pass more than three piped cars or cut-out cars. If the piped cars should accidentally get on the head end, and the air-braked cars on the rear end, great care would be necessary to prevent breaking in two at each application.

Death of P. J. Carney.

Mr. P. J. Carney, road foreman of engines on the Ashland division of the C. & N. W. Ry., died September 13, 1896, at his residence in South Kaukauna, Wis. He had been afflicted with heart trouble for the past three years, and on July 11th last became confined to his home with a complication of ailments from which, in his weakened state, he did not recover.

Mr. Carney was born at Chester, N. Y., June 29, 1853. Before he saw the light of day his father died, and at the age of 14 he went out into the world to fight life's battle alone. In the year 1874 he entered upon his railroad career as freight brakeman on the Wisconsin division of the C. & N. W. Ry. Some time afterwards he gave up that position and acted as newsboy on passenger train, and subsequently obtained a situation as passenger brakeman with the same company. In the year 1878 he began firing on passenger for Engineer R. J. Lewis, on the Wisconsin division. Was promoted to engineer and left their service in 1882. On May 27, 1882, he entered the service of the M., L. S. & W. Ry. as locomotive fireman, and was promoted to engineer August 8, 1882. On March 1, 1891, he was appointed air-brake inspector and instructor for the whole line. On August 15, 1893, he assumed the duties of traveling engineer, in conjunction with those of air-brake inspector, for the Ashland division of the C. & N. W. Ry. (the M., L. S. & W. Ry. being now merged with the C. & N. W. Ry.), and he held this position until the date of his death.

Mr. Carney was one of the charter members of Division 249 of the Brotherhood of Locomotive Engineers, and had held positions of trust in the division since its organization, of late years having had charge of its funds and the insurance of its members. At the formation of the Association of Railroad Air-Brake Men at Pittsburg, June 8, 1893, Mr. Carney was chosen secretary of the Association. Immediately upon having the traveling engineer's duties assigned to him he applied for and secured membership in the Traveling Engineers' Association, and attended their second annual convention held at Denver, Col., in September, 1894.

Having been denied the advantages of careful training and education in early life, he started out comparatively poorly equipped; but a clear, perceptive mind, keen observation, a natural ability to grasp and hold fast to that which was good in all that his experience brought him in contact with, and a persistence that overcame difficulties, served to place him in the front rank among engineers and air-brake men in this country.

The fiftieth anniversary number of the "Scientific American" contains a group of portraits of "Some Distinguished Inventors of the Last Half Century." In this group are portraits of Morse, Thompson, Ericsson, Howe, Tesla, Bell, Harvey, Colt, Corliss, Edison and McCormack, all of whom are truly great men; but in point of importance of invention, it would seem that the group should contain, in a prominent place, the portrait of the genius in whose brain originated the scheme of a practical air brake, George Westinghouse, Jr.

CORRESPONDENCE.

Connecting Air-Pump Exhaust to Exhaust Port of Locomotive.

Editors:

On page 350 in your April number, in reply to general question No. 32, you state that it is bad practice to connect the air-pump exhaust pipe to the exhaust passages in the cylinder saddles. I would like to know what objections can be raised to this practice, aside from the resistance it gives to the air-pump exhaust, due to back pressure in cylinders when engine is working steam? This objection is not serious and does not materially affect the working of the pump, there being no such resistance when pump is most needed, descending grades, etc.

Advantages gained by connecting as above are, first, a considerable saving in fuel, especially in standing around stations, as there is less pull on the fire when the air-pump exhaust is delivered through the nozzle of the engine; second, no such noise as is occasioned by the exhaust going up stack direct; third, there is no pipe in the front end to get loose or to project over nozzle, so as to interfere with exhaust, as is frequently the case with the old plan.

W. R. Scott,
Trav. Eng., A., T. & S. F. Ry.
Newton, Kan.

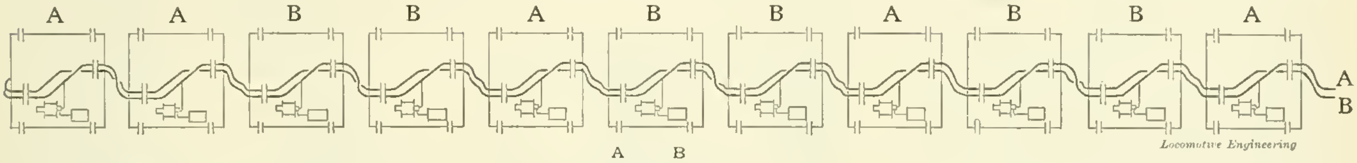
[If, in the above-described method of piping, the exhaust from the air pump be given the same freedom had with the present system, there should be no objection found to it from an air-brake standpoint.—Eds.]

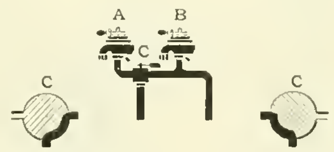
A Two-Train Pipe System of Air Brakes.

Editors:

I hereby take the liberty of bringing to your notice a new system of operating the automatic air brake, which is particularly adapted for use with heavy freight trains on roads where the grades are frequent and heavy, as it not only gives the engineer better control over his train, but at the same time allows of his using only a portion of his brakes at a time, allowing the rest to cool off should they have been under use before, or having them in readiness and cool for use when those in service shall become warm, and so obviate the danger arising from cracked or split wheels or flanges. With my system, an engineer with a thirty-car train can use the brakes on all thirty of the cars if he so desires, or should he be able to control his train easily he can apply the brakes to, say, every other car throughout the train, and before they are heated he can alternate to the others, and this by a simple twist of the wrist and without any outside help. On most roads where there are grades they will be found to have various gradients, ranging from, say, 1½ per cent. to as high as 4 per cent. in some instances; and should the engineer so desire he can have his train arranged so that he will be able to apply the brakes on all thirty cars if the grade demands it, and should the grade become lighter, so that he can control the train easily with brakes on ten, he can release from twenty, leaving them set on the other ten, and then can recharge the reservoirs on the twenty released, ready for use in a case of emergency; and should the grade become heavier, so as to necessitate the use of the braking power on twenty cars he can release the brakes from the ten and set them on the twenty simultaneously.

These changes can be made as often as required and very easily, and yet at the same time all the brakes will be under his control for use at once should he need them. This system virtually does what the retaining valve does and a great deal more. The engineer can control the train with a portion of the cars and have the rest ready for use all the time, and yet have the brakes absolutely under his control all the time, which is not the case with the retaining valve, as he is not able to release the brakes after they have been set until the retaining valves have been opened on all cars. This system would be of very great advantage not only on grades, but would be a great saving on the rolling stock at all times, as the engineer could just use the amount of braking power needed at the time. I inclose a sketch which will explain to you my method of operating, and, as you will see, all I use in addition to the present system is a train pipe and proper mechanism on the engine to operate same.





Position 1 Position 2

In the sketch, train pipes *A* and *B* on Car *A* are connected with pipes controlled by engineer's valves *A* and *B*. When the three-way valve *C* is thrown in position 1 it places both pipes under the control of valve *B*, and all the brakes on the train are controlled through the two pipes by this valve in exactly the same manner as they are at present. With the valve *C* in position 2, pipes *A* and *B* are under control, respectively, of valves *A* and *B*, and brakes on Cars *A* can be controlled by valve *A*, and those on Cars *B* by valve *B*, independently of each other.

As you will note, this is not accomplished by the use of any valves or cocks on the cars, but simply by the manner of coupling, which is done according to a fixed rule, though any desired combinations can be made.

F. O. Dunning.
New Orleans, La.

[As the cost of hose is the principal item in maintaining air brakes, those brake systems requiring two lines of hose have been declared objectionable. This is especially true where the object sought by the double-line form may be obtained as efficiently with the standard system.

On a gradient where thirty or fifty per cent. of the brakes will hold the train, there will not be any great amount of wheel-heating if all brakes are cut in, and each does its own share and lighter proportion of the work. On heavy grades all brakes will be needed, and one portion cannot be spared to cool off while the others are doing the work.

The necessary combinations obtained by coupling could hardly be had in regular railroad practice. The system contains the spice of novelty, but it is extremely doubtful whether it would ever become a practical commercial success.—Ed.]

Irrelevant and Insufficient Data.

Editors:

Having been a regular subscriber to "Locomotive Engineering' and a student of air brakes, I am much interested in the air questions and problems appearing in the Air-Brake Department of your paper, and therefore feel privileged to register the following "kick" regarding the "Queer-Acting Brake," as offered by P. P. Haller.

In the first place, Mr. Haller withholds data as to the kind of triple valve involved. True, he says it was a quick action, but he makes no mention of the fact that it was one of an obsolete and isolated kind with which but few air-brake men are familiar. In the second place, he lays undue stress on the fact that a certain number of cars were equipped with Janney couplers, and others had the old link and pin couplers. This data sends a fellow off on a wrong line of reasoning, in which the stretching of the hose couplings plays the most prominent part.

It would seem that reference to the Janney couplers was purposely made with a view to mislead rather than assist readers in the solution of the problem. This seems all the more apparent when we notice that no reference to the Janney couplers whatever is made in Mr. Haller's solution of his problem.

Considering the unusual combination and conditions surrounding the case, it would seem that Mr. Haller could well afford to give more full and serviceable data and then feel that he had given a problem that would require some good strong head work before a solution would be given.

AMOS JUDD.

Boston, Mass.

[We feel called upon to confess that the problem was inserted without the careful editing that other problems will receive in the future.—Ed.].

Concerning Haller's Problem.

Editors:

In the Air-Brake Department of July issue of "Locomotive Engineering" I noticed the problem, "A Queer-Acting Brake," by P. P. Haller, which, from the insufficient data given and the misleading way in which the problem is put, would tend to lead a person to think that the mysterious action was caused by the Janney coupler, links, pins, etc., and that these same things were looming up in air-brake service that would require the attention of air-brake men.

From the answer published in August number, I don't see why or where the car couplers had anything to do with the case. Therefore I must say that Mr. Haller's problem was very wrongly put. From reading the problem, it would naturally be supposed that the couplers were brought in more to throw the reader astray than to give data that would lead to a solution.

One thing in particular that should have been mentioned was the kind of quick-action triple that was used. Had this been mentioned, there is no doubt but what it would have been a very good problem for many to sleep over.

H. A. FLYNN,
D. & H. C. Co.

Wilkesbarre, Pa.

Object of Port "A."

Editors:

Replying to query of J. J. Plunkett in September number of "Locomotive Engineering," regarding the object of port "A" in the rotary valve seat of the brake valve, I would say that port "A" was drilled in the corner of the large exhaust port of some D-8 brake valves (the corner of which had been filled in to accommodate it), so that when brake valve handle was placed in emergency position the equalizing reservoir and chamber D would be drained, and the black pointer on the gage would drop the same as it does now with the E-6 or D-5 valves. I understand that but a few D-8 brake valves having this port "A" were sent out by the manufacturers.

Two of our engineers had a pretty warm argument some time ago regarding the question of whether the black pointer would drop suddenly when the emergency application was used on the D-8 valve. One man claimed that it did on his engine, and the other man claimed the opposite effect was had on the engine he was running. An examination proved that one man had a D-8 valve with the port "A," and the other had a similar kind of valve, but the port "A" was omitted.

AMOS JUDD.

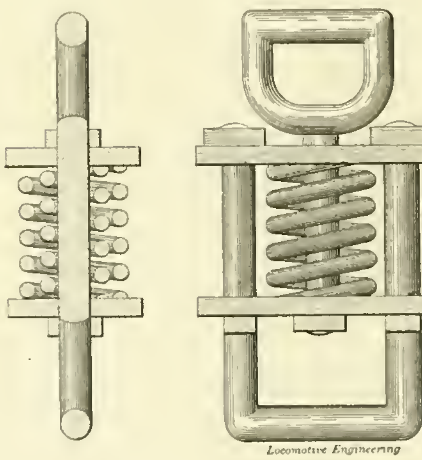
Boston, Mass.

[Mr. Judd's solution is correct.—Ed.]

A New Brake Hanger.

Editors:

The inclosed print illustrates a brake hanger which I would like to have your opinion upon. It has been tried on one brake beam of an engine tank. I have



been running the engine and have been watching the service of the hanger, and I am very well satisfied that it will do all it is intended for.

With this hanger you can increase braking power and avoid sliding of wheels. You will agree with me that something of this kind is needed for high-speed trains.

PETER CARROLL,
F. E. C. Ry.

East Palatka, Fla.

[There is so much to be said about brake hangers, brake shoes, and their influence upon and tendency to skid wheels, that we cannot discuss them at present in connection with our correspondent's device; but, having in mind the results of carefully conducted experiments we are obliged to confess that we fear the introduction of a spring in a brake hanger would not prevent the wheel from skidding.

The fact that not a single flat wheel has been removed from trains using the High Speed brake seems to indicate that, instead of causing flat wheels, it prevents them.—Ed.]

Emergency Valve-Seat Tool.

Editors:

In response to your inquiry, in August number, I inclose sketch of a device for pulling down the emergency seat of quick-action triple valves.

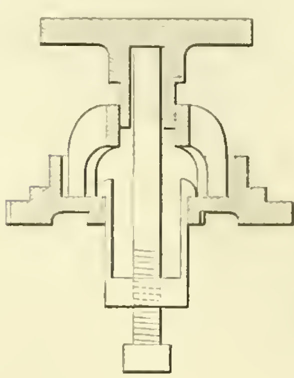


Fig. 1

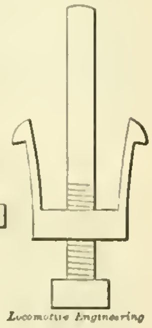


Fig. 2

Fig. 1 shows puller in position, and Fig. 2 shows the puller itself. Screwing up on the bolt causes the seat to back down. It is a very simple affair and never fails.

J. A. JESSON,
L. & N. R. R.

Nashville, Tenn.

Suggestion for Hose Connections Between Engine and Tender.

Editors:

In August number of "Locomotive Engineering," Mr. H. A. Gillis, M. M., Norfolk & Western Railroad, shows, with the aid of two cuts, an "improved form of (air hose) coupling between engine and tender."

Messrs. Pritchard and Gillis advocate the use of a single hose to each line of pipe, with a coupling head screwed on the locomotive end of hose and a nipple connection on the tender end. Why not use a coupling head on both pipes, engine and tender alike, and make the connection with a double-headed, or what is commonly called a "dummy" hose?

I think the average engineer who has been obliged to get under his engine and replace a burst hose between engine and tender, compelled in the majority of instances to take down the clamp that supports the pipe, with corroded bolts to contend with, will agree with me when I say that this is the crudest feature of our air-brake equipment. With a double-ended hose the job would resolve itself into the simple matter of making two couplings.

As a rule, hose remain in service until they fail; and with the three lines of pipe connections on such engines as carry their main reservoir on the tender, these failures happen frequently, and often at a time when the bleeding of the auxiliaries and stopping the pump is the easiest way to repair the damage.

EUGENE MCAULIFFE,
K. C., Ft. S. & M. Ry.

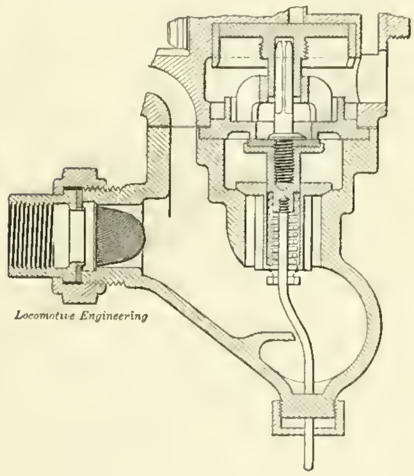
Springfield, Mo.

Device for Showing Movement of the Emergency Valve.

Editors:

I think if you want a man to remember what is told him about the air brake it is important that he should be shown as far as possible, so that he can see with his own eyes that what you say takes place is true.

One of the hardest things for those studying air brakes to understand is the operation of the quick-action triple valve when brakes are applied in the emergency. They are told that the train-line air is reduced very suddenly in pressure by part of it entering the brake cylinder of each car. They are shown by the gage that a higher pressure is obtained in the brake cylinder when brakes are applied in the emergency, with a quick-action triple valve, than when applied in a service application with the same piston travel. They are then told that this increase of pressure is due to a part of the train-line air entering the brake cylinder. They will believe you;



but will they remember it? I think not, or at least not as well as they will to have it proved to them. For this purpose I have arranged one of the triples on a plant of ten brakes, as shown in the cut. As will be seen, a small rod is attached to the stem of the emergency valve, and extended through the check valve and out through plug in check-valve case. Stuffing boxes on the check valve and plug prevent leakage.

In the later triples the center of the emergency valve stem is just in line with the center of plug, or near enough so that rod will work free. The cut, as will be seen, does not show them in line. To make this arrangement perfectly plain, I have a sectional triple connected up in the same manner. With this arrangement it is readily seen that the pulling of the emergency valve from its seat will open communication between the train line and brake cylinder, just the same as there would be if a pipe were to be extended from the train line to the brake cylinder in which there is a stop cock, the stop cock filling the same office as the emergency valve in this case. That is, when closed it prevents train-line air entering the brake cylinder, and when open allows it to enter directly. When the emergency valve is pulled from its seat all the brakes apply by a full emergency application, and if the handle of the engineer's valve is on lap position will stay on. This will show to anyone that it is train-line air entering the brake cylinders that causes a quick-action application of the brake.

On a plant with ten brakes, 8-inch piston travel, 70 pounds train-line and auxiliary-reservoir pressure, applied in the above manner, gives about 60 pounds pressure in brake cylinders and auxiliary reservoirs, and leaves about 50 pounds in the train line. This is a very simple thing to arrange, and I think any instructor will be more than paid by the benefit derived.

E. G. DESOE,
A. B. Ins., B. & A. R. R.
Springfield, Mass.

Practical Observations and Suggestions.

Editors:

I have just finished the perusal of the Air-Brake Men's Boston Proceedings, and have found it teeming with valuable instruction and up-to-date data. I was much interested in the article on "Water-Raising System" which heretofore was Greek to me; and while I have not yet a practical understanding of same, I will be better able to cope with occasional mysterious disappearance of train-pipe pressure. The Proceedings should be in the hands of every engineer who handles air in any capacity.

The "single application" and "non-use of emergency port" features are two very important items of successful air-braking. I have been handling all kinds of trains this summer, from 2-coach (passenger) to 45-car (freight), and have made ninety per cent. of all stops with single application, and have used emergency but once in six months. I think this is doing fairly well, and practice is making it as hard to go over into the emergency position as it used to be easy.

Where trains are long and only part air, is where the most particular attention should be paid to the "single application," as where two applications are made in making a stop, the second one is always made with train at low speed and not bunched, resulting in heavy shock to hind end of train, even if second application be light. We have handled these trains more, perhaps, than any other, and generally with a coach on rear end, and have noticed that where all stops were made with the single application, and first reduction made at a good speed, stops were smooth and air used was nominal; while where two applications were made (either through leakage or poor judgment), stops were always rough, no matter how light second application was. We are far from perfect, but practice and a fair amount of horse sense will enable one to do very good braking.

It should be remembered that the first application is the best, on account of properly charged auxiliaries, and that the application should be postponed until we know for sure that we will not need to release and set brakes again for any except water stops; and with long trains it is better even then to stop as near spout as possible with the one application (short, of course), then pull up slow and stop with lever carefully. Of course, it is impossible to always make smooth, easy stops with long freight trains, especially with a lot of jacks; and the young engineer should not feel hurt if told the stove is upset, when probably the signal to stop was given immediately after one to go ahead. It is much better, however, to run away by and back up than to go over into emergency with brake valve making a rough stop and likely running by anyway; besides, using emergency teaches brakemen bad habits, as when used sometimes they expect it always and give signals accordingly.

A few brakemen have a bad habit when coupling onto cars to be picked up, of opening angle cock on those cars (which are in many cases charged with air) before hose coupling is made, setting those brakes unnecessarily and wasting all the air in train pipe. Then, after coupling is made, of opening cock quickly on train setting quick action, not only wasting air, but straining all brake apparatus. A careful brakeman is a valuable assistant to an engineer, and they are generally ready to learn, but in many places lack instructors.

L. D. Shaffner,
Nor. Pac. Ry.

Missoula, Mont.

Field Notes.

Editors:

The other day my attention was called to a powerful switch engine which had a 10 x 10-inch driver brake equalized for six drivers, and an 8-inch tender brake working on both trucks. Both the auxiliaries were 16 x 33 inches outside measurement, so that one fed two 10-inch cylinders and the piping from one cylinder to the other, while the other auxiliary fed one 8-inch cylinder, 70 pounds train-line pressure was carried, and engine had a full New York Air-Brake Company equipment in good order.

The engine was giving considerable trouble because the driver brake did not hold as well as it should, while the tender brake made a regular business of sticking nearly every time they coupled onto a train. We put gages on the auxiliaries, which made the cause of the trouble apparent at once. The tender-brake cylinder with 7-inch piston travel equalized with its large auxiliary on a 10-pound train-pipe reduction at 60 pounds piston pressure, and stayed set till the train-line pressure was restored to a little over 60 pounds. If there were very many empty cars coupled on, it took some time to get this train-line pressure.

The driver brakes equalized with auxiliary at 40 pounds, and it took a reduction of 30 pounds from 70 to set them tight. As the train-line pressure was rarely reduced over 15 or 20 pounds in making an ordinary stop, you can see the driver brake did not do its share of the work, and used a lot of air doing it. After showing, by the object lesson with the gages, what the trouble was, the piston travel on tender brake was let out to 9½ inches, and the travel on driver brakes taken up as short as possible, and the shoes would clear the wheels good when released, after which both engine and tender brake could be handled satisfactorily, although the gages showed that the pressure in driver-brake cylinders was still lower than tender brake on a full application, so driver brake would let off first when pressure was pumped up gradually.

There are lots of tender brakes with a 12 x 33 auxiliary to feed an 8-inch brake cylinder, and unless lots of excess is carried in the main reservoir, this brake will give trouble in sticking. One remedy is to extend the piston travel as long as practicable, always remembering that the piston travels about an inch further when brake is set while train is running than with a standing test. Of course, the right way to remedy this matter is to put the proper auxiliary on for an 8-inch brake, which is 10 x 24 inches. This cannot always be done when we want it. High excess helps to release this brake each time, but if the high excess is not properly handled, this brake will creep on again when train line and auxiliaries on the driver and car brakes are equalizing. Extending the piston travel lowers the pressure at which cylinder and auxiliary equalize. This must be about the same as other brakes to have them set and release alike.

This is one operation of the application and release of the automatic brake that should be thoroughly understood, as it is the key to the whole chain of operations. When once you thoroughly understand the equalization of the air pressures in the train pipe and auxiliary, between the auxiliary and brake cylinder, and how it is done, then the rest is easy.

C. B. Conger.

Grand Rapids, Mich.

Habitual Carelessness in Handling Air-Braked Trains.

Editors:

Some time ago I saw a piece in "Locomotive Engineering" relative to the careless manner in which many of the older runners handled the air brakes, and I presume many engineers who saw it never stopped to think what kind of a card would be produced were one to be taken by the pressure recorder from a train they were handling.

After watching this matter closely, I am satisfied that much of the rough braking is done by men who have been handling passenger trains for a number of years, and who may have, at one time, enjoyed the distinction of being skillful men with the brake; but, as the writer said, they become careless and drift into a rut from which it is most difficult to get out.

It is my opinion that a man who is only careful when he knows some official is on the train will never distinguish himself as a skillful brakeman.

RICHARD JONES.

Springfield, Ill.

QUESTIONS AND ANSWERS

On Air-Brake Subjects.

(66) H. C. E., Springfield, Ill., writes:

1. Has the graduating spring anything to do with the movement of triple piston in service application, with both the plain and quick-action triples? A.—No; it does not assist in the graduation of either triple, although a full port opening is not had with the plain triple until the graduating spring is slightly compressed. A full port, however, is not required in the service application with the plain triple. 2. Please explain why you can get no extra pressure in brake cylinder after making a moderate service reduction, and then going to emergency. A.—The auxiliary reservoir pressure is unable to force the emergency piston downward against the brake cylinder pressure under it, and therefore the train-pipe port cannot be opened.

(67) U. S. S., Baraboo, Wis., writes:

One man says that if the feed port in a triple valve becomes partly stopped up, so that the auxiliary reservoir does not become fully charged with the others of the train, that, with a service application, it will take the emergency as soon as the train-line pressure has been reduced low enough to operate the triple piston. Another man says a partially closed feed groove cannot cause this. Which is right? A.—The feed groove can in no way cause the action mentioned. When the reduction in train-pipe pressure is sufficient to cause a movement of the triple piston, the application will be as gentle as though this auxiliary was charged equally with the others. In fact, the tendency to go into quick action would be even less. Care should be taken not to mistake a sticky triple for an undercharged auxiliary.

(68) H. C. E., Springfield, Ill., asks:

1. Why is the governor piped to the train line on engines having the D-8 brake valve? A.—To keep the train-line pressure within the limits that will not allow an excessive brake power, which results in slid flat wheels, and also to allow a higher pressure to be accumulated in the main reservoir for releasing brakes. With the D-5 or E-6 valve the pump governor is attached to the main reservoir pressure, governing that pressure alone, while the feed valve attachment governs the train-line pressure. With the D-8 valve on lap, the main reservoir pressure could be run up equal with the steam pressure, which resulted in useless heating of pump, etc. 2. Could not the D-8 valve, with governor connected to main drum, be handled by a careful and skillful engineer? A.—With but a trifle greater degree of satisfaction than if no governor were used at all. It would prove too troublesome and dangerous.

(69) H. C. E., Springfield, Ill., writes:

1. On page 9 of Westinghouse Instruction Book we find the statement that in admitting steam to chamber M, the main valve being the larger at top, will rise, causing the downward stroke of piston 10. But in starting several different pumps it has been found to be quite the reverse. How do you account for this? A.—After the working parts of an air pump have become worn, gravity causes them to seek the lowest points of their respective traverse after the steam is shut off. Thus all parts are in position to make the upstroke. 2. Would the 8-inch pump work with no rings in bottom piston of main valve? A.—Yes, if piston was ordinarily tight, but not so well, of course, as if rings were used. A bad blow would be had on both up and down strokes, nearly all lubricant would be wasted away, and, in consequence, the pump would groan and work poor generally. 3. Would stop pin 50, being broken off, stop pump unless steam was shut off? A.—No.

(70) C. A. W., Tallahassee, Fla., writes:

I am running an engine equipped with a D-5 brake valve, which acts as follows: When making a service application with train of four or five cars, the brakes apply all right; but when making a service application with the engine and tender alone, it takes the brakes about as long again to apply as it does with the train, and very little air escapes out through the train-pipe exhaust. The engine has no driver brakes, and the brake valve has just been cleaned and repaired. What makes this difference? A.—We do not think that your trouble is in any way due to the brake valve; but instead can be ascribed to the fact that your engine, having no driver brakes, and tender brake possibly in doubtful condition, will not stop in as short a distance when alone as when coupled to the train, which not only holds its own weight, but part of the engine's weight also. The escape of air at the train-pipe exhaust begins probably just as soon after handle is put in service notch with engine alone, as when engine is coupled to train. With short train pipe, such as your tender has, the equalizing piston in brake valve will not have to lift as high as it will when engine is on the train; consequently the escape at the exhaust will be shorter and lighter with engine and tender alone.

"The University Scientific Magazine," published by the Engineering Society of the University of Tennessee, is a monthly, 6 x 9 inches, containing 43 pages of matter solidly technical, relating principally to electricity and chemistry, with a chapter devoted to the practice of freehand lettering in several well-known industrial drawing offices, in which accurate reproductions of letters and numerals are given to show the various styles in vogue by different draftsmen. The magazine is published at Knoxville, Tenn.

The twenty powerful eight-wheeled passenger locomotives being completed by the Schenectady Locomotive Works for service on the heavy fast express trains of the N. Y., N. H. & H. R. R. between New York and Boston will have the Westinghouse-American engine truck brake, thus making them among the best braked engines ever built.

Railroad Signaling Device.

The signaling device shown in our illustration is the invention of Mr. R. T. Kanski, of New York City, who writes, concerning its action:

"It is a combination of lamp, board and gearing, the signal board being 16 x 48 inches. It is manipulated by means of cams which operate a vibrating arm pivoted at lower end, the upper end of arm having a toothed portion which works in the lower part of a double-gear wheel, keyed on a central shaft which has a bridge bearing. The upper teeth of double-gear wheel mesh with a gear wheel on the horizontal shaft, at the end of which is an arm having a roller through which passes a pin that

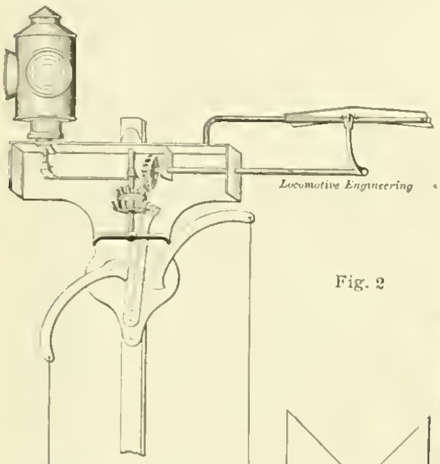


Fig. 2

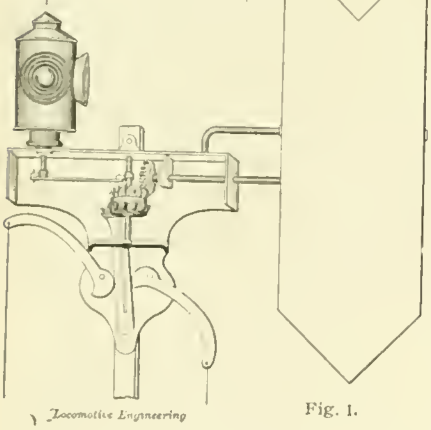


Fig. 1.

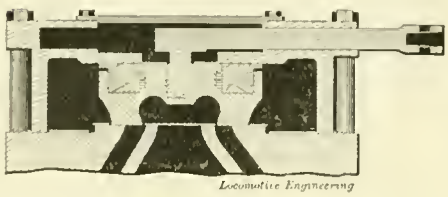
moves through guides attached to the back of the steel sheet signal board, that prevents the board moving any further than the movement of the arm. The board is hung on a separate axis off its center, that causes the board to assume a position of danger, as shown in Fig. 1, in case of breakage of any operating part.

"The movement of the lamp is made by a simple crank and rod motion, working from the central shaft to an auxiliary shaft having a collar at the upper end, that supports the lamp. The signal, when at danger, throws a red light towards the track and causes the rays of the white light to reflect on signal board. Fig. 2 shows the signal board at clear. It is simple in construction and positive in movement, dispensing with extra disk, as will be seen by the illustrations."

Brown's Balanced Valve.

The balanced valve shown in our illustration is the invention of Mr. D. H. Brown, a locomotive engineer on the Illinois Central Railway at McComb City. The valve is similar to the ordinary slide valve on its port face, but has an annular cavity in its upper face which contains a friction ring, into which is fitted on the outside and top the packing rings forming the balance features of the device. The friction ring is provided with an inclined groove on the bottom face, into which a split expansion ring lies, the function of which is to force a wedge-shaped ring against the inclined face of the friction ring and raise the packing against the balance plate, which is solid with the steam chest, and separates it into two chambers, one for the valve and the other for the valve stem.

This balance plate is open at the center to allow the valve stem to pass down so as to engage with the valve, the latter having a slot, 1½ inches wide and 7¼ inches long, to receive a lug forged on the front end of valve stem. It will be seen that the latter has no stuffing box; none is necessary, for the stem only requires a guide



to hold it in line, as there is no steam to provide against, since it is excluded from that part of the chest by the balance plate. The whole top of the chest might be left off, so far as its use as a cover is concerned.

An engine equipped with valves of this type has been in service one month on freight, and three months on passenger, making 1,000 miles a week, without a blow of any kind from the steam chest. It is now being put on a large freight engine to see what the results will be in hard freight service. There is something unique about this stem without packing. An engine should handle easily with valves balanced and all resistance from stem packing eliminated, and it should also show a reduced fuel account for the same reason. Anything that will cut down internal friction should receive the approval of all who are laboring to improve the locomotive.

The July statement of fuel and oil consumption of engine with this valve, furnished by Master Mechanic F. C. Losey, gives a comparative performance with other engines having next best record on the same division, in which the engines made nearly 5,000 miles in passenger service. The table shows a mileage of 274.2 against 129.3 for valve oil, and 54.2 miles against 40.9 to one ton of coal.

This is favorable showing, but we do not have much confidence in statements of this character, notwithstanding that the results might have been honestly obtained, for the reason that expert handling of an engine will always show a saving in fuel, no matter what the device being tried.

Work of a High-Speed Locomotive.

"At 60 miles an hour the resistance of a train is four times as great as it is at 30 miles—that is, the pull must be four times as great in the one case as it is in the other. But at 60 miles an hour, this pull must be exerted for a given distance in half the time that it is at 30 miles, so that the amount of power exerted and steam generated in a given period of time must be eight times as great at the faster speed. This means that the capacity of the boiler, cylinders and the other parts must be greater with a corresponding addition to the weight of the machine. Obviously, therefore, if the weight per wheel, on account of the limit of weight that the rails will carry, is limited, we soon reach a point when the driving wheels and other parts cannot be further enlarged, and then we reach the maximum of speed. The nice adjustment necessary of the various parts of these immense engines may be indicated by some figures as to the work performed by these parts when the locomotive is working at high speed. Take a passenger engine of any of the big railroads: At 60 miles an hour a driving wheel 5½ feet in diameter revolves five times every second; now, the reciprocating parts of each cylinder, including one piston, piston rod, crosshead and connecting rod, weighing about 650 pounds, must move back and forth a distance equal to the stroke, usually 2 feet, every time the wheel revolves, or in a fifth of a second. It starts from a state of rest at the end of each stroke of the piston, and must acquire a velocity of 32 feet per second in one-twentieth of a second, and must be brought to a state of rest in the same period of time. A piston 18 inches in diameter has an area of 254½ square inches. Steam of 150 pounds pressure per square inch would, therefore, exert a force on the piston equal to 38,175 pounds. This force is applied alternately on each side of the piston ten times a second."

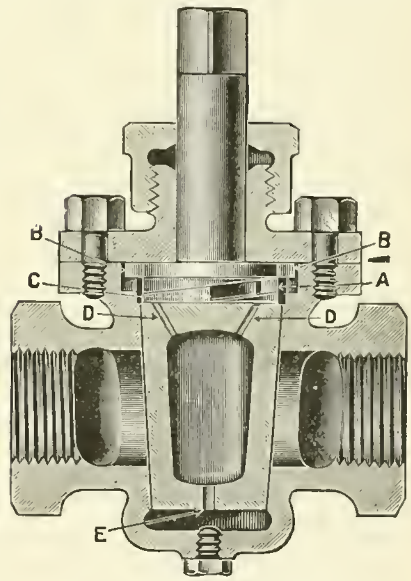
The above article is cut from "The Railway Agent," which stole it without credit from the "Ladies' Home Journal," which received it from a contributor who stole it without credit from Forney. Some of the statements are quite misleading. The resistance of a train is not nearly four times greater at 60 miles an hour than it is at half that speed. This is a popular fallacy due to a theory given in engineering text-books that train resistance increases with the square of the velocity. Experiment has demonstrated that it does nothing of the kind. If it did there would be very few locomotives capable of pulling any train at a speed of 60 miles an hour. By actual experiment the resistance of a passenger train has been found to be 12 pounds per ton at 30 miles and 16 pounds per ton at 60 miles per hour.

The idea that steam pressure of 150 pounds per square inch will be acting on the pistons when the piston speed is 1,200 feet a minute is absurd. The engineers who have applied the steam engine indicator to locomotives give the mean steam cylinder pressure to be about 50 pounds per square inch.

A Good Blow-off Cock.

If there is one abomination worse than another on a locomotive, its the common plug blow-off cock—the kind that you have to slack off the nuts to loosen and then can't get anywhere near it to shut it off.

Our illustration shows a plug cock that has the advantage of tightening itself when closed and loosening itself when opened.



This result is secured by means of the traveling cam *A*, through which the stem passes. The cam is prevented from turning with the stem by means of the lugs *B*, which move vertically in slots. Supposing the valve to be open, the cam will be in the lower part of the chamber in which it is placed and the valve will be free to be easily moved. A quarter of a turn in the direction for closing it causes the cam to rise and take a bearing on the upper surface of the chamber, and the only effect of further effort to turn the stem in that direction is to force the valve more firmly to its seat. A very slight motion in the other direction immediately releases the cam and the valve turns easily, being arrested at its proper open position by contact of the fingers of the cam at the other end of its travel. *E*, *D*, *D* are balancing ports. The bottom plug is for the purpose of draining valve to prevent freezing and also the removal of sediment. *C* indicates traveling cam. Under no condition does the plug lift from its seat.

This cock is made by the Homestead Manufacturing Company (Limited), of Homestead, Pa.

R. D. Wood & Co., of Philadelphia, manufacturers of the Taylor gas producer, have issued a catalog illustrating their output, which deserves mention. This is a trade pamphlet of 6 x 9 inches standard size, containing 56 pages of information, descriptive of the gas producers made by the firm, with notes on gas fuel that must be of the greatest value to those interested in fuel economy. It is, in fact, a treatise on the production of gas for fuel purposes, and handles the subject in such a clear manner that all can understand the material points of the subject without any previous knowledge of it. Comparisons of the calorific values, beginning with producer gas, and ascending by the amount of heat energy shown, to water gas, and then from coal gas to the natural article, as it is given up by Mother Earth, are of the highest interest, showing by table that the cheapest artificial fuel gas per unit of heat is common producer gas, and that the calorific power of natural gas is about fifty per cent. greater than that of coal gas, the producing value of which is given for Anthracite, Bituminous and the Lignites. The chemistry of all these gases, to show the heat energy in each, is arranged in the simplest form to give the clearest comprehension of the facts. Under the head of "Boiler Firing" there is a fund of information that will do much to let a bright light in on the theory of boiler economics. The pamphlet is intended for the enlightenment of the managers of power plants and all others who have to do with fuel consumption, and the masterly manner in which the subject is handled will make interesting reading to those for whom it is intended.

Night Schools Not Appreciated.

Our volatile friend Watson, of the "Engineer," does not think that workmen as a rule appreciate the educational advantages offered to them in the shape of night schools and other aids for overcoming the deficiencies of mental training. Discussing the apathy of those for whom certain night schools were established, he says:

"These facts are very discouraging to the lovers of progress and the human race, the assumption being that men are illiterate only because they lack facilities for education, but close observers may find another and a truer reason, which is that study of any kind is unpopular to the masses. The average man prefers to break his back, or lose his job a dozen times in blundering through his work, rather than tire his brains by acquiring the fundamental principles of the business he is to follow through life. We speak of the mass, not of individuals here and there, who are exceptions to the rule."

WHAT YOU WANT TO KNOW.

Questions and Answers.

Correspondents wishing to have questions answered in these columns should send in their names and addresses, not for publication, but for evidence of good faith. We throw all anonymous letters into the waste basket.

(77) Q. V. A., Lake Elmo, Minn., writes:

Has the return flue boiler ever been used on a locomotive? A.—The "Coventry" boiler, a return flue affair, was tried on a locomotive only a few years ago, and was pronounced a failure at that time.

(78) S. O., Omaha, Neb., writes:

If compressed without loss of heat, what would be the temperature of air at 1,000 pounds pressure per square inch, as shown on the gage? A.—According to Rankine, the temperature would be about 2,450 degrees.

(79) W. L. F., So. Easton, Pa., writes:

Does a low-driving wheel in fast passenger service mean economy? We have 5-foot drivers on our express trains, and also have hot boxes and pins. A.—Piston speed, when excessive, is not conducive to economy; it is bad for not only the engine but the track as well. Centrifugal force having a disastrous effect on the rods, pins and boxes. A 5-foot wheel will have to make 1.2 more revolutions than a 6-foot wheel (that being the ratio of wheel circumferences), to do the same work in a given time, with same size cylinders, and the steam and fuel consumption will also be greater in the same ratio.

(80) J. S., Conneaut, O., writes:

Will you please answer the following questions in your paper and oblige a subscriber? I have a piston ¾ inch in diameter with 70 pounds air pressure on its top. I want a spring sensitive to a 4 or 5 pound reduction of pressure on the piston. The spring to push the piston ⅜ inch, and the cavity under the piston for the spring to be not more than 1 inch deep. Can I get such a spring? If so, where? A.—A spring would have to be made to suit these requirements, and any machinist or model maker that is up in his business can easily make such a spring, which must of necessity be small—not over ¾ inch diameter outside of the coil, and 1 inch high over all. Spring formulas in such a case as this are too unreliable to waste any time over, and are therefore not given; a cut-and-try process will give results equally as satisfactory as any. Our advice is to get some small wire, from $\frac{1}{16}$ to $\frac{1}{8}$ inch diameter, and wind a spring for yourself, around a spindle whose diameter plus two thicknesses of wire will give the over-all diameter of spring, and experiment until you have what you want.

(81) J. A. D., Whiting, Ill., writes:

Please say in your next issue the proper way to measure the throw of an eccentric. A.—The throw of an eccentric, according to the acceptation of the term among mechanics, is easiest found by taking the difference between the greatest and smallest distances from the axle (or what is the same thing, the bore of the eccentric) to the outside of eccentric. Example: Let the eccentric be 14 inches in diameter; let the greatest distance to the axle equal 5.5 inches, and the least distance equal 1½ inches; then 5.5 — 1.5 will equal 4 inches, the throw. For any other throw, say 5 inches, the measurements on the same size of eccentric would be 6 inches and 1 inch, respectively; and 6 — 1 will equal 5 inches, the throw. The reason for this is,

The Pennsylvania Railroad has organized a number of personally-conducted pleasure tours to be made under the escort of a tourist agent and chaperon, embracing most of the points of interest in the South. An early Autumn trip will be made to include Gettysburg Battle-Field, Blue Mountain, Luray Cavern, Basic City, Va., the Natural Bridge, Grottoes of the Shenandoah, Richmond, Washington and Mt. Vernon. The start will be made from Boston on Monday, October 12th, from New York and Philadelphia on Tuesday, October 13th, and the trip will cover a period of ten days. The cost of the trip, including all necessary expenses, will be $55 from New York, $65 from Boston and $53 from Philadelphia. Detailed itinerary will be sent on application to Tourist Agent, 1196 Broadway, New York; 86 Fulton Street, Brooklyn; 205 Washington Street, Boston; or Room 411, Broad Street Station, Philadelphia. This trip is sure to be popular, and the fact that it is conducted by the Pennsylvania Company is a guarantee that everything possible will be done for the comfort of the tourists.

that if we could measure from the outside of the eccentric, as before, to the circle representing the path of the eccentric center, instead of to the shaft, we would have in the two measurements (the greatest and least) an amount which must be added to an unknown quantity in order to have the full diameter of the eccentric; and since the path of the eccentric center is the unknown factor, we obtain it at once by subtraction, as shown. It is plain, then, that we may take these measurements from the axle instead of the path of the eccentric centers, since they are concentric.

(82) H. M. S., Searcy, Ark., writes:

I am firing a small locomotive with 9 x 14-inch cylinders. On the right-hand side there is $\frac{1}{4}$ inch more clearance at the end of the stroke than on the left-hand side. The driving boxes are in perfect tram and the rods are properly keyed up. The striking point is the same on both sides, but there is $\frac{1}{8}$ inch more clearance at each end of the stroke on the right-hand side than on the left. I think the cylinder on that side is a little longer than on the left, as the engine has never been square as far as the exhaust is concerned. Am I right? A.—Your statement that the striking point is the same on both sides cannot be correct, for the reason that the piston in the longer cylinder will travel $\frac{1}{8}$ inch farther at each end before striking the cylinder head, which is the striking point; therefore the striking points would be $\frac{1}{4}$ inch farther apart on one side than on the other. The cylinders may be of same length, and the difference be accounted for by a thinner piston on one side than on the other, but this fact would not alter the proposition made above. If the piston travels an equal distance from the striking points, the exhaust should be square for the reason that there would be an equal amount of space between the piston and cylinder heads when exhaust occurs, and consequently an equal amount of steam would pass to the atmosphere provided that the valve was set so as to give an equal cut-off for each end of the cylinder. In order to have a square exhaust, the main rod must be of correct length; that is, the clearance must be equal at each end of cylinder when the crank pin is on its centers, and the valve must be made to cut off equally from each striking point. These are the fundamental principles of accurate valve-setting. If they are followed the engine will be square, notwithstanding there is a difference in the length of cylinders. The only difference in the exhaust of the two cylinders will be in the slightly larger volume of steam from the larger one.

(83) A. J. H., New Orleans, La., writes:

I would greatly appreciate and thank you most heartily to explain through the columns of your journal, the most accurate rule of determining the horse power of any steam boiler. A great many mechanical writers differ as to the number of square feet of either heating or grate surface used for one horse power. I would like to know if it is better obtained by the evaporation of gallons of water in a certain time, or by the consumption of coal in pounds in the same certain time. Any information relative to above would be greatly appreciated by myself and other readers of your paper. A.—The horse-power (so called) of a boiler is measured by its evaporative capacity per hour with a given temperature of feed water, and a stated gage pressure. The American Society of Mechanical Engineers have adopted for a standard commercial horse-power, an evaporation of 34.5 pounds of water per hour, from a feed water temperature of 212 degrees Fahr. into steam at the same temperature. An application of this standard to a boiler that evaporates 2,500 pounds of water per hour, with a gage pressure of 140 pounds per square inch, and feed water temperature of 60 degrees Fahr. would be as follows: The heat units in a pound of steam under the given conditions are first determined by the formula $(212 - 60) + 966 + (0.305 \times (316 - 212) = 1,163.44$, in which $212 - 60$ equals 152, the thermal units required to raise the water from 60° to 212°, and 966 equals the number required to evaporate one pound of water from and at 212° at atmospheric pressure at sea level, then $152 + 966 = 1118$ heat units to evaporate one pound of water at atmospheric pressure with feed at 60°; but we have assumed a boiler pressure of 140 pounds, and the heat units required to raise the steam to that pressure are by the formula, found by subtracting from the temperature of the steam at 155 pounds absolute, $(140 + 15)$, which is 361°, the temperature of evaporation 212°, and multiplying this by .305; this gives 45.44 additional heat units due to raising the steam pressure from 212° to the boiler pressure of 140 pounds. These two quantities, $1118 + 45.44$ equal 1163.44 thermal units, as by the formula, and is the quantity of heat required to evaporate one pound of water under the conditions stated. When these values are understood, they can be more easily obtained direct from a steam table, by subtracting the temperature of feed water from the total heat of absolute boiler pressure, thus: the latter is found by table to be 1,223.5° which minus 60° equals 1,163.5° as found by the formula. It is plain from this that 2,500 pounds of water will require $2,500 \times 1,163.5 = 2,908,750$ thermal units, and since 966 heat units are required to evaporate one pound of water from and at 212°, $2,908,750 \div 966 = 3,011$ pounds of water per hour from and at 212°. We have stated that an evaporation of 34.5 pounds of water per hour was taken as equivalent to a horse-power; then $3,011 \div 34.5 = 87$ horse-power for the conditions under consideration.

The Twenty-Ninth Annual Report of the Proceedings of the American Railway Master Mechanics' Association is at hand, replete with the good things always looked for between its covers. It is bound in cloth, half leather, making a neat appearance in its new suit of clothes.

The Baldwin Locomotive Works and the Westinghouse Electric Manufacturing Co. have issued an illustrated catalog entitled Electric Locomotives. This is a work 6 x 9 inches, containing 123 pages of matter devoted to electric propulsion and matters relating to that class of motors, together with half-tone and line illustrations of the details entering into their construction. All classes of these motors, known or projected, from the express locomotive to those for service in mines, are shown, and particulars concerning their build and drawbar pull are handled at length. The chapters on "Why an Electric Motor Revolves," "The Efficiency of Electric Locomotives," also the glossary of technical terms used by electricians, will be found interesting by the novice in electric engineering. A copy can be secured by addressing either company.

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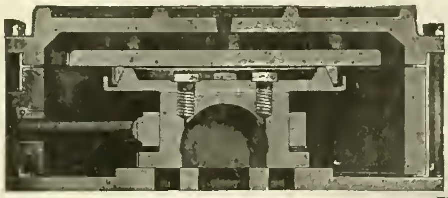

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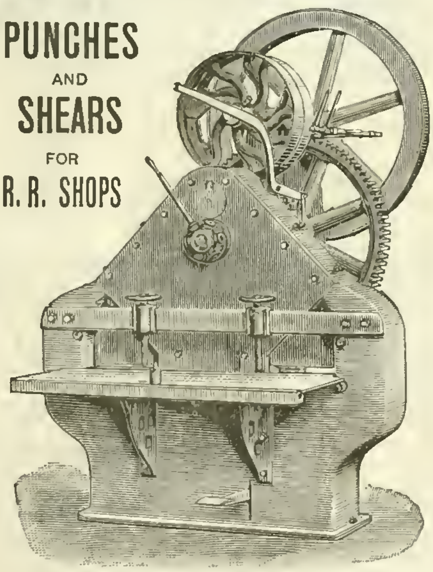

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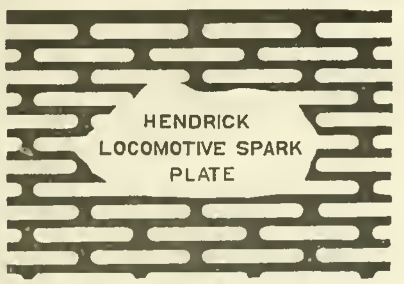

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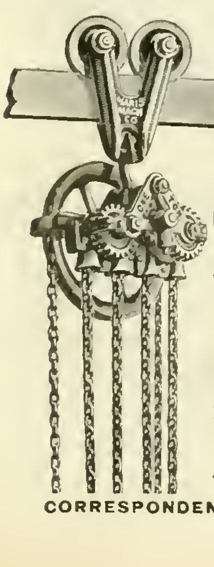

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U. S. Metallic Packing Co., Philadelphia, Pa.

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Shoenberger Steel Co., Pittsburg, Pa.

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Rue Mfg. Co., Philadelphia, Pa.

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Safety Car Heating & Lighting Co., New York.

Car Paints.
Detroit White Lead Works, Detroit, Mich.

(Continued on page 863.)

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(Continued on page 864.)

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Detroit White Lead Works, Detroit, Mich.
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Page Woven Wire Fence Co., Adrian, Mich.

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Ramapo Wheel & Foundry Co., Ramapo, N.Y.

(*Continued on page 865.*)

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Rubber.
Boston Belting Co., Boston, Mass.
N. Y. Belting & Packing Co., New York.

Safety Valves.
Ashton Valve Co., Boston, Mass.
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Krupp (T. Prosser & Son, New York).
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Shoenberger Steel Co., Pittsburg, Pa.

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Standard Steel Works, Philadelphia, Pa.
Washburn Car Wheel Co., Hartford, Conn.

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Jenkins Bros., New York.
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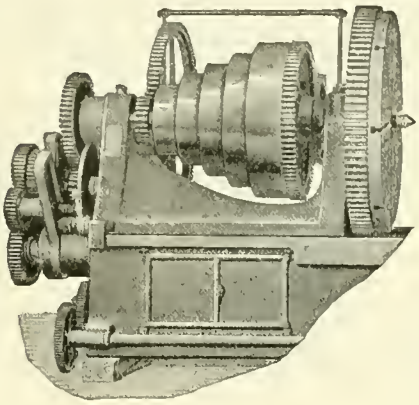

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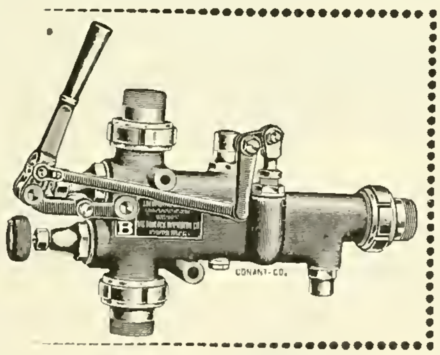

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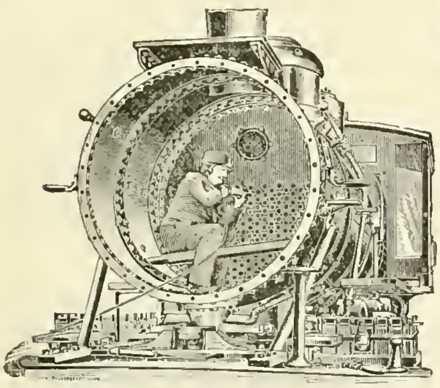

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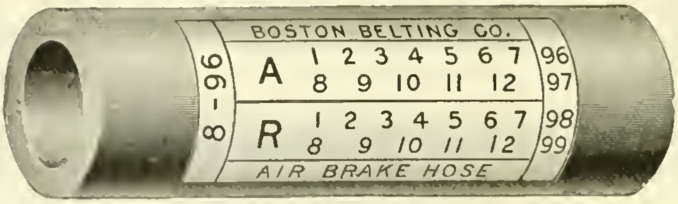

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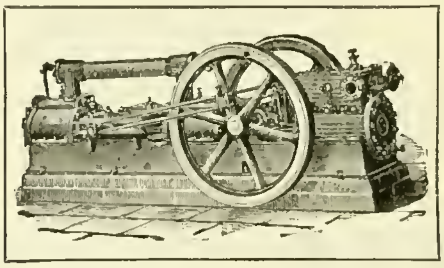

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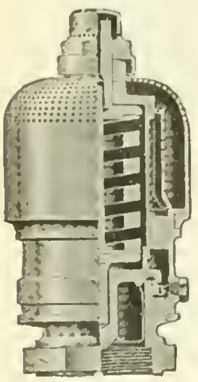

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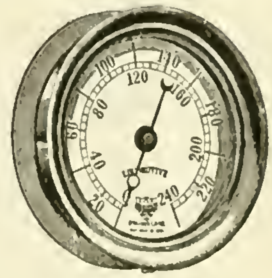

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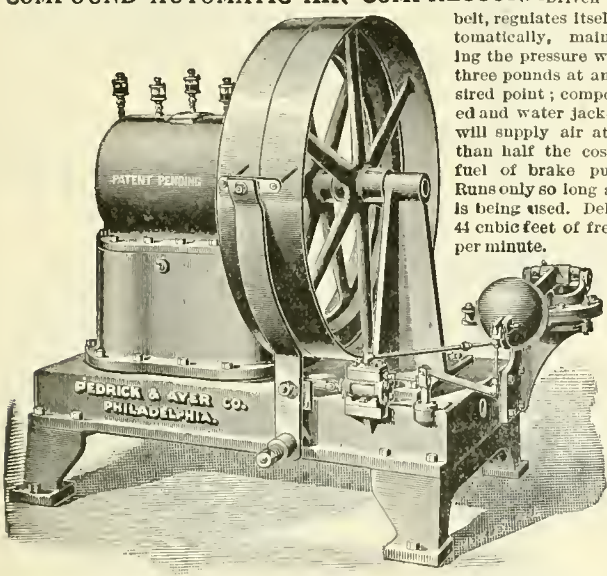

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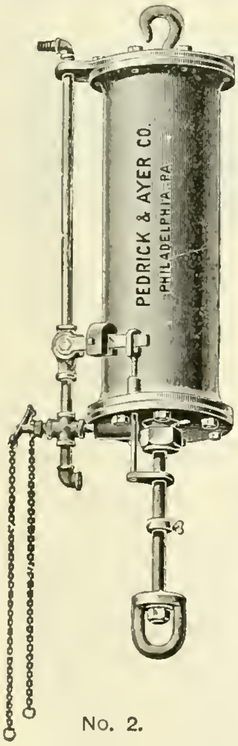

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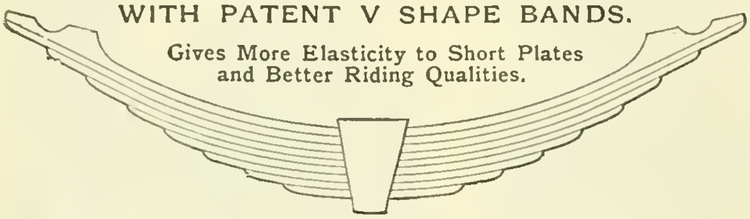

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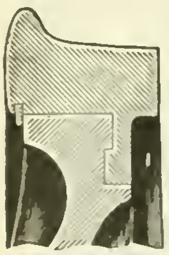

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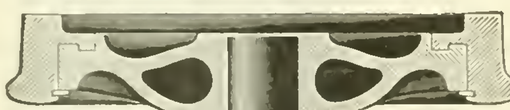

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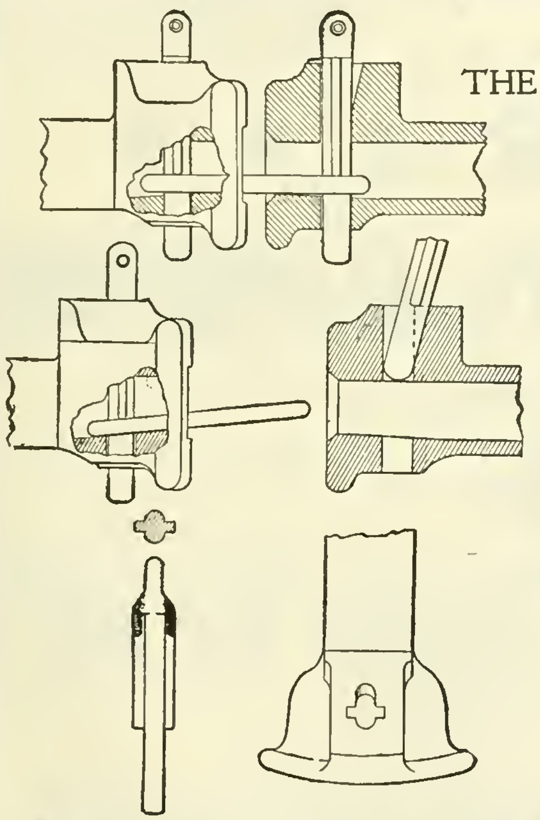

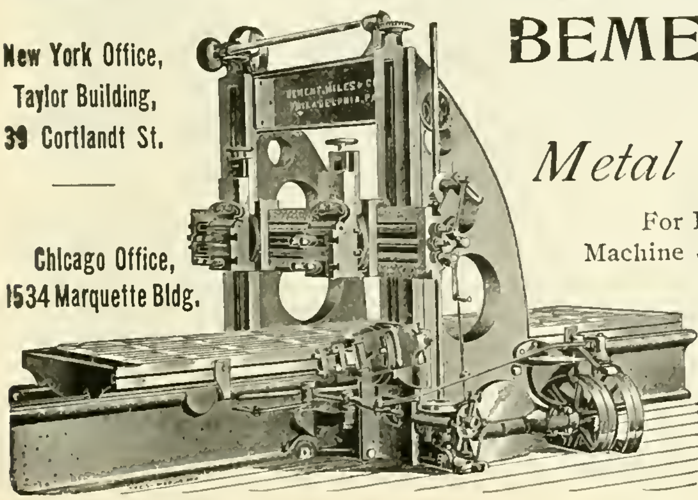

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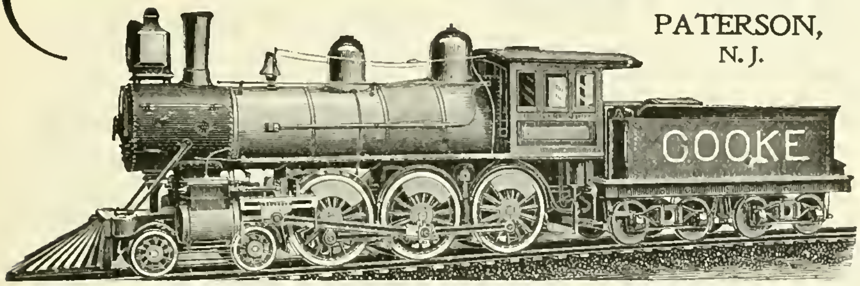

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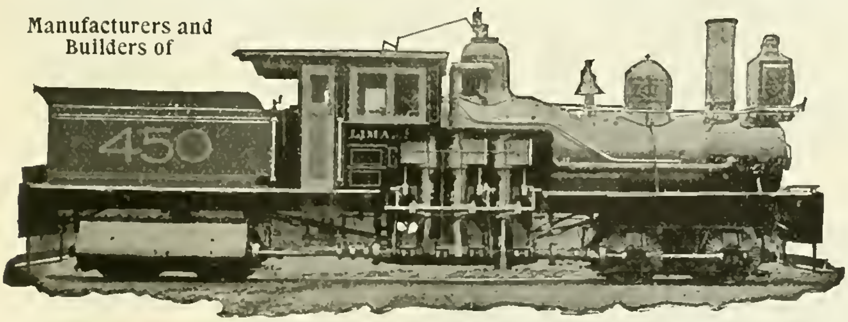

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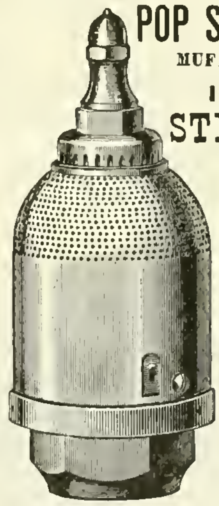

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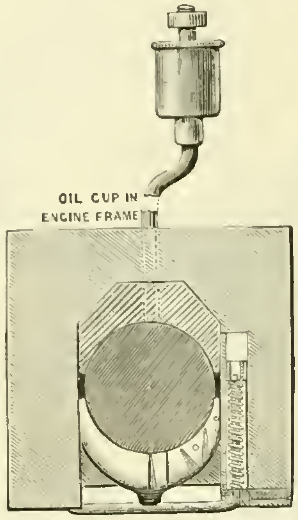
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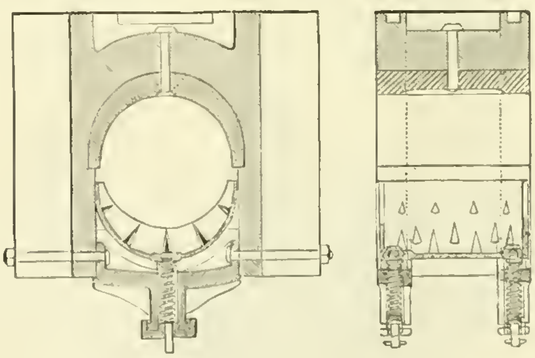

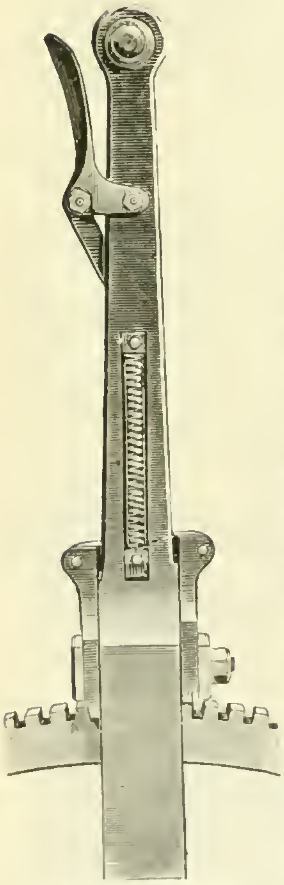

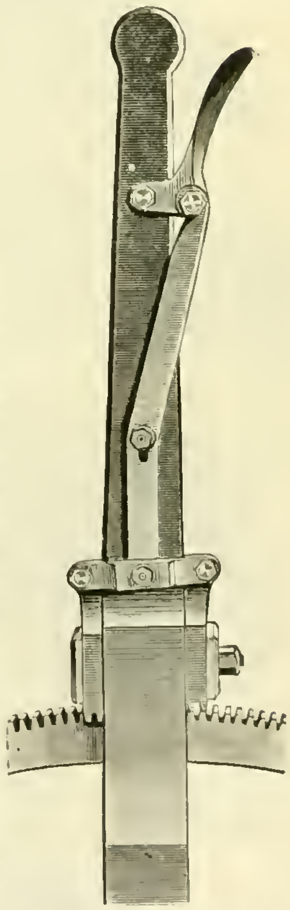


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[Trade-Mark Registered.]

Vol. IX. NEW YORK, NOVEMBER, 1896. No. 11.

A Peculiar Old Hermit.

Mr. H. E. Cram, one of our readers at Albany, Ore., sends us the photograph from which this picture was made, and the following brief history and description of the engine:

"Two engines of this build were designed by C. W. Stevens, and built by the Vulcan Iron Works, at San Francisco, in 1862. They soon after came to Oregon and were the property of the Oregon & California Railroad. They were both in service until they needed repairs; and, their parts being interchangeable, one was put away, and this one kept running by taking parts that broke or wore out from the other.

"This engine is now in service on the Scio branch of the Southern Pacific system, and has been in continuous service. The engineer, Frank Butcher, shown in the photograph, has had charge of her for some time.

"Her dimensions are: Gage, 4 feet 8½ inches; diameter of drivers, 36 inches; cylinders, 10 x 18 inches. The drivers are cast centers, with cast tire; the pumps are inside the guides; the boiler has return flues; the firebox is very narrow; the eccentrics are on the back axle."

A HERMIT OF THE CASCADE MOUNTAINS.

Lake freights from Buffalo to Duluth are only twenty cents per ton—usually sixty cents to one dollar—and still there is comparatively no coal going up; something wrong.

Drawbar Pull.

The tractive power of a locomotive is a subject of the liveliest interest to the inquiring minds of beginners in motive power service, and a great many outside of it. This is evidenced by the letters we receive, asking for formulas to calculate the power of a locomotive; and while some are content with the information furnished, others ask to have explained the reasoning from which the formula is derived. This desire to get under the surface of the formula is a natural one, since it is usually given in a condensed form, leaving out the factors that would make it possible to calculate the work done, and thus trace effect from cause.

By the term "work" we understand the overcoming of a resistance through a space; therefore the power multiplied by the distance through which it moves is equal to the resistance multiplied by the distance through which it is overcome—let that distance be inches, feet or any other unit—and the fundamental formula for the tractive power of a locomotive will be shown to agree with the above proposition, which means that the resistance overcome at the circumference of the driving wheels in one revolution is equal to the work done in both cylinders during one double stroke of the piston—providing that the steam pressure is undiminished to the end of the stroke, that there is no internal friction, and that the adhesion is sufficient to prevent slipping of the wheels on the rails.

The work done in the cylinders equals the area × mean effective pressure × stroke × 4, for the reason that the area multiplied by the pressure equals the total force in pounds on the piston, and this multiplied by four times the stroke equals the work done, because the force on the piston moves through a distance equal to four piston strokes; that is, two for each cylinder while the wheels make one revolution. Taking the pressure in pounds and the stroke in inches, the work done will be in inch-pounds. The work done, therefore, at the circumference of the driving wheels, is equal to the pull on the drawbar in pounds multiplied by the circumference of the wheel in inches.

Letting D = diameter of driving wheels, d = diameter of cylinders, p = mean effective pressure, s = stroke of pistons, and T = tractive power, we have the expression:

$$T = \frac{\frac{1}{4}\pi\, d^2 \times p \times 4\, s}{\pi\, D} \qquad (1)$$

By cancellation this reduces to:

$$T = \frac{d^2 \times p \times s}{D} \qquad (2)$$

from which we get the formula for tractive power as given in most works on the locomotive.

This calculation gives the average or mean energy, but it does not represent the starting power of the engine under all conditions, for there are certain positions of the crank when they will exert a greatly reduced power; such as when the piston on one side is near the end of its stroke, with its valve closing the port to admission, and the opposite piston—which must now do all the work of starting—is at such a short distance from the beginning of its stroke as to exert a low rotative effort. Since this effort is proportional to the sine of the angle, measured between the crank positions and their dead point, it follows that the greatest rotative effect is had when both cranks are at an angle of 45 degrees with the dead centers, or, in the parlance of the road, standing on their eighths.

One of the most important factors in the tractive power problem is that of mean effective pressure on the piston, and it looks like a poor compliment to it to calculate it for a given boiler pressure and cut-off, when so many influences are at work to render *nil* the results of the computation. It is well known that the work done in a locomotive cylinder does not approach the lines of theory close enough to accept the latter as an index of events actually occurring in the cylinder. Tortuous and restricted passages from the throttle to the valve face cause a drop in pressure; the valve itself may cause a further loss by wire-drawing, and condensation and excessive back-pressure also tend to rob the engine of her own, and keep down the effective pressure. It is the inability to foresee these losses accurately that makes futile any attempt to calculate the tractive power of an engine from a computed mean effective pressure, even if we were absolutely certain of the magnitude of all frictional resistances, which we are not.

What has been said about the losses in a simple engine applies with equal force to compounds; and if the latter are of the receiver type, further complications may ensue from drop of pressure, due to expansion in the receiver, of the exhaust steam from the high-pressure cylinder. This is a total loss, as far as work is concerned in the low-pressure cylinder when not provided against.

The indicator diagram eliminates these elements of uncertainty at once and furnishes exactly what is sought; that is, the net pressure on the piston at any part of the stroke. The mean effective pressure thus obtained is reliable and of some use, and when placed in the formula (2) gives the pull on the drawbar plus internal resistances, that are variable with the time engine has been in service, and which are not well defined; but it is usual to deduct 10 per cent. from the tractive power thus found, for the net pull. When this friction is likely to be anything from 5 to 25 per cent., it is seen that the occupation of the guesser is not gone. So eminent an authority as Trautwine says, in referring to this subject: "Deduct 20 to 30 per cent. for internal friction, etc."

Formula (2) applied to a simple engine, with 19 x 24-inch cylinders, 62-inch wheels and a diagram pressure p equal to 135 pounds, which is due to a gage indication of 150 pounds, and a cut-off at 21 inches (maximum), we have:

$$T = \frac{19 \times 19 \times 135 \times 24}{62} = 18{,}700 \text{ pounds.}$$

Deducting 10 per cent., we have 16,830 pounds pull, provided the internal resistances are not greater than 10 per cent., and provided also that the adhesion is more than 16,830 pounds. The weight on drivers and condition of the rail would decide the latter point; but the internal friction is likely to remain a sealed book.

The tractive power of a two-cylinder compound may be found by calculating the power of each cylinder separately and adding the results for a total, as in formula (3); or the pressure p may be referred to the low-pressure cylinder, and all the work assumed to be done on the latter piston by formula (4). Illustrating (3) by a two-cylinder compound having a high-pressure cylinder 14 inches diameter, a low pressure cylinder 24 inches, stroke 24 inches, boiler pressure 185 pounds, cut-off at 21 inches, and wheels 72 inches diameter, we find the cylinders to have by the indicator diagram a pressure p of 82 and 86 pounds, respectively. The expression would read:

$$\left\{\begin{array}{l} H.P.C. \dfrac{14^2 \times 82 \times 24}{2 \times 72} = 2{,}678 \text{ pounds.} \\ L.P.C. \dfrac{24^2 \times 86 \times 24}{2 \times 72} = 8{,}246 \text{ pounds.} \end{array}\right. \qquad (3)$$

Here is shown a pull of 2,678 pounds for the high-pressure cylinder and 8,256 for the low-pressure cylinder. The total effort at the drawbar is therefore 10,934 pounds. It will be noted that the factors in above divisors are not the same as given in (2); the reason is because the power developed by one cylinder is sought in this case, whereas (2) gives the power in both cylinders. Investigation will show that (3) is derived from (1) by reduction.

Assuming all the work to be done in the low-pressure cylinder, we have:

$$\frac{24^2 \times 114.2 \times 24}{2 \times 72} = 10{,}934 \text{ pounds,} \qquad (4)$$

which is seen to equal the pull obtained by (3). The pressure p in this case is found by dividing the mean effective pressure of the high-pressure cylinder by the ratio of the cylinder areas and adding the quotient to the mean effective pressure of the low-pressure cylinder. It is found to be,

$$86 + \frac{82}{2.9} = 114.2 \text{ pounds,}$$

which is the low-pressure equivalent for both cylinders. By referring p in the high-pressure cylinder to the low-pressure cylinder, it is seen that pressure p can be found for any combination of cylinders in compound engines. Precisely the same results would be had if the pressures were referred to the high-pressure cylinder, in which case the equivalent pressure would be the mean pressure in the low-pressure cylinder multiplied by the cylinder ratio and the product added to the mean pressure in the high pressure cylinder, thus: $(86 \times 2.9) + 82 = 331.4$ pounds; a mean pressure that would do the same work in the high-pressure cylinder as the combined high and low pressures in their respective cylinders.

In the case of a four-cylinder compound, with all of the elements of the preceding example, and all of the work assumed to be done in the low-pressure cylinders, we have:

$$\frac{24^2 \times 114.2 \times 24}{72} = 21{,}900 \text{ pounds,}$$

which force is twice as great as that found in (4), as it should be, because there are twice as many cylinders in the latter instance. The divisor here does not agree with that in (4), and it should not, for the reason that the formula is exactly the same as (2).

Enough has been written to make it plain that proper factors must be used, and correctly posed when using these formulæ; and in solving a problem like this of starting power of a locomotive, that care must be exercised in making allowance for all the losses enumerated here, in accordance with the observations of experience.

Experience with Joy's Valve Gear in America.

A discussion has been going on in certain English railway papers concerning the merits of the Joy motion and the ordinary forms of link motion. Mr. Joy has contributed an article to one of these papers, in which he gives diagrams from a locomotive in use on the Northern Pacific, which evidently show that the Joy motion produced better diagrams than the link motion.

Mr. Joy was not very fortunate in selecting the Northern Pacific locomotive having his valve gear on, to prove that it would give better distribution of steam than the link motion. The experience of that road with Mr. Joy's motion was not of a character to boast about. When a second engine having the motion on was tried, it was found that the cut-off could be adjusted fairly well in full gear; but as soon as the reverse lever was pulled towards the center of the quadrant, the exhaust became very irregular. The reason of this was that the center of the axle was three inches out of line with the center of the cylinder, which aggravated the distortion due to the angularity of the main rod, and made adjustment of cut-off impracticable. Various changes were made to try and make the valve gear satisfactory, without success, and it was eventually taken off and a link motion put in its place.

This is a matter of history, and may prove interesting to those who are advocates of Joy's gear under all circumstances. While it may give economical results on a stationary or marine engine, or with a locomotive, having center of cylinder coincident with center of axle, it is not a good or economical motion for the ordinary American locomotive.

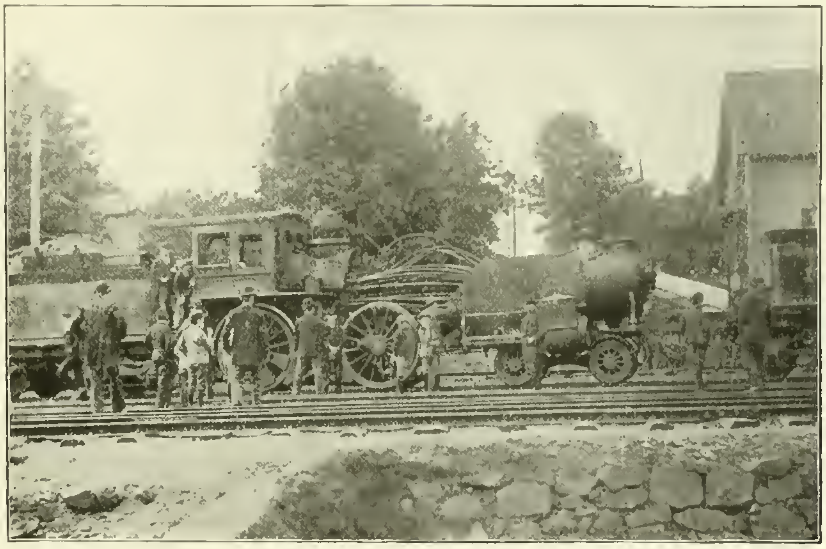
We believe this subject has been pretty well investigated by American engineers, and the opinion on this side of the water is, that there is nothing in it. There was quite a number of locomotives equipped with the Joy motion in America some eight or ten years ago, and we do not think there is a single one in service today, which seems to be pretty strong evidence that the motion is not so satisfactory as the link. The experience in America has been, that the numerous joints of the Joy motion made it much harder to maintain than the link motion, and as soon as wear takes place the distribution of steam is injuriously affected. It was found also that on tracks which were not perfectly smooth, the travel of the valve was very much affected by the vertical motion of the axle box, which led to a waste of steam that is never found in engines equipped with link motion.

The only claim for the Joy motion which our English friends seem to think as being highly important, is that the lead is practically the same at all points of cut-off. Those who have investigated this subject in America have concluded that constant lead is a drawback instead of a merit. Under proper control, a motion which gives increased lead as the cut-off is shortened is found to make a much better working engine for high speed and gives a better distribution of steam in full gear. With the shifting link motion, the high-speed engine can have the valves set without any lead in full gear, which is no disadvantage at the highest speed, since the lead increases to give the necessary advance opening when cutting off at the shorter points.

We believe that the subject of valve motion has been studied out much more thoroughly in America than it has in Great Britain, and the result of this study has been that our engineers and designers have no use for valve motion with constant lead.

New York, New Haven and Hartford Boiler Explosion.

On the 7th of September, in the streets of the city of Meriden, Conn., Engine No. 68, of the New York, New Haven & Hartford road, exploded her boiler. The engine was on a way freight and was running at the time. The engineer had just shut off and was drifting over a bridge. Our photographic reproduction shows the engine as she appeared after she was towed to a side-track.



COULDN'T STAND THE PRESSURE.

The "68" was not a new engine, and was certainly old enough to know better than to blow up. Strange as it may appear, the engineer and fireman were not injured in the least, and no damage was done in the city, with the exception of breaking of glass, although parts of the boiler came down in the streets and went into some of the stores.

The "Daily Republican," of Meriden, gives a description of the accident, and, as usual, the reporter got off some peculiar things. For instance, he says all the "sheet iron" that composed the boiler was stripped off, leaving a mass of "hot air" tubes visible! Perhaps the use of sheet iron in the construction of the boiler was the cause of this explosion. One of our correspondents writes that he thinks the explosion was caused by the hot air trying to get out of the tubes.

Another peculiar statement was a rumor about town to the effect that the engineer and fireman jumped off when they saw the boiler was about to burst! We would like to have that engineer and fireman tell us the sure signs of a coming explosion. It would be a mighty good thing for every engineer and fireman to know.

The Maine Central recently got some moguls with some features that seemed new to one of the local papers, so a reporter was sent to write it up. He got his information from "the boys" instead of at headquarters. The good points were all brought out, but the engines had one drawback—"all of 'em had trouble from hot drawbars!"

American steel rails are sold in Japan cheaper than in America.

A Bad Explosion in Colorado.

The engravings on this and the following page are from photographs taken of what was left of a Colorado Midland engine after a boiler explosion, which took place on August 16th.

This engine was a Baldwin ten-wheeler, used as a switch engine at Basalt, Col. The engineer and fireman had just left her at the coal chute and gone away. A switchman was standing about three cars in the rear of the engine, and says that he heard a small report and the engine started back, and then a very loud report as the explosion took place.

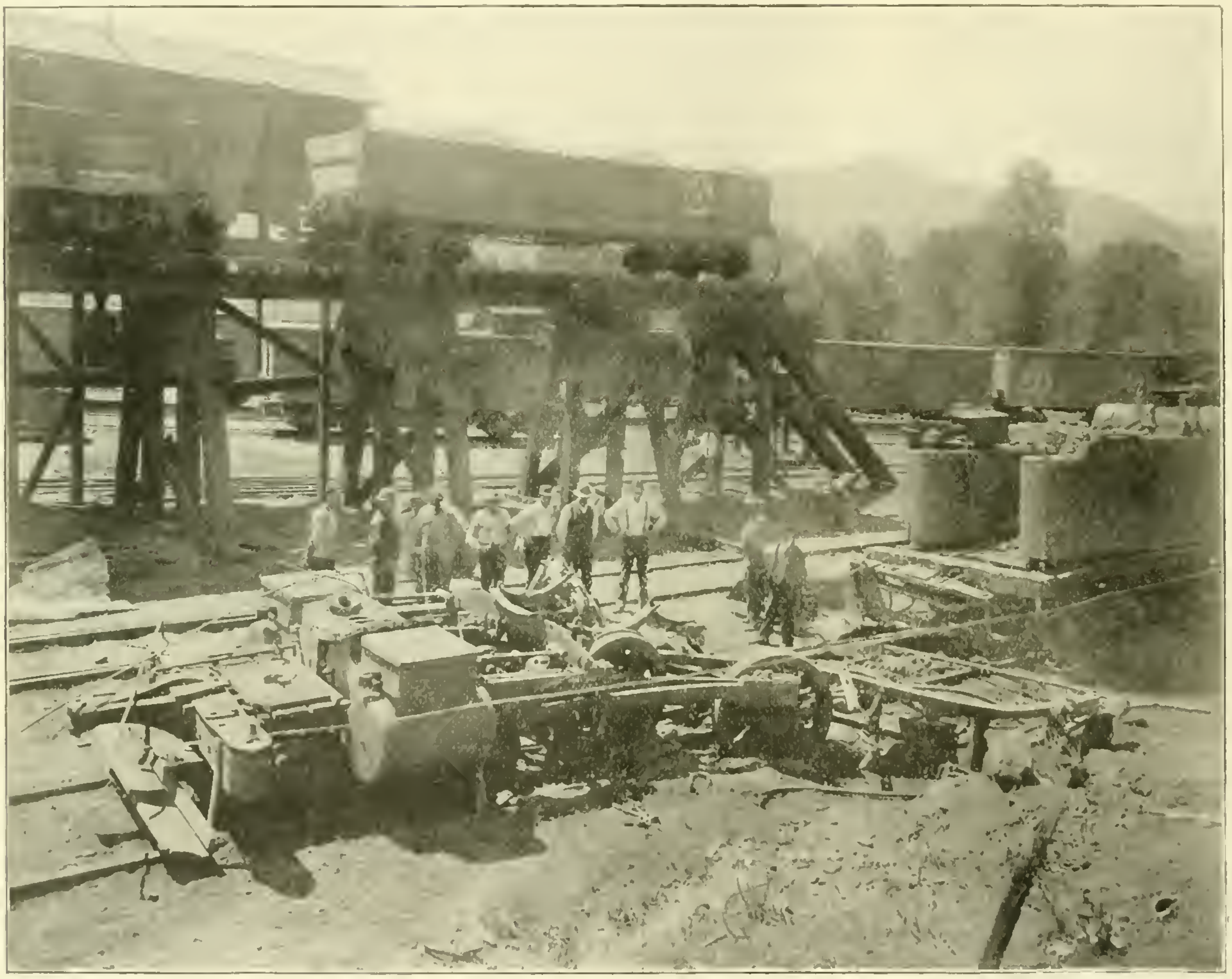
As will be seen, the boiler tore itself away from the machinery entirely, the largest part of it going over the coal chute and landing 600 feet the other side. This piece is shown in the upper picture on page 887, just as it landed, half buried in the soil. It was pulled out with a locomotive, and presented the appearance shown in the second picture.

The barrel of the boiler, together with the tubes, as shown in the lower picture, landed in the yard, about 100 feet ahead of where the engine stood. The only person injured was an engine watchman, some distance away, who was struck by one of the hand-rails, but his injuries were not serious.

The great destruction shown in the boiler is pretty good evidence that there was lots of water present—disastrous boiler explosions do not occur from extremely low water. Just what the cause of this explosion was will perhaps never be known, but the old and sound theory that the boiler was not strong enough to stand the pressure is explanation enough.

From the looks of the wreck, it would seem as though this explosion took place simply from over-pressure. In that case, something must have been the matter with the safety valves.

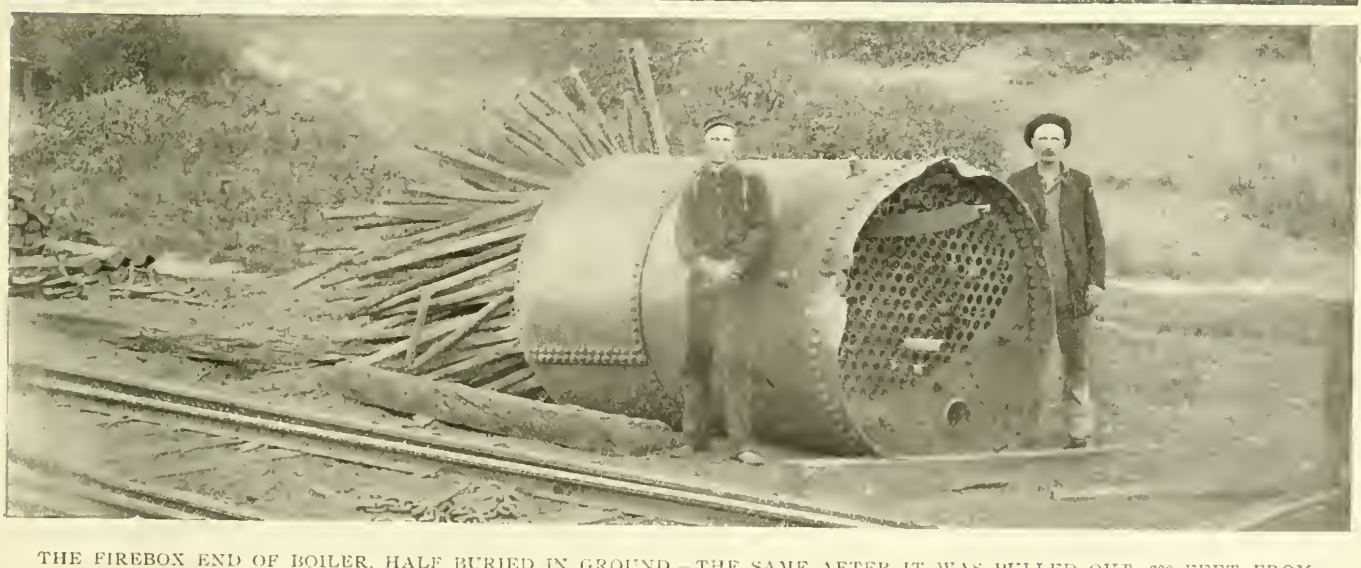
As will be seen in the picture on this page, what appears to have been the firebox was blown down and remains directly under where the engine stood. This fact will cause a great many people to assert that the explosion took place from low water. We must say, in this connection, that in no case of a burned crown sheet have we known of a disastrous explosion of this kind tearing the sheets of the boiler through solid metal. There is not generally enough water to flash into steam to do this amount of damage. However this may be, the explosion was certainly a serious one, and it is indeed lucky that the crew and workmen in the neighborhood were not about the engine.



WRECK OF MACHINERY AFTER EXPLOSION OF BOILER.

A Big Business.

There are 180,000 miles of railroad in the United States. In 1895 they carried 543,074,263 passengers and moved 763,799,883 tons of freight. Passenger trains made 327,294,734 miles, and mixed trains and freight trains made 501,868,759 miles. The earnings amounted to $1,093,139,605, and the operating expenses $769,943,151. Besides operating expenses, there was paid out, approximately, $240,000,000 as interest on bonds; $8,200,000 other interest; $81,400,000 in dividends; $60,000,000 for tolls, rents, etc., and $33,500,000 for miscellaneous charges—a total of about four hundred and thirty-two million dollars. This, added to operating expenses, leaves a balance of only five millions profit on the year's business. There were 1,627.59 miles of new railroad built in the United States in the year 1895.



THE FIREBOX END OF BOILER, HALF BURIED IN GROUND.—THE SAME AFTER IT WAS PULLED OUT, 600 FEET FROM ENGINE.—BARREL OF BOILER, 100 FEET FROM ENGINE.

Good Firing the Best Smoke Preventer.

From the time that steam boilers and furnaces first came into use up to the present day, the scientific men of the world have been, without cessation, discoursing, inventing, experimenting and dogmatizing on problems intended to show how smoke could be prevented. All sorts of attachments have been made to furnaces and fireboxes in order to burn coal in the most scientific manner, so that the greatest possible proportion of heat should be given out from the fuel and the least possible nuisance caused by smoke. There has always been an effort to reduce intelligent work and intelligent supervision of the fire to the smallest limits. The efforts of some of the improved combustion and smoke-preventing experts seem to promise the elimination of intelligent firemen altogether, and promise to make any man who can shovel coal equal to any other man with the physical strength necessary to do the work. The furnace attachments and fuel apparatus devised to bring about this comfortable state of affairs have been successively applied and always found wanting, until nowadays, when people have learned pretty well what everything in the line of mechanical appliances will do to promote good firing, and wherein the personal equation is strongest, they have settled down to depend upon the man and doubt the utility of the apparatus.

Among the latest testimony in favor of a good fireman, and against special apparatus, are notes of experiments made in Germany by two learned engineering professors. They examined a number of steam boiler furnaces, selected as types among those that had been reported by inspectors as smokeless or as smoking badly, and they arrived at the conclusion that the most important thing to be done to make an efficient and smokeless furnace is proper firing. Any and all mechanical appliances are insufficient to prevent smoke if the air supply is not exactly right, while the ordinary plain grate works admirably with intelligent firing. The generally prevalent opinion that there is a great loss of fuel in smoke is incorrect, as even in a flame free from smoke, traces of carbonic oxide and marsh gas were found. The principal condition for smokeless combustion is a high flame temperature. Smokeless firing may be effected with the ordinary grate if the fresh coal is uniformly spread over it in a thin layer, but a simpler method is to push the fire back to make room for fresh coal in front. In this way the fuel becomes completely coked at the bridge, and the heat radiated is sufficient to start the distillation of the coal and to burn the gases evolved without smoke.

Another edifying experience with smoke consumers came to our attention many years ago. An extremely simple smoke-preventing device was invented by one of the locomotive superintendents who first took the lead in applying smoke preventers to locomotives. His device was applied to the furnaces of various factories in a large Scotch manufacturing town, with the result that smoke was entirely prevented, except a small puff that would come out during the time of firing. The invention was so simple that it was easily managed by firemen, and was rather an aid than otherwise to them in doing the work. Very careful tests were made of it by certain intelligent engineers, and they reported that the smoke preventer was entirely satisfactory, except that it increased the consumption of coal 7 or 8 per cent.

A TWO-FOOT GAGE DOUBLE ENDER, FESTINIOG RY., WALES.

The Sea Beach road runs something over a hundred regular trains a day in summer, and only five a day in winter. They lay up all engines but one, and in doing it practice a little trick that saves taking off chest covers or cylinder heads: An engine to be laid up is blown off and all the water drained out; then she is towed up the track, by another engine, with her reverse lever in reverse motion, and throttle open; this pumps air into the boiler. When 70 or 80 pounds pressure is reached, the valves are oiled heavily with oil thinned with kerosene. Air is worked through injectors and all valves; the engine is run by air, and all the water of condensation thus removed. When housed, the interior of chests and the cylinders are thoroughly oiled.

Heavy Consolidation Engines for the Baltimore & Ohio Railroad.

The Cooke Locomotive & Machine Company, of Paterson, N. J., have recently turned out ten heavy freight engines as shown in our engraving. These engines were designed by Mr. Harvey Middleton, superintendent of motive power of the road, and are the first of their kind on the system. Cylinders 22 x 28 are scarce in the East.

The general dimensions are as follows:

Type—Consolidation.

Size of main crank-pin journals—Main rod, 6½ x 6 inches; parallel rod, 6½ x 5¾ inches.

Description of boiler—Wagon-top.

Diameter of boiler at smallest ring—64 inches.

Material of boiler—Park Bros.' steel.

Thickness of plates in boiler barrel—9-16 and ⅝ inches.

Thickness of plates in firebox shell—⅝ inch.

Thickness of plates in sides, back end and crown of firebox—⅜ and 7-16 inch.

Heating surface of firebox, 182.5 square feet.

Heating surface of tubes—2,155 square feet.

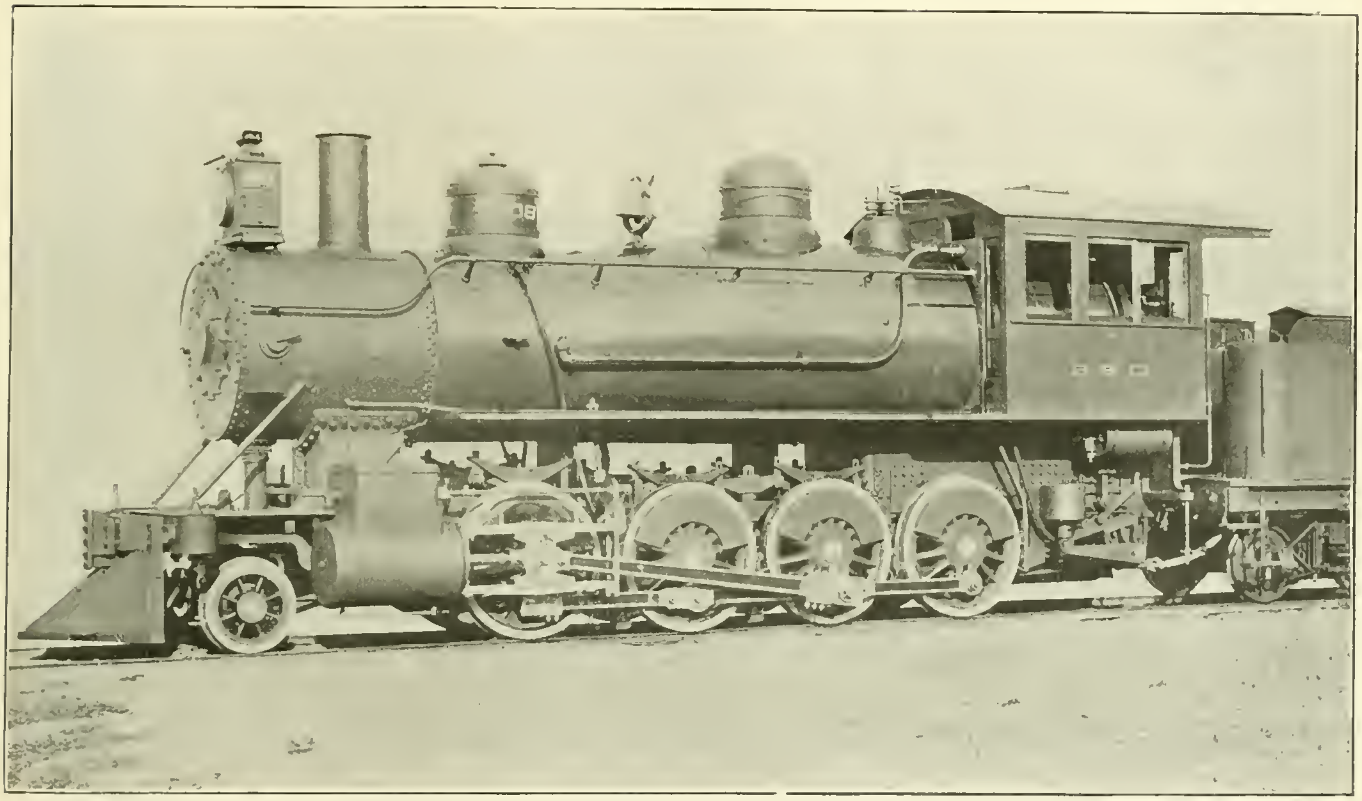
Total heating surface—2,337.5 square feet.

Height from top of rail to top of smoke-stack—14 feet 7 inches.

Tires—Standard Steel Company's.

Guides and crossheads—Guides, steel; crossheads, steel; alligator style.

Brakes—Westinghouse-American driver brakes.



B. & O. CONSOLIDATIONS FOR HEAVY FREIGHT SERVICE.

Total wheel base—23 feet 2 inches.

Rigid wheel base—15 feet.

Total wheel base of engine and tender—51 feet 7 inches.

Total length of engine and tender over all—61 feet 3 inches.

Diameter of cylinders—22 inches.

Stroke of piston—28 inches.

Diameter of piston rods—4 inches.

Size of steam ports—20 x 1⅝ inches.

Size of exhaust ports—20 x 3¼ inches.

Greatest travel of slide valves—6 inches.

Outside lap of slide valves—15-16 inch.

Lead of slide valves in full stroke—1-16 inch.

Diameter of driving wheels, outside—54 inches.

Kind of truck wheels—30-inch, steel-tired, wrought-iron spoke center.

Diameter of truck wheels—30 inches.

Size of driving-axle journals—8½ x 10 11-16 inches.

Size of truck-axle journals—5 x 8¾ inches.

Thickness of plates in front and back tube sheets—½ inch.

Kind of horizontal seams—Butt with double welt.

Kind of circumferential seams—Double-riveted.

Material of tubes—Iron.

Number of tubes—248.

Outside diameter of tubes—2¼ inches.

Length of tubes over tube sheets—14 feet 9 inches.

Inside length of firebox—115 inches.

Inside width of firebox—41 inches.

Depth of firebox from crown sheet to bottom of mud ring—Front, 69 7-16 inches; back, 67 3-16 inches.

Water spaces, sides and back—3 inches.

Water spaces, front—4 inches.

Crown sheet stayed with—Crown bars.

Diameter of dome, inside—30 inches.

Height of dome—24 inches.

Steam pressure—180 pounds.

Kind of grate—Rocking.

Grate surface, 37.75 square feet.

Connecting rods—Channeled bodies.

Lubricators—Nathan triple.

Injectors—Monitor No. 10.

Valves—Richardson balanced.

Gages—8½-inch Crosby.

Springs—Pickering.

Safety valves—Coale 3-inch muffled.

Packing, valve stems and pistons—United States.

TENDER.

Wheels—33-inch chilled.

Axles—Steel.

Size of axle journals—4¼ x 8 inches.

Water capacity of tank—4,000 gallons.

Frames, wood or metal—Wood.

Brake beams—National hollow.

Brake heads and shoes—Christie.

For the month of September the exports of American products were $34,272,889 more than the imports of foreign goods. Last year the imports were $6,765,257 more than exports.

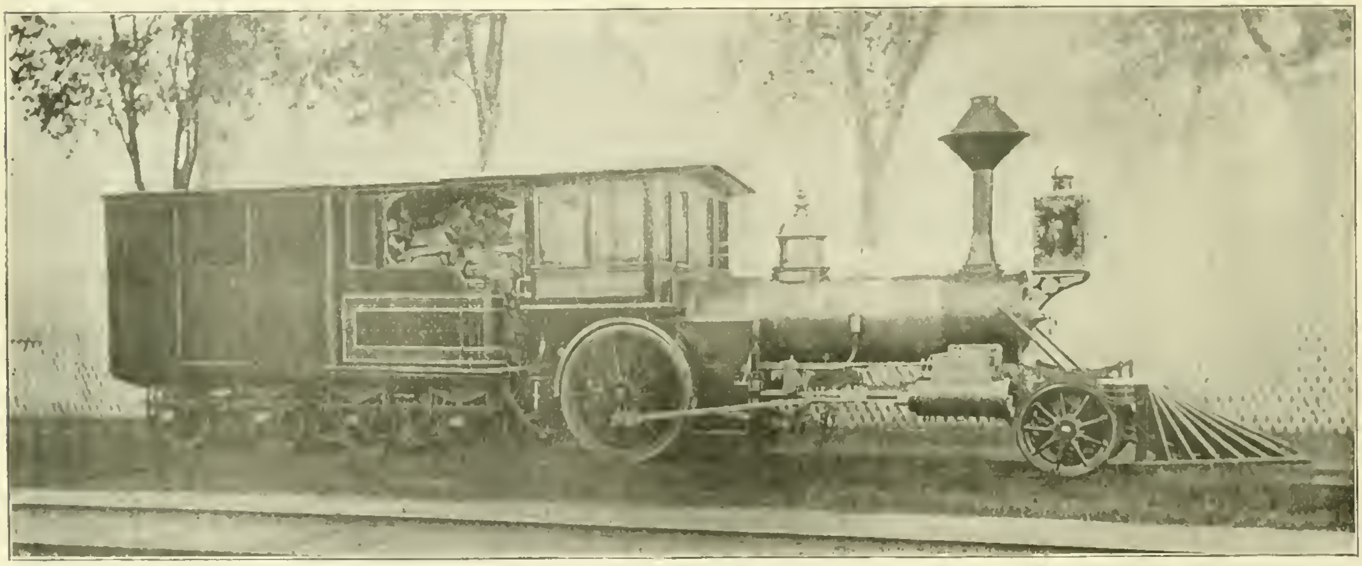
Irregular Wear of Driving-Wheel Tires.

The necessity for putting counterbalance weights in the driving wheels of locomotives to counteract the disturbing effect of the reciprocating parts, and to help balance the crank and rods, has led to a great deal of discussion and theories about the effects of the counterbalance, wherein the evil effects of the counterbalance are very often exaggerated. When driving wheels are very small and reciprocating parts excessively heavy—an evil combination very often found in American locomotives—the counterbalance is likely to do considerable injury to track and bridges if the speed is not kept down. There is no doubt whatever that the evil effects of heavy counterbalance are bad enough, but it is often blamed for disturbance due to other causes.

A fairly good illustration was given when the subject of counterbalancing locomotives was under discussion at a recent meeting. Mr. G. R. Joughins, of the Norfolk & Southern, asked the question: "How are we to know when an engine is properly balanced?" "What effect will it have on the engine, or what parts will show that the engine is properly or improperly balanced?" He believed that the particular track on which an engine is running has great influence on the counterbalance required, his belief being that a sandy soil had an important bearing on the proper counterbalancing of an engine. They had great difficulty in keeping the drivers of certain engines in good condition, and he attributed the trouble to improper counterbalance. The tire flattened out so quickly that the engine could not be run to make a reasonable mileage. They have "mogul" engines with 56-inch driving wheels, that run very satisfactorily at 20 miles an hour; but if an emergency arises, which required that the engine should be run at 40 miles an hour, they flatten their tires before they have run 5,000 or 6,000 miles, and flatten them so badly that the engines have to be taken out of service. Another class of passenger engines, which is evidently well designed, cannot be run over 20,000 miles without the tires being turned. This was such an excessive case of irregular wear that the wheels were taken out, and the different parts weighed and found to agree with the ordinary rule for balancing driving wheels. The makers of the engines were applied to, to see if they could suggest a remedy, but they replied that the engine was properly counterbalanced, according to the most approved rule, and that they could do nothing. Mr. Joughins was then at his wits' end, and applied to the Master Mechanics' Association for counsel to find out the cause of the excessive wear.

In reply to his inquiries, Mr. E. M. Herr, who has devoted a great deal of attention to counterbalance of driving wheels, and to the irregular wear of tires, expressed the opinion that the excessive wear was due to unskillful handling of the engine on sandy track, that the wear was caused by slight slipping of the engine in starting, and that it would be found to occur on the points of the tire resting on the rail when the engine was doing its most powerful rotative work. The explanation given seems to be a very rational one, and it may be correct, but we are not entirely satisfied with it.

It is well known that the best counterbalanced locomotive, with small driving wheels, will slip slightly, through the action of the counterbalance, at very high speeds. On a sandy track this would have a grinding action on the part of the tire where slipping took place, which would lead to rapid flattening. An engine in ordinary passenger service has to be started comparatively seldom, and we do not think that the number of times the engine had to start in 20,000 miles' service would be sufficient to grind flat spots on any part of the tire; but if the engine was doing a little slipping at each revolution every time she got into high speed, it would not take very much mileage to grind flat spots. A few years ago, the late J. N. Lauder reported having had great trouble with driving wheels of engines running on the Cape Cod division of the Old Colony Railroad. The track was very sandy, and the engines wore their tires irregularly, and just in the same way reported by Mr. Joughins, and no satisfactory explanation was given of the phenomenon. Other men in charge of locomotives on sandy roads have encountered similar difficulties in keeping their driving wheel tires in running order. It seems to us that the subject is worthy of special investigation. If any of our readers, operating locomotives on sandy roads, have found any remedy for the trouble of tires wearing irregularly, we should be glad to hear from them.



SMALL SPECIAL ENGINE BUILT BY WM. MASON THIRTY YEARS AGO.

Meanwhile, we think that it would be well for people who have their engines thrown out of service owing to excessive irregular wear of tires on sandy roads, to keep down the weight of counterbalance just as low as possible, consistent with the smooth running of the engine. The best practical test that the counterbalance is sufficient, is to find that the engine runs smoothly when steam is shut off.

The Santa Fé freight cars are all painted by air at Topeka. They seem to have overcome the trouble experienced elsewhere, and use no more paint than is used with brushes.

There seems to be an epidemic of locomotive boiler explosions. Inspect!

When Furnace Sheets Get Hot.

A committee has lately been investigating for a foreign engineering society, the best procedure to be followed by a man in charge of a steam boiler when he discovers that the furnace sheets have become overheated from shortness of water. The committee was unanimous in recommending that water be forced into the boiler as quickly as possible no matter how hot the sheets may be. This is undoubtedly the right thing to do, but there are many persons, especially in the United States, who believe that pumping cold water into a boiler with over-heated sheets is almost certain to cause a boiler explosion. That is a mistake. Red hot cast iron is likely to break if cold water is poured upon it, but wrought iron and steel do not act in that way.

About twenty years ago, a committee appointed by the Franklin Institute made a very thorough series of experiments with steam boilers, and one line of tests was to ascertain the effect of pumping cold water into the boilers after the sheets were overheated. A variety of trials of this character were made, and neither explosion nor rupture of the sheets resulted.

The seams and staybolts leaked so that they put out the fire but no indications were discovered that could lead the engineers making the tests to believe that the danger to the boiler was increased by filling it when hot with water.

If the characteristic of hot boiler plate was to fly to pieces when suddenly brought in contact with cold water, there would be some reason for the belief that opening the feed would be dangerous when the plates were accidentally overheated; but this tendency has never been manifested. If a piece of red hot boiler plate is plunged into cold water the act has an annealing tendency. We never heard of a plate cracking when treated in that way, and there is no reason for believing that the material would act differently when composing furnace sheets.

Some people who know better than to believe that cold water would make boiler plate fly to pieces, are under the impression that a rush of steam might be formed from the water striking the red hot plates which would be of too great a volume to be relieved by the safety valves and that an explosion might result. Those who are alarmed about the generation of heat from hot plates should look up in an engineer's pocket book the specific heat of iron and proceed to figure on how many pounds of red hot iron it would take to convert one pound of water into steam at 100 pounds pressure. This increase of knowledge would dissipate the rush of steam theory.

There is nothing in the popular belief that pumping cold water into an overheated boiler increases the danger of explosion. That is a mere theory unsupported by facts, but it has led to many a boiler being badly burned that would have sustained little damage had the feed been promptly applied. The mistaken fear of the disastrous effects of cold water on hot sheets sometimes deters firemen from quenching the furnace with water, and this helps to render the danger and damage all the greater.

It is the fashion to say when a boiler explodes that the accident was due to low water. This is very rarely true. The only way that hot plates makes a boiler dangerous is that the material is weakened and therefore more liable to rupture from the steam pressure within. When this condition of weakness is discovered, the best plan to pursue is to restore the original strength of the sheets by pouring cold water upon them with the least possible delay.

EXPRESS TRAIN, N. Y. ELEVATED ROAD, RUNNING THIRTY FIVE MILES PER HOUR.

Early Days of Coal.

W. K. Humphrey, a veteran in the coal business, has furnished to the Ithaca "Journal" an interesting account of the introduction of coal as a fuel in Central and Western New York. In 1851, Ithaca was the distributing point for Syracuse, Rochester, Buffalo and other points West, the coal being shipped by canal. All over this section of the State the fuel burned was wood, and the coal men found it very difficult to introduce coal. Mr. Humphrey recalls the fact that in October, 1851, shortly after the first load of coal arrived in Ithaca, he shipped to Mr. Barker in Buffalo 200 tons of coal. The coal was taken to Buffalo by canal by Capt. B. L. Johnson. After it had arrived there he received word from Mr. Barker stating that the coal had arrived, but that there was no market for it. The coal had been invoiced to Mr. Barker gratis, he having only to pay the canal charges. It was so valueless to him, however, that he would not even do this. Mr. Humphrey directed Captain Johnson to deliver the coal to Mr. Barker without any charges whatever, and that man unwillingly accepted it. It remained in his possession nearly a year, during which time he managed to ship a part of it to Western cities.

In Syracuse they knew nothing of coal. Mr. Humphrey shipped a lot of coal to Syracuse, and, to introduce it, got one of the hotel men to use it. In order to gain this concession Mr. Humphrey bought a coal-stove of Treman, King & Company and presented it to the hotel man, and he burned coal all that winter.

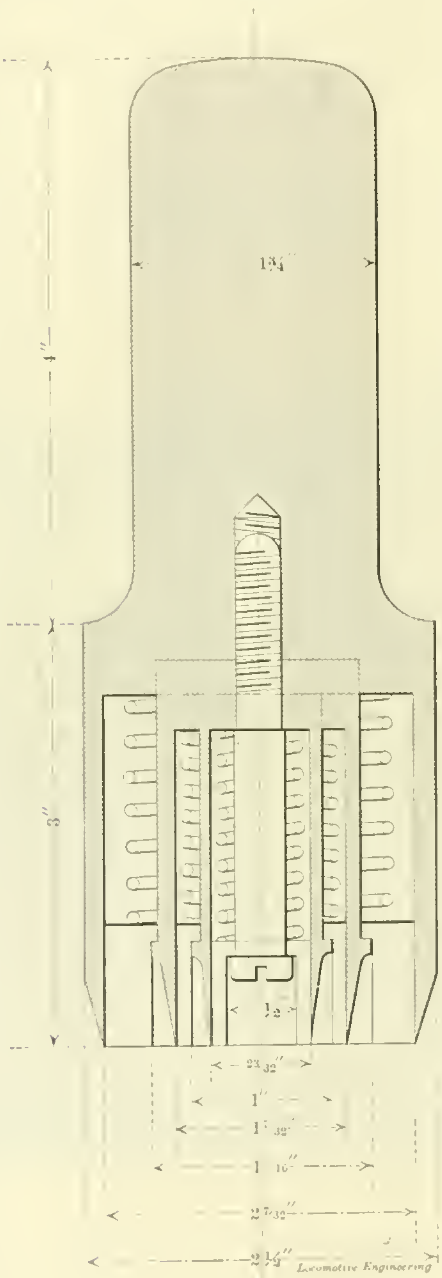
Rochester was an exceedingly hard city to introduce coal into. The coal was shipped from Ithaca to an agent there. The agent had to give away stoves, and, further, had to show the people how to start the fire. Some would fill the stove with coal, put a piece of paper on top, light it and expect it to burn, and when it failed to ignite, send word to the agent to come and take back his stove and coal as it was no good.

Mr. Humphrey states that the first coal train rolled into Ithaca over the Delaware, Lackawanna & Western Railroad on October 15, 1851. Word that the train would arrive had spread around the city, and when it reached there over 1,000 people were at the station to see the train and the coal. The people swarmed around the train and took pieces as curiosities, probably the major portion of those present never having seen coal. In those days it was called "stone coal." The canal men termed it "mineral coal." In Ithaca very little coal was used before that time. Mr. Humphrey used some at his office, which was brought to him by canal men at his special order.

There is a car famine in the West on account of the boom in wheat exports. Grain roads busy.

Gang Gasket Cutter.

Our illustration of the punch for cutting gaskets shows a device for which Mr. John Porter, foreman of the Wisconsin Central tool room at Waukesha, is responsible. The cutter will make two perfect gaskets at one cutting, and leave a blank at the center from which one more can be made if it is thought necessary to



utilize the small scrap left. The tool is an ingenious one, covering the usual sizes in joint work requiring gaskets, by means of several punches similar to the one shown, the waste pieces from the larger sizes cutting into gaskets on the next smaller size of punch.

We want to say here that there are few tool rooms within our knowledge that outrank this in putting out rational schemes by which to do work quickly and well in the shop. The rigid insistence of proper treatment of tools while in use has reduced the breakages to a minimum, and has much to do with keeping the cost of maintenance down to a reasonable figure—a result that would be naturall looked for when men are made to show cause for the abuse of a tool.

Prince Hylcoff, Minister of Ways and Communications of the Russian Empire, is in the United States on a tour of inspection. Prince Hylcoff once worked as a mechanic on the Pennsylvania Railroad, was a blacksmith in the Argentine, and ran a locomotive between St. Petersburg and Moscow. Though a prince, his finances got disarranged; but he came up from the lowest round of the ladder through all the offices, on his own merit, and re-established the house and fortune of Hylcoff. As he is a self-made man and served his time in the ranks, the railroad men of America will give him a royal welcome and won't hold the fact of his being a prince against him.

On October 5th an express train on the A., T. & S. F. was nearing Topeka, Kan., at a speed of forty-five or fifty miles per hour. Without warning there was a frightful explosion, the engine was torn to atoms, the trucks of the tank and first two cars blown in a heap together and the train wrecked—no one hurt except engineer and fireman, who were killed. It was at first thought that it was a boiler explosion; but the engine, a Baldwin 10-wheeler, was only about two years old; the engineer was one of the best, and had been on the run for eighteen years; and there was a hole in the track deep enough to bury an engine and tender. The officials believe now that the explosion was that of dynamite.

In the Havemeyer Building, this city, they have recently put an Ingersoll air compressor in the engine room, and supply air to all the floors of the building. Any of the tenants who want air can have it. The Ingersoll-Sergeant people themselves will probably be the largest users, as they use air to run all their tools for exhibition purposes in their show-room. The doors are opened by air, call-bells are operated by air, letter-presses are operated by air, and the furniture is dusted and carpets cleaned by compressed air. This is a new feature in office buildings, and may become a very popular one. Anybody that knows anything about compressed air knows that when air is compressed it is heated, and when it is expanded it is cooled. Perhaps the time may come when a jet of air in the office, in the heat of summer, will be used as the most convenient and effective way of cooling.

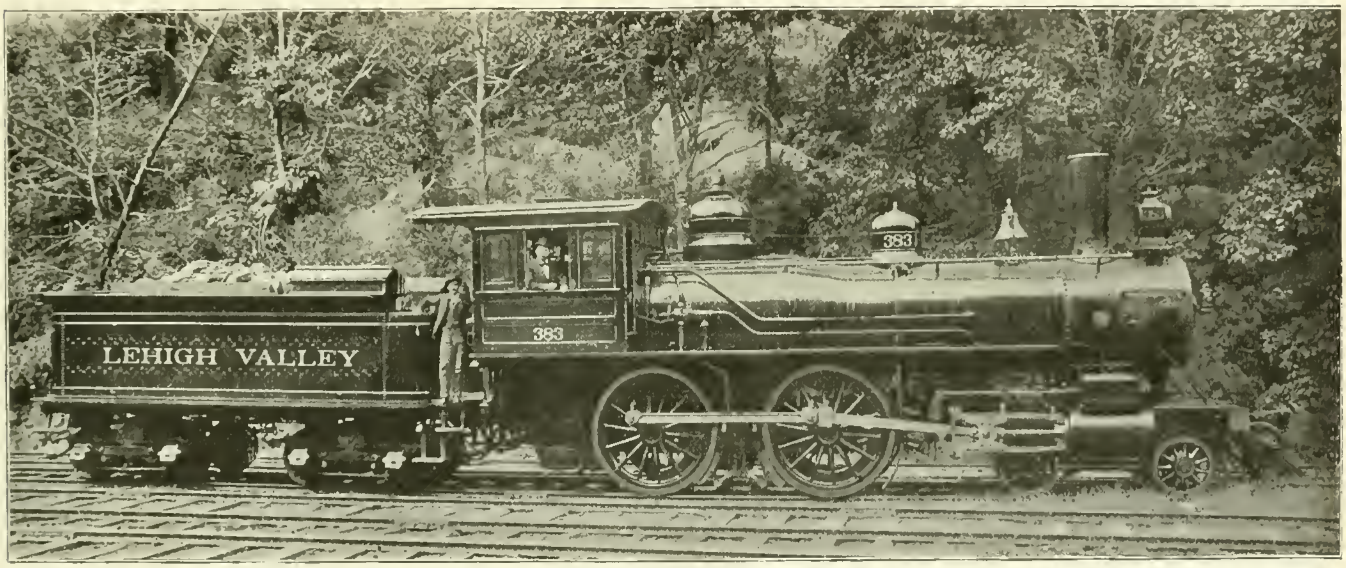
A Reformed Strong Locomotive.

Our picture shows the Lehigh Valley Engine "383," just out of the Wilkes-Barre, Pa., shops, the first locomotive fitted with the Strong valve motion.

A relic of this invention is shown in the boss on the main rod—from this a pin agitated the valve motion in the first design. The gear was afterward modified and operated by eccentrics. Now it is thrown away for the old reliable link motion.

After this experimental work with the valve motion, the famous "Duplex 444" was built at Wilkes-Barre, the first with the Strong twin corrugated fireboxes.

This engine has had many ups and downs, like the tramps—one day in affluence, the next in the gutter. For the past two years she has had no work at all. Now, after a thorough overhauling, she is helping to tote coal over the Wilkes-Barre mountain on the Wyoming Valley division of the Lehigh Valley Railroad.



FIRST ENGINE WITH STRONG VALVE GEAR—REFORMED.

The Blenkinsop Engine.

A description of one of the first locomotives and its performances, in a practical test to determine its adaptability to the work then done by horses, is an interesting bit of history as it appeared in the "Leeds Mercury" of June 27, 1812, and reproduced in the "Railway Herald" as follows:

The following paragraph, descriptive of the above engine, appeared in the "Leeds Mercury" of June 27, 1812:

"On Wednesday last (June 24th) a highly interesting experiment was made with a machine constructed by Messrs. Fenton, Wood & Murray, of this place, under the direction of Mr. John Blenkinsop, the patentee, for the purpose of substituting the agency of steam for the use of horses in the conveyance of coals on the iron railway from the mines of J. C. Brandling, Esq., of Middleton, to Leeds. The machine is, in fact, a steam engine, of four horse-power, which, with the assistance of cranks turning a cog-wheel, and iron cogs placed at one side of the railway, is capable of moving at the speed of ten miles an hour. At four o'clock in the afternoon the machine ran from the coal staith to the top of Hunslet Moor, where six, and afterwards eight, wagons of coal, each weighing 3¼ tons, were hooked to the back part. With this immense weight, to which, as it approached the town, was superadded about fifty of the spectators mounted upon the wagons, it set off on its return to the coal staith, and performed the journey—a distance of about a mile and a half, principally on a dead level—in twenty-three minutes, without the slightest accident. The experiment, which was witnessed by thousands of spectators, was crowned with complete success; and when it is considered that this invention is applicable to all railroads, and that upon the works of Mr. Brandling alone the use of fifty horses will be dispensed with, and the corn necessary for the consumption of at least two hundred more saved, we cannot forbear to hail the invention as of vast public utility, and to rank the inventor amongst the benefactors of his country."

Another paragraph in the same paper two months later describes Mr. Blenkinsop's "machine" as being in full activity. Other engines of the same kind were built by Mr. Murray, and in 1813 one of them was forwarded to Newcastle, and was used on a railway leading from the Kenton and Coxlodge Colliery to a point on the Tyne below Walker. It was doubtless seen in operation there by George Stephenson, who had made the acquaintance of Murray, and become familiar with the strange mechanism that subsequently in his hands revolutionized the carrying trade of the country. Until a better locomotive was found at work, the "machine" at Middleton Colliery was a sight which attracted many visitors. Amongst other notabilities who came to see it was the Grand Duke Nicholas (afterwards Emperor) of Russia. This was in 1816. On that occasion the power of the engine was shown in the conveyance of thirty loaded coal wagons at a speed of about 3¼ miles an hour.

The patent, dated April 10, 1811, is taken out in Blenkinsop's name. The engine showed a manifest improvement on Trevethick's previous attempt, being provided with two double-acting cylinders placed vertically, which were immersed for more than half their length in the steam space of the boiler. A regular and steady action was thus obtained without a fly-wheel. The idea was to run the engine on a rack-rail, into which a pinion would fit, and in accordance with this notion the engine and rails were constructed. The engine was provided with a double set of smooth wheels (the pinion being the center one), so that the purpose served by the pinion and the rack was only for leverage or purchase. By this means the difficulty of working upon gradients was overcome. The engine commenced to run two years before George Stephenson started his first locomotive.—"Railway Herald."

It was announced in all the railroad papers last month that Mr. J. G. Thomas had been appointed superintendent of motive power of the Lehigh & Susquehanna division of the Central Railroad of New Jersey. As a matter of fact, Mr. Thomas is assistant superintendent of motive power as heretofore. If all roads followed the commendable practice of the Lehigh Valley in sending to the railroad papers all notices of appointments, great and small, it would do much to make information authentic and reliable.

Mogul for the Great Northern Railway.

The new mogul shown in our half-tone is a product of the Brooks Locomotive Works, built for the Great Northern. It is a sample of heavy freight engine extensively used on that road, and of a type that has been found to be admirably fitted to cope successfully with the hardest problems of freight service. Following is a description of the engine:

Type—Mogul.

Simple or Compound—Simple.

Gage—4 feet 8½ inches.

Kind of fuel—Bituminous coal.

Steam pressure—180 pounds.

Diameter of cylinders—19 inches.

Stroke—26 inches.

Wheel base of engine—21 feet 6 inches.

Driving-wheel base—14 feet.

Total wheel base of engine and tender—49 feet.

Diameter at smallest ring—63 inches.

Thickness of cylindrical plates, waist—9/16 inch.

Thickness of throat sheet—⅝ inch.

Longitudinal seams, kind—Quadruple and quintuple riveted.

Vertical seams, kind—Double-riveted.

Firebox, kind — Sloping, between frames.

Firebox, length inside—98 inches.

Firebox, width inside—32 inches.

Firebox, material—Homogeneous firebox steel.

Firebox, side sheets, thickness—5/16 inch.

Firebox, back sheet, thickness—⅜ inch.

Crown sheet, thickness—⅜ inch.

Flue sheet, thickness—Front, ⅝ inch; back, ½ inch.

Water spaces, width—3½ inches sides and back, 4 inches front.

Tubes—diameter, 2 inches; length, 11 feet 1 inch.

Whistle—Curran chime.

Bearing metal—Phosphor bronze.

Brakes, train—New York automatic on all tender wheels.

Brakes, driver—New York automatic, outside-equalized.

TENDER.

Frame, kind—10-inch channel iron.

Truck, kind—Two, four-wheeled.

Wheels, kind—Steel-tired.

Wheels, diameter—33 inches.

Tires—Krupp No. 4, O. H. steel.

Truck axles—Hammered iron.

Truck-axle journals—4¼ inches diameter, 8 inches long.

Capacity for water—4,000 United States gallons.

We will present any Y. M. C. A., or other railroad reading-room, with a bound volume of 1894 if they will pay $1 for the postage.

MOGUL FREIGHT LOCOMOTIVE FOR GREAT NORTHERN RAILWAY.

Driving wheels, diameter over tire—55 inches.

Driving wheels, diameter over center—48 inches.

Driving wheel centers, kind—Cast iron.

Driving-wheel tires—Krupp crucible steel.

Engine-truck wheels, diameter — 30 inches.

Engine-truck wheel centers, kind—Spoked cast iron.

Engine-truck tires, kind—Krupp No. 3, O. H. steel.

Weight on drivers—114,000 pounds.

Weight on engine truck—16,000 pounds.

Weight of engine, total — 130,000 pounds.

Weight of tender—85,000 pounds.

Weight of engine and tender, total—215,000 pounds.

Tractive power, at 90 per cent. B. P.—23,800 pounds.

Co-efficient of adhesion—4.78.

BOILER.

Type—Patent improved Belpaire.

Material—Homogeneous steel plates.

Tubes, number—250, No. 11 B. W. G.

Grates—Railway company's pattern.

MACHINERY.

Piston rods, kind—Hammered steel.

Piston rods, diameter—3½ inches.

Piston-rod packing—Jerome metallic.

Piston packing—Cast-iron rings.

Crosshead—Laird, cast steel.

Driving axles, kind—Hammered steel.

Driving-axle journals—8 inches diameter, 9 inches long.

Engine-truck axles, kind—Hammered iron.

Engine truck journals—5¼ inches diameter, 10 inches long.

Connecting rods—I-section.

Side rods—Rectangular section.

Valves, kind—Richardson balanced.

Lubrication, guides—Adjustable needle cups.

Lubrication, rods—Spindle feed cups.

Lubrication, cylinders—No. 9 Nathan.

Injectors—One old-style No. 9 Monitor, and one No. 9 New Nathan.

Safety valve—One 3-inch Crosby muffled.

Some New Ten-Wheelers for the Baltimore & Ohio.

The Baldwin Locomotive Works have recently turned out ten ten-wheeled engines for the Baltimore & Ohio road, on the general plan shown in our photographic reproduction.

Six of these engines have 21 x 26-inch cylinders, and four of them have 20 x 26-inch cylinders. All the way through there is a slight difference in the engines. There is a difference in height of three inches and a difference in the size of some of the materials used.

We give below the general dimensions of both kinds, of which the one shown has the largest cylinder:

Type and number ordered ....Ten-wheel.	6	4
Total wheel base.	24'6"	24'6"
Rigid wheel base.......	13'8"	13'8"
Total wheel base of engine and tender.	51'8¼"	51'8¼"
Total length of engine and tender over all....	61'9"	61'9"
Diameter of cylinders...	21"	20"

Stroke of piston	26	26
Diameter of piston rods	3½	3½
Size of steam ports	19 x 1⅜	19 x 1⅜
Size of exhaust ports	19 x 2¾	19 x 2¾"
Greatest travel of slide valves	6"	6"
Outside lap of slide valves	1	1"
Lead of slide valves in full stroke	$\frac{3}{32}$"	$\frac{3}{32}$"
Diameter of driving wheels, outside	78"	68"
Kind of truck wheels	Wro't Center.	
Diameter of truck wheels	33"	33"
Size of driving axle journals	8 x 10"	8 x 10"
Size of truck axle journals	5 x 10"	5 x 10"
Size of main crank pin journals	6 x 6"	6 x 6"
Description of boiler	Wag. Top.	
Inside length of firebox	120⅜"	120⅜
Inside width of firebox	41	41"
Depth of firebox from crown sheet to bottom of mud ring	F. 73½ B. 61	F. 73½ B. 61"
Water spaces, sides and back	3	3
Water spaces, front	4"	4"
Crown plate stayed with one ⊥ iron front; bolts 1⅛" diameter	Radial Stays.	
Diameter of dome	31½	31½"
Height of dome, from top of rail, with boxes in cen. of ped	14'9"	14'4"
Steam pressure, pounds	190	190
Kind of grate	Rocking Co.'s pat.	
Heating surface of firebox, sq. ft	215.2	215 2
Heating surface of tubes, sq. ft	1978.52	1978 52
Special devices, air signal, Leach sander, Gold steam heating device, Gould coupler.		

TENDER.

Wheels	36	33
Axles	Steel.	Steel.
Size of axle journals	4¼ x 8"	4¼ x 8"
Water capacity of tank	3500	3500
Frames, wood or metal	Wood.	Wood.
Brake beams, kind and make, National hollow.	2½"	2½"
Brake heads and shoes, kind and make, mall. head east iron shoe.		

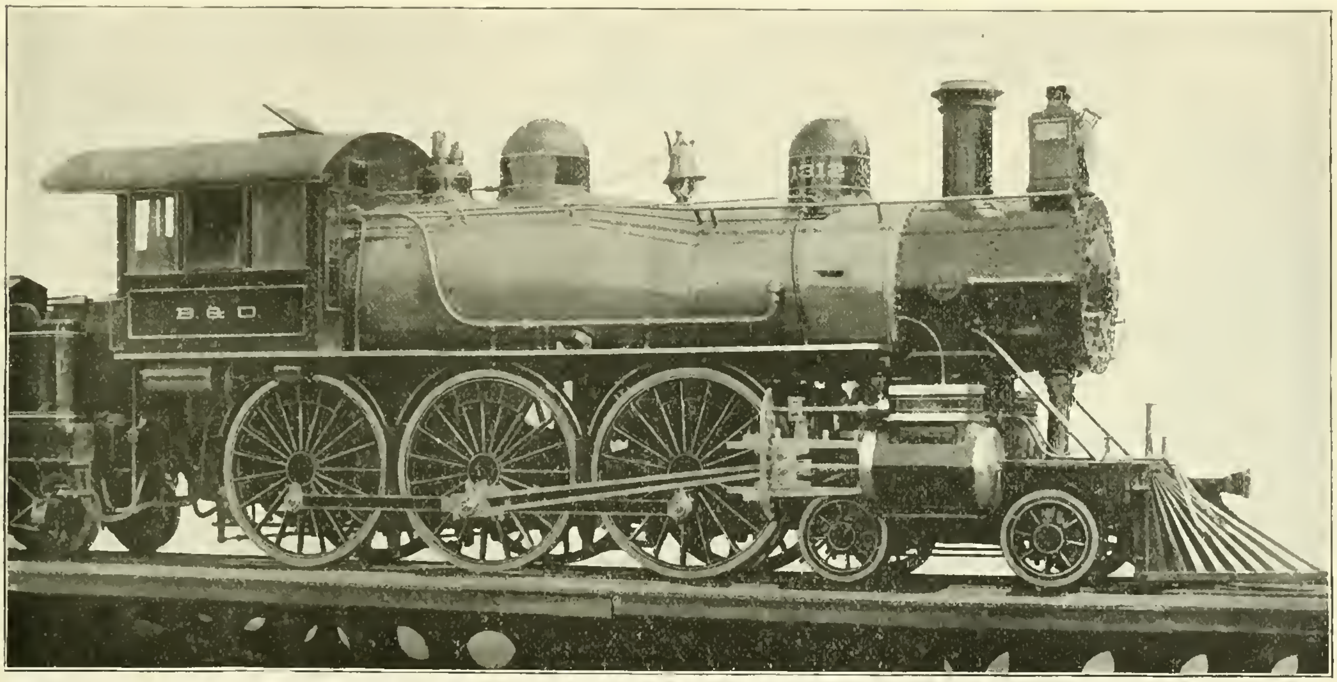
Notes from the Baldwin Locomotive Works.

Notwithstanding the too apparent paralysis in all industrial occupations, and particularly in the field of locomotive engineering, the Baldwin Locomotive Works have built 169 four-cylinder compounds thus far this year, and have 12 large engines of the same type well toward completion, in addition to 28 simple engines also under way.

The records show 715 compounds all told as the output since they began the manufacture of compound locomotives, and the total number of locomotives turned out of these works has now reached the handsome figure of 15,070 engines.

A new tank shop and blacksmith shop, erected on the site of the old Norris Locomotive Shop, does not have the appearance of hard times. The blacksmith shop and foundry are working full time, and the other shops two-thirds time, with orders in sight that have a cheerful look to those interested.

That there is confidence in the future is



TEN-WHEELER EXPRESS LOCOMOTIVE FOR BALTIMORE & OHIO.

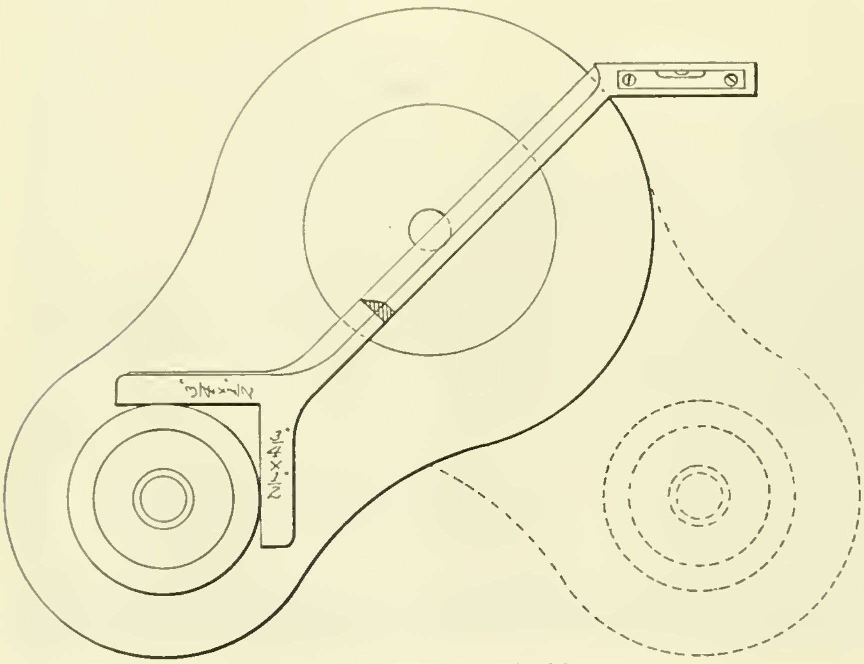
Diameter of boiler at smallest ring	60"	60"
Material of boiler	Steel.	Steel.
Thickness of plates in boiler barrel	⅝"	⅝"
Thickness of plates in firebox shell	$\frac{9}{16}$"	$\frac{9}{16}$"
Thickness of plates in sides, back end and crown of firebox	⅜" $\frac{7}{16}$"	⅜" $\frac{7}{16}$
Thickness of plates in front and back tube sheets	½	½"
Kind of horizontal seams	Butt.	Butt.
Kind of circumferential seams	Double Riveted.	
Material of tubes	Iron, No. 12 to 9.	Iron, No. 12 to 9.
Number of tubes	231	231
Outside diameter of tubes	2¼"	2¼"
Length of tubes over tube sheets	14'7½	14'7½
Grate surface, sq. ft	34.27	34.27
Total heating surface, sq. ft	2193.72	2193.72
Height from top of rail to top of smoke stack boxes in cen. of ped	15'	14'7"
Tires	Steel, Standard.	
Guides and crossheads, type and metal, two bar type	Iron C. H. Guides.	Cast Steel X Head.
Connecting rods, parallel rods, I section, solid ends	Steel.	Steel.
Brakes, Westinghouse-American, outside equalized		Sch. X m
Lubricators	Nathan S. F.	
Injectors	No. 10 Metrop'tn	
Valves, three Coale muffled	2½	
Gages, two Crosby thermostatic.		

shown by the installation of a 100-inch double-head driving-wheel lathe, and its duplicate to go in as soon as the foundation is ready for it. There are many special features of merit about these lathes, built by Sellers & Co., that will be exploited in a later issue with a full description of the tool.

Quartering Test Gage.

The gage shown herewith for testing driving wheels and crank pins to determine the accuracy of quartering, or whether the pins are sprung, was designed in 1884 by Mr. D. J. Limlin, now general foreman of the Cleveland, Cincinnati, Chicago & St. Louis Railway shops at Bellefontaine, O.

This tool is made of steel, ¾ inch wide and ½ inch thick, with an arm at 45 degrees with the square at lower end. This arm is beveled on the outer face to a sharp edge at the inside, as seen in section, and its upper end is fitted with a spirit level that is true with the lower edge of the upper limb of the square.



QUARTERING TEST GAGE.

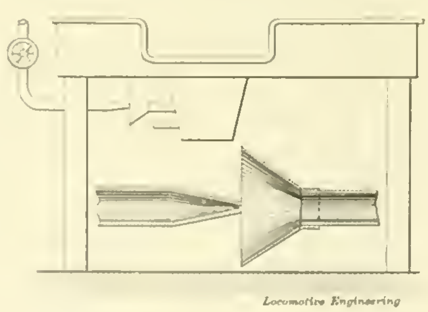
In use the tool is applied as shown, with the pins on the lower eighths, the square against the collar on the pin, the beveled edge passing through the center of the axle, and the bubble in the spirit level in the middle of its travel. With this side for a base of comparison the tool is placed on the opposite pin, showing at once how near the wheels are in quarter. We are indebted to Mr. Ralph E. State for the particulars of this useful device.

Compressed Air as Forge Blast.

A novel application of compressed air to an ordinary portable forge is to be seen at the Northern Pacific roundhouse in Minneapolis, Minn. The most of the novelty lies in the results so cheaply attained by a little experimenting with the air plant, with the view of using some wind on the forge shown in our engraving.

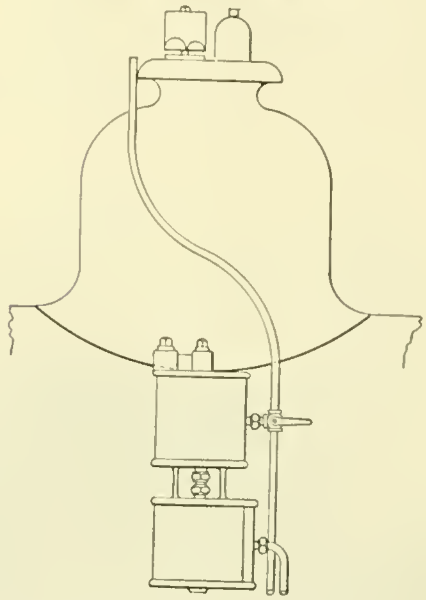
Mr. John Ellstrom, the foreman blacksmith, who is responsible for the "borning" of this idea, found that there was greater intensity of blast on the fire when the air pipe was led into the tuyere by a funnel-shaped opening; in fact, too much blast. This discovery resulted in contracting the opening of the air-discharge pipe until the nozzle was left at 1-32-inch diameter, as shown in the enlarged view.

The position of the nozzle with reference to the funnel, or perhaps it should be called the combining tube, was found to give the best results, just as in the case of an injector. Too far in or too far out, it would deaden the fire so as to be inoperative. Holding a piece of waste around the funnel would have the same effect; the 1-32-inch stream of compressed air at 60 pounds pressure having barely enough force to cause a glow on the coal, showing that the induced currents set up through the combining tube are responsible for the blast, they furnishing the volume of air, and the nozzle contributing the energy to put them into the fire.



COMPRESSED AIR AS FORGE BLAST.

All roundhouse blacksmithing at this point is now done on the small forge shown; welds are made easily on work as large as 2½ x 4 inches. It would seem that the information gained by Mr. Ellstrom in perfecting this idea could be utilized to advantage in many places where compressed air is now used wastefully.



Air-Pump Exhaust.

Mr. John Ellis, master mechanic of the Chicago, St. Paul, Minneapolis & Omaha road, has for some time past been of the belief that the air-pump exhaust, as carried to the smoke arch, caused a waste of fuel through its constant fanning action on the fire.

With the end in view of preventing this loss if possible, several engines were equipped as shown in the engraving, in which the exhaust pipe is shown carried both up and down from the pump by a two-way cock; one end of the pipe passing up to the top of dome, and the other end going down to a point inside of the rail, by which means the exhaust can be diverted either way at pleasure.

The downward action is used to drain all condensation from the pump at starting, after which the valve is turned so as to send the exhaust upward. Great claims are made for fuel-saving since this move was made, said to be due to the easier running of the pump owing to a freer exhaust, and also to the elimination of the objectionable urging of the fire when the engine was standing on sidings.

Harry Peters, the "Brotherhood overall" engineer, has recently invented a form of watch-pocket for jackets and overshirts that prevents a watch from dropping out, even if jacket is turned upside down—something engineers will appreciate. A patent is being taken out on the pocket.

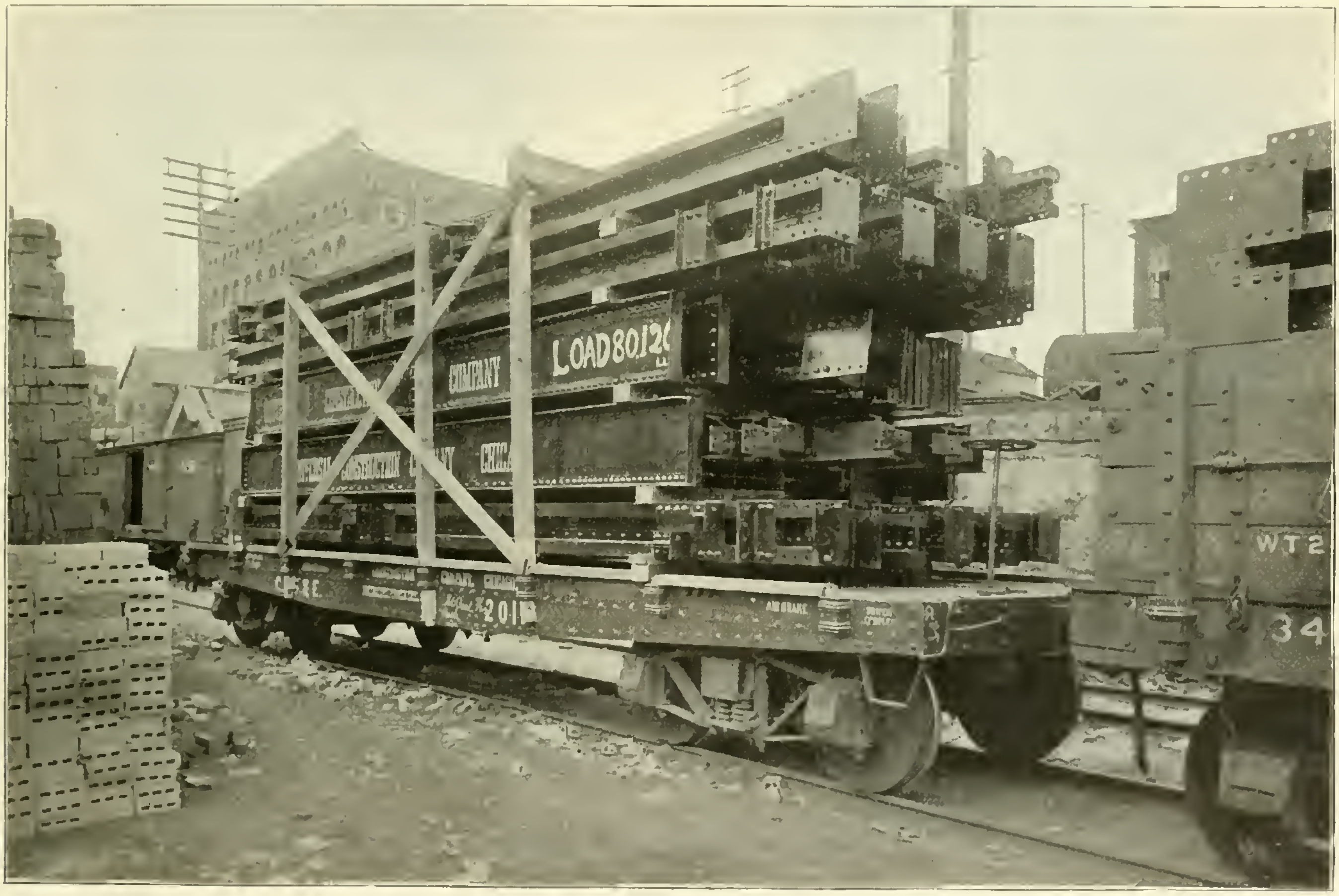
CAR DEPARTMENT.

Conducted by ORVILLE H. REYNOLDS, M. E.

80,000-Pound Capacity Steel Car.

Our photographic reproduction shows a somewhat remarkable car and load, taken on its arrival at St. Paul on the morning of September 24th. This is one of the "Pennock" cars exhibited at Saratoga, and of which quite a number are in use in the coal and iron trades. This flat car was taken over the Northwestern road from Chicago to St. Paul, a distance of 409 miles, in 27¼ hours, on one of their fast freight trains. The load weighs 80,-120 pounds. That such an immense load can be taken over one of the regular lines in such time, defeats a good deal of argument that 80,000-pound cars cannot be handled in regular service.

The Universal Construction Company—who built this car—have been experimenting for some time with flat cars built on the "Pennock" plan, in which the body consists of inverted trough-shaped sections of rolled steel, illustrated and described in our January number. This company are proving in a better way than that usually employed by people introducing new things, that their theories about car construction are right. They have already put into service a large number of gondola cars which are daily carrying from 68,000 to 75,000 pounds each, and are now putting into service flat cars carrying from 78,000 to 89,000 pounds. Such evidence as this will go a great deal further toward the introduction of heavy-capacity steel cars than a world of argument.



AN EIGHTY-THOUSAND-POUND CAPACITY CAR WITH LOAD.

The New York Belting & Packing Company are making a very good advertisement out of the first lot of their interlocking rubber tiling, that was laid in the Broad Street Station of the Philadelphia road, at Philadelphia. After wearing two-and-a-half years, with an average of 50,000 people passing over it daily, it shows a clean wear of 1-16 inch, and this only where nine-tenths of the travel takes place, in the passageways. In all this time it is claimed that not a cent has been paid out for repairs on this tiling.

Inquiry into the general status of hot-box on roads operating in widely diverse sections, brings the information that, while they are still getting in their vexatious work, they are growing beautifully less. This must be ascribed to the better work done in fitting up, and a more exacting system of care and inspection.

Eye-Bending Machine.

The operation of bending an eye on a bolt or rod by hand has always been an unsatisfactory and expensive feature of the smith shop, and to this fact may be attributed the numerous late attempts to get up something that would do the job cheaper and better.

Williams, White & Co., builders of forging machinery, at Moline, Ill., have put on the market a machine for doing this work, that turns out a job that leaves little to be desired, either for workmanship or rapidity of output. We illustrate two views of the front of this machine, with reference marks on the vital working parts, of which mention shall be made.

In Fig. 1 a bar of round iron is shown with an eye on one end, and the opposite plain end between the dies 1 and 2 and against the stop *M* which regulates the length of iron to be turned over. The die 1 is attached to the crosshead which moves down at an angle with the rod. Die 2 is stationary. Die 3 is secured to the face plate *R*. The mandrel *I* is the point around which the eye is bent.

In operation, the rod to be bent is placed between the dies 1 and 2, above the mandrel *I*, and against the stop *M*. The machine is then started by the treadle. The first movement is that of the die 1, which goes down and clamps the rod against die 2. The face-plate *R* then revolves, carrying the die 3 around with it. The stop *M* drops down out of the way of the approaching die 3, as shown in Fig. 2, where the machine is shown as having completed its movement and bent the eye.

After the machine has performed these functions, the face plate *R* reverses and returns to its former position, where it stops and leaves the dies open for a new piece of iron. The mandrel *I* automatically slides into a bushing in face plate *R*, thus leaving the center clear for the introduction of a new bar, making it possible to feed the machine with great rapidity.

The machine stops automatically, leaving the jaws wide open; but as long as the treadle is held down, the machine will work continuously. The stops are adjustable, so that the machine can be set so as to make either a full stroke or any part of a stroke; forming the full eye, or any part of an eye or hook, with the same die. This machine is double-geared, the pulley running at a high speed with a narrow belt. It will bend, without sign of fatigue, 1½-inch iron around a 1¾ inch mandrel, and is satisfactory when pushed the hardest.

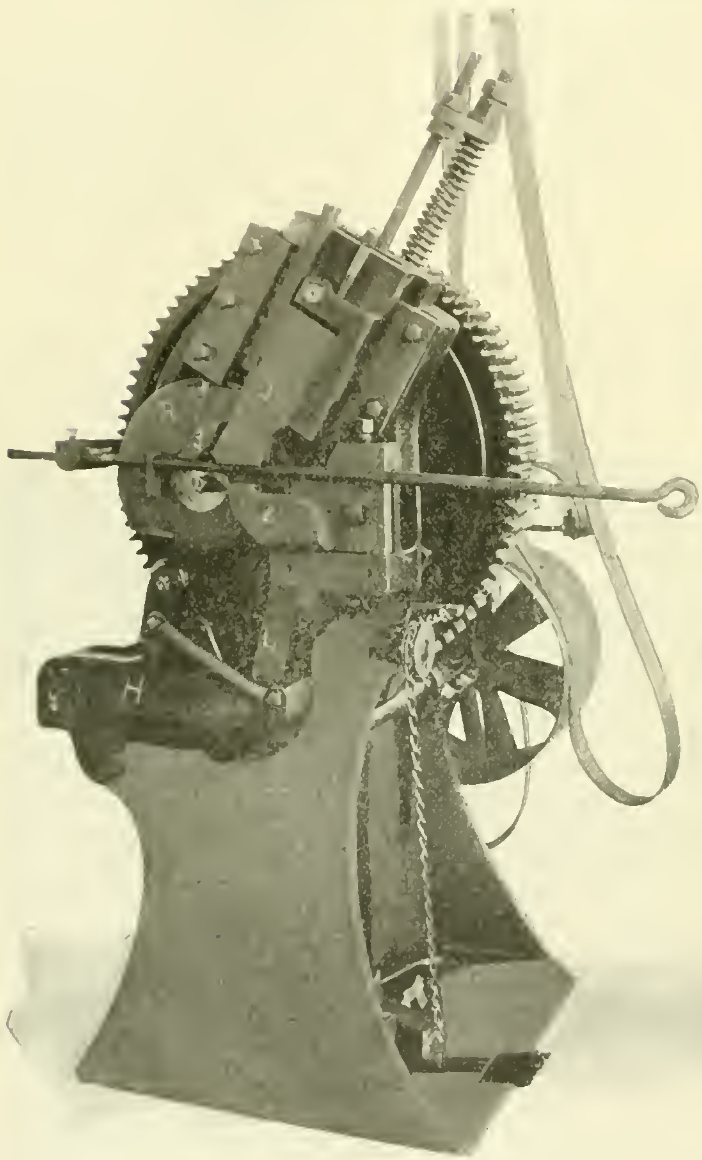


Fig. 1.

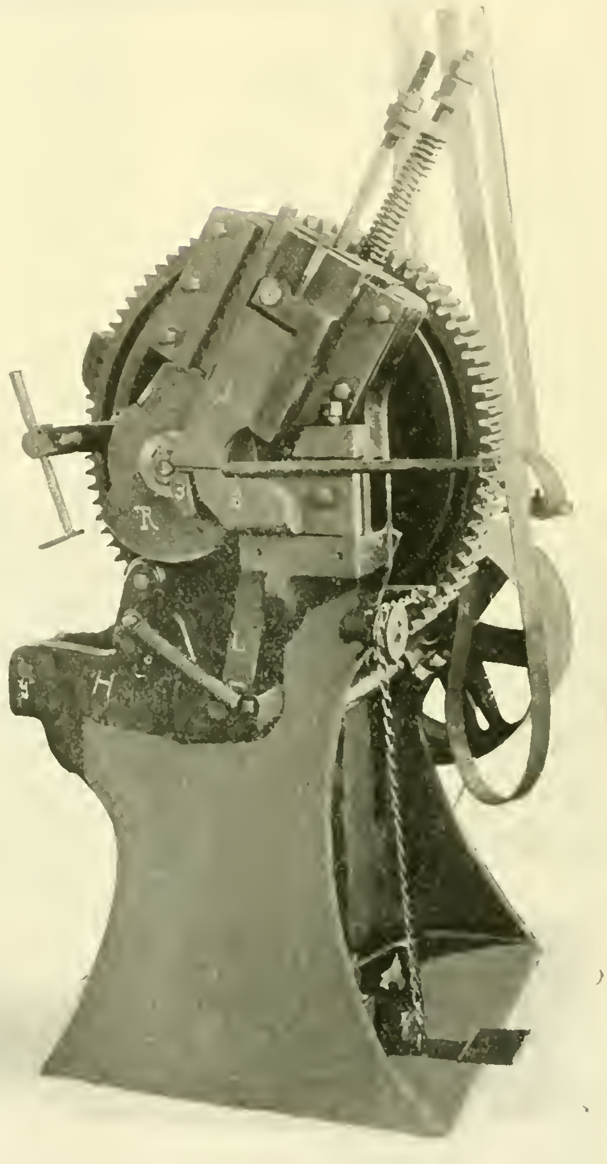


Fig. 2

Paying Practice at the Philadelphia, Wilmington & Baltimore Car Shops.

The car department of the Philadelphia, Wilmington & Baltimore Railroad at Wilmington does all work by the piece, a system long in vogue at this place, and with the most satisfactory results to employers and the men.

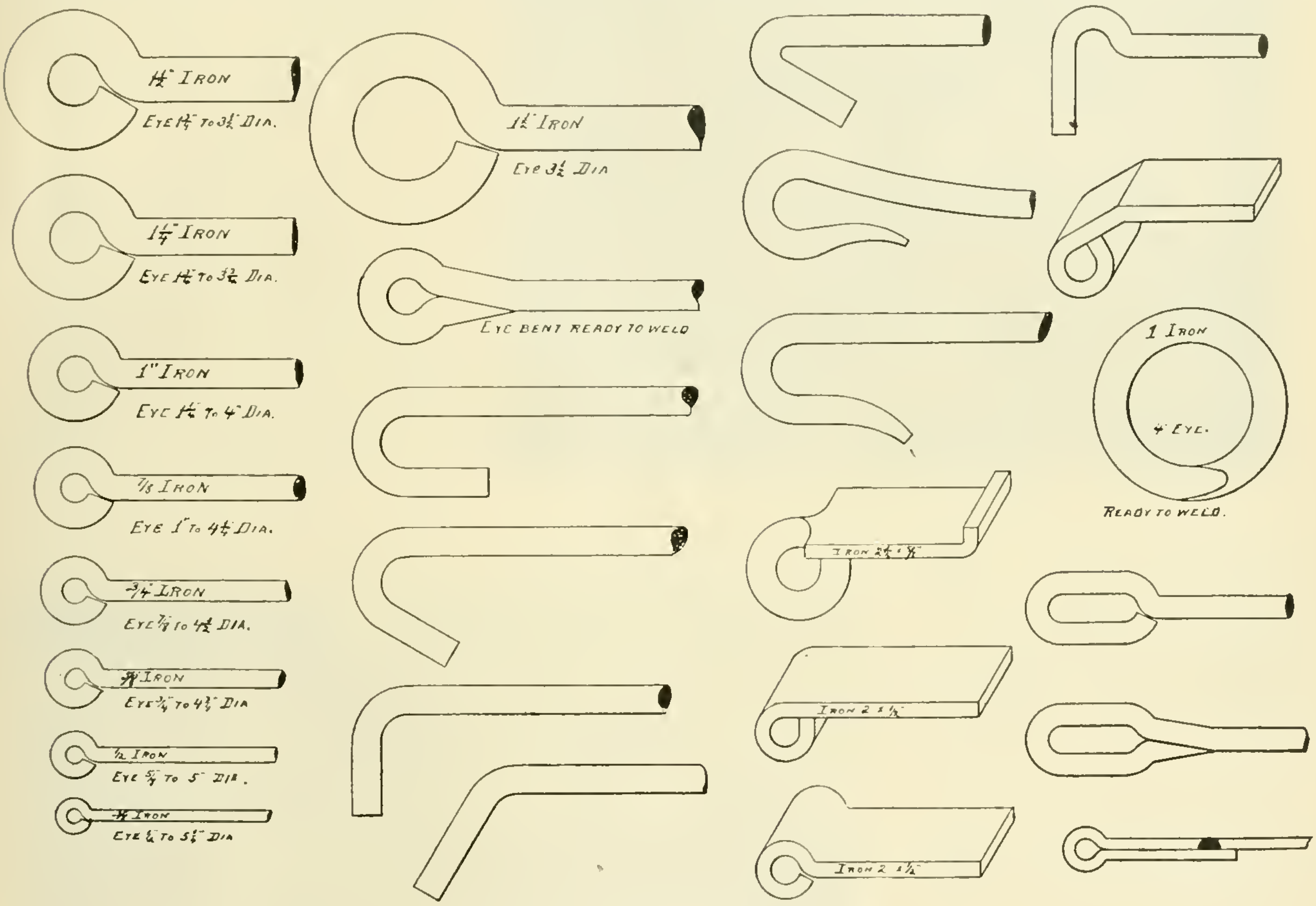
This system, it was feared, would not work to the advantage of all interested when applied to car work, but a trial of it demonstrated that the limit of elasticity had not been reached in the motive power department by any means, and after a general trial such work as repairing and cleaning passenger car trucks, all platform work, as well as removing, cleaning and replacing seats and seat backs, could be handled as well on the piece-work basis as by the old day plan, and it was adopted accordingly.

Figures are not essential to prove that the piece-work schedule has advantages over the old, and perhaps it is a good thing for us that this is so, because they are not readily forthcoming, there being an evident reluctance on the part of officials to give up the data for a comparison. But the fact that it is tenaciously held to when adopted after a trial is proof sufficient for the assumption that it pays; otherwise railroad companies would not continue its use. The case is not yet recorded where the men held the long end of the lever and retained it for any appreciable length of time.

Framing our opinion on the meagre information at hand, it is only fair to believe that the leverage gives an equality of moments, and that neither party to the compact has any cause for complaint. This position is taken not alone from the case in consideration, but is based on the healthy spread and growing adoption of the piece system in all branches of railroad service.

There is a measure of economical practice here in the paint shop that has all the elements to create astonishment in those who have never heard of saving the scrapings or "skewings" as they are called, from the surfaces of passenger-train cars when the paint is burned off.

This refuse paint, as scraped from a car, represents a net gain to the company of about $3, the amount they receive per barrel. It is said that the buyer realizes about $2 net from the gold realized from one barrel of this refuse. When it is understood that from thirty-five to forty books of gold are used on the average passenger car, the source of profit is revealed, and it is seen that any percentage of this gold saved is worth looking after. It is also plain that when two, three or more coats of paint and ornamentation are often included in one burning-off, the chances of winnings are multiplied in the same ratio —however this may be, there is no difficulty in disposing of these "skewings;" somebody works a profit out of them.



WORK DONE BY EYE-BENDING MACHINE.

Finish of Axle Journals.

The diversity of practice in finishing of journal bearings is one of the things that has a peculiar look to the average investigator of shop methods. Shop practice in this respect presents different phases to different people, depending on the point of view, the kind of optics taking the observation, and the capacity of the observer to assimilate what he sees; but just why there should be such wide range of opinion about the amount or quality of work laid out on an axle journal, is something that our mental equipment does not grasp.

Foremen whose mechanical judgment is beyond all question on average shop matters, will complacently take the position that a journal will be finished in the highest state of the art when it is touched up with the file and emery clamp. Those of us who have been caught in the meshes of the emery net, can only look with questioning on this exhibition of what we believe to be an error of judgment; but it shakes a man's faith in old traditions a little, and in his own experience with the same way of doing business, when he is told that a bearing don't get hot after such treatment.

When a journal runs warm after the very acme of good work has been laid out on it to have a good job, there is plainly some cause for it, not chargeable to the journal; and by the same token, when a journal runs cool from a file and emery, it is hardly fair to ascribe its good performance to its rough work. A little search will probably reveal that the excellent quality of the bearing or lubrication is entitled to more credit than the journal.

It has been noticed that where the best work was laid out on a journal, that the character of the lubricant used sometimes made it necessary to use more than ordinary care to have a true and smooth cylindrical surface. This is a condition that bars the fiend with the file and faceted work, and gives the mechanic who knows how to grind a tool a chance. But while a true surface from the tool is possible, it is not so easy to get the requisite degree of smoothness, particularly on steel, and this is the place where the roller comes in.

A journal finished with the roller is true and smooth, and in the best condition to carry its load, because the surface is practically burnished, and is condensed similarly to cold-rolled steel, all minute flaws being closed. The best tribute to the little roller is the wide use it is having among the more progressive shops, where they have long outgrown the file, and where coarse feeds are the order.

INTERIOR THIRD-CLASS CAR.

Interior of a Third-Class Car.

Our illustration of the interior of a third-class car built for the Ferro Carril Merida a Peto, a road in South America, is a good example of cars of that class, and conveys the idea of a people's poverty more eloquently than words. The seats, without backs or upholstering of even the most primitive kind, have an uninviting appearance to us who are wont to associate the word "luxury" with travel.

It would be the height of absurdity to say anything about finish; there is absolutely none. Hard wood and hard lines are all that can be seen in the picture; but these are toned down when brought under the influence of the flickering light of the two oil lamps placed in diagonal corners of the car.

The J. G. Brill Company have built many of these cars for export, and the one shown is a good example of the type.

ON SWEDISH STATE RAILWAYS.

Combination Car of the Swedish State Railways.

The illustration, as implied in the caption, is a foreigner, a combined second and third class car, and is of the side-corridor type with end doors, a construction which is practically American, and which is surely replacing the old side-door style of car. In fact, the car would not excite comment if placed in an American train, so close is the resemblance to our cars, with the steps and platform gates.

The elliptic springs resting on the truck boxes, and the corner buffers would, however, dispel the illusion, and proclaim the presence of a stranger to those versed in car lore. These cars are equipped with Pintsch gas, automatic air brake and iron trucks. The absence of ornamentation is a noticeable feature—no striping or gold leaf; just plain color and varnish—a scheme that would pay over on this side.

We are indebted to Mr. Vincent Halberg, the chief designer of the Swedish State Railways, for the photograph from which the cut was made.

Cleaning Facilities at the Pavonia Shops.

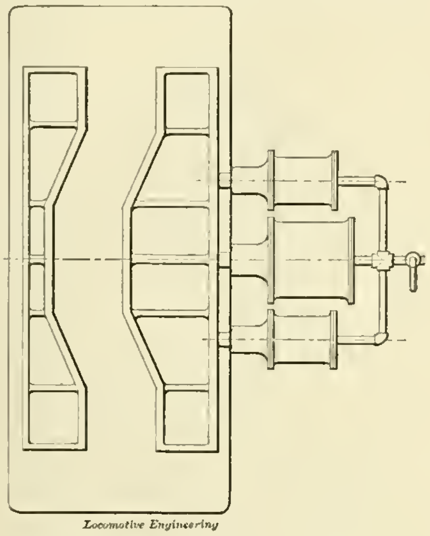
The cleaning of work from a dismantled engine is one of the most disagreeable things connected with overhauling work in a locomotive repair shop, when provision is not made to get the parts in a proper condition to work on.

Mr. Rufus Hill, master mechanic of the Amboy division of the Pennsylvania Railroad at Camden, N. J., has facilities for doing this work that are practically unsurpassed. All parts covered with grease are taken to a one-story building about 40 feet square, which was erected and dedicated to cleaning purposes, near the machine shop. It has an equipment for doing the work at the least expense, consisting of a lye vat 32 feet long and 3 feet deep, having a capacity for holding the parts from all engines stripped at one time.

Above the vat, and extending across the room, is a gallows frame, from which is suspended an air cylinder, rolling on a four-wheeled carriage, and carrying a huge table on which the dirty parts are submerged and removed from the vat. Hot and cold water are at hand to complete the cleansing, and a man can go into that shop with clean overalls under his arm on Monday morning, feeling that they are good for one week at least.

A Home-Made Bulldozer.

The need of a device to do riveting with was felt at the Northern Pacific Railway shops at St. Paul, Minnesota, at the time the reinforcement of the 40,000-pound box cars was taken up. All the old body bolsters required a great many rivets in the strengthening project then under way,



HOME-MADE BULLDOZER.

and it being realized that hand-riveting would be too costly for serious consideration, Mr. John Hickey, superintendent of motive power, at once marshaled into line the inventive forces of the plant, and a home-made bulldozer and riveter, as shown in plan in our illustration, was quickly gotten up to handle the problem.

A cast-iron face plate, used for a forming block, was pressed into service to hold the dies. Two 8-inch freight air cylinders and one 14-inch passenger air cylinder were then properly secured to the face plate and piped to the air supply of 120 pounds per square inch. So efficient was this affair that eighty ⅞-inch rivets per minute were driven in everyday practice until the order was completed.

The machine is now used as a bulldozer to form brake-beam safety straps, draw-bar carry irons, all pipe hangers, safety-strap links, bands for vestibule draft timbers, and so on. Dies for other work are being made as required, and the usefulness of the machine is constantly extending to a point where it cannot be abandoned and a return made to the old way.

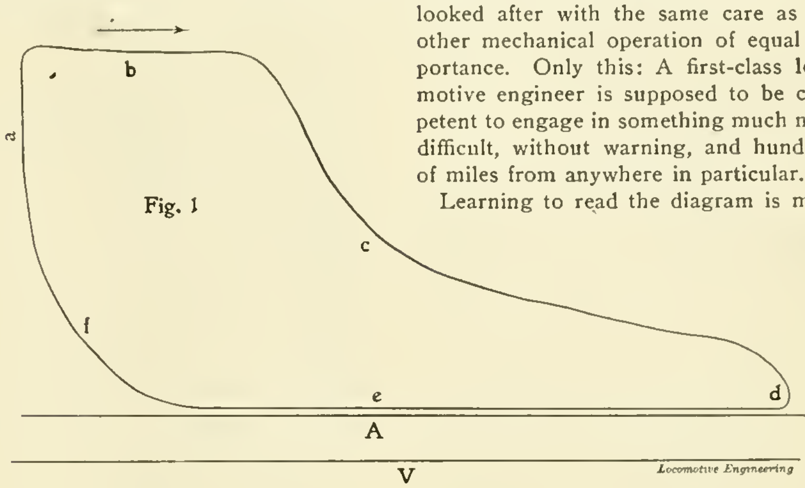
The Sheffield Car Company, of Three Rivers, Mich., have sent out a catalog of their light cars. Hand cars, dial cars and velocipedes are their specialty.

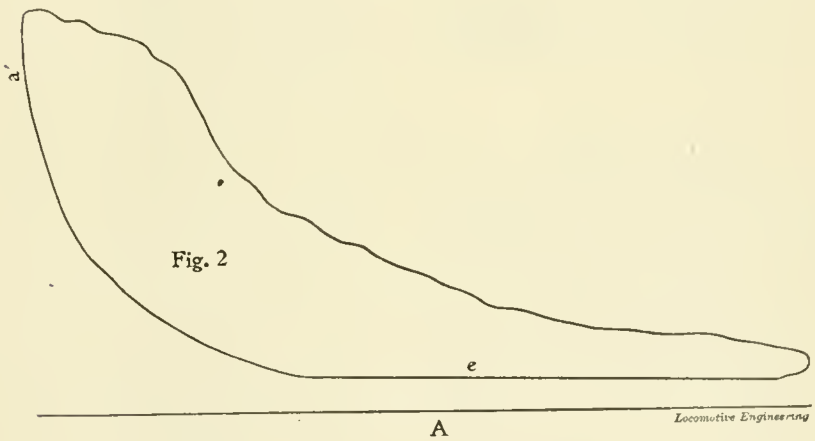
Reading the Indicator Diagram.

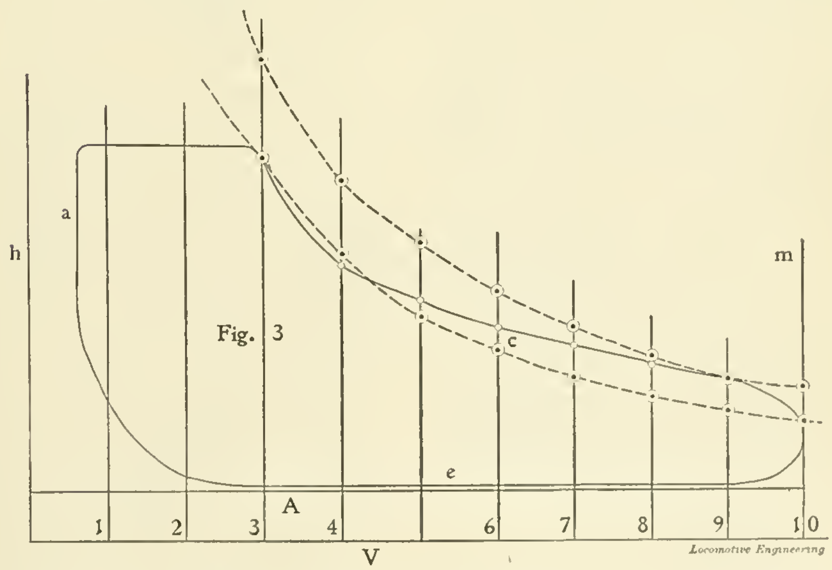
BY F. F. HEMENWAY.

It is altogether fortunate that one does not have to write a book in order to enjoy the satisfaction of reading one. Most men do not have time to write books. While it is in every way desirable that a locomotive engineer or a railroad machinist, by one means or another, familiarize himself with the handling of the indicator, it is not advisable that he wait until he has practice in the use of the instrument before he studies what it says in the hands of another.

Attaching the indicator to the cylinder of a steam engine, and taking the diagram, is purely a mechanical operation, to be looked after with the same care as any other mechanical operation of equal importance. Only this: A first-class locomotive engineer is supposed to be competent to engage in something much more difficult, without warning, and hundreds of miles from anywhere in particular.







Learning to read the diagram is much like learning to read printed matter. First comes the alphabet and the easy lessons; the rest comes more as a matter of course than from any specific advance in reasoning from something that will never occur.

It is necessary, or at least advisable, in order to have an easy comprehension of the diagram, to fully impress oneself with the fact that the indicator gives but a single item of information; that is, the presence of steam in the cylinder at every point in the stroke of the piston; from this we gain all the informatioin we may gain from its use. It really draws but two lines, one of them the atmospheric line *A*, and the other the continuous circumscribing line *a-b-c-d-e-f*, Fig. 1.

The atmospheric line is the datum line for all vertical measurements of the diagram. Although for some purposes many measurements are made from the line of vacuum—the line of no pressure—this line must first be established from the atmospheric line. It is a line of convenience.

The continuous line, *a-b-c-d-e-f* is, for convenience, divided into sections, *a* being the admission line, *b* the return line, *c* the expansion line, *d* the exhaust line, *e* the line of back pressure, and *f* the compression line. As previously stated, *A* is the line representing the pressure of the atmosphere, and *V* is a line drawn by hand and presumed to represent the line of no pressure.

A very trifling consideration will make clear what occurs during the periods represented by the continuance of these several lines, to a purpose, better than a page of explanatory type. Thus, in the period represented by the continuance of line *a*, we should conclude that steam is being admitted to the cylinder; in that represented by *b*, that the piston is moving along as indicated, steam still being admitted; that during *c* the steam is being expanded; that during *d*, and continuing through *e*, steam is being exhausted, the distance apart of *A* and *e* representing the back pressure against which exhaustion occurs; while during *f* the steam remaining in the cylinder is being compressed into the clearance space, this clearance space representing all the space between the piston at the end of its stroke and the valve face.

Fig. 1 does not represent an actual diagram. Fig. 2 is a copy of one taken from a locomotive engine cylinder under conditions favorable as to clear lines. It will be observed that the various periods referred to are for the most part much less apparent in Fig. 2 than in Fig. 1. At higher speeds and other conditions less favorable, this difference is magnified to a still greater extent, until it becomes a matter of no little difficulty to locate points and periods in the continuous line traced by the indicator.

An excellent way, certainly the best I know, to study this part of the subject is to record from the engine itself the exact position of the crosshead for different periods, at different lever positions. Then, by correspondingly marking the diagram, much will be learned in a way that will readily suggest itself.

Referring again to Fig. 1, if the diagram had been taken from an engine on regular duty we should say that the lines *a*, *b*, *d*, *e* were good, and of lines *c* and *f*, the expansion and compression lines, respectively, that they required a further and more definite consideration. They may be good or they may be vicious. Reference will be again made to them.

Regarding the line *V*, very explicit directions are usually given for its establishment at a distance of 14.7 pounds below the atmospheric line *A*. The most that can be said of this is that it may be right, but is more likely to be wrong, in locomotive practice. In some instances, at great altitudes, it would be rather materially wrong; and in ordinary practice, I think that something less, say 14.5 pounds, would be a better average. I venture to make it this, not that 0.2 pound makes much difference, but 14.5 are better figures to reckon with and from, and more nearly correct away from the sea level. I believe in establishing it, or considering it established, then, for these reasons.

As in opposition to Fig. 1, one would say of Fig. 2 that the lines are mostly bad; that the lead a^1 was excessive; that line *b* shows a considerably diminishing pressure during the period of full steam, indicating small ports, or improper valve motion. It will also be seen that the back pressure is excessive, the effect of small ports, possibly aggravated by a small exhaust nozzle. As in the instance of Fig. 1, nothing can be definitely said of lines *c* and *f*.

These are, of course, cursory examinations only, but by following up criticism of this kind of such diagrams as come to hand the engineer or machinist may soon become an expert reader of the indicator diagram, something likely to be of advantage at any time.

It has been said that in order to properly scrutinize line *c* (Fig. 1) further consideration of another kind must be given it. This line, as drawn by the indicator, represents the manner in which the steam has been expanded only apparently. A given volume of steam has been expanded; but this steam may have been added to or taken from by leakage, or there may have been little or much loss by condensation. Of the losses from either of these causes the indicator gives scarcely more than an intimation, but this intimation may be exceedingly valuable.

To judge of the character of the curved line *c*, draw, in relation to it, the true expansion curve. Regarding this, much has been and is being written in favor of some other than the curve of the hyperbola. It is easy of demonstration that under perfect conditions another than this curve would be right, but under conditions as we find them in locomotive practice it may be assumed that the nearer the actual line *c* approaches this curve the better the diagram. Nothing more is needed. According to the law applicable to the construction of this curve for the purpose it is wanted, all that it is necessary to remember is that if we expand a given volume of steam so that it will occupy twice as much space its pressure will be only one-half as great. It is a simple curve to draw, and desired points may be found in it, in an emergency, with no other instrument than a pocket rule.

In drawing this curve in comparison with that traced by the indicator, volumes and pressures are dealt with; hence, it is necessary to know the clearance volume up to valve face—that is, the percentage this volume bears to the volume swept through by the piston. Say it is 7 per cent.: Draw the line *h*, Fig. 3, 7 per cent. of *a m* from *a*, as represented. Draw any number of vertical lines, 1, 2, 3, etc., dividing the distance *h m* into equal spaces. As will be comprehended, the height of any one of these lines measured from *V* (in such calculations pressures are always to be measured from vacuum) to a point where it crosses the curve to be drawn, multiplied by its distance from *h* is equal to the height of any other line multiplied by its distance from *h*. From the point where either of these vertical lines crosses the line *c*, drawn by the indicator, the true expansion curve may be drawn in either direction, or in both directions. It is customary to draw it either from a point just after cut-off, as from line 3, or from line 9, just before the exhaust opens. No actual measurement from line *h* is required, that line being the starting point of the vertical lines, the numbers of the lines standing in place of their distances from it. Thus, starting from line 3, the height to the point where it crosses line *c*, measured, for example, by the scale of any one of the springs, is, say, 60. Multiply this by the number of the line (3) and we have 180. Divide this by the numbers of the other lines, and the respective quotients will be the heights of the other lines. Similarly, we may draw the curve from line 9 if desired, as shown. Drawing it from line 3, however, usually covers all that is desirable.

Comparing the curve drawn from line 3—the lower of the two dotted curves—it will be seen that curve *c*, drawn by the instrument, at first falls considerably below it. This is owing to the condensation of some of the hot steam that has just entered the cooler cylinder. A little later in the stroke, as the temperature falls by expansion, heat is again abstracted from the walls of the cylinder to re-evaporate some of this water of condensation, and the actual curve rises above the true curve. It continues to rise so rapidly, and rises to such an extent, that we are led to believe that a leaky valve is continuously supplying the cylinder with steam after cut-off. The variation of these lines is purposely exaggerated for the sake of greater clearness.

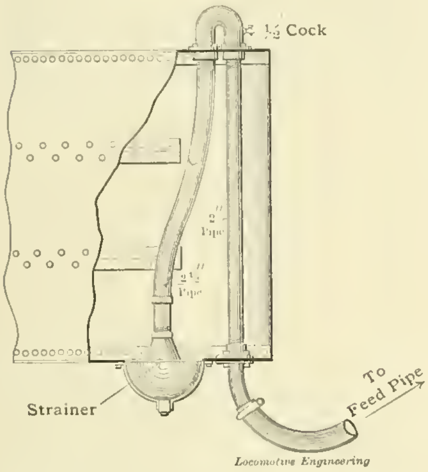
If the three curves, or, what is the same, the one drawn by hand, coincided altogether, with the curve *c*, we should say that conditions were as nearly perfect as we could ever expect. To the extent that they do not coincide, we say that conditions are not the best.

The foregoing suggests the manner of drawing the same curve in comparison with the compression curve, which is seldom done, however.

There are other ways of drawing this curve; the one given is satisfactory and the easiest of comprehension by those not trained to such work.

A Valveless Tank Connection.

Our illustration shows a device recently patented by Mr. Charles Linstrom, master mechanic of the Y. & M. V. R. R., Vicksburg, Miss.



This simple invention does away with the valves, valve rods, lifting screws or cams, packing, etc., and makes the connection to the tank always open and safe.

As will be plainly seen in the engraving, the strainer is in the bottom of the tank in a cast pocket, which has a washout plug in it. From the top of this device the pipe leads to the top of the tank inside, is fitted to a flange on the under side of tank head, connecting with an inverted U-casting on the top and outside of the tank, from the bottom of which a second pipe leads down to the bottom of the tank through flanges to the outside, and is there connected to the hose and feed pipe.

It will be readily seen that when the injector produces a vacuum in the feed pipe and hose, that the water will be drawn up through this loop and on to the injector, as usual, and that steam can be blown back from the injector for heating purposes the same as it is with the valve arrangement.

In the inverted U-piece a small pet cock is introduced. This is to be used in case of a breakage of the hose, or for any other opening that will cause the water to siphon out of the tank. By allowing the air to enter at this loop, the siphoning action is stopped and the water will assume the level of that in the tank. The inventor has used this small cock to introduce lubricant for the injector.

It is evident that this device will last as long as the tank itself and cost nothing for repairs, and it is also much quicker to operate in case of breakage of the hose, and is absolutely non-freezable.

A Railroad Superintendent on Labor Organization.

"Labor Organization: A Detriment to the Railroad Employé" is the name of a pamphlet by William Gibson, superintendent of the Cleveland, Cincinnati, Chicago & St. Louis Railway. Mr. Gibson makes a somewhat seductive effort to show that the interest of railroad employés lies more in close and harmonious relations with railroad companies rather than with labor organizations. He says:

"When we inquire into the principle which governs or should govern the relation between the officials and the employés of a railroad, we touch the keynote to the prosperity of both. The one class is, and from the nature of things must be, dependent upon the other, in the same sense that the great commercial interests of the country must depend upon the railroads for service, and the latter upon the former for revenue.

"Recognizing that principle, it is plainly the duty of every operating official, more particularly the division official who is brought into direct contact with the employé, to see to it that nothing on his part is left undone to cultivate a good feeling and understanding with his men, to see that he meets them half way in any reasonable proposition. The men will not be slow to reciprocate, and thus the process of harmonizing will prove mutually advantageous; experience has proved to me that the natural impulse of the railroad man is to be generous, loyal and devoted to duty."

The last paragraph may be taken as the text, along with the idea that prevention is better than cure, of Mr. Gibson's address. If the policy and practice he describes had always been followed by railroad companies, labor organizations would never have become so powerful as they were a few years ago. Unfortunately, it was a policy of gross injustice, followed by many railroad companies, that brought into existence, for self-protection, the labor organizations which at times have proved as aggressive and unjust as the worst class of operating officers.

It is good for brethren to dwell in unity, and we hope that the happy family which Mr. Gibson describes as the existing condition of the Big Four will soon extend itself to all railroads in the country.

We believe that anyone interested in what Mr. Gibson says can obtain a copy of the pamphlet by applying to the author at Springfield, O.

Shop Fire Protection.

The fire protection system at the Pavonia shops of the Pennsylvania Railroad is said to be the best on that road, where especial attention has been paid to protection from fire. Two compound Knowles pumps furnish the pressure, and 16 fire pumps are located on the ground in the most advantageous positions to handle a conflagration in any building in the plant.

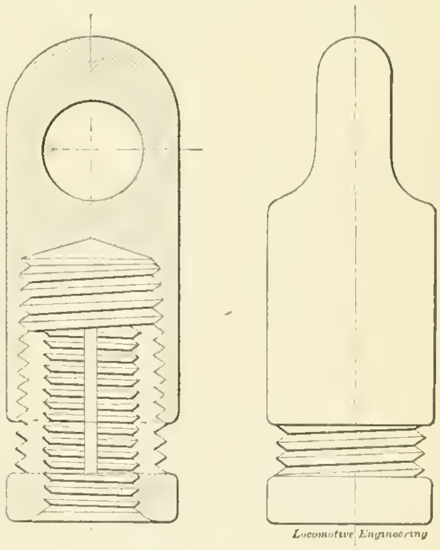
There are two hose carriages of 300 and 400 feet capacity, respectively, and 1,700 feet, all told, of the best Eureka 4-ply hose to draw on, besides 14 portable fire extinguishers. Organization of the employés is relied on exclusively, gangs being assigned to certain positions and duties, just as in a paid department. Upon an alarm being given, each man hurries to his assigned duties, whether at the hydrant or hose carts, and the shops and grounds are at once policed and the doors locked.

Five streams of water have been made to leave the nozzles inside of two minutes after an unexpected alarm, which found the men at work at their usual duties, had been turned in. Such a high efficiency is only obtained by hard work in drilling, but it puts the insurance rate 'way down.

A Bell-Cord Union.

There are occasions when a reliable metallic connection is required at the ends of a bell cord, or the numerous rope devices about a shop.

The one shown in our illustration was gotten up by Mr. Bergmann, the general foreman of the West Shore shops at Frankfort, N. Y. It is one of the best



BELL-CORD UNION.

things yet devised for firmness and surety of grip. The sectional view shows its construction, in which a tapered split bush, threaded inside and out, is seen screwed into the body—all of brass. The rope is simply screwed into the bush, after which the body is forced onto the latter, compressing it on the rope. Wide use of the device at these shops has demonstrated that it is a good thing.

PRACTICAL LETTERS FROM PRACTICAL MEN

A Peculiar Accident.

Editors:

I send you an account of a remarkable mishap which occurred on the Pennsylvania Railroad.

The train was running at a rapid rate between Xenia and Trebeins, on Friday, September 25th, when the trucks of one of the cars came out from under the car and jumped onto the tracks of the Cincinnati, Hamilton & Dayton Railroad, which runs parallel with the Pennsylvania at that point. The trucks alighted squarely on the rails, and continued running until they smashed into the pilot of a Cincinnati, Hamilton & Dayton engine, running in the opposite direction.

The Panhandle train evidently did not suffer any inconvenience owing to the loss of trucks, as it was not discovered until Trebeins was reached, and then it was found that the body of the freight car was held in position by the couplings, and had run two miles without the truck.

The accident is without a parallel in the annals of railways, and, being vouched for by the motive power department officials, it seems stranger than fiction.

I thought I would send you this account so that you could publish it in "Locomotive Engineering" for November.

OSCAR C. PEASE.

Dayton, O.

Wanted--Nickel-Plating Dope.

Editors:

Can you, or any of your readers, tell me how to make a dope that leaves brass looking like nickel? I know there is such a thing; the color lasts about thirty days. I would like to get the receipt.

MAX BLANK.

Salt Lake, Utah.

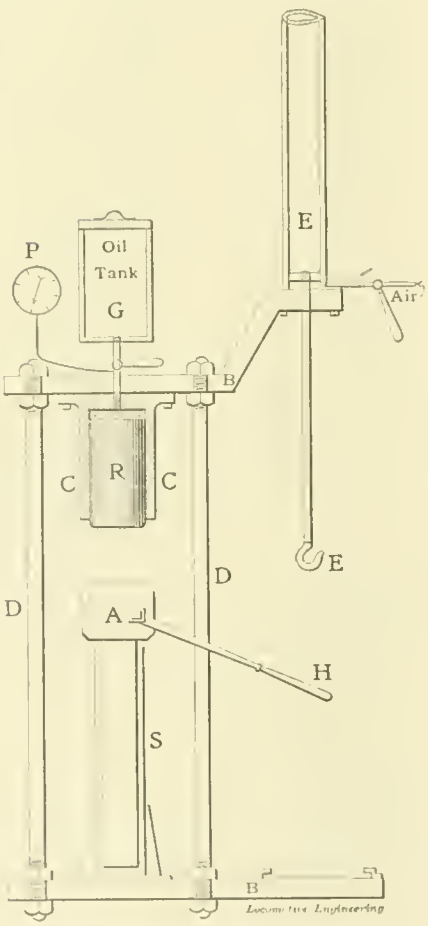
Machine for Testing Hydraulic Jacks.

Editors:

Mr. W. de Sanno, in his article in October "Locomotive Engineering," page 834, asks: "Who can suggest some good way for testing hydraulic jacks, without hunting a pair of driving wheels to test the lifting and sustaining qualities of the jack, when being repaired?"

It is a good thing to test a jack after it is repaired, and see if it will come up to its full capacity, say 20 tons, before it is used for raising part of an engine or loaded car.

I will illustrate a plan which I made some time ago, and which will answer the purpose very well. It consists of four bolts *D D*, two pieces of flat iron *B-B*, cylinder *C C*, with ram *R* and leather cup, oil tank *G* and hydraulic pressure gage *P*. We put the jack *A* in frame; now we open cock handle *X*. This will let the oil out of oil tank *G*, in cylinder *C C*, and will cause ram *R* to go down on top of jack *A*, and will fill the space with oil, whatever the ram *A* will make. We now shut cock handle *X* again and pump up *A* with handle *H*, and the suitable pressure gage *P*, according to size of ram *R*, will soon indicate if jack is properly repaired, or if it will be in good condition for raising



JACK TESTER.

engine or car. Now, before anything else, we open cock handle *X* and pump up *A* as far as it will go. This will force up the oil out of cylinder *C C* into tank *G*; then we shut cock handle *X*, and by doing so, ram *R* will not go down and fall out when jack *A* is let down and taken away (it forms a suction and holds up ram). *E E* is an air hoist for taking ram *A* out of barrel *S*.

J. A. EISENAKER,
Elmira Shops, N. C. Ry.

Elmira, N. Y.

Another Reason for Water-Throwing.

Editors:

In answer to Altoona correspondent, page 764, September number, about throwing water out of top of stack, would say that it is caused by tight ash-pan dampers and tight furnace door. If they put air holes or a register in door, or open a damper, it will stop it. It is caused by steam and atmosphere coming together in stack, and no heat from firebox to stop condensation. I ran an engine four years ago that acted in similar manner from the above cause.

JAMES HEPINSTALL,
B. & A. R. R.

Greenbush, N. Y.

Slipping When Shut Off—Another Case.

Editors:

I am running a passenger engine, 8-wheel Rhode Island, and we have some heavy grades on our division. When we leave one end of the division about 4:30 A. M. we have about 30 miles down grade, about 60 feet to the mile, and in going around side cuts when there is frost, my engine starts slipping and will not quit until I apply sand to rail. I have told several about it, and they all think that it cannot be possible for such to occur. Will you please let me hear from you in connection with this, through the columns of your journal?

La Grande, Ore. WM. ENOS.

[Cases of this kind have been reported for five or six years, and there seems to be plenty of proof that the trouble does exist, although at one time we offered to bet that there was nothing in it. The only explanation that has been offered is the discovery that engines acting in this way have been found to be out of quarter. —Eds.]

The Record of J. F. Holloway.

Editors:

Of your kindly worded note in reference to the death of Holloway, I am sure no one will take exception to a word you said as to the ability of one of the brightest and most genial men whom engineers ever met with. But I hardly think all your readers will agree with you in speaking of him as making "a record seldom earned by those not having a college education." If you had stopped short at "earned" there would have been no ground for argument; the qualifying part of the sentence is the part about which there may be honest difference of opinion. You refer in the quotation I have made to his record as superintendent and president of the Cuyahoga Works, and to his prominence in engineering societies; all of which is more than true if that were possible. But looking at our manufacturing establishments, in the line of engines and machinery, how many that are at the head of these establishments are so by virtue of a college education? Did not the great majority of them rise precisely as Holloway came to the front, without seeing more than the outside of a college?

Holloway, it may be admitted, missed a college education, but he had what for his purpose was better, viz., a shop education. He succeeded without the college education. Who that knew of him and knew of his work believes that he would have succeeded without the shop education? And how many besides Holloway who are or were members of engineering societies, to join which a college education is not a requisite, are amongst the most honored and respected members?

All this is not in the way of saying a word against the college education. It is only a pity, perhaps, that every young man in the land cannot see his way clear to obtain one. But "Locomotive Engineering" has amongst its readers thousands of bright young men who must get along without such a privilege, and not a word should be said to discourage the belief that, as Holloway did, and hundreds of others have done, they may get along very well indeed without it. To paraphrase Chordal, all the colleges in the world cannot *make* anything of a man. The making of a doctor of a man is something quite different from agreeing, over a seal, that he may write himself down as one.

FRANK GLEASON.

Brooklyn, N. Y.

The Smith & Perkins Locomotive.

Editors:

Smith & Perkins built and placed in service on the Pennsylvania Railroad, between November, 1852, and December, 1854, twelve locomotives of the following type:

Six driving wheels placed closely together, and in front of them a pair of leading, or pony, wheels only a few inches less in diameter than the drivers. All these wheels were of spoke pattern with tires; all were located between the firebox and the cylinders; all had boxes fitted into pedestals or jaws rigidly attached to the main frame, and all were flanged except the middle pair of drivers. Neither shoes nor wedges were used.

The frames were of bar type, except from front of firebox to back. Here slab type was used to allow greater width of firebox. At rear of firebox a cross-frame contained the pin by which engine was coupled to tender through the medium of a long pulling bar made in two parts.

The cylinders were set at a slight angle, and the crossheads moved on a single square guide bar set to present a V-surface to the brasses.

The parallel rods had split brasses with keys and adjusting screws.

The pumps were two in number, and placed on each side of the firebox behind the wheels, and driven by short cranks on pins of rear driving wheels. The check valves were placed on the sides of the smokeboxes, which formed a water space.

Each steam chest contained a single slide valve driven by drop hooks. The rocker shafts vibrated on another shaft which had an arm on its right-hand side outer end, from which a reach rod extended to the reverse lever, and at its center was fastened to a toothed quadrant which geared into a cog-wheel on another shaft underneath. This latter shaft carried the "half-moons" by which the hooks were thrown into or out of gear. There were six hooks, all driven by eccentrics. Two of these were fore-gear cut-off, two full stroke fore-gear, and two full stroke back-gear. The arrangement of the half-moons only permitted two hooks, and these of the same direction, to be in gear at one time; but all could be thrown off together.

Rods from valve-rod pins in rockers were attached to arms on ends of rockers, working on a shaft across back of firebox. These last rockers had pockets in which short bars could be placed, in order to move engine by hand while hooks were lifted, or to put rockers in proper position to engage the hooks after dropping them. The reverse lever was close to the side of cab and moved on a rack with four notches, viz., forward cut-off, full forward, out, and full back. Four inverted half-elliptic springs were used, placed two on each side of the engine; one having its ends attached to spring posts rising from the axle boxes of the pony wheel and the first driver, respectively; and the other similarly meeting the boxes of the second and third drivers. The saddles were, of course, fastened to the frames between the wheels.

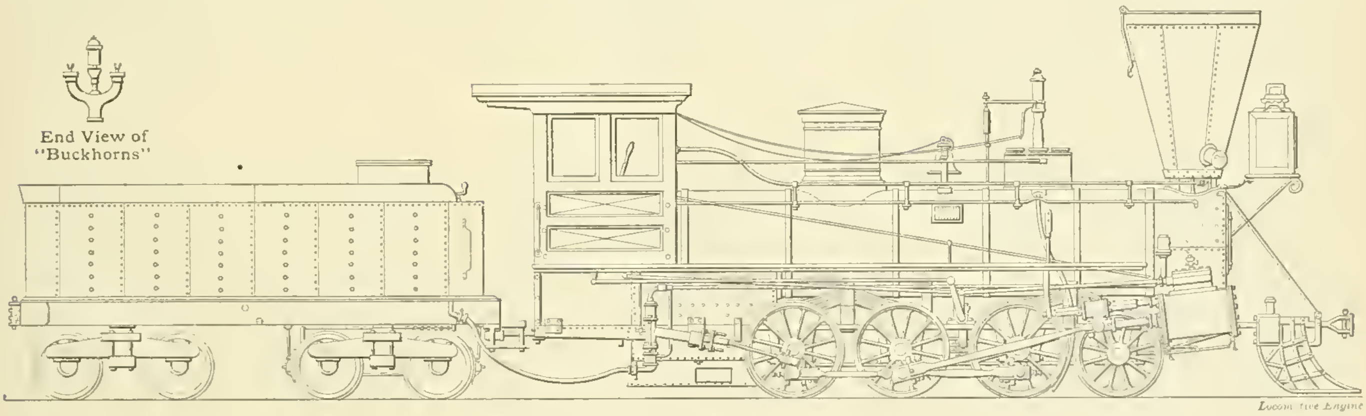
The cab differed but little from many now in use, and was at rear of engine; was fitted with iron foot-plates, and about one foot of the boiler extended into it.

The boiler (except in two instances) was flush-topped, with copper firebox, and had a water space around the smokebox. The bottom of smokebox was square. The dome was large, with tight cover and no external fittings. It contained a slide throttle worked by a rod passing through a gland in the boiler head. This rod was at first arranged to partially rotate, and was fitted with regulator handle, which moved from one side of engine to the other, as in English practice. This dome was about 6 feet from rear of boiler.

Three feet from the front tube sheet a standpipe carried cast-iron "buckhorns," upon which the safety valves were placed, with the whistle between. A large, circular sandbox surrounded the standpipe. Between this box and the dome the bell was placed, and neat handrails of the type now used, and in about the same position, extended on each side of the boiler its entire length. Running boards reached from cab to smokebox.

The smokestack was of the inverted cone type, with straight stack inside and the entire top covered with netting.

The tender differed from those now in use only in form of trucks, and in having a short firing platform placed a few inches below the floor level. Each truck frame was formed of two pieces of timber, one on each side, to the ends of which the axle boxes were attached by strap bolts passing entirely around the semi-circular boxes. The centers of these timbers were united



SMITH & PERKINS ENGINE OF 1852.

underneath by a plank running across between the wheels, and by two narrow pieces at the top. These were all well bolted together, and between the upper pieces a bolster rested upon springs of solid india-rubber, which in turn rested upon the under plank. The forward truck, only, had a brake, and access to inside of axle boxes could only be had by removing them.

The ornamentation of these engines and tenders was: Jacket of Russia iron fastened with bands of same, on boiler; hand rails, cylinder heads, rods, crossheads, steam chest and cap, bands at bottom and top of sandbox, and bell-frames, all polished; neat plates of brass bearing builders' name and address; dome cased in Russia iron with two bands of brass, and cast-iron base and cornices; wheels, cab, sandbox, dome cornices, tender frame and cistern, all painted vermilion; pumps, frames, buckhorns, stack, cow-catcher, smokebox, outside of foot-plate, cylinders, springs and tender wheels, all painted black; and truck frames of tender trucks were painted in dark ochre. All striping and lettering were of neat design. Each engine was named. The names were selected from those of the stations on the line.

The two engines which differed had wagon-top boilers with dome only a few feet back of smokestack, and safety valves on standpipe placed on wagon top about 2 feet in front of cab. These had a square sandbox between stack and dome, and had boiler jacket secured by bands of brass. Two more engines of this latter type, but having somewhat larger boilers, came into the Pennsylvania Railroad Company's possession by their purchase of the State's railroads and canal in 1857.

In April, 1856, the same company purchased three more engines from Smith & Perkins, of an improved type; but, for some reason, sold them after a brief service. On this type, the rear driving wheels were behind the firebox; the pumps were at back end of engine and driven by arms on main pins, which were, as usual, on central pair of drivers; and forward end of engine was carried on a four-wheel swinging truck. The cylinders stood at a very slight angle.

The boiler was wagon-top, with dome near the front end, having safety-valves on top. The sandbox was circular, stood between stack and dome, and had whistle above it on standpipe passing through center. The bell was directly in front of cab.

The valves were driven by Gooch (suspended) links.

Russia iron secured by brass bands covered the boiler, and dome, steam-chests and cylinders shone in jackets of polished brass.

The tender, cab, dome base, sandbox and wheels were painted vermilion.

The other fourteen were run many years, and notwithstanding the excessive overhang at each end, which caused severe rocking or sudden turning around if derailed, they were well liked on account of steaming qualities, and good material used in their construction. Not one of their boilers ever exploded, and even when taken to the company's testing ground after being put out of service, they stood remarkable trials.

A few dimensions are subjoined:

Diameter of driving wheels, 44 inches.

Diameter of leading wheels, about 36 inches.

Diameter of cylinders, 17 inches; stroke, 22 inches.

Distance of leading wheel to first driver (centers) about 47 inches.

Distance first to second driver (centers) about 54 inches.

Distance second to third driver, (centers), about 48 inches.

Total wheel base, about 12 feet 5 inches.

Diameter of boiler, about 46 inches.

Firebox (inside) about 40 x 60 inches.

Length of engine over all, about 30 feet 8 inches.

Top of stack from rail, about 14 feet 5 inches.

Weight of engines, 54,200 pounds to 61,500 pounds.

The company at one time fitted eight of these engines with Gill & Co.'s smoke-burning firebox, and straight stacks. At a later period several received link-motion, injectors and four-wheel swinging trucks. The cut-off was taken off those which retained the drop-hook motion, as the last years of their service were spent in yard shifting. C. H. CARUTHERS.

Pittsburgh, Pa.

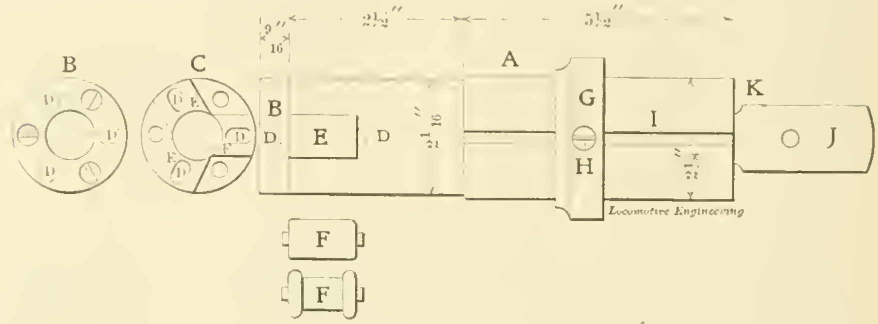
Arch Pipe Roller.

Editors:

Inclosed please find sketch of an arch pipe roller designed and made by the writer. It has been the practice to thread the hole in the inside sheet, and depend on the compression of a tapered brass nut, or sleeve, pinching the pipe and making a joint. Sometimes the joint was tight, and at other times it would leak, caused by the movement of the pipe due to contraction and expansion. To roll or expand the pipe, we must work through the outside sheet, and through the water space or leg of boiler. Owing to the projection of the end of arch pipe into the water space, the ordinary expander (Prosser) cannot be used.

The tool *A* is made of machinery steel 8 9-16 over all in length. The largest diameter fits loose in a 2⅛ hole in outside sheet. The small end is a very loose fit in end of tube. As the water space varies, the movable collar *G* (held in place by the set screw *H*) is adjusted so that in rolling the pipe the beaded roll *F* will swell the pipe on either side of the sheet. *C* shows the end of the tool with the cap *B* and rolls removed. The oval recesses *D*, *D*, *D* in tool and cap are to prevent the rolls dropping out, the rolls having small journals on either end, and are a loose fit. *E*, *E*, *E* are the spaces cut out to hold the rolls. *B* shows cap and countersunk screws for holding it in place.

The end of tool where the rolls work is case-hardened; the rolls being of tool steel, hardened. Three rolls are used, two plain and one beaded, the beaded end being of the same diameter as the plain rolls. To prevent the pin *J* going through far enough to strike the bend in pipe, it is made of a length to have the shoulder *K* strike before the point can touch the bend in pipe. In case the first pin does not roll tight enough, a second pin is inserted, of the same taper, but large enough to take up the work where the first pin left off. The pins are turned straight part of the way, and are an easy fit in the tool.



ARCH PIPE ROLLER.

In measuring for the adjustment of the collar *G*, always measure from any projection the collar is liable to bear against, a possible staybolt or rivet head. The groove *I* in tool is to prevent the set screw making a burr.

In the hands of a mechanic this tool does a first-class job, and does it quick. The beaded roll forms shoulder enough to prevent any movement to the pipe. Use it if you want it.

W. DE SANNO,
Tool Room F'man, P. H. Shop.
Indianapolis, Ind.

Hydraulic Press for Piston Removing.

Editors:

This hydraulic press is intended for removing piston from crosshead. It is a very useful instrument for that purpose, is easily applied, and very effective when in operation; will accumulate a pressure of about 225,000 pounds against piston rod end. The screw, running in oil, lubricates itself; thereby friction is greatly reduced.

In connection with the application of the press, the crosshead pin is used; this makes it applicable to all classes of engines without any extra pins. In this way a good fit and a straight, square push are always secured, and no damage is done to either crosshead or piston center. This is a very important feature.

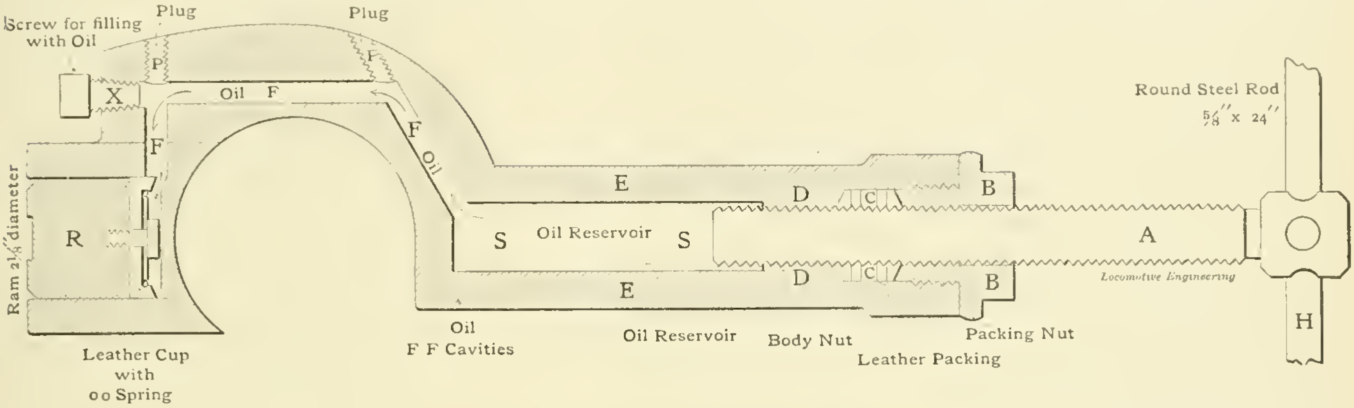
The ram will follow the screw when screw is turned outwardly—a vacuum being formed in oil reservoir, which causes the ram to go back to its starting point.

Sketch illustrates how it is used. The key X is taken out of crosshead; also the pin. Now we put the press into crosshead and put pin back to its place, and operate handle, and in this way force out piston. It is not necessary to take down the back end of main rod; only the pin is taken out, which disconnects the front end and makes room for the press.

I have seen a good many pistons taken out of large Pennsylvania Railroad Altoona engines with this press. They generally jump out the full length, clear away from crosshead, with a loud report—showing that they were tight, and showing that they were well fitted. The press has been made and used at the Northern Central Railroad shops, Elmira, N. Y.

J. A. Eisenaker.

Elmira, N. Y.



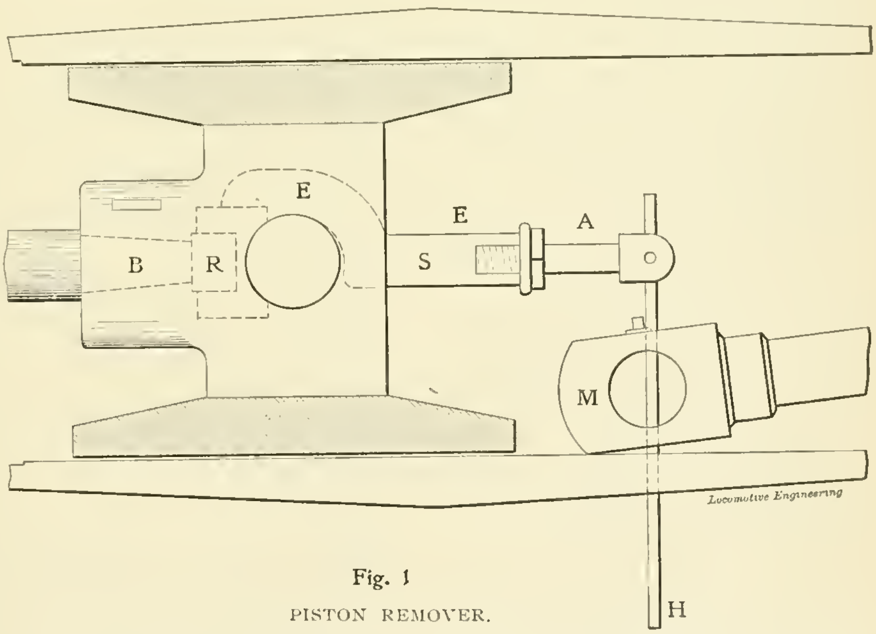


Fig. 1

PISTON REMOVER.

❦ ❦ ❦

At the last meeting of the New York Railroad Club the subject of steam heating of trains was up. Several of the speakers were arguing the necessity for automatic devices, stating that any system depending on the trainmen to regulate it was defective. Mr. W. S. Morris, of the C. & O., touched the point when he stated that his road had five or six different systems in use, and that the best results were found where the trainmen controlled the heat by hand; that by giving them a temperature to go by, and not the whims of anybody, and keeping the discipline up, the men got results without any apparent trouble. Mr. Morris believes in men. Automatic devices have proved highly advantageous in connection with train mechanism, but it is a good thing to remember that the human element cannot be entirely dispensed with.

From the Imperial Railway of China.

From Mr. C. W. Kinder, chief engineer of the Imperial Chinese Railway at Tientsin, China, we have received the following interesting letter to James Skeevers. Skeevers says it ought to be published, and here it is:

AN OPEN LETTER.

My Dear Skeevers—I read with great interest your statements made to "Old Frosty," published in the June number of "Locomotive Engineering," and it struck me that he might persuade the "Old Man" to go a step farther, *i. e.*, adopt plate frames and inside valves, and thus make the "Prince of Wales" and "Lord Algernon" more infernally British, and therefore more daring innovations than the forward slab arrangement he suggests can ever make them. If he will only do it I am certain that the hearse will pull easier and a great saving of fuel will result, to say nothing of doing away with the sewer which the "Old Man" naturally is rather scared about.

Although a bloated and debased Englishman, I have adopted almost all American devices which I think you regard as essential to enable a railway man to procure a seat in heaven, and among them are forty locomotives with outside cylinders and valves on top. Now, if these same valves had been inside the boiler itself it would not matter very much, because it is only on very rare occasions that they ever need any attention, due to good treatment and high-class workmanship.

In future engines I therefore intend to place the valves between the frames, not in the smokebox, as in England, but just under it, well cased in, but of easy access if need be. By this I shall save steam, but not quite so much as is done in English engines; this will be a half-way measure for fear of scaring "Old Frosty" too much at one time.

While in the United States six years ago I asked a very celebrated locomotive builder why he still stuck to the more costly bar frame. His reply simply indicated prejudice, more or less, on the part of his customers, and he fully agreed that an equally good frame at less cost could now be made in the United States on the plate system, universal elsewhere.

In small engines the bar frame did have some superiority in the way of permitting access to certain parts; but with modern high centered boilers, this no longer holds true. The same may be said of the impossibility of valves being placed under smokebox because wheels were so small and boilers so low.

Twenty years ago, when in a Russian locomotive works, we had all our plates drilled so that stays were visible; but we never found this any advantage, and most lines have given it up as boiler stays began to be better fitted. Hollow stays were used at same time, and these also have long been done away with as unnecessary, but seem to be in growing use in the United States.

I hope you will disabuse your mind that what I write is due to prejudice, when I tell you my line was the first to introduce the Janney or vertical plane coupler as standard; that our freight stock is practically all 20-ton and 30-ton 8-wheel cars; that our passenger cars are all of the American type with "National" brake beams, and that the high-speed Westinghouse brake will be fitted as soon as we can afford it. I do not despair about plate frames yet, because recently you have adopted several things which you previously regarded as bad English practice, viz., solid ends to coupling rods, large driver wheels, and even 6-wheel tenders with metal frames. You have steel centers to your best wheels, and fasten your tires to these with retaining rings. Surely there is hope!

So try "Old Frosty" still once more, and you will then be able to truly state you have the finest engines in the whole world, whereas now you can only truly state you have the biggest.

As to copper boxes, where the water is hard and no chlorides present, they will beat steel any day, as I have proved over and over again; but where chlorides exist, as in most American waters, steel is undoubtedly advisable.

Can you get "Old Frosty" to permit you to test a train of cars with 42 inch wheels, and one of equal weight etc., with 33-inch wheels? I have made this test, and you can kick me from here to New York if I will ever use a 33-inch wheel again.

Our 42½-inch steel-tired wheels run over 270,000 miles even before re-turning, and will at least last a million before new tires must be put on; they cost us about fifteen gold dollars each, f. o. b. Europe. Of course, we do not yet use air brakes, but otherwise the conditions are as with you, except, perhaps, brakesmen go to sleep more soundly and driver brakes have harder duty. As freight is such a serious item, we take every precaution to get very high-class materials.

Wheels and axles are imported, but practically all the rest is done here, where cheap labor and teakwood allow of a considerable saving.

Now, my dear Skeevers, if you will construct an automatic sewer deodorizer and atmospheric disinfector for the S. A. L., I will risk the yellow fever, the oysters at Delmonico's, and the ubiquitous American interviewer, and come and see it at work.

(Signed).

We also append the specifications for passenger and freight engines, as sent out by the locomotive superintendent, Mr. G. D. Churchward, for bids. Please note the "extras" to go with these engines; 500 gage glasses ought to last an engine a long time, even in China:

SPECIFICATION FOR PASSENGER ENGINES AND TENDERS—CLASS A.

To be constructed to the same specification as the freight engines, and as many parts as possible to be interchangeable.

The following are the leading dimensions:

Cylinders, 19 x 24 inches.

Driving wheels, 84 inches diameter on tread, and not less than 3 inches thick on tread.

Four-wheeled bogie, with swing bolster and plate frame, with wheels 36 inches diameter on tread, and not less than 3 inches thick on tread.

Air brakes to be fitted to all wheels, including bogie.

Weight on drivers not to exceed 3 English tons per wheel.

Weight on bogie not to exceed 5 English tons per wheel.

An extra pair of trailing wheels may be arranged behind drivers, if found necessary.

One complete set of tracings on cloth of working drawings to be supplied.

SPECIFICATION FOR FREIGHT ENGINES AND TENDERS—CLASS M.

Gage, 4 feet 8½ inches.

Fuel to be used, soft bituminous.

Weight on drivers not to exceed 8 English tons per wheel.

Weight on pony truck not to exceed 5 English tons per wheel.

Total weight not to exceed 58 English tons.

Running gear must be made as light as possible, in order to obtain the maximum amount of heating surface in boiler.

Wheel-base total of engine and tender (6-wheeled) not to exceed 46 feet.

Maximum height of chimney top above rails not to exceed 15 feet.

Total effective heating surface not to be less than 1,600 square superficial feet.

Grate area to be from 20 to 24 square superficial feet.

Frames preferably of plate type, but the American bar frame can be used.

Pony trucks to be of American type, and not with radial axle boxes.

Cabs must be 9 feet wide over all, and tender may be of same width; cab top to be made removable, with rings in each corner for lifting.

Coweatcher or pilot to be of iron.

Coupler to engine and tender—arrangements to be made for fitting Janney couplers to engine and tender in China.

The wheels must be equalized all around on the American system.

The means for efficient lubrication must receive special attention and to be well arranged for a dusty and intensely cold climate.

WHEELS.

Number of drivers, 6; diameter on tread, 60 inches.

Pony truck wheels, 2; diameter on tread, 36 inches.

Tires to be not less than 3 inches thick on tread, and to be of the best Siemens-Martin open hearth steel, and fastened on to wheel by Stroudley & Carlton's fastening, or other continuous fastening.

Centers must be of cast steel or best hammered iron.

Counterbalance weights to be solid to the wheel, and great care taken for their accurate adjustment.

Area of journals to be of ample dimensions to secure cool running.

AXLES.

To be of best quality hammered iron.

CYLINDERS.

Cylinder diameter, 19 x 24-inch stroke.

Piston packing to be Ramsbottom cast iron rings. Cylinders to be outside frames, with valve box on top, on American system.

VALVES.

To be the ordinary D-valve and made of cast iron, worked by ordinary Stephenson link motion and rock shaft, on American system.

Valves to be balanced.

BOILER.

To be of Belpaire type, or round-topped outside firebox, flush with barrel, and with radial stays.

Working pressure to be 180 pounds per square inch. Material to be of specially-selected locomotive boiler steel.

Horizontal seams to be quadruple-riveted butt joints. Circumferential seams to be double-riveted.

Crown sheets to be stayed with best iron staybolts, and also all other staybolts and stays to be of best iron, equal to Lowmoor iron.

Diameter of dome to be 30 inches.

Tubes to be of best iron, 2 inches outside diameter by 12 to 13 feet long, and enlarged at smokebox end to enable the easy withdrawal.

Fire-box to be of copper or steel—quotations required for both.

Barrel and firebox to be sheathed with a suitable non-conducting covering, and then covered with painted sheet iron.

Smokebox to be provided with an extended front and wire spark-catching netting.

Foundation ring to be double-riveted.

Regulator to be of the English double slide-valve system, placed inside dome and easily get-at-able, and also to be worked by vertical lever.

Fire bars to be of cast iron.

Ash-pan doors to close tight.

Smokebox door to be on English system, with machine-faced joint and absolutely tight.

Unusually good arrangements must be provided for the efficient cleansing of the boiler.

BRAKES.

Driving and tender wheels to be fitted with the most modern quick-action Westinghouse air brake, and the system must be such as to insure the most perfect equalization on all brake blocks; the parts must be of ample dimensions to withstand the roughest usage.

In addition, the tender must be fitted with a powerful hand brake.

The brakes must be fitted as per blueprint attached to this specification.

SUNDRY DETAILS.

Cabs to be of steel and of American type, with louvre clear story on top, as shown in diagram attached to this specification.

Engines to be painted black and lined out with vermilion.

Two injectors to be fitted of the most simple and best accepted pattern (the working parts to be easily removable), and capable of feeding water into the boiler at a temperature of 150 degrees Fahr.

Injectors to be fitted inside cab, and live steam pipes must be fitted to prevent water freezing in both delivery and suction pipes of injectors.

The engines to be provided with all necessary tools and cab lamps; head light, or platform for same on smokebox, is not required.

"He-and-She" spring buffers to be fitted between engine and tender, and suitable provision made for tight coupling.

Cylinders and valve boxes to be sheathed with a suitable non-conducting covering, and then covered with painted sheet iron.

Threads of all screws to be Whitworth standard.

Sandboxes must not be on top of boiler.

Cylinder and valve drain cocks to point outwards right and left of engine.

Adjustable horn block wedges are not required.

Two water gage glass fittings to be provided on each engine.

Safety valves to be of Ramsbottom type, with lever inside cab.

High finish for purely decorative purposes is to be avoided; otherwise both workmanship and material to be of the very best description to withstand trying climatic conditions.

On settlement of contract, certain detailed drawings of standard parts will be supplied: such as chimney top, water gages, clocks, fire-hole door, safety valves, regulator, whistle, etc., etc. One complete set of tracings on cloth of working drawings to be supplied by contractor.

TENDER.

Type to be 6-wheeled, with steel plate frames.

Wheels to be 42 inches diameter on tread, and tires 3 inches on tread, and to be fastened onto wheel in a similar way to those of the engines; also of same quality as engine wheels.

Tank to be of the horse-shoe type.

Water capacity of tank to be 4,000 English gallons.

Coal capacity to be 7 English tons.

Water to be heated by live steam jet.

The trailing and center pair of axles must be equalized.

SPARE PARTS TO BE SUPPLIED FOR EACH TYPE OF ENGINE AS UNDER.

1 Complete set of springs.
1 Complete set of journal brasses.
3 Injectors.
500 Gage glasses.
2 Pistons with rings complete.
1 Slide valve complete.
2 Springs for Ramsbottom safety valves.
1 Spare pony truck complete.
2 Sets of tubes with ferrules.
2 Sets of ferrules.
1 Firebox.
1 Tube plate.
1 Set of tender wheels and axles with brasses.

G. D. CHURCHWARD.
Loco. Supt.

February 8, 1896.

Rules Made to be Broken.

The practice of railway operating officials in respect to making orders that are to be regarded as dead letters, is one of the most pernicious things in railway management. It is a two-edged sword that is bound sooner or later to work disaster to those involved.

A rule to slow down to, say, ten miles an hour over switches, when it is perfectly plain to the author of it that schedule time cannot be made if literally construed, is not only rank injustice to the men, but positively criminal. Men will make running time day after day by violating this rule, simply because they are obliged to break it in order to get their trains over the road and hold their positions, a fact well known to railroad men for years, but the public never hears anything about this phase of travel until there is a pile-up.

This status of things is seen to be in existence in other countries than ours, as shown in the appended letter from Mr. Clement E. Stretton to "Transport," in which reference is made to the tactics followed on the East and West Coast lines, which led to the wreck in the Preston yards, illustrated in our September issue. The letter is interesting as showing a marked similarity in the handling of fast trains in England and America. Under the caption of "Railway Racing and the Preston Accident," it says:

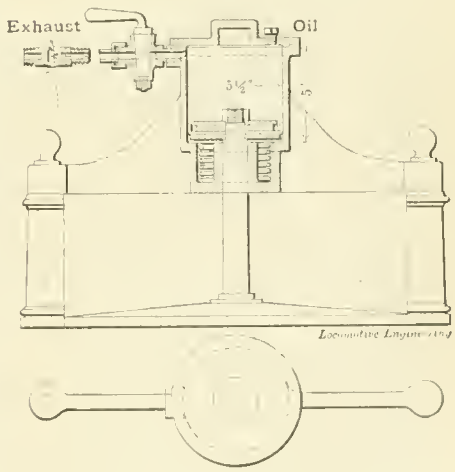
"The verdict of the jury in the case of the Preston accident clearly shows the evil of railway racing. It is a well-known fact that the competition between the East and West Coast routes to Scotland is so severe that each side, in order to beat the other, has booked the train on paper at speeds which it cannot safely perform in practice on the rails. There are in the time-tables and notices instructions that speeds are to be reduced to 10, 15, or 20 miles an hour over certain curves and junctions; also that trains are to run into stations at slow or hand-brake speed. Because the London & Northwestern train has met with a disaster it must not be supposed that that is the only line upon which the speed orders are disregarded, for as a fact all the racing trains on the various routes have to disregard the rules if they are to keep the time booked. The engine-drivers are severely cautioned and removed from the fast trains if they lose the least time on the journey, and they are 'expected' even to pick up lost time, although they are not informed to that effect in writing. The engine-drivers have brought the facts before the Society of Drivers and Firemen, and protests against excessive speed have been forwarded to the Board of Trade. Last year 85 miles an hour was run in England, and 86 in America, and it is no secret that it was intended by the English companies to beat both those records in 1896. Another evil of the 'railway race' is the large amount of 'betting' which goes on amongst the passengers in the trains, as to the time of arrival, or time of the fastest mile, and I have proof of cases in which passengers have been to the drivers and promised them money if a certain time were kept, in order that they could win bets. I do not say that any driver has run faster on that account, because I know that some drivers have refused, but the practice is a dangerous one, and should not be attempted by passengers. The practice of sending telegrams from one line to the other, to inform each company how the rival train of the other is progressing, also tends to cause fast running. Telegrams are received, for instance, at York stating that the other company's train is a certain number of minutes before time at Crewe. Or Carlisle is informed as to the rival train at Newcastle. When the driver of one racer is informed that the rival train is, say, six minutes in advance of him, it is nothing more than natural and is intended that he should 'push on.' Of course he does 'push on,' and the only way to pick up the time is to disregard the speed orders and run faster than is safe. The result of this has been seen at Preston, and unless the trains are allowed more time and the racing given up, other accidents are certain to follow."

Pitch of Gear Teeth and Screw Threads.

The fact that one of our correspondents takes exception to our definition of the term "pitch" as applied to gear teeth or a screw thread, shows conclusively that there is missionary work to be done still on the subject. If he will reflect a little he will see that our definition of the word is strictly correct, and that it does not conflict in any way with that given by the authority he cites.

The pitch of gear teeth is most conveniently referred to as the distance from center to center of teeth at the pitch line, either for circular or chordal pitch the first-named being the distance between centers on an arc of the pitch circle, and the second the length of the chord of the angle measured in a straight line by the distance between the centers of teeth and the center gear wheel.

This proposition is not affected in the slightest by the fact that pitch can be measured in some other way, or that other authorities do not agree with our explanation.



D., L. & W. Pneumatic Letter Press.

We show herewith drawings of a letter press worked by air as used on the D., L. & W. road. Many other roads use air for this purpose, notably the U. P. and the G. N., but this is the first drawing we have seen. For large presses, such as used in railroad offices, the air operated press is as much better than the screw press as it is handier and quicker.

AIR BRAKE DEPARTMENT

Conducted by F. M. NELLIS.

Li Hung Chang and Air Brakes.

We learn that the conductors and enginemen who managed the special train of the Pennsylvania which carried Li Hung Chang from Washington to Niagara Falls have received silver medals from the Viceroy. We congratulate the engineers who handled the brakes so smoothly for the distinguished Chinaman. (They must have handled him smoothly, else they wouldn't have gotten medals.)

Knowing that Li Hung possessed a remarkable penchant for investigating all matters, and that he asked numerous and all kinds of questions at every opportunity, we fancy that after pumping dry the officials who acted as escorts to him on this trip, he perhaps turned to the conductor with questions something like this:

"What is your age?

"What salary do you receive?

"Do you know the difference between straight and automatic air?

"Do you think by hanging onto the signal cord until the line is drained, gritting your teeth, growing red in the face, and muttering naughty things meanwhile, that your signal to the engineer will be more correct and better understood?

"Do you think that your 'get out o' here quick' signal immediately followed by a 'stop on a ten cent piece' signal is any rottener than your engineer's water-tank stops?

"Don't you think that if the engineer knew half as much about the air brake as you do that everything would be perfectly lovely?

"When you were on freight, did you ever commit to memory certain sweet passages of Scripture or poetry to be used when crawling from the coalbox, or far corner of the caboose, whither you had been thrown by Engineer Callahan's dynamite water-tank stop?

"Did you remember your lines on that occasion?

"Did you ever set hand brakes on the rear end of a partially equipped air-brake freight train when the engineer was using the air; and afterwards, while chaining up where the break-in-two happened, did you cuss him and declare that he hadn't enough brains to run a wheelbarrow? No?

"Do you think that when the air is applied to test brakes, and you try, but can't push the shoe away from the wheel with your foot, that that brake is a 'corker'?

"Do you think when a brake sticks that if you kick it with your heel, cuss a bit, and pelt stones at the triple, that the cramp in its stomach will be cured?"

In our fancy we see the big Chinaman as he dismisses the conductor and calls for Engineer Callahan to appear:

"Reckless," familiarly begins this past master in quizzing, "what is your age?

"What salary do you receive?

"Are your officials easily soft-soaped by air-brake failure fairy stories? No?

"Did it ever occur to you that your water-tank stop was a first cousin to a head-end collision?

"Is it true that you have suggested the use of anchors by the trainmen in the caboose to prevent being thrown through the front wall and possibly the next car when you 'catch 'em up a little?'

"Do the trainmen love you?

"Do you think that Dan Dugan and Jake Baker will ever learn the difference between an overcharged trainpipe and a stuck receiving valve?

"Do you hammer the gizzard out of an air pump when it faints?

"What do you think is the best lubricant for a rotary—hair-oil, election grease, or flattery?

"Is coal oil or concentrated lye the best physic for a constipated air pump?

"Did you start the rumor that your 9½-inch air pump was responisble for your asthma—that it was such a pumper that it made the atmosphere so rarified around it that you had difficulty in breathing?"

Having obtained much valuable information that may be used in China later on, he dismisses "Reckless" with a smile that is child-like and bland.

Preparatory Grinding of Cast-Iron Wheels.

In a paper on "Cast Iron versus Steel-Tired Wheels," read by R. P. C. Sanderson before the August meeting of the Southern and Southwestern Railroad Club, the cost of twenty-one cents for "grinding true" was added to the cost of fitting up and mounting on an axle a pair of new wheels. This item is significant, inasmuch that it recognizes the fact that very few cast-iron wheels come perfectly round from the foundry. This, coupled with the fact that wheels are not always centrally bored, places in service wheels which are out of round and eccentric-shaped, and is a direct sacrifice and an invitation to "slid flats."

While visiting one of our large railroad shops recently, our attention was attracted to a pair of newly mounted wheels suspended by the axle centers in a grinding lathe, and nearly three-sixteenths of an inch was being taken off one part of the tread by the emery wheel, while the opposite side was barely touched. Upon inquiry, we were informed that this was no exceptional case—that nearly all wheels required grinding after being mounted on the axle. Doubtless many of the skidded wheels attributed to the air brake could be traced to their improper condition when entering service, and might have been prevented had they gone through the grinding process.

The first cost of twenty-one cents for putting in proper condition a pair of wheels for entering service, when compared to the ultimate cost of labor and material involved in replacing "slid flats," is so inconsiderable that the better results to be thereby obtained would seem an eloquent appeal for a general adoption of the preparatory grinding process.

Air-Brake Items.

Better signals to the engineer from the train crew will save drawheads, and, perhaps, the religion of the men as well.

A volume of truth is contained in the statement of a correspondent who says, in substance, that the caboose stove is frequently upset on account of a signal to stop being given immediately after one to go ahead.

A new and decidedly practical scheme for ascertaining whether the brake on each car is doing its share of the holding, is that of feeling with the hand the temperature of the wheels at the foot of grades, or other points where the brakes have been long and continuously applied.

There is little doubt that rough stops at water tanks are oftener due to overcharged train pipes than anything else.

Mr. James Downing, of Arkansas City, Kan., sends us a bush puller which he has used for sometime in removing obstinate bushings out of the 8-inch pump. A modified form of this tool is used to dislodge the emergency valve seat in the quick-action triple. Mr. Downing's device, while differing structurally from that presented by Mr. Young, is sufficiently similar to it in principle that we have not illustrated it.

The Philadelphia & Reading Air-Brake Instruction Car.

The Philadelphia & Reading Railroad recently launched an air-brake instruction car which has been in service at Reading for nearly a month, and is now at Philadelphia.

The car, which was taken from service as a passenger car to be fitted up for its present mission, is mounted on two four-wheel trucks, and weighs, probably, about 45,000 pounds. It is divided into two compartments. One contains the 12 horse-power boiler and attachments. The other is the instruction room, and is about 30 feet in length. A rack, supporting eight freight brakes, one 10-inch passenger car equipment, one tender and driver brake equipment and full amount of piping for same, stands lengthwise in the middle of the car. An 8-inch pump, which furnishes the air pressure, is attached to one side of the car. A work bench, on which sectional triple valves, brake valves and other necessary apparatus are mounted, is opposite the pump. The engineers' brake valves are at the end of the rack. A board, near the brake valves, contains several gages for registering the various pressures. The instructor's desk is at the end of the car. Air-signaling apparatus, with full amount of piping for six cars, is neatly arranged in the clerestory of the car.

A liberal space is reserved for a good-sized class at the end of the rack. Along the right side of the car, attached to the wall, are folding seats for the use of the class while undergoing examination. The light is furnished by four clusters of Pintsch gas globes. Steam heat will be used. A locomotive tender, carrying coal and water, is coupled to, and will accompany the car on its trips.

The car has been placed in charge of Instructor W. A. Knabb, of whom, as an efficient instructor, and an accommodating and painstaking gentleman, the men speak very highly.

We are not informed of the future plans of the car, but it is safe to presume that it will proceed in its work of instruction over the system, stopping at terminal points, where all men having to do with air brakes will be instructed and examined. The men are much interested and speak very highly of the car and the knowledge they have obtained from their visits to it.

Best Location for the Air Gage.

The following circular letter has been addressed to the members of the Air Brake Association:

To All Members:

The committee appointed to report at our next annual meeting on the "Best Location for the Air Gage Where It Can Be Seen by Day and Night," is desirous of obtaining a general expression of opinion on the subject, that it may be enabled to render as complete a report as possible. They therefore call on all members for information on the following points:

Question 1—Have you a standard location for the air gage on the different classes of locomotives on your road? *(a)* If so, where is it? *(b)* Can you suggest an improvement on it?

Question 2—Can the gage be easily read from the engineer's position by day? *(a)* At night? *(b)* What distance is the gage away from position occupied by the engineer?

Question 3—Have you tried locating the air gage directly to the brake valve, or extension of the brake-valve bracket? *(a)* If so, what is your opinion of this connection?

Question 4—Where the gage is placed on the brake-valve bracket, side of boiler, or on cab forward of the engineer, is separate gage lamp used, or does the one cab lamp suffice for both gages? *(a)* What style of gage lamp is furnished, hood, or painted globe? *(b)* Where the air gage is located as above, do you not think that light from cab lamp or water-gage lamp could be made to strike the face of the air gage?

Question 5—Are your air gages easily accessible for repairs? *(a)* Please answer in full, giving best way of testing and doing roundhouse repairs when gage is placed in what you believe to be the best location.

Question 6—Have you any gages fastened directly to the cab frame? *(a)* If so, do you find the vibration of the cab tends to loosen pipe connections and throw the gage out of adjustment?

Question 7—Would not a better location for the air gage result in smoother and safer train-braking, and defects in the apparatus be more quickly detected and remedied?

Question 8—To what extent should the air gage be visible to the fireman? *(a)* In this connection would it not be an additional precaution to place a gage, showing train-line pressure, on the back end of boilers of the "Wootten" type and others where the engineer and fireman are widely separated? *(b)* Give your personal preference for the location of the air gage on the different types of boilers in service on your road.

Question 9—Do you not consider that air gages differently located on engines being worked on the "pool system" is discouraging to the practice of "watching the gage?" *(a)* Is this not also true where the connections are made differently as at side or bottom?

Question 10—Are the faces of your gages painted black with white numerals, or do you use a white enameled dial with black figures? *(a)* Which style do you prefer, and what means are employed to keep the faces of gages clean?

Full and explicit replies are requested, and it is especially urged that same be sent in before December 15th of the current year. The committee would be pleased to receive any additional information not covered by the foregoing questions.

Address all communications to

C. P. Cass,
Chairman.

Continuous Brakes in Great Britain.

The following quotation is from an English contemporary which comments upon the returns of the Board of Trade, for the half year ending December 31, 1895, relating to this subject. It says:

"The facts very clearly show which is the best and safest form of brake. The Westinghouse brake never once failed to stop the train. On the other hand, the automatic vacuum had six serious failures to act, and in consequence loaded passenger trains overran stations as follows: Failed at Newark, G. N.; failed at Holloways, G. N.; failed at Hemsworth, G. N.; failed at Purton, G. W.; failed at Middleton, L. & Y.; failed at Wellington, S. E. Fortunately, in each case the line was clear, or serious accidents would have resulted. As to the faults of brakes, 510 cases are recorded. The vacuum brake is recorded as 'failing to act' on six occasions, and the Westinghouse brake on no occasion."

A Chinaman on Politics.

Indifferent as is the "Heathen Chinee" to the politics of this country, the hard times and hopes for renewed prosperity led one to open up his heart and pour forth his troubles to Mr. F. B. Farmer, who relates the incident as follows:

"A few months ago I was a passenger on a Mineral Range train in the Upper Peninsula of Michigan, where I had been looking after air-brake matters. Hankering for a soothing "drag" on a choice cheroot presented by a friendly car repairer, I passed into the smoking car. The only vacant seat was beside a Chinaman. After sitting down beside the heathen and airing a few Chinese expressions learned while a youth in California, a general conversation ensued. 'John,' I learned, ran a laundry in Red Jacket, and complained that business was 'welly bad;' but added 'byme-by get new Plesident; I tink be all lite.'

'John,' wanted no more Cleveland Administration, and firmly believed that a third term meant 'no washee.' He wanted a change. Anything would do. McKinley, Bryan, Palmer, gold, silver, money, marbles or chalk. But, to 'John,' it was clear as mud that a 'new Plesident' was needed to persuade men to more frequently change their shirts."

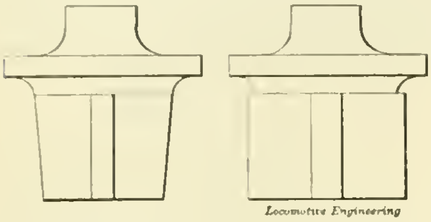
The practice of switching ahead and using all air braked cars is happily becoming almost general throughout the country. Surely the advantage thus gained in safer running of trains justifies this additional work by yard men.

CORRESPONDENCE.

Pound Caused by Worn Air Valves.

Editors:

I would like to say in answer to W. K. T.'s question, No. 51 in August number of "Locomotive Engineering," that an air valve with the clearance worn out, as per



accompanying sketch, will make a pump pound.

J. B. Downing.

Arkansas City, Kan.

[An air valve worn so badly as to be in the condition illustrated in No. 1 would have excessive lift. Would not the pound be caused by the excessive lift rather than the absence of clearance? We gravely doubt that the pound would cease if the worn valve were merely put in the lathe and a new clearance cut in it.—Eds.]

Jake Baker Visits the Instruction Car.

Master Veditor:

Aboudt a cooploo two three mondths past ago I ask me some gwestions aboudt dose are bragkes undt thry to eggsblain der throubles. Now I vos again vonce more in der mudtles. Veek before lest of lest veek der are bragke *ens thruck shun* cars coome our defishun upon und all der bhoys moost pess der siven bints or go mit der cars along.

Vell I vent in der cars und der mans vat vas give us der dance und song, go tru der bisness very putiluly. Eggsblainen der driple velves der augsziliries und der bragke cilinders der bisten drevels und so fordt.

He also tell us how to pull der visel und magke up der thrains. Efter he hadt plowed avay about dree times der full ov der mane trum ov are he say "Now shentlemens, I have toldt you aboudt helf ov der bisness hear budt I haf gone py my time und you moost coome beck und get der rest some dimes vonce again." Undt diregts us to go in der onder cars vere der Schudge vould gife us der grossgwestion mit der touple shiffel undt gife his desishins. Now dis vas dedt eazy to enser dose gwestions but ven der Schudge say "Vy vouldt you do dis vay?" dose vas der sthickers. Ven he ask me vat made der bragkes ably, I said, "Der enginers pudt der hendel in der eggsdreme ridte undt traw are from der mane trum, undt plow it beck tru der drain pibe into der bragke cilinder oudt tru der augsiziliry razorvoy undt tru der redaning velve, soundting der alarm ven der bragkesman vould ably der hend bragkes."

I dink my enser vas goregt for I see der Schudge schmile undt saidt to der cless, "How about dot?" undt den some vone saidt, "Pudt der Dutchmens oudt," but der Schudge say, "Hold on phoys, gife him er chence. He is efter his nine bints."

Budt I dink der Schudge he magke som mestagkes for does tigkets onley saidt two bints. I go me der cars on in der mornings undt vile I schleep some tonight I sthudy purty hardt undt gedt me myself bostedt.

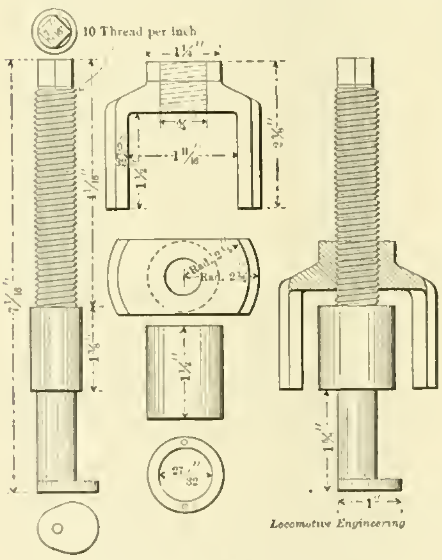
Jacob Baker.

Elmira, N. Y.

Bush-Drawing Tool.

Editors:

I am mailing you a blue-print of a tool I use for drawing out the upper valve-chamber bush in the 8-inch air pump. It is my own ideà, and I have used it for two years with the best results. It draws the bush out perfectly square and does not injure it at all. I have found it very handy on passenger trains for doing quick work and not delaying them. When the bush would give out, and I found the head



BUSH-DRAWING TOOL.

of the set screw broken off, I could draw it up through, and then file a groove in the new one to keep it from turning.

I don't think it necessary to explain the drawing at any great length, as it is simple. Put the bush *A* on the screw before putting on the bridge. When putting the tool in the bush to take it out, hold bush *A* up until you place the tool; then drop it in to keep it in the center.

W. O. Young,
Old Colony R. R. Shops.

Boston, Mass.

Inside Brakes on Freight Cars Hung to Bolster.

Editors:

One of the problems before railroad companies is the care and adjustment of air brakes. The ordinarily accepted limits of piston travel on freight cars is not less than five nor more than nine inches.

If a car has its piston travel adjusted to five inches, when loaded, we will find the piston travel somewhat shorter when the car is unloaded. This may cause the brake shoes to rub against the wheels when the car is light, causing a hard-pulling train. This is an everyday occurrence, especially with cars not having a low leverage. This is due, of course, to the fact that when the car is loaded, the springs under the bolster being compressed, the shoe is forced to its greatest distance below the center of the wheel, and to a point on the curvature of the wheel where the shoe has to travel a greater horizontal distance in order to come in contact with the wheel.

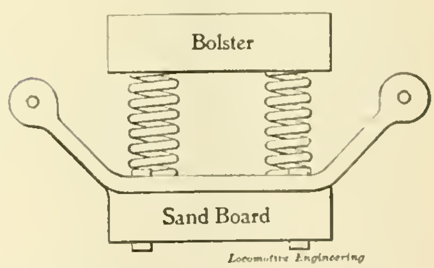
The more shoe clearance we have, the more piston travel; hence, if piston travel is set when a car is loaded, it is shorter when light; and when within the limits light, it may be too long when loaded.

The drop of the shoes, when a car is loaded, is due to the compression of the springs on which the bolster rests. When the brakes are set, on cars having brake hangers fastened to the bolster, an additional strain is put on the springs equal to the downward pull of the shoes. This, of course, also increases the piston travel, as the extra pull produces a corresponding deflection in the springs, thus dropping the brake shoes still lower on the wheel. Why would it not be well to look after this variation in travel as much as possible?

This could be done if the brake shoes could be so hung that, regardless of whether a car was loaded or light, the brake shoe would be the same distance from the rail and unaffected by the movement of the bolster.

Why not, in building new cars, cast a lug on the bolster guide, or in equipping old cars with air brakes, place a casting, like or similar to the one in the sketch below, on the spring plank, from which to suspend the brake beams? By so doing, the shoes remain in the same position, regardless of whether the car is light or loaded.

A greater angle can also be given to the



INSIDE BRAKE HANGER.

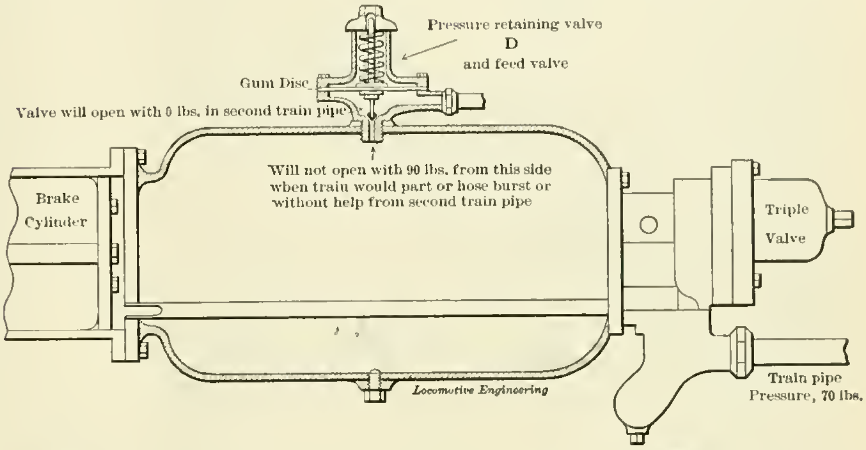
hangers applied in this way, thus causing the shoes to fall away from the wheels more readily when brakes are released.

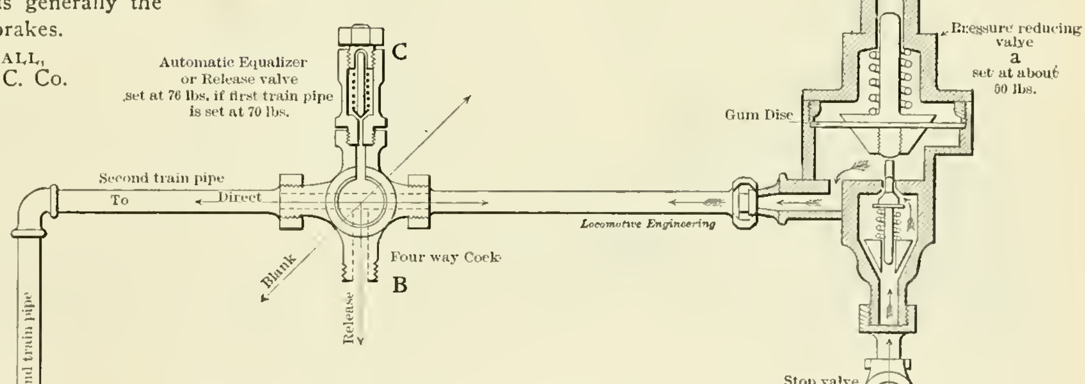
There is also another point in favor of this plan, especially on cars with a low leverage, in which case, if the shoes are practically stationary in regard to their vertical movement (that is, hung from the spring plank or other point below the springs), the travel may be adjusted to five inches, and the travel, in all probability, will never get beyond the maximum limit.

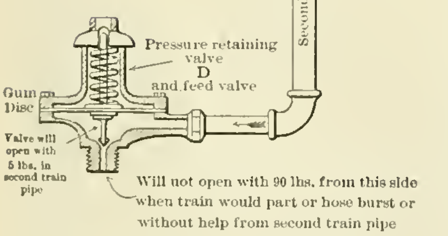
On a low leverage car we can adjust the travel at five inches with new shoes, and then, leaving the dead levers in the same holes and putting on all old shoes, the piston travel will not increase over from four to five inches in travel. Each new shoe applied shortens the travel, and it cannot get too short; for if all new shoes are put on at the same time we will still have a five-inch travel, with which we started. This is on a low leverage car, with all old shoes. How seldom do we find shoes all worn out at the same time!

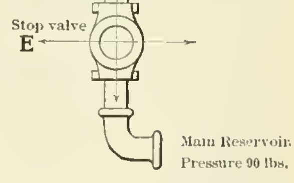
Another great help in reducing the variation of piston travel is to adhere, as nearly as possible, to the Master Car Builders' standard in regard to the height of the shoe above the rail. The nearer the shoe is hung to the center line of the wheel, the less will be the variation in piston travel, when a car is running, over what it is when standing, and the less variation we would have in the travel between a light and loaded car, even were the brakes hung from the bolster or from the body of the car, as is generally the case with outside-hung brakes.

R. H. BLACKALL,
A. B. Ins., D. & H. C. Co.
Oneonta, N. Y.









AUTOMATIC STRAIGHT AIR.

An Automatic Straight Air Brake.

Editors:

Having seen your request for anyone having new devices to send them to you for publication in "Locomotive Engineering," and get the credit of being the inventor, I am sending you an automatic straight air brake which I have designed.

I am a locomotive engineer of a work train now, having run all others, and it has always been a question in my mind that there should be a different air brake for such trains, so that the engineer always has full charge of his train in all cases, whether there are small leaks in train pipe or auxiliary reservoirs—in fact, anywhere.

First, a work train frequently stops from one minute or less to hours at a time, and then moves a few feet and stops at once. On a steep grade from 90 to 140 feet to the mile, everyone familiar with the air brake knows that if he has been holding the train with the air brake alone he has trouble about that time. There are also other cases, such as loading or unloading rails, where you have to hold a train on a grade, throw off brakes, recharge and brake again, all in 30 feet, and at the rate of about two stops a minute. The brake must be perfect, no leaks anywhere, to do this kind of work satisfactorily. With the Westinghouse alone that is almost impossible, as the cars get hard usage, and get to leaking. Now, what I want is to overcome these leaks without making daily repairs—such leaks as release the brake, when it should stay applied, if the train should stand on a grade for five or ten hours. Sometimes the brake releases in a few minutes, even if applied full, and a big pump working away for nothing.

Following, you will note sketch of brake which I call an automatic straight air brake, which, when attached to the Westinghouse brake, will get behind the brake when applied full or below the equalizing point, or the first train pipe emptied, that will insure the brakes to stay on as long as the pump will work.

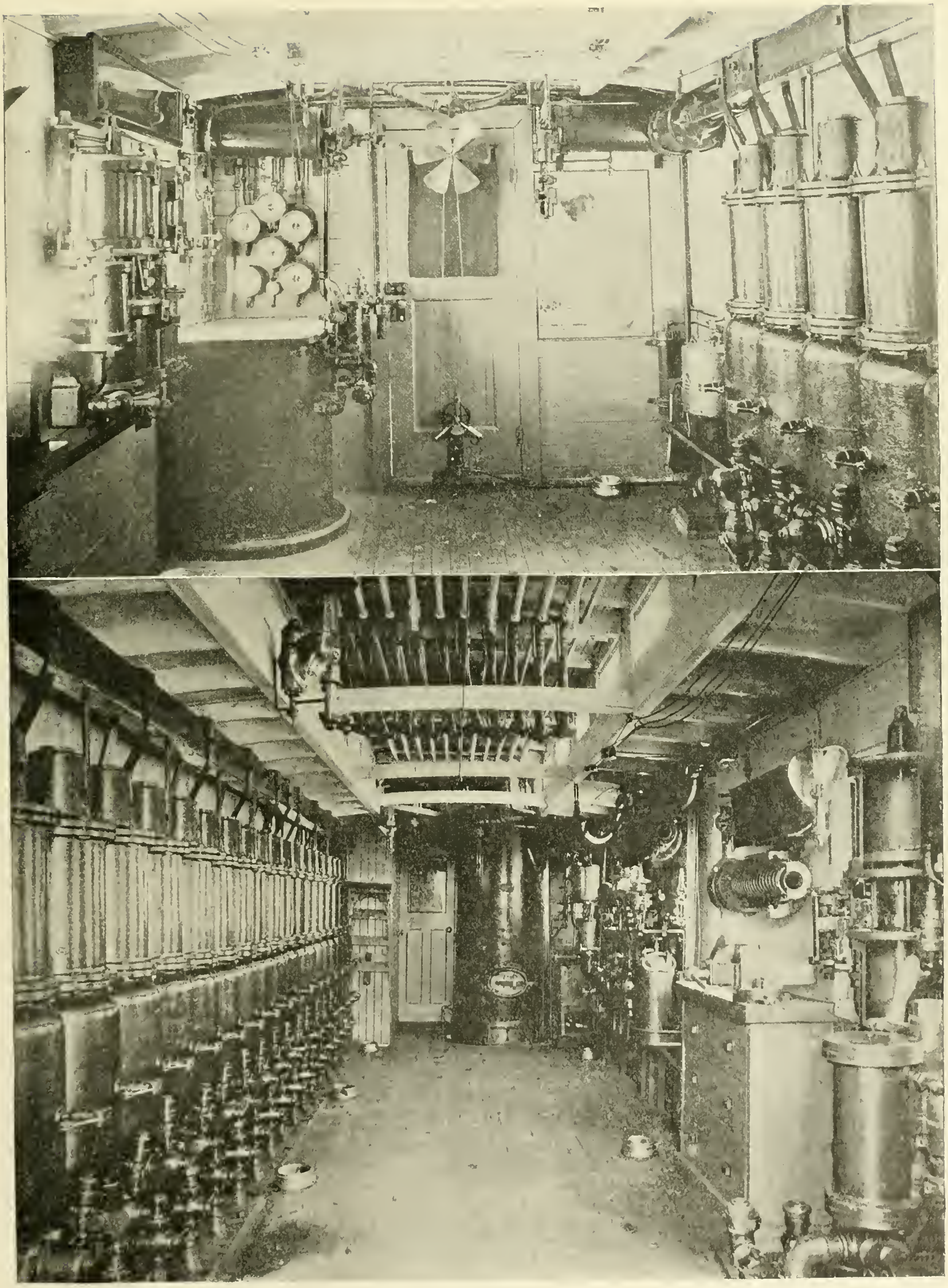
I will use a second train pipe with pressure-reducing valve *a* connected to pressure of main reservoir, and set at about 50 pounds, if first train pipe is set at 70. Next, I use a fourway cock *B*, and an equalizing or release valve *C* set at 70 pounds, and have a pressure-retaining valve *D* so constructed that 5 pounds to the square inch through second train pipe will lift it. If train should part, the air under the disk is gone, and the spring will force valve to seat and retain the auxiliary reservoir pressure. Of course, this train pipe must have all the couplings and cut-out cocks same as the other train pipe. This will make a brake that can be relied on at all times, one that can be used on other trains where there are long grades to be traversed and many stops to be made, and also brake must be applied while standing, and good time is to be made. This will automatically recharge the train to 50 pounds while the brake is applied.

There may be some objection to this brake, on account of the second train pipe and the expense connected with it; but I think the saving in repairs would pay for the extra train pipe. The pump would keep up all minor leaks, that otherwise would make the Westinghouse brake inefficient.

JAMES M. DAMPMAN.
Schuylkill Co., Pa.

[While we are pleased to see that our

AIR BRAKE INSTRUCTION CAR, GREAT NORTHERN RAILWAY.



AIR BRAKE INSTRUCTION CAR, GREAT NORTHERN RAILWAY.

correspondent can diverge from the beaten path, and develop an idea of his own, yet we must say, as we have said before in commenting upon similar devices, that the very considerable expense involved in maintaining an air-brake system which depends upon two train pipes for its operation is sufficient to discourage its introduction to railroad service. The multiplicity of parts, and the expense required to maintain the second train line and its valves, would outweigh the usefulness of the device. It would be impossible to have a separate system of brakes for each different kind of service.

If a train is to be held on a grade for several hours at a time, it would be much the better plan to set the hand brakes. If rails or ties were to be strewn along the track, it could be more quickly done by moving at a slow regular rate of speed, while the crew did the unloading, rather than pull ahead and stop for each piece. If the rails or ties be unloaded in quantities, ample time will be allowed for recharging the auxiliaries, unless the crew is many times more active than they were in our day.

Hand brakes set lightly, so the train will "drag" easily and can be worked to good advantage in making numerous and accurate stops. This is especially true of light trains, such as work trains, both on up and down grades.—Ed.]

From Effect to Cause.

Editors:

The value of the air-brake equipment of this country is already large and being daily added to. The outlay can be only made to yield its proper return when brakes are kept in good working condition at a minimum of expense. We should, therefore, make use of every means that will contribute to this end, and it is with this in mind that the following is recommended where conditions are favorable for its use:

As is known, the effect of brake application is to heat the wheels by reason of the friction between them and the shoes. For the object in view, it may be said that with each brake doing its proper share of the work, this heating would be the same on all wheels. While not strictly true, it is nearly enough so for the purpose. It follows, then, that by feeling the treads of wheels after a brake application of sufficient force or duration to produce heat would, by comparison, be an unerring indicator of the proportion of work done not only by each car, but by every pair of wheels as well.

With errors in brake design and construction, it is possible for one truck to have almost double the proper brake power, and the other one as much too little. This is often found true where a short equalizing lever is employed and too much of the slack is taken up at one end. This short lever is frequently met with on cars fitted with brakes quite a number of years ago; on some tenders of that same time, and others, it is regretted to say, more recently equipped; and with the rigging applied to six-wheel trucks. Worse still is the tender-brake rigging persistently applied by one locomotive works—it having no semblance of an equalizing feature. With several such the writer has, at the foot of a grade, found the wheels in one truck smoking hot, while in the other they were not even warm. As a rule, such brakes are either kept cut out or rendered inoperative by long piston travel, the engineer finding that, unless this is done, wheels will frequently be flattened. In fact, attention was first called to the value of this test by an engineer asking why, at the foot of the hill, one pair of wheels would be hotter than the other in the same truck, it being the forward pair in one and the rear in the other. Examination confirmed his assertion and that the cause was the absence of dead levers on the wheels heating least.

There are many causes that can make a brake do too much or too little work, but they all result in one effect; and while it is proper to eliminate the first before the latter, if allowed to continue, could become apparent, yet, in view of the greater ease and accuracy with which we can detect the effect rather than the cause, and that to profit by this means no extra expenditure, it would seem that trainmen and inspectors, when an opportunity is had to examine the wheels after a brake application sufficient to cause any heating (certain places could be designated), should avail themselves of it; and where any wheels are found much higher or lower in temperature than the average in train, they should report the cause, if possible (inspectors to make repairs if they can), and if not, at least the fact. Then at the first opportunity the car could be set out where better facilities, more time or greater knowledge would enable the cause being determined and remedied.

Feeling the temperature of one wheel in each truck by touching it lightly and quickly with the hand, will suffice.

This idea is not an experiment, having been in use by the Duluth, South Shore & Atlantic Railway this past summer, on their ore trains, and with most satisfactory results; their traveling engineer, Mr. M. M. Meehan, having made statements to this effect at the recent Traveling Engineers' Convention, held in Minneapolis, Minn. It was also tried by the writer on the Duluth & Iron Range and Duluth, Missabe & Northern railways, where defects were found and located by its aid which neither time nor facilities would have rendered possible otherwise. Instead of examining each car for too long or too short piston travel, leakage from brake cylinder, auxiliary reservoir, triple valve or pressure-retaining valve (the grade necessitating the use of the latter), only those were thoroughly inspected that, by reason of a too low or too high temperature, were known to have some defect.

Among the undesirable results this test will assist in obviating are: Inability to stop trains in a proper distance or prevent them running away on grades; wheel sliding, undue shocks to trains, and cracked or broken wheels. Also, injury to steel-tired wheels from overheating.

The following are among the defects that will be indicated by wheel temperature:

Wheels Too Hot.—1. Shorter piston travel than other cars of train. 2. Hand brakes applied very heavily or in conjunction with air brake. 3. "Stuck" brake. 4. Stopped-up exhaust port in pressure-retaining valve. 5. Undesirable brake-shoe metal. 6. Leaky emergency valve in quick-action triple, or fourway cock in plain valve. 7. Many poor-holding brakes or non-air cars in train. 8. Defective rigging.

Wheels Too Cool.—1. Brake cut out. 2. Cylinder leakage. 3. Retaining valve or pipe leaking. 4. Auxiliary reservoir leakage, either from it direct, by triple-valve slide valve, triple-valve gasket, or, with freight, the tube through auxiliary reservoir. Also, the plug in end of auxiliary reservoir next to brake cylinder. 5. Too long piston travel. 6. Piston travel too short to pass leakage groove.

It is not intended to convey the idea that this should supersede the regular terminal and shop tests of brakes, but, instead, that it be made auxiliary to them.

Those who have not tried this test will find it both interesting and useful, and it is hoped that where conditions are favorable, as on mountain roads, especially, where the best brakes are needed, it may be made a part of the regular car inspection at least.

F. B. Farmer.

St. Paul, Minn.

A Queer-Acting Six-Inch Air Pump.

Editors:

Inclosed please find the description of a queer-acting Westinghouse 6-inch air pump, which may be interesting to the readers of "Locomotive Engineering."

The above-mentioned air pump was repaired and put on Engine No. 237 of the C., St. P., M. & O. R. R., and was in use about three weeks when the engineer reported the pump running hot and only taking air on the down-stroke; also that he could not get air enough. Upon examination, the packing rings were found to fit all right, air valves seated properly and had correct lift. All air passages were clear. But upon closer examination of the air cylinder, a hole about 3-32 of an inch in diameter, and 2½ inches from the bottom of the cylinder, was found to have worn through to the discharge chamber, as that chamber is cored out larger just above the discharge-valve seat, so as to give the valve clearance. Now, as that hole had worn through, it allowed main reservoir air to flow back into the cylinder and hold the lower receiving valve onto seat when the piston moved up. But on the down-stroke it would not affect the upper receiving valve.

I should also mention that the air cylinder had been bored out, and only a thin shell of metal separating the cylinder from the valve chamber, which gave out and caused the trouble mentioned.

T. E. FREEMAN,
C., St. P., M. & O. R. R.
Sioux City, Ia.

The Great Northern Railway Air Brake Instruction Car.

The car illustrated on pages 914 and 915 was fitted up about eighteen months ago on the Great Northern Railway, to the designs of the writer, who is superintendent of air brakes of that road, and is an example of how a large floor space for class instruction can be obtained in a comparatively small car by a judicious arangement of the models and apparatus. This was rendered far more difficult on the Great Northern, on account of that road having in use both the Westinghouse and New York systems of air brakes, and, in consequence, room had to be found for sectional views for the triples, pumps and brake valves peculiar to both of those companies.

Referring to the photographs, Fig. 1 is an outside view of the car, and it will be noticed that the train pipes for the brakes on the rack inside are suspended from the floor of the car. This was one of the first instruction cars in which this plan was followed, but since that time its advantages have become so generally recognized as to require no explanation. The piece of apparatus seen above the triple should be especially noticed. This is the McKee brake adjuster, which has given such perfect satisfaction wherever it has been applied, and we like to have one underneath the car, so that we can watch its work in practical service.

The car is 39 feet long inside, and is divided into two compartments, one of which, 30 feet long, is the instruction room, and contains all the apparatus and models, pump, boiler, etc. The other compartment, 9 feet long, is used for an office in the day and sleeping room by night. The photographs, Figs. 2 and 3, are views of the office, Fig. 2 being taken from the end of the car, and Fig. 3 being taken from the door leading into the instruction room.

To the left of Fig. 2 will be seen a folding bed, on which is a photograph of the Westinghouse Car and its old occupants, Messrs. Farmer and Nellis, whose picture is turned toward the floor when the instructor goes to bed. Overhead is a locker in the clerestory, and on the right is the washstand, etc.

Looking towards the end of the car, the gage on the left-hand side of the door is that of the Boyer speed recorder. On the right door post is a duplex gage connected to train line and brake cylinder pressure, and on the right side of the car is another one connected to auxiliary reservoir and signal-pipe pressures. Above the door is a clock, and on the left side of the car is a Peerless pressure recording gage, which can be connected to either the air brake or signal pipes. A desk, typewriter and bookcase complete the furniture of the room.

Figs. 4 and 5 show the arrangement of the instruction room, Fig. 4 being taken from the end of the car, and Fig. 5 looking towards the door. At the end, near the office, is seen the boiler, which is 34 inches in diameter, with sixty-eight 2-inch flues, and carrying 125 pounds steam pressure. The boiler is separated from the office by a water tank 18 inches deep by 48 inches wide and 66 inches high, which prevents the heat from the boiler making the office uncomfortable, and also eliminates any trouble from the frost in winter. At the left side is the closet and clothes locker.

The air pressure is supplied by a New York pump attached to the side of the car, close to the boiler, and under the pump may be seen the coal-box.

There are eighteen sets of freight brakes ranged along the side of the car, and the train pipes can be seen passing directly through the floor to the pipes underneath, of which there is a full length, as required for each car.

Referring to Fig. 5, it will be seen that next to the first freight cylinder is a push-down driver brake, which also serves as a pneumatic letter-press, the reservoir and triple being on the left side of the door, and the triple having a sectional model of the New York plain triple attached to it. The two triple pistons are connected by a rod and work tandem. The piece of pipe in the corner by the driver-brake cylinder represents the other cylinder, for which room could not be found.

Above the driver brake is a tender-brake outfit with a plain Westinghouse triple, also having a sectional model attached to it, working tandem. An adjustable screw is fitted with a yoke to the tender-brake cylinder head, so that the piston stroke can be varied.

The engineer's valves used are the Westinghouse E-6 and the New York. The pipe connections shown in front of the New York valve were arranged for the Vaughan positive discharge valve, which was invented on this road, and is now being experimented with by one of the brake companies.

One single and six duplex gages are attached to the back of the brake-valve stand. The single gage is connected to the air-signal pipe. The duplex gages are connected to the Westinghouse and New York engineer's valves, the auxiliary reservoirs and cylinders of the driver brake, tender brake, and brakes of the first and eighteenth cars.

Air-signal apparatus for ten cars is arranged in the clerestory, and connected to the whistle and reducing valves seen on the other side of the car on a level with the gages. The signal valves are fastened to the clerestory facing, and can be partly seen behind the first carlin.

The main reservoir is $26\frac{1}{2} \times 34$ inches, the brake valves being piped directly to it.

From Fig. 4, the right side of the car is seen to be filled with sectional models, both New York and Westinghouse pumps, triples, brake valves, governors, freight and passenger cylinders and reservoirs and all signal apparatus being shown by one or more models of each. Under the passenger brake is a vise and bench with tool drawers.

The little engine shown driving the fan on the door is one of a pattern that they use a good many of on the Great Northern in place of a rotary motor, as it is far lighter, and does the work it was designed for, such as wood boring, staybolt tapping and threading, very successfully.

The train of brakes is fitted with a cord connection so that the train can be cut out or in between the fourth or fifth cars, so that the instructor can exhibit the differences between short and long trains without leaving his position. There is also an exceedingly neat arrangement by which the train can be broken in two by separating a hose coupling, and recoupled again by simply pulling a cord, which we hope to illustrate at some future date.

M. E. MCKEE,
Supt. A. B., Gt. Nor. Ry.
St. Paul, Minn.

An Ailment With a Simple Remedy.

Editors:

Recently I noticed a queer action of the air brakes on a passenger train, in which, after releasing the brakes in making a station stop, the cars seemed to crowd ahead against the engine and a slight shock resulted. The engineer is rated A1 in handling the air, and called my attention to a very slow release of his driver brake.

The engine came out of the shop about eight months ago, equipped with the cam brake, push-down type, and an E-38 triple valve. After carefully examining the cylinders and auxiliary reservoir, they were found to be correct. The tender had a 10×24 auxiliary and an 8-inch cylinder, and worked all right; but the driver brake failed to respond in releasing with the other brakes, and had given trouble for about four days. It was remedied in a half a minute and worked as well as ever. What was the trouble?

Answer—The half-inch cut-out cock for the E-38 triple valve was placed between the triple and brake cylinder, and was nearly closed. Hence, with a given time in applying the brakes in making a stop, no trouble was experienced. But an equal length of time in releasing (air from driver cylinders) brought about the trouble. The brake worked to perfection when the cock was opened.

WM. H. DURANT,
B. & M. R. R.

Concord, N. H.

How to Reduce Wheel Sliding.

Editors:

Flat wheels, incident to air-brake application, is a more or less frequent source of annoyance to the mechanical department of railroads, to say nothing of the entailed expense. And how to avoid these flat wheels seems, with many, to be a perplexing question.

A braking force of 90 per cent. of the light weight of passenger equipment cars has, in general, been accepted as a proper standard, this brake force being obtained with an initial pressure of 70 pounds in the train-pipe and auxiliary reservoirs.

To the uninitiated, when these conditions prevail, it does not clearly appear that such conclusions are correct; if so, why do the wheels lock and slide when the prescribed conditions are maintained?

To point out some of the whys and wherefores is the purpose of this article. I am talking particularly to my engineer friends, and, as a prelude, would inquire why it is that engines are provided with sandboxes? Engineers are aware of the fact that in designing locomotives no more weight is placed upon the drivers than is required to keep them from slipping on a fairly good rail, and that when, owing to the laws of Nature, the rail is in a more or less slippery condition, the sandbox provides the means of producing adhesion which, for the time being, the elements have failed to provide. It is from this same standpoint that the present percentage of braking force is considered a proper one.

When the rails are in good condition, the weight of the car is sufficient to furnish the requisite adhesion to prevent the sliding of wheels, but in the absence of these conditions, the sandbox is intended to perform precisely the same function as it does for the driving wheels.

Now, the question might be asked—How are we to determine when, or when not, to use sand? The observing engineer does not wait for the engine to slip before using sand, but, by a close observance of existing conditions, he anticipates results and applies the sand accordingly.

What has been said regarding the driving wheels is equally applicable to air brakes, for if the driving wheels have a tendency to slip in starting, the same tendency is liable to prevail when the brakes are applied, for the conditions of adhesion of the drivers and braked wheels are practically identical. The driving wheels are a pretty good criterion from which to judge of the requirements of the braked wheels. That this is an infallible guide, however, is not entertained, for we may have a good rail leaving one station and a slippery one approaching the next, or *vice versa*, but as a general index the driving wheels play no unimportant part.

Surely every engineer wants all permissible brake force, for in his calling the business is one of frequent emergencies, and at such times too much braking force cannot be obtained. It is a well-known fact that the lower the rate of speed, the more liable the wheels are to skid with a certain brake force. Again, the driving wheels can be depended upon to teach us this, for every engineer has experienced the fact that as the engine continues to slow up on a hard pull, and with throttle and reverse lever in the same position, sooner or later, if rail conditions are not normal, the engine slips unless adhesion is increased by the use of sand.

As a general proposition, the driving wheels are a considerably effective gage to determine the condition of the rails; but close observation and vigilance must be exercised in noting existing conditions, such as wet rails, slack ballast, frost and other enemies of adhesion, to obviate the skidding of wheels, or, at least, reduce the invitation in that direction to a minimum.

From what has been said, it should not be inferred that sand will bring this desideratum if not judiciously applied, for sand under wheels already sliding quickly flattens them, and never start them again revolving with the brakes applied. Unless the rails are in good condition the sand must be spread upon the rails before the brakes have been tightly applied, in which event the wheels will continue to revolve, the brakes do what is expected of them, and the 50 per cent., or more, of brake force will be realized, which is sacrificed when the wheels are skidding along the rails.

S. J. KIDDER.

Chicago, Ill.

Overcharged Train Pipes Responsible for Shocks at Water Tanks, Etc.

Editors:

A subject has been brought to my mind by a conversation which I had recently with the road foreman of engines of one of our neighboring lines, regarding the cause of rough handling of trains where close stops like those at water tanks, coal chutes, short platforms, etc., were being made with passenger trains.

A great many engineers try to make too quick a stop, and as they near the spot they either run by it or stop too soon. Then they place their brake-valve handle in full release and let it remain there, which results in the train pipe being charged from ten to twenty pounds higher than the auxiliary reservoirs. The time and distance being so short, the conditions remain about the same when the point to stop is reached. They start to make a service application and the brakes do not take hold. Then they resort to the emergency, and perhaps run by after all, or stop dead short of the point. Then they open throttle wide and release the brakes at same time. When engine does start, the emergency has to be used again, also the reverse lever, to stop. Now, if the engineer had used more time, a few seconds only, in slowing his train down for the stop, and had he made his reductions in such a manner that if he were to hold his brakes on he would have stopped 40 or 50 feet short of this point, and then release his brakes by going to release and immediately returning his brake valve handle to lap position, he would not have overcharged the train pipe, and when he applied the second time the brakes would have responded immediately, and his speed being slow he could stop at any point he wished without shock to the train.

I think one of the first and most important points to learn about the automatic air brake is, that by the making and breaking the equilibrium of pressures is where the action of the brake is obtained. When we couple to a train not charged with air, we can fill the train pipe and at once draw it all out again; but we have no action of triples or brakes. If we wait, however, until the train pipe and auxiliaries have equalized, and then draw from the train pipe, the triples will be moved from and by the auxiliary pressure, it then being the greatest, until the port leading from the auxiliary reservoir to the cylinder has opened, when the auxiliary will equalize with train pipe by discharging a part of its pressure to the cylinder. The graduating valve, or feature of the triple valve, prevents the auxiliary reservoir pressure from equalizing with the brake-cylinder pressure until train pipe has been reduced till it can also equalize with auxiliary and cylinder. A further reduction from train pipe is a waste of air.

With freight trains, and especially with part air-braked trains, the slack in the train has to be taken into account and cared for, or a very dangerous and damaging effect will be produced. An engineer of a freight train should shut off steam at a sufficient distance to allow the slack of the train to bunch, which it will do, as the engine has a tendency to hold back against the train, taking up slack smoothly. There will be felt a gentle pushing ahead about the time the slack is all taken up, then he can begin to apply the brake to make the stop. With freight trains make but one application of brakes, and make it in such a manner that the train will come to a dead stop a short distance before reaching the objective point. Do not release until stopped. Now, if this is on a grade where it would be impossible to back up if he got by, the engineer had better cut off his engine from the train, and get water or coal, as the case may be. If the grade is light he can pull up gently and stop with the reverse lever. With a little practice, combined with good judgment, he will soon become familiar with this plan of stopping, and he will have no complaints lodged against him.

If we come into a station, making several applications of the brake, the slack is continually jarring the train. If we have a freight train and come into the station like the passenger man, intending to use two applications, of the brake (which is wrong), and then placing brake valve in full release, leave it there until there is a difference of 15 or 20 pounds between the auxiliaries and train pipe, then we try service and wind up with an emergency application, the shock is appalling at rear end of train. Perhaps a drawbar is pulled out, sometimes such cars as empty flat cars, or other old and weak cars, are broken in two, derailed or trucks displaced.

The slack in the train does the damage; the engineer only assists it in its action. Learn to handle the slack of freight trains. Study the equalizing features of the automatic brake and the emergency application is unnecessary, except where a life is at stake or an unexpected emergency arises, such as a collision, or an obstruction on track is encountered.

I. H. Brown,
C. & O. Ry.

Covington, Ky.

QUESTIONS AND ANSWERS

On Air-Brake Subjects.

(71) A. L. M., Cincinnati, O., asks:
In replacing leather packing in a driver-brake cylinder, should the smooth or rough side go next to wall of cylinder? A.—The rough or flesh side.

(72) M. M. H., Burlington, N. J., asks:
Please say what kind of oil you would recommend for the air cylinder of the pump. A.—West Virginia ground oil, 33 degrees gravity; or, in the absence of this particular oil, use valve oil sparingly. A candle-wicking swab on the piston rod, occasionally oiled, will furnish sufficient lubricant to the cylinder in nearly all cases. Use oil sparingly, and never put it in through the suction valves.

(73) B. U. D., Cleveland, O., asks:
Would you consider it good practice to use a fine wire strainer in train-pipe joint at engineer's brake valve, to keep iron rust and other foreign substances from getting into valve? A.—No. There should be no screen at this point. In a service application the air does not travel sufficiently rapid to raise sediment and rust from the train pipe into the valve. It is only in emergency applications that screens would be advantageous, and they are not made so frequently as to require screens.

(74) P. P. B., Chicago, Ill., asks:
Was there ever a quick-action triple valve made which could be cut out, made to work straight air, or automatic by a three-throw cock, such as is found to-day on the plain triple? A.—Yes, the first few quick-action triples manufactured had the three-position cock, and could be worked as above described; but the cock was discontinued early in the manufacture of the valves, and a common stop cock was placed in the cross-over pipe, as straight air had become a thing of the past.

(75) J. J. H., Montgomery, Ala., asks:
What pressure will there be in the brake cylinder after a 20-pound reduction has been made? Main reservoir pressure at 90 and train pipe at 70 pounds. A.—About 50 pounds with a service application, and about 60 with an emergency application, with piston traveling at 8 inches. Main reservoir pressure has nothing to do with applying brakes, and it would not matter whether it was 90 or 150 pounds, as it is cut off and retained by itself during brake application, and is only used to release and recharge brakes.

(76) B. U. D., Cleveland, O., writes:
Fish oil and tallow, and also axle grease, have been recommended as a good lubricant for driver-brake cylinder packing. What would you advise? A.—Kent's lubricating compound has proven far superior to anything yet tried in driver-brake cylinders. It keeps the leather in good condition, and adheres to the sides of the cylinder, regardless of how close to the firebox the cylinders may be located. This grease has been thoroughly tested by the Air Brake Association, and is also being used by the Westinghouse Air Brake Company.

(77) B. U. D., Cleveland, O., asks:
1. Could gasket 56, E-6, Westinghouse Air Brake Company's engineer's brake valve be made of lead and hold all right? A.—Yes; if it were properly alloyed. The Westinghouse Air Brake Company is sending out those gaskets of similar composition, having raised circles around the passages to prevent the pressures from mingling. 2. Could not a simple slide valve be made to take the place of main valve, reversing piston and reversing valve in 8-inch Westinghouse Air Brake Company's pump? A.—A smaller pattern of the present 9½-inch pump would be equivalent to the above proposed plan; but on account of the many standard 8-inch pumps now in use, a change containing the 9½-inch construction would require an additional kind of spare repair parts to be carried in stock, and would be too expensive and inconvenient to warrant the change being made.

(78) M. M. H., Burlington, N. J., asks:
What makes the hand on the air gage move up and down while the pump is working? A.—We assume that you have a single pointer gage. Maybe the hand is loose, or perhaps the gage is mounted on a light stand or frame. Possibly the pump is fastened insecurely, and jars so that the gage hand vibrates. If the pointer has a single distinct dip at each stroke of the pump, the piping is probably at fault. A single pipe should lead from the pump to the main reservoir, and a second pipe should lead from the main reservoir to the brake valve. Sometimes shopmen endeavor to economize on pipe, and instead of piping properly as described, they use but one pipe to connect the main reservoir and brake valve, and tee the pump pipe into it. Thus, each stroke of the pump discharges air both into the reservoir and brake valve, causing the dip of the pointer. Dirt and oil thus find their way into the brake valve.

(79) E. J. M., Montgomery, Ala., writes:
When making a service application with my D-5 brake valve on light engine and tender, the driver brake and tender brake both remain on; but when I make an emergency application, the driver brake will whistle off in ten or fifteen seconds afterwards, and the tender brake will remain on. I am unable to locate any leaks anywhere. What is the cause of this queer action? A.—If you were to leave handle of brake valve in emergency position after making the application, both brakes would remain set, for then the train pipe would be empty; but you doubtless return the handle to lap. In making the emergency application, the equalizing reservoir pressure has not been used, and remains at 70 pounds. When the handle is brought to lap, the equalizing reservoir pressure leaks past the packing ring of the equalizing piston into the train pipe, increasing that pressure higher than that remaining in the auxiliary reservoir of the driver brake, and releases it. The tender brake remains set because the pressure in its auxiliary reservoir is higher. If the tender piston travel were lengthened and the driver-brake piston shortened, the tender brake would release and the driver brake stay set.

(80) W. R. J., New York City, writes:
If you have 70 pounds air pressure in your auxiliary, 70 pounds in train line, 90 pounds in main reservoir, and you place the engineer's brake-valve handle in emergency, how much air pressure would you have in the brake cylinder? One party states that all over 20 pounds would be a waste of air, and that I could not get any more in cylinders, no matter where brake valve handle is placed. A.—About 60 pounds. In making a service application of the brakes, a 20-pound reduction will give about 50 pounds in the brake cylinder. Any further reduction is a waste of air, and no more brake power can be obtained, no matter whether such reduction be made in the service application position or emergency position. In making an emergency application, the brake-valve handle should be thrown to full emergency position and left there. It is true that no greater pressure than 60 pounds is obtained by leaving the handle there, but then in an emergency we can afford to waste the last 50 pounds of train pipe to insure getting all the brakes on as soon as possible, and also know that they will stay on. As stated in a similar question in this column, main reservoir pressure cuts no figure whatever in applying brakes, and should not be considered.

As an originator of free advertising for his company, General Passenger Agent McCormick, of the Big Four, has no equal. Speaking of their "Knickerbocker Special" to a writer for the "Indianapolis Evening Story Teller," Mr. McCormick said: "It is the fastest train in the world. The schedule of the 'Empire State Express' does not begin to touch our 'Knickerbocker.' She runs from St. Louis to Indianapolis, 263 miles, in 5 hours and 15 minutes, and still has half-an-hour up her sleeve. She has to stop at nearly every station in Illinois. This kind of running is done every day. Not long ago we were side-tracked for her at Windsor, Ill. Mr. Schaff went down the road a short distance and Mr. Van Winkle went up the road, while I remained at the station. I heard Schaff say, 'Here she comes,' and then Van Winkle said, 'There she goes,' but I did not see her at all. I bet she tore up three tons of gravel and dirt near the platform where I was standing."

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Chances of Improving the Steam Engine.

Ever since electricity began to come into use for the transmission of power, we have grown familiar with the oft-repeated prediction that electric energy will be the power of the future. A few months ago we gave particulars of certain experiments made to transform the energy of coal directly into electricity, and it appeared that the prospects of performing this revolutionary operation were encouraging; but later developments indicate that the apparatus employed were merely improved forms of batteries, and that the prospects of making electricity without the aid of the steam engine are as remote as they ever were. The combustion of copper and zinc produces electricity in ordinary batteries, but there is something wanting in the oxidation of coal to bring out the same product. Every effort of science to produce this result appears to strike a dead wall with no beyond. An opening may some day be found in this barrier of darkness, but it is quite improbable, just as improbable as it is that the greater part of the heat carried by steam into the cylinder of a steam engine will be converted into useful work.

When scientists first began to realize the extent of the heat losses that resulted from the round of operations employed in compelling the heat energy of coal to drive a steam engine, they cheerfully undertook the task of saving the greater part of the heat wasted, but very little labor brought them to a dead wall which proved as formidable as that encountered by the searchers after the means of generating electricity directly from coal.

There have certainly been decided improvements effected on the steam engine since the labors of Watt, Evans and others made it a practical mode of motion, but most of the changes which enhanced its efficiency have been on details worked out by engineers and other practical inventors. Science, *per se*, has done remarkably little to indicate where prevention of waste could be effected. There is good reason for believing that the steam engine, with all its wasteful habits, is now as nearly perfect as it will ever be made, unless someone discovers a new method of transmitting the power from the boiler to the driven mechanism . That some revolutionary method will be discovered is highly improbable, and so engineers must content themselves to go on improving on details and stopping leaks that defective designs leave open. Meanwhile, about 90 per cent. of the heat generated in the furnace will continue to pass out through the smokestack and exhaust port, and science will continue to look on, impotent to stop or lessen this immense waste of energy. There is some probability that inventors or investigators may discover means of using the heat energy of coal without the intervention of steam, or they may effect radical improvements on heat engines which will render them as reliable as the steam engine and infinitely more economical; but there is remarkably little prospect that the steam engine will ever be made much more economical than the best forms now in use.

To appreciate the magnitude of the losses involved in harnessing machinery to the force generated by burning coal through the medium of steam, it is necessary to study each link in the chain of operations between the furnace and the driven mill, car or loom.

The potential energy in every pound of good coal is immense, and painfully in excess of the amount of useful work performed by the steam which it generates. Scientific experiments have shown that a pound of good coal, when burned to carbon dioxide, releases sufficient heat to raise the temperature of 14,500 pounds of water one degree. The heat energy expended in raising one pound of water one degree at ordinary temperature is known as the thermal unit of heat, and is equivalent to the raising of 772 pounds one foot. The total heat energy in the pound of coal is, then, $14,500 \times 772 = 11,194,000$ foot-pounds. As 33,000 pounds raised one foot is the measure of one horse-power, the single pound of coal represents, if fully utilized, mechanical work to the extent of 34 horse-power. When it is considered that very few steam engines have developed a performance of less than 2 pounds of coal per horse-power per hour, and that 5 pounds is a common consumption of coal for that amount of work, it will be understood how far short steam engines come of utilizing the coal energy generated in the furnace.

The waste of heat that forms such a large aggregate in the cycle of operations common to every steam engine begins at the furnace and hardly ends with the steam passing out of the exhaust port. A well-designed furnace in which the supply of air is just about sufficient to supply the oxygen necessary for combustion, and from which the heat gases do not pass into the smokebox at a temperature more than 300 degrees above the heat of the boiler, will waste only about one-quarter of the heat released by the burning fuel. In common practice an excessive supply of air is passed through the furnace and, all that has to be heated to the steam-generating temperature, so it carries away a large percentage of heat without doing any good. The temperature of the escaping gases is also made higher in most cases than what is consistent with economy of fuel, and so, between the excess of air and the high smokebox temperature, there is seldom more than half of the heat energy of the coal expended in generating steam. The proportion of waste is often much greater. Coal having 14,500 heat units when burned under favorable conditions will evaporate about 12 pounds of water from and at 212 degrees Fahr. There are few locomotives that evaporate more than 5 pounds of water per pound of coal.

The steam being generated in the boiler is ready for its journey to the cylinder. On its way there, there is generally some losses that are great or small in proportion to the character of the steam passages and to their protection from chilling influences. It is important that the steam should reach the piston with as little loss of heat or pressure as possible, because the elastic force of the steam is due to the heat energy put into it, and the efficiency of the engine depends upon the amount of heat that is converted into useful work. Anything that happens to rob the steam of part of its energy on the way from the boiler to the piston reduces the capacity for doing work. A common initial defect is the carrying of water from the boiler with the steam in the form of spray. In the course of the cycle of operations, that water is partly evaporated by robbing the true steam of part of its heat. The next source of waste is the amount of steam required to fill the clearance spaces before pressure can be applied to the piston. In many engines this loss by clearance is considerable. On reaching the cylinder, the steam enters a vessel cooler than the boiler, and part of the heat is absorbed in heating the cylinder walls. Then the work of pushing the piston is done, the exhaust is opened, and the greater part of the heat that has been put into the steam passes into the atmosphere or into the condenser. The proportion of the heat converted into work in pushing the piston is the measure of the engine's efficiency. If the steam reaches the piston at 145 pounds above the atmosphere, the heat is about 363 degrees Fahr.; when expanded down to 30 pounds above the atmosphere, the temperature falls to about 274 degrees Fahr.; so that about 90 degrees of the heat generated has been utilized. This seems a small proportion, but it can never be made much greater. The losses from too much clearance, from initial condensation and re-evaporation of condensed steam towards the end of the stroke, may be reduced by intelligent engineering, but there are no prospects that the supreme loss of heat present in the exhaust steam will ever be overcome.

Poisoned by Carbonic Oxide Gas.

Several years ago three men were engaged doing some work under the roof of a rolling mill in Pittsburgh, and they were all taken violently sick. The best medical aid was called in, and everything within the knowledge of the doctors was done to relieve the sufferings of the men, but two of them died from what was considered a species of suffocation due to the combustion gases hanging under the roof.

Another case of a similar nature, which illustrates the danger of working near the roof of a building when fires are sending up gases from beneath, was that of a young boiler-maker who was sent up to do some work under the roof of a railroad blacksmith shop. He had not been there long when he was taken sick, which caused painful retching. In spite of this, he pluckily finished the job before descending. No person thought that he was seriously ill, and it was only next day that a doctor was called to give assistance. The young man, however, gradually grew worse and died three or four days afterwards.

We once witnessed a case of severe prostration which overtook a man who went under the roof of a roundhouse to secure a smoke-jack. He recovered, but it was only because the kind of gas he inhaled was less deadly than that which killed the others, and which has killed many other men doing work under the roofs of buildings where there are fires burning and imperfect ventilation.

Very few men in charge of buildings where noxious gases are liable to accumulate under the roof, seem to be aware of the danger of sending workmen to do jobs among the rafters. The prevailing belief is that a man will smell the noxious gases and get down before he inhales enough to do serious harm. The worst of it is that the gas which proves most fatal to human life has scarcely any smell.

There are three kinds of noxious gases that prove sources of danger under the roofs of badly ventilated buildings where products of combustion are present in large quantities: The first is carbonic acid gas, which is the gaseous product of the complete combustion of carbon. If inhaled in large quantities it causes suffocation, but persons prostrated by this gas may be brought round by simple remedies.

The second noxious gas is sulphurous acid gas, which comes from the combustion of sulphur. It affects respiration so acutely that there is little danger of a workman breathing it long enough to sustain serious injury.

The third and most dangerous of the gases under consideration is carbonic oxide gas, the product of the incomplete combustion of coal. This gas is an active poison, and no antidote has been found which will counteract its death-dealing effects. This makes it all the more imperative that shop foremen should exercise great caution in sending workmen into places where this dangerous gas is likely to be drawn into the lungs.

Under the heading of "Carbonic Oxide," Taylor's Medical Jurisprudence says: "The noxious effects of the vapor of burning charcoal are considered to be partly due to the presence of carbonic oxide. The action of this gas upon animal life has been made a subject of experiment by Bernard. An atmosphere containing from 5 to 6 per cent. of it will destroy life. The blood is brightened in color by this gas, while it is darkened by carbonic acid. Bernard has observed that this bright color has been retained for three weeks; and he considers the mode of action of this gaseous poison to be, that it prevents the arterial blood of the body from becoming venous, while carbonic acid operates by preventing the venous blood from becoming arterial.

"The action of carbonic oxide on the body is that of a pure narcotic poison. M. Tourdes has ascertained that rabbits died in twenty-three minutes when kept in an atmosphere containing one-fifteenth of its volume of pure carbonic oxide; when the proportion was one-thirtieth they died in thirty-seven minutes, and when one-eighth in seven minutes. Dr. Letheby states that in his experiments a mixture of ½ per cent. killed small birds in three minutes, and of 1½ per cent. in about half this time. The animals showed no sign of pain; they fell in a state of insensibility, and either died at once without convulsions or they gradually passed into a state of profound coma. He found, on inspection, that the blood was redder than usual, that the muscles of the heart were somewhat gorged, and that the brain was congested."

Working Hours Shortened by Legislation.

Men of middle age cannot remember a time when there has not been agitation among the workmen of the United States to secure from employers a larger proportion of the fruits of their labors, or for amelioration of the conditions under which work is done. In most of the States this evidence of discontent has exhausted itself in agitation over impracticable schemes, and real practical grievances have been left without remedy because the persons most interested have not agreed to use their rights and influence to make concentrated demands for remedial legislation.

The workmen of the United States are nearly all voters, and through this power they ought to secure the enactment of just laws more readily than the British workman, but the reverse is notoriously the true condition of affairs. A large proportion of British workmen have no vote for members of parliament, but they never suffer long from a palpable grievance or injustice before they secure the enactment of laws intended to bring about a remedy.

This has been very well illustrated in the efforts made to improve the condition of railway servants. There is probably no class of workmen whose hours and condition of labor are more difficult to regulate justly by law than that of railway employés; and there is no class of workmen in which the public are more directly interested in the prevention of overwork. The piecework system of paying for the amount of work done has made very slow progress in Europe. Trainmen are paid by the day, and all others on a similar basis. The consequence has been that railway companies have been interested in making the day as long as possible, while the men have striven to keep their hours of labor short. Conflicts have frequently arisen over this cause of dispute, but the companies generally got the best of every fight.

For a long time railway men kept up an agitation in favor of legislative enactments for the regulation of hours of labor of their class. Three years ago this culminated in a law called the Railway Regulation Act, which made it the duty of the Board of Trade, which performs functions for railway companies similar to those performed by our Interstate Commerce Commission, to put certain restrictions upon the hours of labor performed by railway employés. The powers given to the Board of Trade are merely of an advisory character, but they have been exercised in a manner which has resulted in reducing the working hours of a great many men. When the Board finds that men on any line are overworked, they take the case up with the railway manager or directors, and then recommendations are generally complied with. In case of a refusal to reduce the hours, the Board may refer the case to the Railway Commissioners, who have power to make public investigations and compel the companies to reduce the hours of labor.

The Board of Trade have recently published a report on the working of the Railway Regulation Act for the last year, and it is a statement which shows that a great deal of hardship has been prevented, and that the railway companies have not suffered from the changes made to ameliorate the condition of their men. During the period in which the Act has been in operation, the Board have investigated 325 complaints, each of which generally represented a class of men. The report says:

"The Department has every reason to be satisfied with the working of the Act during the past year. In a large number of cases the railway companies have responded very fairly to the demands made upon them by the Board of Trade, and have met complaints as to long hours in a reasonable spirit. It would be interesting to be able to give some estimate of the number of railway employés who have obtained the benefit of shorter hours of work. The Department is assured that the number must be very large, but it is impossible to give figures. Representations, as a rule, are not made by or on behalf of individuals, but affect a class or classes of servants, and a reduction in hours on one section of a company's line must necessarily often form a precedent for a similar reduction on another section worked under similar conditions. When the Department is successful in its action upon some particular complaint of long hours, the beneficial effect is often felt by a number of servants not parties to the original complaint, and, as a consequence, it is impossible to form any accurate estimate of the number of railway servants throughout the country who have been reached by the operation of the statute. The railway companies have also been busy in doing a great deal of voluntary work in connection with the revision of hours of labor, and no doubt the result of the consideration they have given to this subject has been beneficial to their servants and has kept down the number of complaints made to the Board of Trade.

"From another point of view, however, the general revision which has been made by some companies is not altogether satisfactory; the Department finds that when a railway company has resettled the hours of its servants all over the system to its own satisfaction, the company do not care to disturb their arrangements in cases in which the Board of Trade are disposed to hold hours to be unreasonable. This attitude on the part of certain companies adversely affects the policy which the Board of Trade have steadily adhered to, of carrying on the administration of the Act by negotiation with the companies with a view to settlement of complaints, rather than by recourse to the legal remedies."

If legislation of this kind could be obtained in the United States we are convinced that it would be the means of overcoming many hardships; it would remedy acute grievances, and break down many of the antagonisms that now exist between employers and their employés.

BOOK REVIEWS.

"Locomotive Mechanism and Engineering." With an Appendix on the Modern Electric Locomotive. By H. C. Reagan, Jr., Locomotive Engineer. Second Edition, Revised and Enlarged. First Thousand. New York: John Wiley & Sons. Price $2.

This is a work of 409 pages, 5¼ x 7½ inches, bound in cloth. It is filled with information that is useful to the engineman, and which is imparted in the simplest language. The locomotive, simple and compound, is written about from the standpoint of an engineer who is posted on the practical phases of the subjects handled. The treatment of break-downs is such as to be of assistance to the man who happens to get caught on the road in like cases, for the breaks are shown in good clean cuts, and the method of disconnecting and blocking up to get in are clearly shown and described. It tells what rods should come down, and why, when a pin, strap or rod breaks; what to do when the valve motion gives out in any vital part; how to set valves, etc. The different types of compound in service, up to date, are described, together with their principles of action and reason for economy over the simple type, with half-tone engravings of the latest productions, both simple and compound. The appendix of 38 pages, on the electric locomotive and the action of motors, has also some elementary instruction in electricity that will pay for its perusal by the beginner. Having been compiled from well-known authorities on electricity as a motive power, this section of the work cannot be overestimated. As a whole, it deserves to be widely read.

"Block and Interlocking Signals." By W. H. Elliott, Signal Engineer, C., M. & St. P. R. R. What They Are For; What They Do; How They Do It. "Locomotive Engineering," New York. 1896. $3.

This work is a comprehensive and interesting description of all systems of signaling on railroads, written by a practical signal engineer, in an entertaining style, best calculated to make plain a subject very little understood by the average railroad man. The book is 6 x 9 inches, has 277 pages, 129 illustrations, of the best matter ever published on the subject, and is elegantly bound in flexible leather covers. It is printed on fine paper, and the text is supplemented by half-tone and line engravings of the highest type, making the work worthy of a place in any library.

The White Star steamer "Germanic" has United States packing in the gland of the high-pressure valve stem. It was put in as an experiment, and is giving entire satisfaction. The engineers are urging that the company put this packing in all the piston-rod and valve-stem glands.

Mr. B. Wooster has been appointed master mechanic of the Cartagena-Magdalena Ry., with headquarters at Çartagena, Republic of Colombia.

"Tales of an Engineer," railroad stories by Cy Warman, $1.25, at this office.

PERSONAL.

Mr. J. B. Walsh, general yardmaster of the Chicago & Eastern Illinois, has resigned.

Mr. J. E. Dean has been appointed car accountant on the Centralia & Chester Railroad at Sparta, Ill.

Mr. J. H. McGill has been appointed master mechanic of the New Orleans & Northwestern Railroad.

Mr. W. L. Clough has been appointed machine shop foreman of the Big Four shops at Bellefontaine, O.

Mr. J. F. Sechler has resigned as master mechanic of the Louisville, Evansville & St. Louis, at Princeton, Ind.

Mr. H. L. Hawkins has been appointed chief engineer of the Oregon Improvement Company at Seattle, Wash.

Mr. W. H. Stark, formerly master car builder of the Wheeling & Lake Erie Railroad, has resigned that office.

Gen. Horace Porter, for many years vice-president of the Pullman Palace Car Company, has resigned that position.

Mr. David J. Timlin has been appointed general foreman of the Big Four shops at Bellefontaine, O. In effect October 1st.

Mr. W. A. Wolford, general foreman of the Big Four shops at Bellefontaine, O., has resigned on account of poor health.

Mr. James Gaston has been appointed master car builder of the Louisville, Evansville & St. Louis at Princeton, Ind.

Mr. E. D. Stegall has received the appointment of master mechanic of the Mexican National Railway at Acambaro, Mex.

Mr. J. B. Kerr, of Madison, Wis., has been appointed land attorney of the Northern Pacific Railway at St. Paul, Minn.

Mr. C. D. Boyd, superintendent of the San Diego, Pacific Beach & La Jolla Railway, has resigned his position and the office is abolished.

Mr. Geo. Egan, trainmaster of the Chicago & Great Western Railway, has removed his headquarters from Kansas City to St. Joseph, Mo.

Mr. C. G. Burkhardt has charge of the new office of the Sams Automatic Coupler Company in Chicago, in Room 1223, Monadnock Block.

Mr. George F. Tyler, who was the first president of the Norfolk & Western Railroad, died at Philadelphia, September 25th, aged 74 years.

Mr. W. Hale, formerly superintendent of the Montana division of the Great Northern Railway at Havre, Mont., has resigned that position.

Mr. Wm. Rhodes, of Philadelphia, will look after the interests of the Baldwin

Locomotive Works at Chicago; address, 1217-19 Monadnock Block.

The office of Mr. T. E. Adams, superintendent of the Dakota division of the Great Northern, has been removed from Grand Forks to Larimore, N. D.

Mr. C. R. Brown, at one time connected with the Illinois Steel Company, is now with the Lappin Brake Shoe Company, with office in the Rookery, Chicago.

Mr. W. L. Tracy, who was master mechanic at Birmingham, Ala., for the Southern Railway Company, has been transferred to a like position at Atlanta, Ga.

Mr. F. C. Cleaver, late master mechanic of the Vandalia Line, is appointed master mechanic of the Louisville, Evansville & St. Louis, with office at Princeton, Ind.

Mr. A. H. Porter, formerly superintendent of the Macon & Northern Railroad, has been appointed roadmaster of the Charlestown & Western Carolina Railroad.

The headquarters of Division Superintendent E. D. Wright, of the Chicago, Milwaukee & St. Paul Railway, are to be removed from Kansas City, Mo., to Ottumwa, Ia.

Mr. John L. Wigton is appointed master car builder on the Missouri, Kansas & Texas Railroad, with jurisdiction on lines north of Denison, Tex., and headquarters at Sedalia, Mo.

Mr. W. H. Brehm has received the appointment of master mechanic on the Missouri, Kansas & Texas, with jurisdiction north of Denison, Tex., and headquarters at Parsons, Kan.

Mr. H. Walter Webb, third vice-president of the New York Central & Hudson River Railway, is appointed temporary receiver of the Ogdensburg & Lake Champlain Railroad.

It is said that Mr. Perley Putnam, president of the Laconia Car Company has petitioned for a receiver. The company is said to have $350,000 liabilities, of which $150,000 is in mortgage bonds.

Mr. John G. Pinkerton, master of transportation of the Kansas City, Memphis & Birmingham Railroad, was run over and fatally injured by the cars at Sulligent, Ala., on October 20th.

Mr. John G. Williams, at one time vice-president and general manager of the Vandalia Line, will, it is understood, remove from Terre Haute to Indianapolis, Ind., to engage in law practice.

Mr. Max Osterberg, E. E., M. A., consulting engineer, has become associated with the Correspondence School of Technology, Cleveland. He will be an instructor and representative for Greater New York.

Mr. B. F. Bush, formerly general superintendent of the Oregon Improvement Company, has resigned that position to accept the superintendency of the Northern Pacific Coal Company, with headquarters at Roslyn, Wash.

Mr. Henry Holmes, of the West Shore Railroad, died at Buffalo, N. Y., on September 25th. He was master mechanic of the Wabash, St. Louis & Pacific for several years, and later was road foreman on the Missouri Pacific Railway.

Mr. Thos. H. Wickes, second vice-president of the Pullman Palace Car Company, was chosen first vice-president on October 16th, to succeed Gen. Horace Porter, resigned. The office of second vice-president has been abolished.

Mr. Isaac Pressey, who had seen twenty years' service as roadmaster on the New York, New Haven & Hartford Railroad, and also eight as superintendent of supplies of the above road, died at Stamford, Conn., September 14th, aged 77 years.

Mr. P. Ryan is appointed superintendent of the Montana division of the Great Northern Railway, succeeding Mr. W. Hale, resigned, and also retains charge of the Kalispell division, with Mr. J. P. Rogers as assistant of the latter division.

Mr. John W. Fortune, of Detroit, who recently retired from the position of assistant to General Manager Spicer, of the Grand Trunk, has, it is stated, been appointed confidential adviser to Henry B. Ledyard, president of the Michigan Central.

Mr. A. F. Conklin is now in charge of the railway department of the New York Belting & Packing Company, in place of Mr. D. H. Darling, resigned. Mr. Conklin is pushing the sale of air-brake and steam-heat hose and interlocking rubber tiling.

Mr. W. A. Gardner, superintendent of the Wisconsin division of the Chicago & Northwestern, has received the appointment of assistant general superintendent on the same road, with headquarters in Chicago; the appointment taking effect October 1st.

Mr. P. T. Bancroft, who was general foreman of the Columbus, Sandusky & Hocking shops at Columbus, O., has received the appointment of foreman of the machinery department at the Chicago shops of the Chicago, Rock Island & Pacific Railway.

The Northern Pacific Beneficial Association has elected Mr. M. C. Kimberly, general superintendent of the Northern Pacific, as president. Mr. W. G. Pearce has held this office for several years, and tendered his resignation owing to his removal to Tacoma.

Mr. E. W. Knapp, formerly master mechanic of the Mexican National Railway at Acambaro, Mex., has been transferred to the City of Mexico, relieving Mr. R. Fitzsimmons, who has been acting master mechanic, and is now appointed foreman of engine house at Saltillo.

Mr. F. W. Brazier, recently general foreman of the Illinois Central car department at Burnside shops, has been appointed assistant superintendent of machinery of the same road and of the Yazoo & Mississippi Valley, with headquarters in Chicago.

Mr. William Buchanan, superintendent of motive power of the New York Central, has passed through an attack of illness which kept him home about five weeks. His numerous friends will rejoice to learn that he is now almost completely recovered and is again back in his office.

Mr. L. E. Smith, assistant superintendent of the Columbia & Puget Sound Railroad, has been appointed general superintendent of the Oregon Improvement Company, to which system the Columbia & Puget Sound belongs. Mr. Smith succeeds Mr. B. F. Bush at Seattle, Wash.

Mr. E. F. Ingles, the locomotive engineer who killed a train robber at Websters, Cal., September 5th, has received as a reward for his bravery on that occasion a gold watch and chain from the Southern Pacific Railroad Co. General Manager Fillmore also handed the engineer a check for $250.

Mr. John King has been appointed general roadmaster of the Peoria & Rushville division of the Chicago, Burlington & Quincy Railroad. Mr. C. H. Cuyler, who has been roadmaster of the Peoria division for several years past, has resigned. Mr. Jas. Langton has been appointed roadmaster of the Hamilton division of this road.

Superintendent Senft, of the Ligonier Valley Railroad, was shot and fatally wounded at Ligonier, Pa., September 29th, while at the head of a force of laborers and attempting to take possession of a strip of land which is claimed by other parties. Several of the railroad company's force were also seriously injured in the conflict which ensued.

Mr. Alexander Galloway, recently appointed superintendent of the Cincinnati division of the Cincinnati, Hamilton & Dayton Railroad, will continue as superintendent of the Indianapolis divison also, with office at Cincinnati, O. Mr. Galloway rose through the mechanical department, having been master mechanic for many years of the Cleveland & Marietta Railway.

The following have been elected directors of the reorganized Northern Pacific Company: Edward D. Adams, Chas. H. Coster, Charlemagne Tower, Jr., Robt. M. Gallaway, Eben B. Thomas, Robt. Bacon, D. Willis James, Edwin W. Winter, Francis Lynde Stetson, Samuel Spencer, Dumont Clarke, Brayton Ives, John D. Rockefeller, James Stillman and Walter G. Oakman.

We have to acknowledge a pleasant call last month from Mr. Harry Pollitt, chief locomotive and marine engineer of the Manchester, Sheffield & Lincolnshire Railway, Gorton, England. Mr. Pollitt had been traveling for several weeks over the United States and Canada, examining the railways to see if he could find any appliances or methods that would be of value for the use of his company. He expressed himself as being highly pleased with what he had seen.

An English railway locomotive superintendent, located in Asia, in the course of a private letter, writes us: "Your excellent papers on railway discipline, and those of our mutual fellow-worker, 'Jim Skeevers,' have done an untold amount of good, especially amongst the general managers, who generally do not appreciate 'things mechanical.' I know of more than one locomotive superintendent who has passed your excellent paper on, saying: 'Boss, read this; it is worth studying,' and the upshot has been that it has considerably modified existing methods of ruthless fining and 'sack' on the spot for trivial and venial offenses."

A discussion in the New York Railroad Club, on Car Heating by Steam, brought information about train-pipe pressure used in car-heating that seems curious. On the Pennsylvania it was reported that from 5 to 10 pounds pressure was sufficient for the return system. On the Erie, 50 pounds is the standard pressure for fourteen cars, and the Lehigh Valley use 40 pounds for seven cars. On the Chesapeake & Ohio, trains of nine cars and over are heated by a pressure of from 20 to 30 pounds.

The Terminal Railroad Association of St. Louis is the latest to adopt the Brown system of discipline without punishment. Under the system, as put in force, every employé will be entitled to sixty-five demerit marks before dismissal. A credit of ten marks will be given for every six months' worked without demerit.

By the time most of our readers get this paper read the presidential contest will be over. No matter which way it goes we venture to predict that the railroads will run about as usual and that poor coal will make steam just as slow and heavy cars pull just as hard as ever.

We understand that the Fitchburg Railroad Company are figuring on operating the Hoosac Tunnel by electric motors. This will prove an effectual remedy for the smoke and gas nuisance, which now makes the long tunnel an undesirable place to go through even in a fast train.

EQUIPMENT NOTES.

The Green Bay & Western have ordered 150 cars.

The Louisville & Nashville are about to order 300 cars.

The Winona & Western Railroad is about to order fifty box cars.

The Green Bay & Western Railroad is asking proposals on 150 box cars.

At the Great Northern shops the company is building fifty cinder cars.

The Colorado Midland people are in the market for five heavy locomotives.

The Richmond Locomotive Works are building consolidations for the B. & O.

The Pittsburg Locomotive Works have turned ten consolidations for the B. & O.

The Louisville & Nashville Railroad, it is said, is about to build 300 gondola cars.

The Cudahy Packing Company is receiving proposals on fifty refrigerator cars.

The Louisville & Nashville Railroad has placed an order for fifteen locomotives.

The Cooke Locomtive and Machine Co. have built 20 consolidations for the B. & O.

Mr. J. C. Werden, of Chicago, is having five stock cars built by the United States Car Company.

The Dickson Locomotive Works are to build two locomotives for the Winona & Western Railroad.

The Canadian Pacific Railway is building five first-class vestibuled coaches at their Montreal shops.

The Michigan-Peninsular Car Company is said to have received an order for 1,000 cars for the Erie Railroad.

The Pittsburgh Locomotive Works are building five six-wheel locomotives for the Ota Railway of Japan.

The Atchison, Topeka & Santa Fé Railroad is having four baggage cars built by the Pullman Car Company.

The new $200,000 shops at Spokane, Wash., built by the Northern Pacific Railway, are ready for occupancy.

The Chicago, Rock Island & Pacific Railroad is building two fast passenger engines at the Chicago shops.

The Michigan Central Railroad Company has purchased three Rand air compressors for their Detroit shops.

The Chicago, Rock Island & Pacific Railroad has ordered 200 cars from the Michigan-Peninsular Car Company.

The Baldwin Locomotive Works are building one 6-wheel connected engine for the Spokane Falls & Northern Railway.

The Imperial Railway of China has ordered eight locomotives from the Baldwin Locomotive Works, of Philadelphia.

President E. H. R. Green, of the Texas Midland Railroad, has received his new private car from the St. Charles Car Works.

It is reported that the Georgia Railroad has ordered 100 freight cars from the Youngstown Car Manufacturing Company.

The Monon Route has a new vestibuled train, built at their own shops at Lafayette, Ind., for service between Chicago and Cincinnati.

The Brooks Locomotive Works have just completed an order for several engines of the 42-inch gage, to be shipped to Japan.

The Swift Refrigerator Car Company has given the contract for building 100 refrigerator cars to the Wells & French Car Company.

The Canadian Pacific Railway has just completed at their Montreal shops fifty stock cars, equipped with the Westinghouse air brake.

The Chicago, Rock Island and Pacific Railway has received the new ten-wheel freight engine ordered from the Brooks Locomotive Works.

The Rogers Locomotive Works are engaged on an order of three ten-wheel, 17 x 24, simple engines for the Des Moines & Kansas City Railroad.

The Grand Trunk Railroad of Canada has placed an order for five 4-wheel connected engines with the Portland Company, of Portland, Me.

The Southern Railway has contracted with the Chattanooga Car & Foundry Company, of Chattanooga, Tenn., for the repairs of a lot of iron cars.

The Iowa Central, we understand, has put Trojan couplers on all its cars, and that coupler, it is said, will be adopted as standard by the company.

The Atchison, Topeka & Santa Fé Railway is building an 8-wheel locomotive for fast passenger service. It will have 17 x 24 cylinders and 63-inch drivers.

The West Shore Railroad has received twenty-two stock cars and the Reading Railroad 500 coal cars, built by the Union Car Company, of Depew, N. Y.

The Pullman and Wagner Car companies have some litigation in store for them by Mr. Edw. H. Beckley, who is suing for infringement of patents.

The Car Trust Investment Company of New York has a contract to furnish 50 freight cars and 100 coal cars to the Stone, Coal & Lumber Freight Line of Atlanta.

The new shops of the Grand Trunk Railway at London, Ont., will be built of white brick and the roofs covered with slate. They will have a total floor area of 165,000 feet.

A disastrous fire at Woodstock, Va., recently burned the roundhouse, shop and other property of the Southern Railway, besides one locomotive and several freight cars.

The Schenectady Locomotive Works has an order from the Lake Shore & Michigan Southern Railway for ten ten-wheel simple engines with 18 x 24 cylinders and 68-inch wheels.

The five ten-wheel passenger engines, recently ordered by the Erie Railroad from the Brooks Locomotive Works, have been received. These engines are 20 x 26 and have 62-inch wheels.

The Jackson Junction shops of the Michigan Central, at Jackson, Mich., are to have a new installment of tools. The company, it is understood, has appropriated $160,000 for this purpose.

The Illinois Central has received four switching engines with 18 x 24 cylinders from the Brooks Locomotive Works, and is having eight heavy 8-wheel passenger engines built at the same works.

The new machine shops of the Baltimore & Ohio Railroad at Cumberland, Md., were recently put into full operation. The plant includes a large roundhouse and was installed at a cost of $340,000.

The Barney & Smith Car Company, of Dayton, O., is building thirty-five cars for the Brooklyn Heights Railroad Company, and the New York Supply Company is building 15 for the same road.

The International & Great Northern Railroad Company has built a number of cars on the drawing-room plan, with twelve sections and supplied with buffets, for service on their line between St. Louis and Galveston.

The National electric headlight is said to have been applied to a locomotive on the Missouri, Kansas & Texas Railroad, with a view of adopting the electric headlight as the standard of the company if the experiment is satisfactory.

The new 60,000-pound coal cars of the New York Central Railway are nearly as high as an ordinary box car. The cars are equipped with all the latest improvements in car equipment and are said to be an innovation in coal-car construction.

Among orders recently received by the Baldwin Locomotive Works are fifteen engines for the Louisville & Nashville, eight engines for the Paulista Railway of Brazil, six for the Magana Railway of Brazil, and two for the F. C. de Acajutla Railway.

The furniture car recently built at Ft. Wayne shops of the Pennsylvania Railroad has proved so satisfactory that the company has ordered twenty-five more of them built. They are ten feet longer than any furniture cars heretofore built for the company.

The San Francisco & San Joaquin Valley Railroad has received its new passenger rolling stock, consisting of two combination baggage and smoking cars and six passenger coaches. The coaches are painted a bright yellow with aluminum ornamentation.

The American Brake Beam Company is filling an order for 4,000 Kewanee brake beams, to be used on the Erie cars building by the Michigan-Peninsular Car Company. They will also supply the brake beams for re-equipment of the cars on the New York, New Haven & Hartford Railroad.

General Superintendent Miller, of the Vandalia Line, is very enthusiastic over the new freight engines on that road, claiming that they are the best locomotives for that service in the country. There are ten yet to be delivered of the twenty-two being built by the Pittsburgh Locomotive Works.

Orders now in with different car works will aggregate about 50,000 cars, and orders in sight at this time with locomotive works will foot up to about 200 engines. Car works are running with only about one-half of their usual complement of men. Locomotive works, it is said, are employing a somewhat higher number at present—about 60 per cent. of the usual force.

The Chicago, Milwaukee & St. Paul Railroad is building thirty new cabooses for the especial use of stockmen traveling over that line. Each car is fitted with three sleeping-car sections, washstands and other luxuries. The cars are equipped with seats of oak, arranged similar to those in a sleeping car, handsomely painted on the interior, and will prove a paying card with stockmen.

The Westinghouse Air-Brake Company have purchased a capacious property in Toronto, consisting of several new buildings, which they are equipping for the manufacture of air brakes and other rolling stock attachments. The works are all of brick, and were built for the manufacture of machine tools, but were never equipped with tools. They are remarkably well arranged, and are as suitable for an air-brake manufacturing plant as if they had been built for that purpose. The necessity for an air-brake manufacturing plant in Canada has arisen through the determination of the Grand Trunk and of the Canadian Pacific to have all their freight cars provided with air brakes by the time that the use of air brakes becomes compulsory in the United States on cars engaged in interstate commerce. There is great rejoicing in Toronto about this important addition to the manufacturing establishments of the city.

Ash and Cinder Pits.

The problem of the handling of cinders and ashes accumulating at a railroad plant is one of no inconsiderable moment, and on account of the cost, has received a great deal of attention from motive power officers. This item of cost for loading cinder dumps on cars by shovels has led to the evolution of the depressed track, which leaves a car in a more favorable position to be loaded, and it can therefore be filled in less time than when loaded on a level with the dump; but it has not been found to diminish the trouble to any satisfactory extent, since the loading process is so slow that it necessitates, in many places, the constant employment of a gang for that work exclusively.

One of the best systems for relief from these accumulations is that in use on the Pennsylvania Railroad, which has a number of small four-wheeled cars made to run in a suitable pit between the tracks near a roundhouse and boiler plant. These cars carry a body or bucket made of wrought iron in two longitudinal sections, which are open at the top and elliptic in shape at the bottom when closed The bodies are about 3 feet wide by four feet long, and pivoted at the ends, so that the two sections can revolve in a vertical plane, thus opening the bottom and depositing the load when the body is lifted clear of the wheels and frame.

In connection with these cars there is a gallows frame extending across the tracks, and carrying an air cylinder on a small trolley having a movement the whole length of the frame. The piston lifts the loaded bucket, and carrying it to a car at one side, deposits the load by raising the bucket sufficiently high to reach a stop, against which two arms on the bucket are made to strike with such a force as to open the pivoted halves and drop the load.

A bucket is run under an engine, and the contents of the ash-pan are raked into it direct, from which it is run out to the air hoist, and all litter and heaping-up at the side of the track is avoided. The cinders from the shop boilers are handled in the same business-like way, by means of tracks into the boiler house.

Forgetting a train order, or misunderstanding it, led to a dreadful railroad accident on the St. Louis & San Francisco, October 25th. The second section of an excursion train failed to stop at a meeting-point, and came into collision with an accommodation train. Nine persons were instantly killed and many others severely injured. Among the killed were the engineer and fireman of the train that had the right to the road.

Americanizing European Railways.

[EDITORIAL CORRESPONDENCE.]

During a somewhat extended tour made in Europe two years ago, I was very much struck with the impress which American inventions and traveling facilities had made upon the conservative managers of European railways. During the present trip I find even more striking evidences of how much European engineers are imitating American railway appliances. Originally English engineers and inventors provided the whole of the world, except North America, with every pattern for railway machinery and with every principle of construction for permanent structures. English engineers were the first to demonstrate that passengers and freight could be safely transported at a speed above twenty miles an hour, and the rest of the world that needed improved methods of inland transportation naturally were willing to imitate the details of railroad machinery and permanent way that had given satisfaction in the country of their origin. When the Continental countries first began to construct railways, they gladly engaged engineers and others who had been employed on English railways, and these naturally helped to perpetuate the forms and practices they had been accustomed to. The consequence was that railways all over Europe were very much alike in rolling stock, track and methods of operation.

As short a time as ten years ago a traveler on the Continent found everything about the trains to be much the same as they were in England. The same small four-wheel compartment carriages, entered by doors at the sides; the same want of intercommunication, and the same absence of lavatory conveniences. First-class passengers sat on well upholstered seats, three persons on each side; second-class passengers sat in compartments having fairly good cushioned seats, five persons on each side; and third-class passengers sat on bare boards, packed as close as the second-class, which was merely as close as possible. They all shivered with the cold in winter and perspired in summer, without artificial means of modifying extremes of temperature.

Although circumstances made the English designers of the patterns of cars for railway travel, the country was peculiarly unfitted to provide designs of transportation vehicles for a long journey. The old stage coach was taken as the model for the railway carriage, and no more conveniences were considered necessary for the people in coaches running on rails behind a locomotive than what were supplied in stage coaches.

The designing engineers were not very much to blame for adhering as closely as possible to old practice, for the traveling public were intensely conservative about adopting new vehicles. For several years after the Liverpool & Manchester Railway was opened, many of the gentry, who had carriages of their own in which they had been in the habit of traveling long distances, insisted on making use of their carriages when they happened to patronize a railway train. The carriage was put upon a flat car, and the owner sat there in solitary exclusive grandeur. The practice might have continued for ever had not divers accidents to these private carriages convinced people that they were safer in a first-class carriage, even if they were less exclusive. Several times the coaches were blown off by the wind; in one case a coach occupied by a lady and her maid took fire, and as there was no communication with the engine driver, the train sped on while the miserable occupants of the coach were getting roasted.

The extension of the stage coach did fairly well in Britain, where the journeys for years seldom exceeded four hours and averaged less than one hour. But on the Continent, where journeys were much longer, the inconvenience of the English system was soon felt, and it is many years since there were agitations in different countries for a change. Through the influence of the Winans and other American engineers who went to Russia, and supervised the equipment of the first railways in that country, cars resembling those used in America were employed, and provision was made in the cars for the comfort of passengers on long journeys. But the sleeping car had not come into service then, and travelers were left to do the best they could for their own comfort during the night.

The repeated agitations in favor of more conveniences in railway cars for long journeys brought forth little practical fruit, until about ten years ago, when lavatories began to be introduced into the cars. Then the corridor, which is a passageway at the side of the car, came into use tentatively. The railway companies were by no means favorable to these innovations, but after they were begun they had to be extended. When once travelers enjoy any new comfort, they take good care that it will soon come into general use. The advantages of the corridor car were so obvious that from the day it was first introduced in Europe there has been no suspension of agitation in its favor, until to-day there are very few through trains that are not made up of corridor cars.

The Government Railways of Austria were the first to make a radical systematic change in their passenger equipment. A few years ago they determined to do away with side doors, and put on end platforms and corridors that permit passengers to traverse the whole train. These changes have already been carried out on nearly all the passenger cars, even with those engaged on local traffic. Other continental countries are following the same line of improvement, but most of them retain the side doors and have no end platforms. Various forms of car heating are coming into use, and there is a strong public sentiment demanding the heating of all cars.

British railway companies are more susceptible to be moved by the voice of the public than the railways of any other country. On this account, and owing to the fact that competition is very keen for through traffic, the British railways have put into service the most luxuriously fitted-up trains to be found in Europe.

There are a few trains in use running between London and Scotland that are American trains in almost every particular, except that the compartment feature is retained, but each compartment opens into a corridor where trainmen and passengers are constantly passing. The cars are built as strongly as the ordinary American palace car, have clear-story roofs, are lighted by gas and heated by the Gold system. They are carried on six-wheel trucks, and have the striking innovation of being coupled in the middle by Gould couplers and platform. Railway men in England are beginning to acknowledge the decreased train resistance on curves that results from the use of center buffers, and there is good reason to believe that these trains will prove object lessons which will eventually do away with the side buffers.

These American trains are exceptionally luxurious, but there are no first-class lines of any length but what have corridor trains, with dining and sleeping car conveniences. Patronage of the sleeping car is slowly increasing, but more slowly than might be supposed, for the change in the habits of travel involved does not appeal readily to the favor of the average John Bull—or Sandy Scot, either, for that matter. He has been accustomed to making journeys in a compartment, where he is kept busy most of the night twisting rugs and plaids about his person to keep out the cold. Between snatches of broken sleep he jumps upon the floor to kick the numbness out of his cramped limbs, and every few minutes he sprawls about, making vain efforts to find a comfortable position. This he declares to be a healthy and diverting way of spending the night; and he does not care to go into a bed where someone else may have slept the night before. Yet he goes quietly to a bed in a hotel without raising any objection on the score that some other fellow has slept in it the previous night. But then sleeping in hotel beds is an old practice, hallowed by years of habit, and done, as a matter of course, by the "best people in the land."

I cannot understand why people should have any prejudice against patronizing the sleeping cars in England, for they are kept as cleanly as those in America and the bedclothes are changed every night. On some parts of the Continent the case is different. They have a sort of half-breed sleeping car, where a traveler is supplied with a berth having a mattress, and he is expected to provide his own bedclothes. Pillows are kept to be hired out. For this indifferent luxury the price is about the same as they charge in a first-class sleeping car in America.

A traveler sees curious things on the Continental railways that incline him to the belief that a good deal of civilizing influences might be usefully expended upon the people who go away from home in trains, to the comfort and satisfaction of their fellow-travelers. In the course of my journeying I traveled a day and a night on what is called the "Orient Express," which runs between Paris and Constantinople via Vienna. I have the authority of Mr. H. Duval, private secretary to the Hon. Chauncey Depew, a great traveler, for saying that the express named is the finest train on the Continent of Europe. When I entered the sleeping compartment of one of these trains at a German town late at night I was not overwhelmed with the luxurious character of the surroundings. It resembles the state-room of a steamer, with two berths on each side, the space between the tiers being about three feet wide. As it is the custom for travelers on Continental railways to drag most of their baggage into the cars, this contracted space was almost completely filled up with portmanteaus, bags, rugs, hat-boxes, fishing baskets, boots and overcoats. There was no room for my own modest bag and coat, so I threw them upon the upper berth, which, by the infinite grace of some official, was assigned to me, and then I crept up and went through the ordeal of undressing. The car did not run steadily, and the truck under me had two or three flat wheels (I scarcely ever rode in a car in Europe that did not have some flat wheels), so I did not sleep very soundly. Early in the morning I sat up and looked about. The scene opposite reminded me of a notice put up, in the early railroading days, in the trainmen's room at a railroad terminus in Southwestern Kansas. It read: "Please take off your boots before going to bed." The people who manage the "Orient Express" had neglected to put up this notice, and the men in both the berths opposite me had turned in with their boots on.

This trip and other incidents of Continental travel convinced me that some of the missionaries who go out to China and other benighted countries might find a fruitful field of labor in the railway trains of Europe. Civilizing influences are greatly needed in some of these trains, especially by the people who sell refreshments. They are the worst heathens I have met, so far as appreciating any principle of justice between seller and buyer is concerned. They reason: "Here is a hungry man, or he would not want to buy food on a train. Let us fleece him," and they always do.

This thing of Americanizing trains in Europe is going to make travel much more comfortable, but it will not prove entirely satisfactory to railway stockholders. The change will lead to an enormous increase of dead weight for the number of passengers carried. At a loose estimate, it will increase the dead weight per pasenger three times. At least this has been the case with the fine corridor trains put in service on the East Coast of England. These trains weigh about 604,800 pounds behind the tender and have accommodation for about 300 passengers. At this rate, over 2,000 pounds of dead weight is necessary per passenger. With the light compartment cars the same number of passengers can be put into sitting room with a gross weight of 200,000 pounds. In this case the dead weight per passenger is 666 pounds.

When talking to railway officers about this steady revolution going on, they all deplored the public demand that is forcing them into the running of such heavy cars. But the rivalry between the different routes stimulates the men in charge of the rolling stock of the competing lines to do their best to eclipse their rivals. With the ordinary competing line, it is not a question of how heavy the trains are, but—Can you run them from terminus to terminus in shorter time than that taken by your rivals? This has led to renewed efforts to increase the capacity and efficiency of locomotives, and every locomotive superintendent is striving to get out locomotives that will do the heavy work put upon them as well as those of an earlier period handled the lighter trains. During my stay in the British Isles I traveled a good deal on different railways and noted the performance of the locomotives hauling the train. My impression was that the "Dunalastair" class of the Caledonian (illustrated in "Locomotive Engineering" of May, 1896) were a little ahead of any locomotives in Europe, but all the leading lines in Britain have engines that are very little behind the Caledonian's pride and glory.

While writing on fine locomotives, I might mention, in passing, that I was surprised to find the celebrity attained by Buchanan's "999" among mechanical men in Europe. I saw our transparency of the engine framed in a number of railway offices, and I was repeatedly questioned about the performance of that class of engine. It seems to me that the aim of European engineers of high-speed locomotives capable of handling heavy trains is to attain something like an equality with the heavy express engines of the New York Central.

There is an attenuated class of puny-minded railway men in Europe who are never tired of abusing things American, but they are impotent to arrest the progress towards our best ideals. One very seldom hears commendation of American railway practice, but the observer sees the most flattering testimony to the utility of our methods in the form of intelligent imitation. A. S.

London, October 4, 1896.

The Way They Take Care of Queen Victoria When She Takes a Railroad Ride.

The extreme caution used on European roads when a royal train passes over one of them is interesting.

We have before us a set of these instructions issued by the Caledonian road, and have others of older date from the London & Northwestern, the same care being used in both. On the back of the instruction sheet is a special time-card for the train.

In connection with the instructions on the London & Northwestern, a chart of the train is issued stating the numbers of the cars and their kind and who occupies each of them—one of these is reproduced.

All of this care and attention seems extraordinary in this democratic country, where everybody from the highest to the lowest, take their chances in regular trains—except a few railroad officials, actresses and Sunday-school picnics, who sometimes travel special.

CALEDONIAN RAILWAY.

HER MAJESTY'S JOURNEY FROM ABERDEEN TO CARLISLE, EN ROUTE BALLATER TO WINDSOR, ON FRIDAY, THE 17TH OF NOVEMBER, 1893.

INSTRUCTIONS FOR WORKING BETWEEN ABERDEEN AND CARLISLE.

1. A pilot engine in charge of the foreman of the locomotive department, accompanied by the inspector of permanent way, will leave Aberdeen at 3:27 P. M., 20 minutes before the royal train; arrive at Perth at 6 P. M.; leave Perth at 6:55 P. M., and arrive in Carlisle at 11:14 P. M. The driver must run at the speed indicated by the accompanying time table in order that he may occupy the same time from station to station as the royal train, and uniformly maintain the interval of 20 minutes throughout the journey.

2. The royal train will leave Aberdeen for Carlisle at 3:47 P. M., under the charge of the company's locomotive superintendent, accompanied by the general superintendent of the line, and will depart from, pass, and arrive at the various stations according to the accompanying time table.

3. No train, engine or vehicle must enter upon or cross the up main line, at any point between Aberdeen and Carlisle, for at least 30 minutes before the time named in the accompanying time table for the passing of the royal train, except the pilot which precedes the royal train at an interval of 20 minutes.

4. Should any up trains be out of time, they must be shunted into sidings at such stations as will insure their being at a stand 30 minutes before the royal train is due to pass them.

5. No trains or light engines, except passenger trains, must be allowed to

NOTE—These instructions must be kept strictly private, and must only be communicated to those persons in the service of the company who, in the discharge of their duty, require to know and act upon them; and those persons must not give any information to anyone respecting the hours or other arrangements set forth in these instructions.

travel between any two stations on the down line from the time the pilot is due to pass until the royal train has passed between those stations on the up line; and as regards passenger trains on the down line, they must be slowed to a speed not exceeding ten miles an hour while the royal train is passing them on the up line.

6. Working of Junctions.—No train, engine or vehicle, having to proceed upon the up main line, must be allowed to enter upon the block section next to the junction for at least 30 minutes before the royal train is due to pass the junction, nor until it has passed the signal box in advance of the junction, in terms of No. 14 of these instructions; and no train, engine or vehicle, having to cross the up main line, must be allowed to enter upon the block section next to the junction for at least 30 minutes before the royal train is due, nor until it has passed the junction.

7. Drivers of such trains as are standing in sidings or on adjoining lines waiting for the passing of the royal train must prevent their engines from emitting smoke, or making a noise by blowing off steam, when the royal train is passing.

8. The brakesmen of all trains brought to a stand upon the lines adjoining that upon which the royal train is traveling, will be held responsible for carefully examining the loading of their trains, directly they come to a stand, to see that nothing is projecting.

9. Station masters, signalmen, and others in charge of level crossings must lock their gates, and not allow any vehicle of any kind to cross the line for at least 30 minutes before the royal train is due, nor until it has passed.

10. A platelayer must be stationed at each occupation crossing between Aberdeen and Carlisle to prevent anything coming on to the line for at least 30 minutes before the royal train is due, and until it has passed.

11. Each foreman platelayer, after having examined his length of line, must station himself at the north end of it, and appoint one of his assistants to the south end; and, immediately after the pilot engine has passed, these men must walk over the intervening space till they meet each other, and thus see that all is right. Each foreman platelayer, and each assistant along the line from Aberdeen to Carlisle, must be provided with lighted hand lamps and fog signals; and those between Aberdeen and Bridge of Dun must be provided with signal flags as well as with lighted hand lamps and fog signals.

12. As the pilot passes each block telegraph cabin, its progress must be immediately telegraphed by needle instrument to the next block telegraph cabin in the rear; and unless it has been so telegraphed the royal train must be stopped.

13. The passing of the royal train must also be immediately telegraphed by needle instrument to the next block telegraph cabin in the rear.

14. No junction signalman must accept the "Be Ready" signal for any train or engine requiring to cross the up main line for at least 30 minutes before the royal train is due, nor until it has passed the junction; and no signalman must accept the "Be Ready" signal for any train or engine following the royal train, until he

Break.	Van. No. 272.
Queen's Fourgon.	Carriage Truck. No. 137.
Directors.	Lavatory Compo. No. 999.
Directors.	Double Saloon. No. 4.
Munshi Hafiz Karim. — Indian Attendants.	Double Saloon. No. 71.
Sir John McNeill. Lord William Cecil. Lieut.-Col. Bigge. Dr. Reid. Mr. Muther.	Double Saloon. No. 153.
Princess Louise, Marchioness of Lorne. Miss McNeill.	No. 132.
Personal Servants.	Royal Saloons.
Her Majesty and Princess Beatrice.	
Queen's Dressers.	
Children of Prince and Princess Henry of Battenberg and Attendants.	Double Saloon. No. 1.
Countess of Antrim. Hon. Evelyn Moore. Miss Bauer. Mdlle. du Perrut.	Double Saloon. No. 131.
Dressers and Ladies' Maids.	Day Saloon. No. 73.
For Pages and Upper Servants.	Day Saloon. No. 72.
For Men Servants.	Sleeping Carriage. No. 870.
Break.	Van. No. 210.
Engine.	

274 feet 6 inches

258 feet 6 inches

has received information by needle instrument that the royal train has passed the signal box in advance.

15. The pilot and the royal train must be worked on the block telegraph system, and in addition thereto the special regulations in Nos. 12, 13 and 14 of these instructions must be strictly observed.

16. Station masters and signalmen must be most particular that the telegraph is duly attended to during the progress of the royal train, and must take care that the train telegraph wires are not used for any

other messages than those connected with the working of that train and its pilot.

17. Foreman platelayers must block all the facing points on their respective lengths of line by wooden keys or wedges before the passing of the pilot, and must keep them so blocked until the royal train has passed.

18. Station masters at all stations must be on duty and see that the instructions herein laid down are strictly obeyed by the staff at their respective stations.

19. The guard in the front van must keep his face towards the rear of the train, and be constantly on the look-out to observe any signal that may be given from any of the guards or other attendants accompanying the royal train, and must communicate to the driver any signal he may receive.

20. The signal for starting the train must be given by the guard in the front van exhibiting a green flag by day and green light by hand lamp at night, but he must not give the authority for starting until after he has been verbally informed by the London & Northwestern Company's Superintendent that the examination of the train is completed, nor until he has exchanged signals with the guard in the rear van, and has received intimation from the person in charge of the station that all is right for the royal train to proceed, care being taken that all the members of the suite are seated before the signal is given.

21. Brakes—The royal train being fitted throughout with the Westinghouse brake, will be worked in accordance with the instructions relating to the working of that brake, as contained in the Appendix to the Working Time Tables.

The stations are to be kept quite clear and private while the royal train is stopping at or passing them; and none of the public are, under any circumstances, to be admitted to any of the stations, Ferryhill Junction excepted. The servants of the company are to perform the necessary work on the platform without noise; and no cheering or other demonstration must be al'owed—the object being that Her Majesty shall be perfectly undisturbed during the journey.

JAMES THOMPSON,
General Manager.

Glasgow, November 14, 1893.

Government Railroad-Track Experiments.

The Chief of Ordnance of the Army has transmitted to the Department of War the following report of the Commanding Officer at the Watertown Arsenal, Mass., regarding railroad-track experiments:

These experiments were made on the track of the Chicago, Burlington & Quincy Railroad at Hawthorne, Ill., with the co-operation and assistance of Mr. F. A. Delano, superintendent of freight terminals of that road.

The experiments consisted of measuring the depression of the rails under the weights of different classes of locomotives, and the fiber stresses developed in the base of the rail.

Two weights of rails were experimented upon; a 66-pound section and a 75-pound section.

The rails rested upon oak ties supported by gravel ballast, in some of the experiments; in others, upon cinder ballast.

The track selected was in good condition, and the spikes re-driven before the work began.

For the purpose of observing the depression of the rails, bench marks were established on a row of stakes driven alongside the rail, 31 inches distant from it. A beam carrying a micrometer and an astronomical level bubble was used in observing the depression of the rail, first measuring the height, using a point on the outer flange when the rail was unloaded, and repeating the observation when the locomotive was in different positions with reference to this point, making the observations when the observed point was directly under each wheel, and when between them midway.

This constituted one class of experiments.

In another class a preliminary leveling was made of the entire rail and parts of the adjacent ones; then the locomotive was run onto the rail, and while in one position the leveling was repeated, thus showing the depression of the entire rail, and not the movement of one point, as in the first-described experiments

The comparative rigidity of the track under different weights of locomotives and different wheel bases and pressure on the wheels, is shown in the results, the behavior of the two weights of rails and the relative supporting power of gravel and cinder ballast being shown.

In one case a tie was removed, and the behavior of the rail observed under these conditions.

It was found that the roadbed in the vicinity of the locomotive was sensibly depressed, and the bench marks were within the influence of that depression.

It was possible to detect a depression of the roadbed as far as 91 inches from the locomotive, at the side of the track.

A correction for the depression of the bench marks was obtained by means of a cantilever supported 10 feet from the track, and the total depression of points on the rails was also determined with reference to the cantilevers, in some of the experiments, instead of using stakes.

The fiber stresses were determined in the base of the rail by measuring the elongation or compression of the metal on a gaged length of 5 inches established on the top surface of the outer flange, observing the strains when the wheels were directly over or when spanning the gaged length.

The computed stresses per square inch, based upon the observed strains, assumed a modulus of elasticity of 30,000,000 pounds per square inch, and the fibers in the base were strained proportionally to their distance from the neutral axis of the rail.

Advance wave determinations were made on the 66-pound rail on cinder ballast, with Engine No. 526, Class H, at Station No. 10.

With the locomotive slowly approaching, an upward movement of the rail began when the leading truck wheel reached Station No. 1½. The wave increased while the locomotive continued to advance, and reached a maximum of .0037 inch when the truck wheel was over Station No. 5½. Then followed a sudden depression, and the height of the rail was reduced to the normal level when the truck wheel was over Station No. 6.

The trial was repeated, with the result of showing the first effect to be when the truck wheel was over Station No. 1½, as before, maximum height .0034 inch when the truck wheel was over Station No. 6, and reduced to the normal height at Station No. 6½.

The distance from Station No. 10, the place of observation, to the locomotive, when the upward movement of the rail began, was 15 feet in each trial.

When the crest of the wave was reached, the locomotive was 9 feet and 8 feet on the first and second trials, respectively, away from the station; and when the rail was reduced to its normal height, the locomotive was 8 feet and 7 feet, respectively, distant from the station of observation.

The position of the locomotive, when the upward motion of the wave first reached the station, could be identified with considerable precision; but, owing to an appreciable interval of time being necessary for the level bubble of the measuring instrument to stop and reverse the direction of its movement, the position of the crest of the wave, as well as the time when the height of the rail was returned to its normal level, could not be so well defined.

The wave length was probably somewhat less than the observations showed.

The abruptness with which the direction of the wave motion was changed and the rail returned to its normal level—after which, of course, it was depressed below the normal—was a very striking feature in the observations.

With conditions so variable, it is difficult to arrive at refined conclusions from the data furnished by so few tests; but the indications make it appear disadvantageous to allow an abrupt termination of the load on the rail.

It is expected that additional tests will be made for the purpose of showing the relative severity of a short wheel base where drivers are used alone, and with leading trucks and tenders to the rear of the engine.

The dispositions of the weights on the wheel base may be found, in confirmation of the present indications, to exert a very sensible influence on the maximum fiber stresses, as well as the gross load on the rail, and exert a modifying influence on the locomotive designs.

For the purpose of obtaining observations to determine the correction necessary to compensate for the depression of the bench marks themselves which were used while measuring the depression of the rails, a cantilever was arranged alongside of the track, supported at its nearest point 10 feet from the rail, and comparisons made between the height of the cantilever and stakes at the side of and 31 inches from the track, the stakes representing the bench marks used in the earlier experiments.

On cinder ballast, that part of the roadbed in which the stakes were driven was depressed a maximum of .049 inch, and on gravel ballast the maximum was .036 inch.

Wooden stakes and iron bolts were driven different depths into the roadbed with similar results; in fact, the few observations which were made showed the longer stakes to have been quite as much depressed as the shorter ones which did not penetrate the cinder ballast.

Following out the depression of the roadbed in a lateral direction, on cinder ballast, when the middle driver of the engine was abreast the place of observation, there was a measurable depression at a distance of 91 inches from the rail.

The recovery in the depression of the roadbed was not complete immediately upon the removal of the engine from that vicinity.

The principal part of the recovery at once took place; the remaining portion of the depression, however, was very sluggish in returning. The length of time required to effect complete resilience was not determined. One observation, however, made nine minutes after the load was removed from the vicinity, showed the resilience then incomplete.

Hand-Made Files Losing Popularity.

It is curious to observe how much influence tradition exerts in cases where past practices ought to be buried by the living present. This is strongly apparent in the preference of many people for hand-made articles in preference to those made by machinery. The assertion that an article is hand-made is frequently sufficient to secure a higher price for a thing than can be supplanted by machine made goods of superior construction and finish.

One of the most persistent articles to retain prejudice in favor of the hand-made product has been files. There is still a considerable demand in this country for hand-made files, although nearly all intelligent mechanics admit that the machine-made article is generally the better file. The prejudice against the machine-made file is, however, rapidly wearing away, and the indications are that it will soon entirely cease.

Americans were the first to employ machinery in cutting files, and naturally the art has made greater progress here than elsewhere. Until within quite recently, there were very few machines employed in Europe for cutting files, the English mechanics having displayed intense animosity against the improved method of production. The Germans appear to have been the first manufacturers in Europe to perceive the advantages of making files by machinery, and they gradually flooded the English market with machine-made files, until English makers were compelled in self-defence to resort to the use of machines. In connection with this forced change in the production of files, which next to the hammer is the mechanic's most important tool, a paragraph cut from a recent issue of the London "Engineer" has a peculiar interest. Our contemporary says:

"Superstitions, we are told, die hard. A lamentably lingering death has been the fate of the manufacturing fallacy that files can be better made by hand than by machinery. But it is dead at last—dead as a door-nail. The last screw in the coffin of this industrial superstition has been turned by the Government, for specifications from an important Government department are now in the hands of certain firms of file manufacturers in Sheffield, in which occurs the stipulation that they are to be machine-cut. This is understood to be the first time that any tender emanating from the Government has contained such a proviso, and it has excited a good deal of interest and comment in the trade. Moreover, since the men employed by the hand-cutting firms obtained a 10 per cent. advance on their wages, these firms say they have been at a disadvantage in competing with those who use the machine, and whose men got no advance. Some have since adopted machinery, and others are saying that they must come to it, or they will be shut out from securing Government and other contracts. So thoroughly does machinery seem to have taken possession of the file-makers that the orders which they have given out to engineers for the requisite machinery are actually exceeding the capacity of the workshops to supply. Taking advantage of the inability of English engineers to fill all the demand, the Germans are now introducing file-cutting machines into Sheffield, and are trying to obtain orders."

Mr. B. Thomas, Chairman of the General Managers' Association, has made an emphatic statement denying that railroad companies are in the habit of blacklisting employés discharged from their service. He also denies the truth of the reports that railroad companies are in the habit of sending to other companies lists of the men discharged from their service.

WHAT YOU WANT TO KNOW.

Questions and Answers.

Correspondents wishing to have questions answered in these columns should send in their names and addresses, not for publication, but for evidence of good faith. We throw all anonymous letters into the waste basket.

(84) H. F. L., Eagle Grove, Ia., asks:

1. How near boiler pressure is the pressure in the water glass when the water-glass cock is one turn open? A.—The pressure will be something less than boiler pressure, on account of wire-drawing; but just what the reduction is cannot be determined accurately without a gage to measure it. 2. In keying up main rods with the keys between the pins, does it lengthen the distance between the pin centers? A.—Yes, after wear takes place on the brasses; but the lengthening between these points is prevented on old brasses by shimming between the brass and crown of strap.

(85) H. S. T., New Haven, Conn., writes:

We have an engine without a driver brake, and have quite a controversy as to the quickest way to stop with the reverse lever. One man claims to reverse and allow the wheels to revolve in the same direction the engine is moving. Another man claims to reverse and slide the wheels. Still another man says to reverse and make the drivers turn in the opposite direction to which the engine is moving. Please say which way will stop the engine in the shortest possible time. A.—We are not in the enjoyment of facilities, in this office, for demonstrating the best methods for stopping an engine under the conditions noted. Our inquirer has every opportunity, and a few trials with the engine ought to decide the question much more satisfactorily than any opinion we could frame.

(86) F. S. B., Easton, Pa., writes:

Will you please inform me whether superheated steam has been used in locomotives, and if so, where I can get any information on the subject? A.—We do not know of any instance in which steam has been successfully superheated on a locomotive. Steam cannot be superheated while in contact with water, and a separate vessel is therefore necessary to bring it to the gaseous state. For this reason, and the fact that superheating to a temperature that would do away with cylinder condensation would be detrimental to a proper lubrication of the cylinders, we find good cause for its non-use. There is little literature on the subject; but you may get some information from "Steam," published by the Babcock & Wilcox Company, New York.

(87) L. A. C., Denver, Col., writes:

Please say, in "Locomotive Engineering," what governs the size of the hole that is drilled in the top of an ordinary balanced valve that is packed by four balance strips. I notice that the size of this hole varies from 3-16 to 1½ inches. A.—Since the hole through the top of the valve into the exhaust passage is to provide for the escape of any steam that may leak by the balance strips on top of the valve, and thus prevent the leakage from destroying the balance, the diameter of the hole need be only large enough to allow the leakage to escape. This, of course, will depend on how much wear is allowed on the strips before they are trued up. It has been often recommended that the hole

The Pennsylvania Railroad has organized a number of personally-conducted pleasure tours to be made under the escort of a tourist agent and chaperon, embracing most of the points of interest in the South. An early Autumn trip will be made to include Gettysburg Battle-Field, Blue Mountain, Luray Cavern, Basic City, Va., the Natural Bridge, Grottoes of the Shenandoah, Richmond, Washington and Mt. Vernon. The start will be made from Boston on Monday, October 12th, from New York and Philadelphia on Tuesday, October 13th, and the trip will cover a period of ten days. The cost of the trip, including all necessary expenses, will be $55 from New York, $65 from Boston and $53 from Philadelphia. Detailed itinerary will be sent on application to Tourist Agent, 1196 Broadway, New York; 86 Fulton Street, Brooklyn; 205 Washington Street, Boston; or Room 411, Broad Street Station, Philadelphia. This trip is sure to be popular, and the fact that it is conducted by the Pennsylvania Company is a guarantee that everything possible will be done for the comfort of the tourists.

INDEX TO ADVERTISEMENTS.

in the top of the valve be omitted, and thus allow the leakage to make its presence felt to the engineer, through the reverse lever.

(88) H. J. K., Mt. Washington, Md., writes:

1. Don't you think it would improve your paper to publish an index with each number? I suppose you will furnish a year's index at the end of the year; but all during the year we are liable to wish to refer to something in the back numbers, and, for want of a table of contents, have to search through nearly every page. A.—While we concede that an index with each issue might make the paper more convenient for reference in some particular cases, we believe that an annual index, according to our usual custom, fills most of the requirements. 2. Your formula for the tractive force of a locomotive is plain and simple enough; but I would like to see what you can do in the way of a formula for tractive force of a compound locomotive, either 2, 3 or 4 cylinder, together with explanation of its derivation. A.—The formula for tractive power of simple and compound locomotives, with reasoning from which they were derived, will be found in another column of this number.

(89) W. A. T., El Dorado, Kan., writes:

1. Will you please give the cause of boiler explosions, from the latest tests made? We have had very few explosions on our road, but they were frequent several years ago, and they were most all ten-wheelers with a pony truck. In several cases the engineer was blamed for low water. One engineer I know of claimed that his injector was working, and that he had plenty of water in the boiler at the time of the explosion. A.—It has come to be pretty well understood that there is only one cause for a boiler explosion, and that is, that the boiler is too weak to withstand the pressure it is subjected to. There are numerous causes for this weakness. It may be due, primarily, to poor material or faulty construction, or both; it can also be traced to the action of corrosive and pitting agencies in the feed water. There is no mystery about boiler explosions; they all come from the same cause—weakness. 2. Please say if, in your opinion, an injector will work with the water below the boiler check. A.—Yes; there are many engines running, on which the boiler check is located on the dome.

(90) J. J. H., Montgomery, Ala., writes:

Will you kindly explain the following questions? 1. I have often noticed that an engine, when pulling hard on a heavy grade, would slip badly just as the train turned over the top of the hill. Is there any mechanical cause for it? A.—Too much throttle is the cause. 2. What is meant by 6, 8, 10, or any other number of inches cut-off, or rather with the reverse lever cut back to any number of inches? Does it mean the number of inches in the cylinder that the steam follows piston, having in mind that the travel of the valve is regulated with the reverse lever? A.—When speaking of inches of cut-off, it is understood as referring to the number of inches the piston has traveled when the valve closes the port to admission. 3. What distance should an engine having 16-inch cylinders run to one quart of cylinder oil? A.—This is a question that cannot be answered without knowing something of the conditions in which the engine is run and handled, the quality of water, character of road, and so on. 4. Which is the hardest on rod brasses and eccentrics, running fast or pulling hard? A.—Fast running is productive of more harm to the parts named than slow, hard service.

(91) C. M. H., Chelsea, Mass., writes: 1. Will you kindly give your formula for finding the tractive power of a compound locomotive, and illustrate it by showing the tractive power of the Richmond compound mentioned in your July issue? A.—The question of tractive power for simple and compound engines will be found treated on fully in this issue. 2. Can you give me a formula for finding the mean effective pressure on locomotive pistons? A.—The theoretical M. E. P. can be obtained by the following formula:

$$p = P \times \frac{1 + hyp.\ log.\ R}{R} - \text{back pressure,}$$

in which p = mean effective pressure in pounds per square inch; P = absolute initial pressure on the piston; R = ratio of expansion, or the ratio of volume at end of stroke, to volume at point of cut-off. All pressures are assumed to be absolute. The boiler pressure and point of cut-off are seen to be controlling elements in obtaining the mean effective pressure, and taking, for an example, a boiler carrying 150 pounds of steam by the gage, the absolute initial pressure would be $150 + 14.7 = 164.7$ pounds. Assuming the cut-off to be at half-stroke, and the stroke to equal 24 inches, we have: $\frac{24}{12} = 2$ equals the ratio of expansion. In a table of hyperbolic logarithms, the logarithm of 2 is found to be 0.693. The back pressure is an indeterminate quantity; but if we assume that it is not more than three pounds, we will have $3 + 14.7 = 17.7$ pounds absolute back pressure. Now, substituting these values in the formula, we have

$$\text{M. E. P.} = 164.7 \times \frac{1 + .693}{2} - 17.7 =$$

$164.7 \times .8465 - 17.7 = 121.7$ pounds per square inch. This result is founded on the theory that pressures are inversely as the volumes, and that there is no clearance; that is, port space to be filled with steam between the face of piston and the valve face. When this clearance is known, the formula must be modified to read, $R = \frac{24 + c}{12 + c}$, instead of $\frac{24}{12}$, as in the first case. The effect of this clearance will be to reduce the ratio of expansion, and make it something less than two. Indicator diagrams are the only accurate means of arriving at the mean effective pressure in a cylinder, but the above formula will give results close enough for ordinary purposes.

Several months ago we mentioned that they were building an electric locomotive in the shops of the Manhattan Elevated Railroad in New York City. The motor is now at work on a branch on Thirty-fourth street. It is a small affair, capable of pulling two cars with difficulty. It is operated by a combination of direct electric current and storage batteries. When the train is standing at a station or going down grade, the line of current charges the batteries, and the energy thus stored is used for starting and for going up grade. There is an impression among the Elevated Railroad men that the motor has been put in service more for the purpose of advertising the patents connected with the motor than for doing regular tractive service.

INDEX TO ADVERTISEMENTS—*Continued.*

Buyers' Finding List.

Air Brake Fittings.
Crane Co., Chicago, Ill.

Air Brake Hose.
Boston Belting Co., Boston, Mass.
N. Y. Belting & Packing Co., New York.

Air Brakes.
Westinghouse Air Brake Co., Pittsburg, Pa.

Air Brake Gage.
Utica Steam Gage Co., Utica, N. Y.

Air-Brake Pump Governors.
Foster Engineering Co., Newark, N. J.
Mason Regulator Co., Boston, Mass.

Air Compressors.
Clayton Air Compressor Works, New York.
Ingersoll-Sergeant Drill Co., N. Y. City.
Norwalk Iron Works Co., South Norwalk, Ct.
Pedrick & Ayer Co., Philadelphia, Pa.
Rand Drill Co., New York.
St. Louis Steam Engine Co., St. Louis, Mo.

Air Drilling Machine.
C. H. Haeseler & Co., Philadelphia, Pa.

Air Hoists.
Pedrick & Ayer Co., Philadelphia, Pa.

Arch Bars.
Cambria Iron Co., Philadelphia, Pa.

Asbestos.
H. W. Johns Mfg. Co., New York.

Axles.
Cambria Iron Co., Philadelphia, Pa.
Gould Coupler Co., Buffalo, N. Y.
B. M. Jones & Co., Boston, Mass.
Krupp (T. Prosser & Son, New York).

Balanced Slide Valves.
Am. Bal. Slide Valve Co., San Francisco, Cal.
D. H. Brown, McComb, Miss.
M. C. Hammett, Troy, N. Y.

Bearing Metal.
Ajax Metal Co., Philadelphia, Pa.
Paul S. Reeves, Philadelphia, Pa.
U. S. Metallic Pkg. Co., Philadelphia, Pa.

Bell Ringer.
U. S. Metallic Packing Co., Philadelphia, Pa.

Belting.
Boston Belting Co., Boston, Mass.
N. Y. Belting & Packing Co., New York.

Boiler and Firebox Steel.
Shoenberger Steel Co., Pittsburg, Pa.

Boiler Checks—Inside.
Foster Engineering Co., Newark, N. J.

Boilers.
Pittsburg Locomotive Works, Pittsburg, Pa.

Boiler Testers.
Rue Mfg. Co., Philadelphia, Pa.

Boiler Tools.
Richard Dudgeon, New York.
Hilles & Jones Co., Wilmington, Del.
Long & Allstatter Co., Hamilton, O.

Boiler Washers.
Nathan Mfg. Co., New York.
Rue Mfg. Co., Philadelphia, Pa.

Bolt Threading Machinery.
Acme Machinery Co., Cleveland, O.
Detrick & Harvey Machine Co., Baltimore, Md.

Books.
H. C. Baird & Co., Philadelphia, Pa.
Philadelphia Book Co., Philadelphia, Pa.
D. Van Nostrand Co., New York City.

Boxes.
P. Pryibil, New York City.

Brake Adjusters.
Q. & C. Co., Chicago, Ill.

Brake Shoes.
Ramapo Iron Works, Hillburn, N. Y.
Ramapo Wheel & Foundry Co., Ramapo, N. Y.

Brass Castings.
Ajax Metal Co., Inc., Philadelphia, Pa.
Paul S. Reeves, Philadelphia, Pa.

Buffers.
Gould Coupler Co., Buffalo, N. Y.

Bulldozers.
Williams, White & Co., Moline, Ill.

Cars.
Allison Mfg. Co., Philadelphia, Pa.
Lima Locomotive & Machine Co., Lima, O.
Ramapo Iron Works, Hillburn, N. Y.

Car Couplers.
Gould Coupler Co., Buffalo, N. Y.
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National Malleable Castings Co., Chicago, Ill.
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Smillie Coupler & Mfg. Co., Newark, N. J.
Standard Coupler Co., New York.
Trojan Car Coupler Co., Troy, N. Y.

Car Heating.
William C. Baker, New York.
Safety Car Heating & Lighting Co., New York.

Car Lighting.
Safety Car Heating & Lighting Co., New York.

(Continued on page 936.)

BUYERS' FINDING LIST—*Continued.*

Car Roofing.
Standard Paint Co., New York.
Warren Chemical & Mfg. Co., New York.

Car Seats.
Hale & Kilburn Mfg. Co., Philadelphia, Pa.

Car Ventilators.
Harrington & King Perforating Co., Chicago, Ill.
M. C. Hammett, Troy, N. Y.

Car Wheels.
Krupp (T. Prosser & Son, New York).
Lima Locomotive & Machine Co., Lima, O.
Ramapo Wheel & Foundry Co., Ramapo, N. Y.
Standard Steel Works, Philadelphia, Pa.
Washburn Car Wheel Co., Hartford, Conn.

Cattle Guards.
Q. & C. Co., Chicago, Ill.

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Crosby Steam Gage & Valve Co., Boston, Mass.
Star Brass Mfg. Co., Boston, Mass.

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John J. McGrane, New York.

Coal Handling Machinery.
Link Belt Engineering Co., Philadelphia, Pa.

Coal Chutes.
Williams, White & Co., Moline, Ill.

Correspondence Schools.
Internat'l Corres. Schools, Scranton, Pa.
The Scientific Machinist Co., Cleveland, O.

Corundum Wheels.
Sterling Emery Wheel Mfg. Co., Tiffin, O.

Cranes.
Manning, Maxwell & Moore, New York.
Maris Bros., Philadelphia, Pa.
William Sellers & Co., Philadelphia, Pa.
R. D. Wood & Co., Philadelphia, Pa.

Crank Pin Gages.
M. C. Hammett, Troy, N. Y.

Crank Pins.
Cambria Iron Co., Philadelphia, Pa.
B. M. Jones & Co., Boston, Mass.
Krupp (T. Prosser & Son, New York).

Damper Regulators.
Mason Regulator Co., Boston, Mass.

Drills.
Cleveland Twist Drill Co., Cleveland, O.

Drilling Machines.
Gould & Eberhardt, Newark, N. J.

Electric Lighting and Power Apparatus.
Westinghouse Elec. & Mfg. Co., Pittsburgh, Pa.

Emery Wheels.
Sterling Emery Wheel Mfg. Co., Tiffin, O.

Engines.
St. Louis Steam Engine Co., St. Louis, Mo.

Engravings.
Bradley & Poates, New York.

Exhaust Pipe.
The General Agency Co., New York.

Expanding Mandrel.
Geo. L. Weiss, Cleveland, O.

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Arcade File Works, Anderson, Ind.
Nicholson File Co., Providence, R. I.

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A. Major, New York.

Flexible Shaft.
Stow Flexible Shaft Co., Philadelphia, Pa.

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Moran Flexible Steam Joint Co., Louisville, Ky.

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Allison Mfg. Co., Philadelphia, Pa.
Tyler Tube & Pipe Co., Washington, Pa.

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Buffalo Forge Co., Buffalo, N. Y.

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Williams, White & Co., Moline, Ill.

Frogs and Crossings.
Ramapo Iron Works, Hillburn, N. Y.

Graphite.
Jos. Dixon Crucible Co., Jersey City, N. J.

Hangers.
P. Pryibil, New York City.

Heating System for Shops.
Buffalo Forge Co.
Gold Car Heating Co., New York.

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Earle C. Bacon, New York.

Hollow Staybolts.
Falls Hollow Staybolt Co., Cuyahoga Falls, O.

Hydraulic Tools.
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Watson & Stillman, New York.
R. D. Wood & Co., Philadelphia, Pa.

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Crosby Steam Gage and Valve Co., Boston.

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Hancock Inspirator Co., Boston, Mass.
Hayden & Derby Mfg. Co., New York.
Nathan Mfg. Co., New York.
Rue Mfg. Co., Philadelphia, Pa.
William Sellers & Co., Philadelphia, Pa.

Jacks.
E. C. Boyer, Dayton, O.
Richard Dudgeon, New York.

(*Continued on page 937.*)

BUYERS' FINDING LIST—*Continued.*

Jacks—Continued.
A. L. Henderer, Wilmington, Del.
A. O. Norton, Boston, Mass.
Watson & Stillman, New York.

Laggings for Locomotives.
H. W. Johns Mfg. Co., New York.
Keasbey & Mattison Co., Ambler, Pa.

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Baldwin Locomotive Works, Philadelphia, Pa.
Brooks Locomotive Works, Dunkirk, N. Y.
Cooke Loco. & Machine Co., Paterson, N. J.
Dickson Mfg. Co., Scranton, Pa.
Lima Locomotive & Machine Co., Lima, O.
Pittsburg Locomotive Works, Pittsburg, Pa.
H. K. Porter & Co., Pittsburg, Pa.
R. I. Locomotive Works, Providence, R. I.
Richmond Loco. & Mch. Wks., Richmond, Va.
Rogers Locomotive Works, Paterson, N. J.
Schenectady Loco. Wks., Schenectady, N. Y.

Lubricators
Detroit Lubricator Co., Detroit, Mich.
M. C. Hammett, Troy, N. Y.
Nathan Mfg. Co., New York.

Lubricating Oils.
Galena Oil Works, Ltd., Franklin, Pa.
Leonard & Ellis, New York.
Signal Oil Works, Franklin, Pa.

Machine Tools.
Bement, Miles & Co., Philadelphia, Pa.
W. D. Forbes & Co., Hoboken, N. J.
Gould & Eberhardt, Newark, N. J.
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Manning, Maxwell & Moore, New York.
National Machinery Co., Tiffin, O.
Newton Machine Tool Wks., Philadelphia, Pa.
Geo. Place, New York.
Pratt & Whitney Co., Hartford, Conn.
Prentiss Tool and Supply Co., New York.
William Sellers & Co., Inc., Philadelphia, Pa.

Mechanics' Tools.
Armstrong Bros. Tool Co., Chicago, Ill.

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G. W. Hoffman, Indianapolis, Ind.

Metal Sawing Machines.
Newton Machine Tool Works, Phila., Pa.
Pratt & Whitney Co., Hartford, Conn.
Q. & C. Co., Chicago, Ill.

Milling Machines.
Cincinnati Milling Machine Co., Cincinnati, O.
Newton Machine Tool Works, Phila., Pa.
Pratt & Whitney Co., Hartford, Conn.

Mining Machinery.
Earle C. Bacon, New York.

Molding Machines.
Tabor Mfg. Co., New York City.

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H. S. Peters, Dover, N. J.

Packing.
Boston Belting Co., Boston, Mass.
Gould Packing Co., East Cambridge, Mass.
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Jenkins Bros., New York.
N. Y. Belting & Packing Co., New York.
U. S. Metallic Packing Co., Philadelphia, Pa.

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Standard Paint Co., New York.
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George P. Whittlesey, Washington, D. C.

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Harrington & King Perforating Co., Chicago, Ill.
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D. Saunders' Sons, Yonkers, N. Y.

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Page Woven Wire Fence Co., Adrian, Mich.

Regulators.
Mason Regulator Co., Boston, Mass.

Retaining Rings.
Ramapo Wheel & Foundry Co., Ramapo, N. Y.

(*Continued on page 938.*)

BUYERS' FINDING LIST—*Continued.*

Rubber.
Boston Belting Co., Boston, Mass.
N. Y. Belting & Packing Co., New York.

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Falls Hollow Stay-Bolt Co., Cuyahoga Falls, O.
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Crosby Steam Gage & Valve Co., Boston.
Star Brass Mfg. Co., Boston, Mass.
Utica Steam Gage Co., Utica, N. Y.

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N. Y. Belting & Packing Co., New York.

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Mason Regulator Co., Boston, Mass.

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Carbon Steel Co., Pittsburgh, Pa.
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Krupp (T. Prosser & Son, New York).
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Shoenberger Steel Co., Pittsburg, Pa.

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Krupp (T. Prosser & Son, New York).
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Standard Steel Works, Philadelphia, Pa.

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Fox Solid Pressed Steel Co., Chicago, Ill.

Stocks and Dies.
Armstrong Mfg. Co., Bridgeport, Conn.

Switches.
Ramapo Iron Works, Hillburn, N. Y.

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Q. & C. Co., Chicago, Ill.

Tires.
Krupp (T. Prosser & Son, New York).
Latrobe Steel Co., Philadelphia, Pa.

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Armstrong Bros. Tool Co., Chicago, Ill.
Gould & Eberhardt, Newark, N. J.

Tool Steel.
B. M. Jones & Co., Boston, Mass.

Tube Expanders.
A. L. Henderer, Wilmington, Del.
R. Dudgeon, New York.

Turnbuckles.
Cleveland City Forge & Iron Co., Cleveland, O.

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Jones & Lamson, Springfield, Vt.

Twist Drills.
Cleveland Twist Drill Co., Cleveland, O.

Valves.
Ashton Valve Co., Boston, Mass.
Coale Muffler and Safety Valve Co., Baltimore, Md.
Jenkins Bros., New York.
Star Brass Mfg. Co., Boston, Mass.

Valves, Reducing.
Foster Engineering Co., Newark, N. J.
Ross Valve Co., Troy, N. Y.

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F. C. Reynolds, New York.

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Pancoast Ventilator Co., Philadelphia, Pa.

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Buffalo Forge Co.

Vestibules.
Gould Coupler Co., Buffalo, N. Y.

Vulcabeston and Train Pipe Covering.
H. W. Johns Mfg. Co., New York.

Watches.
John J. McGrane, New York.

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Page Woven Wire Fence Co., Adrian, Mich.

Wood Working Machinery.
The Egan Co., Cincinnati, O.
J. A. Fay & Co., Cincinnati, O.
P. Pryibil, New York City.

Wrought Iron Pipe.
Allison Mfg. Co., Philadelphia, Pa.

BOOK DEPARTMENT

Cash must accompany order. No books sent C. O. D. Give name of book and author, and we can furnish any book wanted. The list below is especially recommended for mechanical readers. All books sent by mail free for price named, unless otherwise stated.

A Library of Steam Engineering. Fehrenbatch. 1895. The latest and the best book on Steam Engineering. Illustrates and explains every kind of steam engineering, stationary, locomotive and marine. Has chapters on the mathematics of steam engineering, covering all possible points, but in plain figures. No "higher" mathematics used. Can be understood by any man with a common school education. A whole library of steam engineering. Highly recommended. 800 pages. Price........................ ....**$5.00**

Air-Brake Catechism. Conger. 1895. This is Conger's "Air-Brake and Signal Instructions" rewritten and improved, containing the air-brake and signal instructions approved by the Master Car Builders' and Master Mechanics' Associations; also the standard list of questions for air-brake instruction. This is the latest and best book on air brakes. Issued November 1, 1895. Price...**25c.**

Air-Brake Practice. Phelan. 1890. The only practical book about handling the air brakes on the road, by a practical man. Bound for pocket..**$1.00**

Alexander's Ready Reference. Alexander. 1892. A first-class work. Tells what to do in almost any kind of breakdown on the road....**$1.50**

Block and Interlocking Signals. Elliott, 1896. Tells what signals are. What they do. How they do it. A full, complete description of all kinds of block and interlocking signals with details of their construction, operation and maintenance. The best book published on signals. 277 pages, 6" x 9". Leather binding........**$3.00**

Bound Volumes of Locomotive Engineering. 1895...... ....**$3.00**

Car Lubrication. Hall. Ought to be read by every one interested in keeping journals running cool **$1.00**

Catechism of the Locomotive. Forney. 1890. Enlarged. Illustrated. 50,000 sold. Every beginner wants it, and every engineman ought to have it **$3.50**

Compound Locomotives. Wood. 1894. Enlarged. Tells the history and explains the principles of all the kinds of compound locomotives in use........................ ....**$3.00**

Discipline Without Suspension. Brown. 1896. Pamphlet explaining the "Brown" system of discipline, by the originator; full data.... .**10c.**

Diseases of the Air-Brake System. Synnestvedt. 1894. Tells how to find and repair every defect that the air-brake system is liable to have................ ....**$1.00**

Enginemen's Guide, Time and Pocket-Book. Kinne. 1892. Rules of procedure in a breakdown, for handling air, etc. Contains a time book. Good for three years. Bound for pocket....**$1.00**

Enginemen's Pocket Companion. Booth. 1895. Contains pages arranged for time-keeping. Has Traveling Engineers' Examination for Enginemen, articles on brakes, valve setting, combustion, and much valuable information for enginemen... ....**$1.00**

Evolution of the Air Brake. Synnestvedt. 1895. A brief but comprehensive history of the development of the modern railroad brake, from the earliest conception contained in the simple lever, up to, and including, the most approved forms of the present day.......... ....**$1.00**

Haswell's Engineer's Pocket-Book. 1892. Probably the best authority in engineering matters. Rules for almost everything. **$4.00**

How to Save Money in Railroad Blacksmith Shops by Use of Bulldozer and Helve Hammer. Reynolds. 40 illustrations of dies and work. Very valuable to shop manager and foreman blacksmiths...... ....**25c.**

Indicator Practice and Steam Engine Economy. Hemenway. 1892. The simplest and best treatise on indicating................ ...**$2.00**

Key to Steam Engineering. Williams. 1892. More especially for stationary engines, but good information for anyone. Boiler, engine, combustion, evaporation, etc., explained in a common-sense way.................... ....**50c.**

Link and Valve Motions. Auchincloss. 13th Edition. Just Revised. 1895. The principal authority on the subject **$2.00**

Locomotive Catechism. Grimshaw. 1894. Latest book out. Contains 1,300 questions and answers about locomotives and air brakes. Fully illustrated........ ....**$2.00**

Locomotive Engine-Running and Management. Illustrated. Sinclair. 1893. Enlarged. Best work on running and care of locomotives. Plain facts plainly stated............**$2.00**

Locomotive Mechanism and Engineering. Reagan. 1894. By a practical locomotive engineer. Up to date. A good book...... ..**$2.00**

Locomotive Running Repairs. Hitchcock. 1892. A practical treatise on running repairs, by a practical man. Numerous diagrams and illustrations ....**50c.**

Machine Shop Arithmetic. Colvin & Cheney. 1896. Plain rules showing shop men how to calculate speed of pulleys and gearing, how to figure the gears for screw cutting and giving a great many facts about tools which every mechanic ought to understand...........................**50c.**

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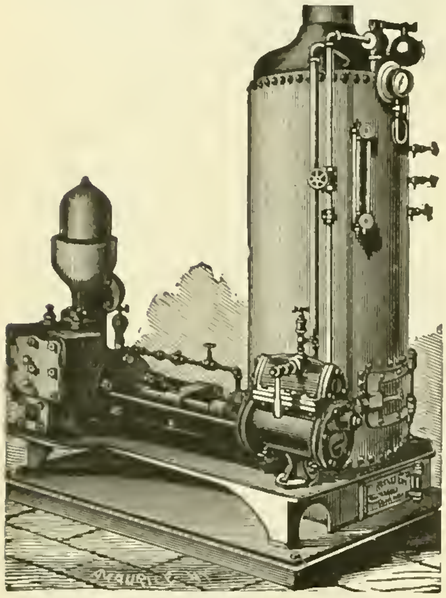

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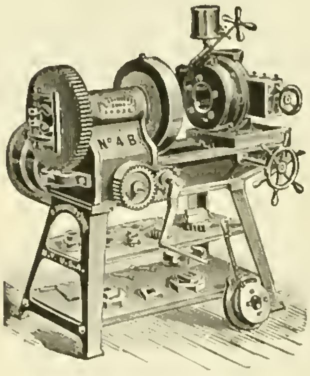

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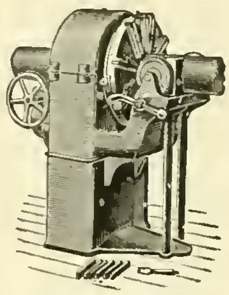

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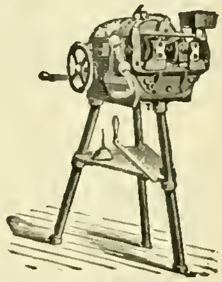

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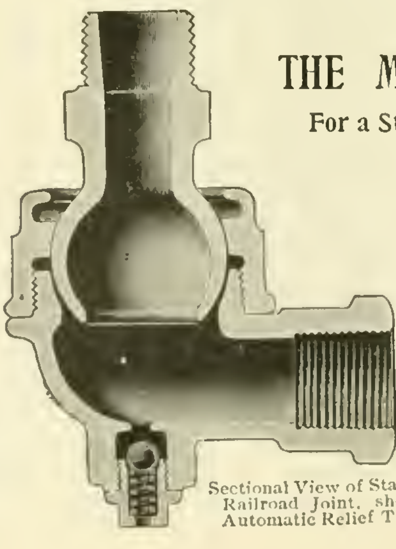

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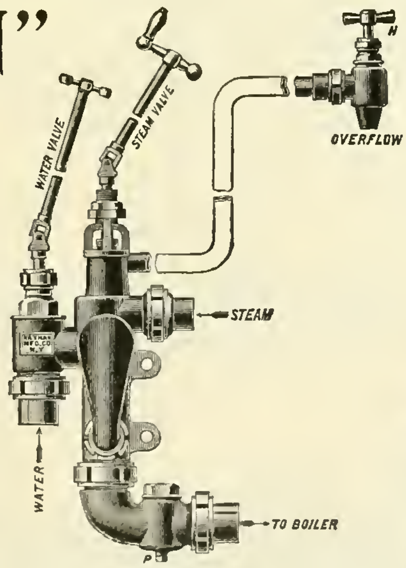

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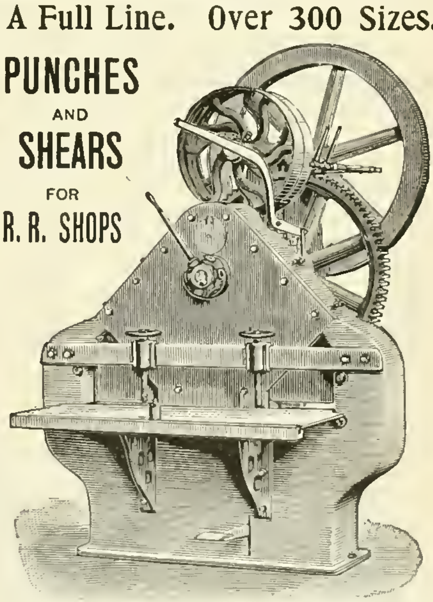

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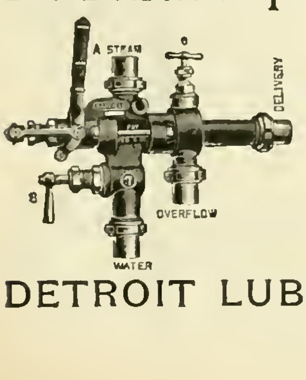

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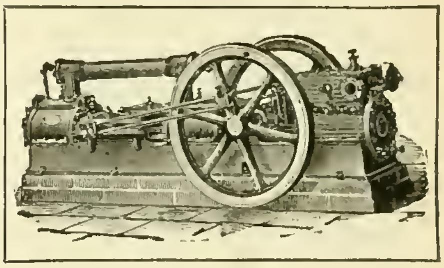

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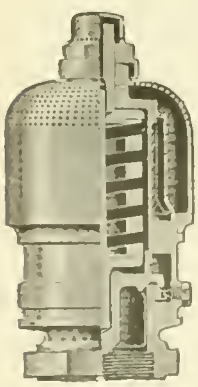

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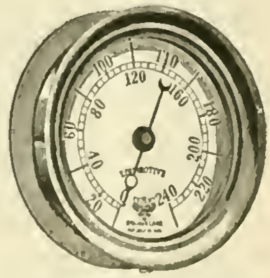

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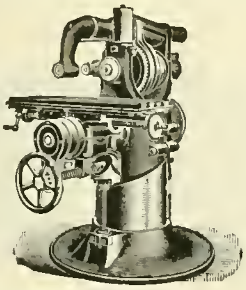

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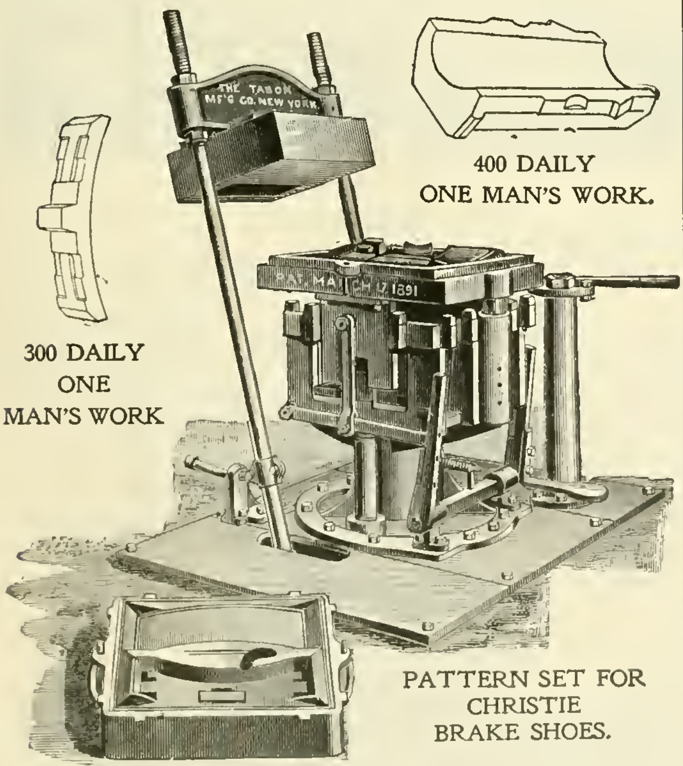

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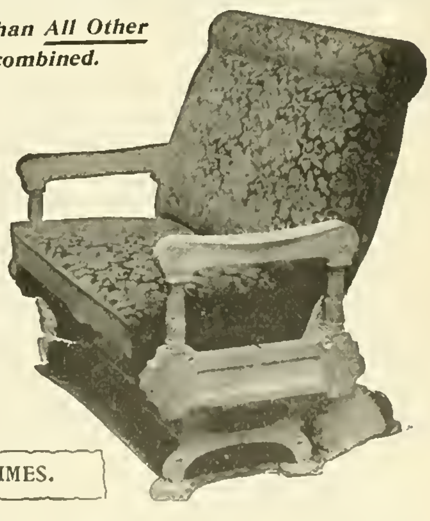

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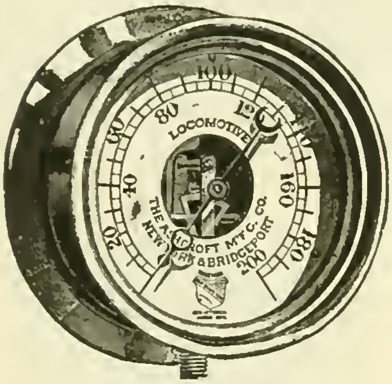

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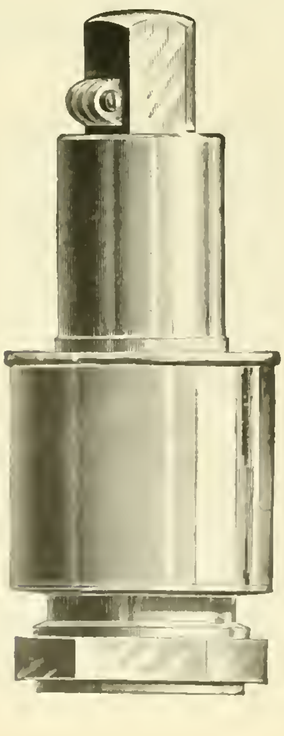

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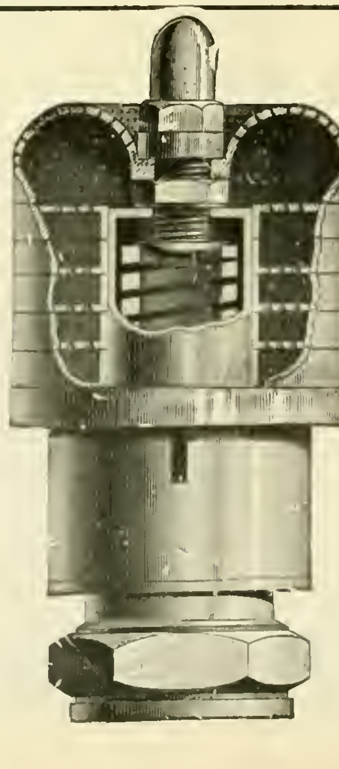

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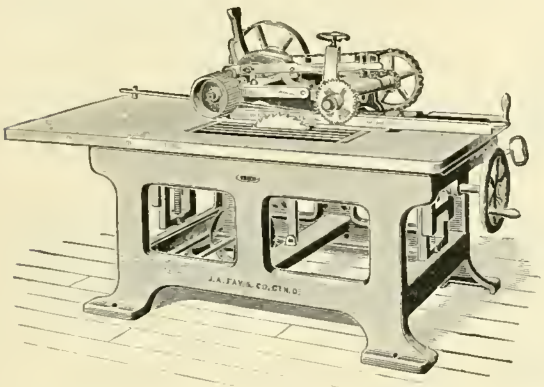

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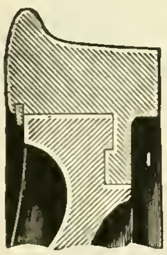

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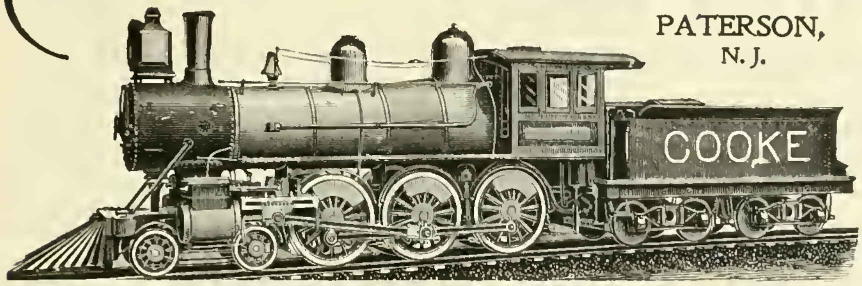

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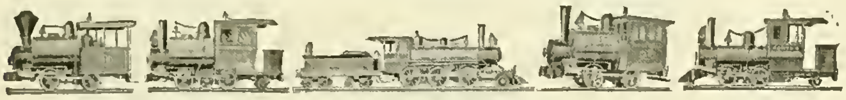

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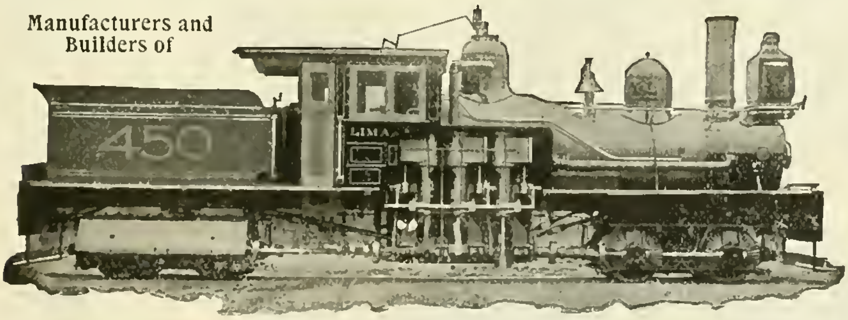

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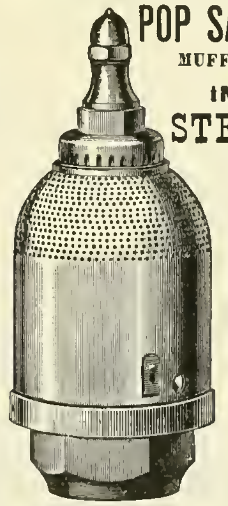

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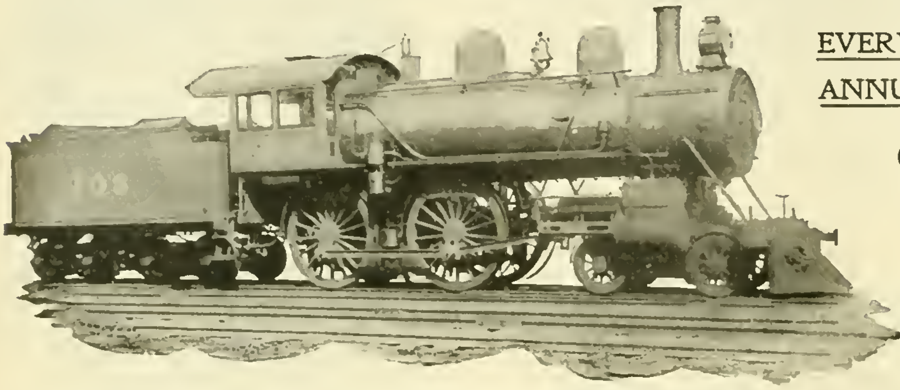

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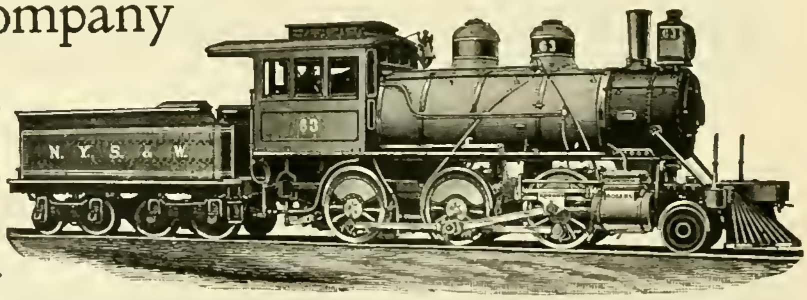

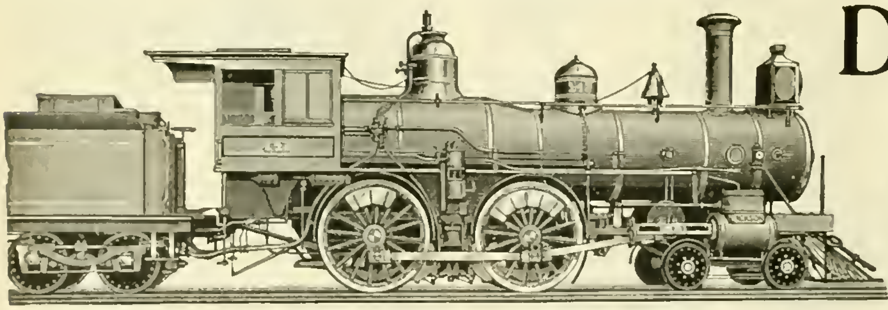

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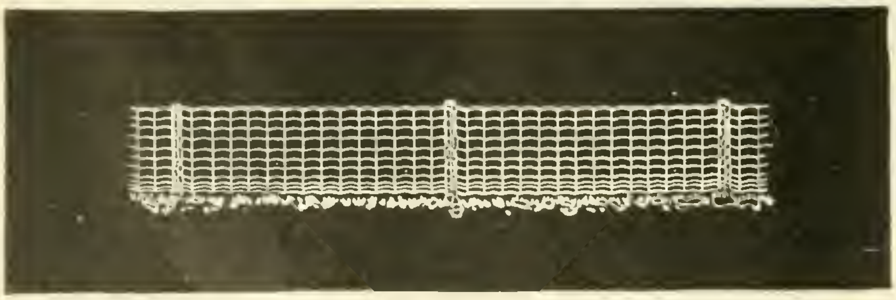

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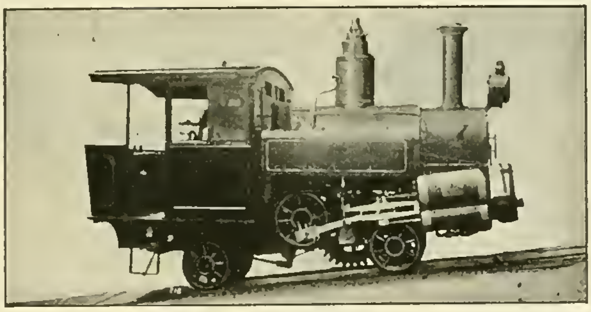
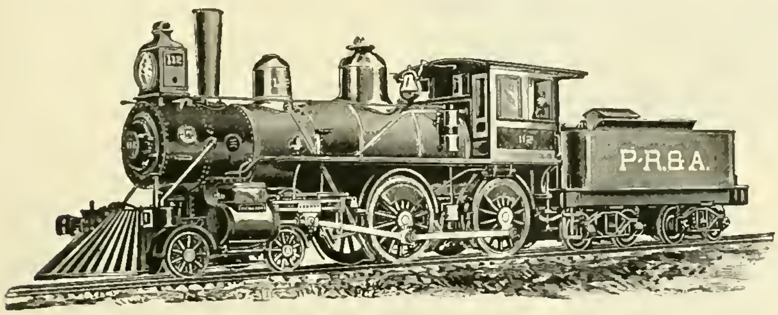



P.R.&A.


564

LOCOMOTIVE ENGINEERING

A PRACTICAL JOURNAL of RAILWAY MOTIVE POWER AND ROLLING STOCK.

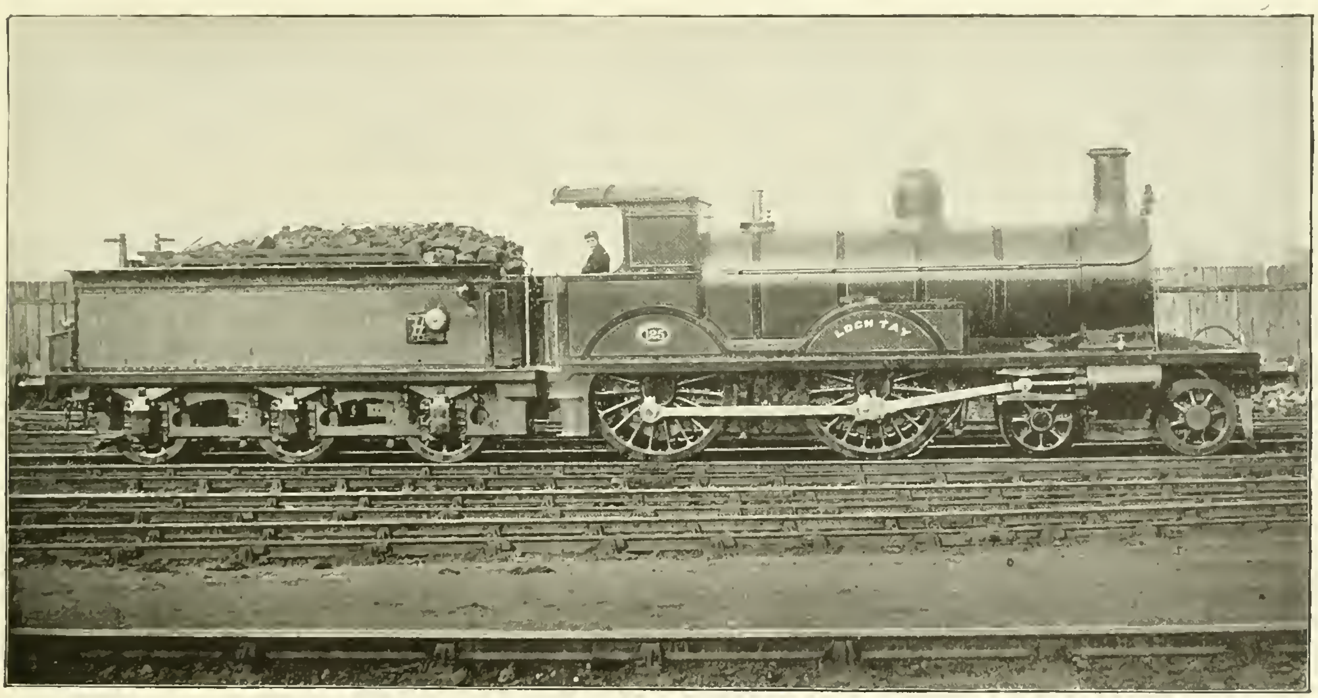
[Trade-Mark Registered.]

Vol. IX. NEW YORK, DECEMBER, 1896. No. 12.

Highland Railway Locomotive.

Mr. Sam A. Forbes, of Perth, Scotland, who has favored us with a variety of photographs of noted locomotives, sent the photograph of the engine hereby illustrated. This engine was designed by Mr. Jones, locomotive superintendent of the Highland Railway, and fifteen of them now in use were built by Messrs. Dubbs & Co., of Glasgow. The boiler, which has a heating surface of about 1,320 square feet, carries a steam pressure of 175 pounds per square inch. The cylinders are 19 x 24 inches, and piston valves are employed, operated by Allen link motion. The driving wheels are 75 inches diameter, and the truck wheels 37½ inches.

The Highland Railway where these locomotives run is the most difficult to operate of any road in the British Isles. Its Southern terminus is Perth. From that city the railway makes direct for the Grampion Mountains and traverses some of the wildest and most picturesque scenery in Scotland on its way to Inverness, the capital of the Highlands.



HIGHLAND RAILWAY EIGHT-WHEELER.

Rambling in Europe.

[EDITORIAL CORRESPONDENCE (DELAYED).]

Zurich, Switzerland, Sept. 7, 1896.

When I left New York it was my intention to make Constantinople the objective point of my journey, where I expected to make notes of the operating of Turkish railways. Friends who had been there had given accounts of curious practices in train operating which promised to supply a good field for description. But on landing at Havre I found that the newspapers were teeming with accounts of massacres and rioting in the streets of Turkey's principal city, which did not appear to be alluring to a peaceful scribe. On considering the situation I decided that discretion was the better part of valor, and that a more propitious season might come later on for studying the habits of what our English friends delight to call "the unspeakable Turk," whatever that may mean.

Failing in my first plan, I determined to see something of mountain railways, and the experience of the last week has brought before my vision many wonderful scenes and stupendous triumphs of engineering valor and skill.

A man has to travel a long time before he ceases to receive new ideas and new impressions from what he sees abroad. I have crossed the Atlantic a great many times, but it never struck me so forcibly as it did on this voyage how glaringly credit is given where it is not due in connection with the speed made by Atlantic liners. Let it be known to our readers that at noon of each day on ocean steamers an observation of the sun is taken with a nautical instrument which enables the officers to calculate the exact locality of the vessel, and to tell how many miles have been traveled since the last day's observation. You gain time going East, as you are meeting the sun, and lose coming West. The engine whistle is sounded the moment the sun has touched the meridian, and old travelers soon learn to tell about how many miles the gain in time represents. This leads to a good deal of betting, in which the man of knowledge invariably comes out ahead.

About forty or fifty minutes before noon a certain class of passengers betake themselves to the smoking-room and begin discussing the likelihood of the speed made during previous twenty-four hours. They talk as authoritatively about the management of the ship as brakemen, on the native heath of the brakemen's room, talk about the weakness of the general manager, and of how much better they could run the road if they were only called to the top.

What amused me with the amateur navigators on this trip was the way they blamed or praised the Captain for a few miles lost or gained. It was the old case of Conductor Tom who had made a magnificent run, while all he had done to aid in getting the train along was punching tickets.

The Captain of the steamer was on deck a good part of the time, and evidently kept a keen lookout to see that the officers on watch were attending to their duties, and that the ship was following the proper course. But away down in the bowels of the vessel there were engines scarcely seen by the passengers, and great boilers that kept these pistons and cranks going. There were many men pouring coal into the furnaces of these boilers, and putting it in after the fashion of developed skill that makes steam most freely. The Chief Engineer was around all the time, watching the steam gages, and if the pressure went back five pounds he understood that it meant one less revolution of the propeller and a corresponding loss of speed. Then he stirred up the engineer in charge of the watch, and that hard-worked officer walked into the stoke-hold, where the temperature was well on towards the boiling point, and the grimy coal-heavers with the perspiration pouring off their half-nude bodies would be told in "language that's plain" that they must hustle to keep her hot. And then big "slice bars" would be taken up into stalwart hands, a door would be thrown open, revealing a blazing mass, white as the glare of a hundred arc lights; the bar would be pushed into the bed of fire, gleaming like a huge sun, and the skilled eye of the engineer would detect whether or not the fire was sound. So the round would go, and when a fire was found hollow in any part, showing the tell-tale traces of air holes, the engineer would stand in silent wrath until the furnace had been put in proper shape, and then he and the fireman of that furnace would go into executive session together.

The success of a business generally depends on how minute details, not very important in themselves, are attended to. The Chief Engineer of a steamer will not make a success unless he has assistants who are keen to detect the premonition of a hot journal and can quickly spot the fireman who keeps a hollow fire. These are the details that keep the speed up to the maximum and prevent delays. The Chief Engineer sees that none of them are neglected; and when an extraordinary run is made, the passengers pass resolutions of admiration for the Captain, and hardly realize that there are such individuals as engineers and firemen on board.

That is a condition of affairs that applies almost as universally on steamers to-day as when it was customary to gush over the run which the conductor had made. Care of air brakes, and the responsibilities connected with that and other lines of knowledge, are slowly redeeming the locomotive engineer in public opinion. I often wonder when a similar measure of justice and appreciation will come to the marine engineer, whose ordinary attainments embrace a knowledge of everything relating to the philosophy of the steam engine, an intimate knowledge of electrical apparatus, a mastery of details concerning hydraulics, thorough acquaintance with the construction and operation of refrigerating machinery; miscellaneous information concerning gas, compressed air, and of every plan that has ever been tried for transmitting power from one point to another.

There are many practices prevailing on steamers that put slights and hardships upon one class and load others with honor and glory that are not due; but reforms are coming slowly, even among the most conservative class in the world—the men who do down to the sea in ships. In what are wistfully spoken of as "the good old days," the qualifications of popular officers were more social than professional. The captain was the presiding spirit in all gaieties; he placed the light of his countenance upon all entertainments, sat around the social board, and joined in the flowing bowl with favored passengers, and his officers imitated his habits as closely as they could.

A great disaster once happened to a steamer that ran ashore on a clear night on the rocks of Nova Scotia. The greater part of a shipful of passengers was drowned. Who was directly responsible for the wreck never was revealed to the public. But sea-going men were aware of facts that were suppressed in the public inquiry. I was sea-going shortly afterwards, and was told by a man who escaped from the wreck that the captain was in the saloon, presiding at a banquet, when the ship went ashore, and that there was not an officer on deck.

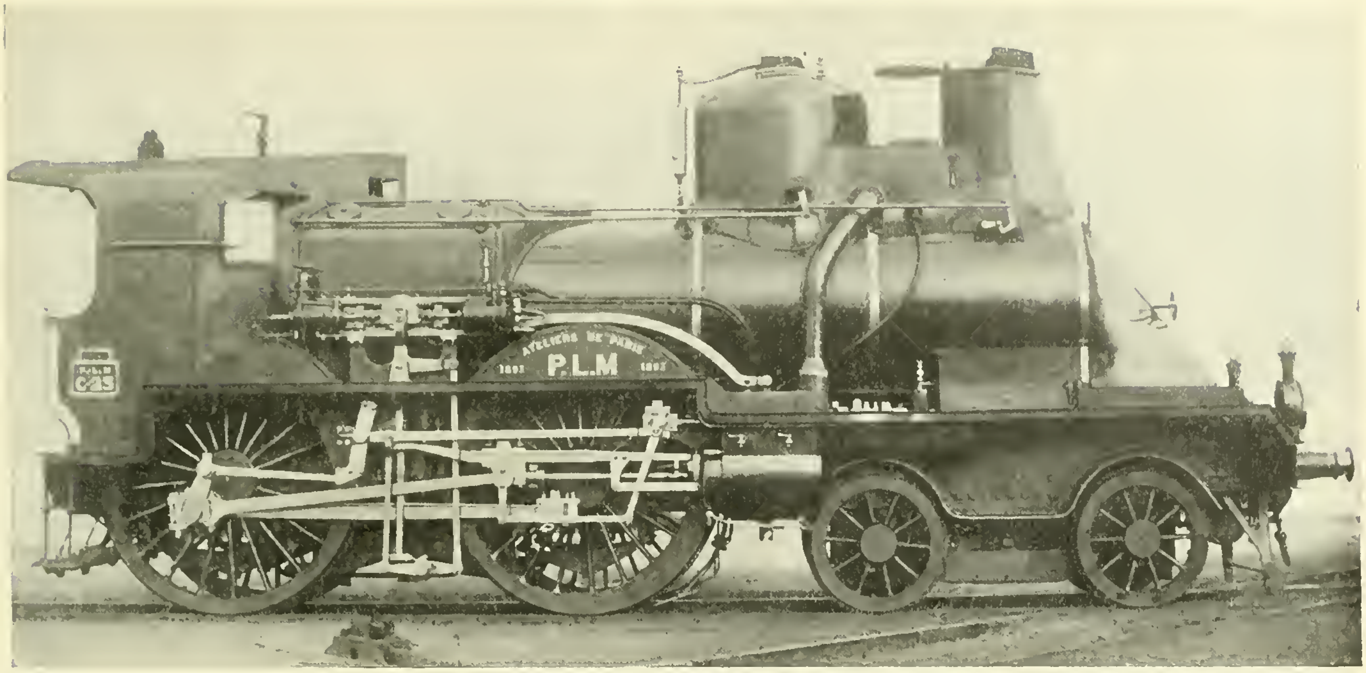
Things are greatly changed now. On the best-managed lines the captain is not permitted to entertain anyone, not even in his own room, and the same rule applies to the other officers. The captain's duties are confined to watching the navigation of the vessel, and he is required to be on deck always, except when sleeping or taking his meals. The benefit of that rule can readily be noted by those accustomed to steamer life, past and present. The present is all business with safety; the past found much jollity and occasional disaster.

When in due time we reached Havre, a curious case of roundabout methods of railroading came to my attention. There was a special "train de luxe" waiting to take the passengers to Paris. The train was a remarkable improvement over the means I had seen provided two years previously. The cars were of the "corridor" type, which is a mild imitation of American practice, and they were about fifty feet long. An embarrassing circumstance connected with the length of the cars was that, tied up in the usual European style, with a screw coupler in the middle, drawing two side-spring buffers together, there was so much curve resistance that the cars would not go round the curves encountered between the docks and the fairly straight alignment that prevails after the city is passed. But some compromiser got over the mechanical difficulty. He put on a sort of attenuated Janney coupler, made long enough to keep the side buffers apart. After a protracted delay we started from the wharf, and I was keeping a keen eye upon the couplers, because they were so slim that I feared they would fail when hard work was put upon them. They held all right, however, until the curves were passed. Then the train was stopped and the couplers taken down, and the ordinary screw coupling put in service. Nearly an hour's time was lost over that operation. It seems strange that they put on a special coupler for the worst curves they have, and do not realize the advantage it would be on all the other curves of minor degree.

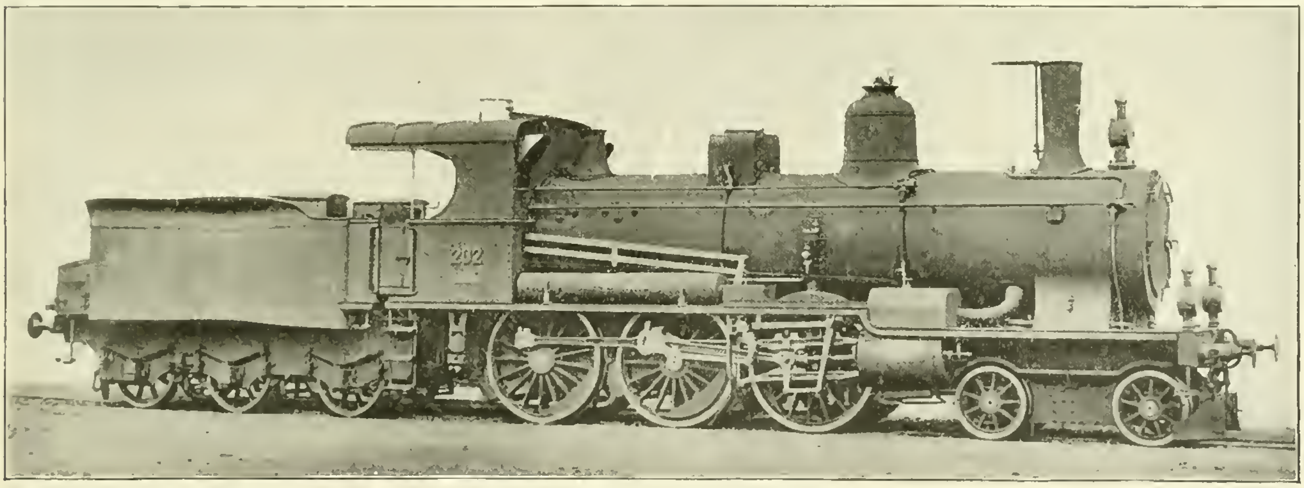
There was an eating-car on this "train de luxe," which gave me reason to believe that the privilege of eating on a train in France is a luxury intended for a very small portion of the passengers. All the food was cold. Their charge for a small plate of cold ham was six francs, or about $1.20, and other things were sold at similar rates. That was the only eating-car that I have found on the Continent thus far. It is not surprising, under the circumstances, that passengers prefer to grab a sandwich at the station bars, gulp down a glass of sour wine, and run to the car, chewing the sandwich, which is the prevailing fashion.

After a brief stay in Paris, I took the Paris, Lyons & Mediterranean Railway for Geneva. The train was a "rapide," as the express trains are called in France, and consisted of twelve corridor cars, each about 40 feet long, pulled by a compound engine whose picture is shown in connection with this letter. The engine had a sort of wind-cutter in front and was the first locomotive I had ever seen so constructed. At one of the stations I interviewed the "mécanicien," as the engineer is called, and he seemed to be very proud of his odd-looking machine, and averred that the air-cutting attachment was "bien bon," which means very good.

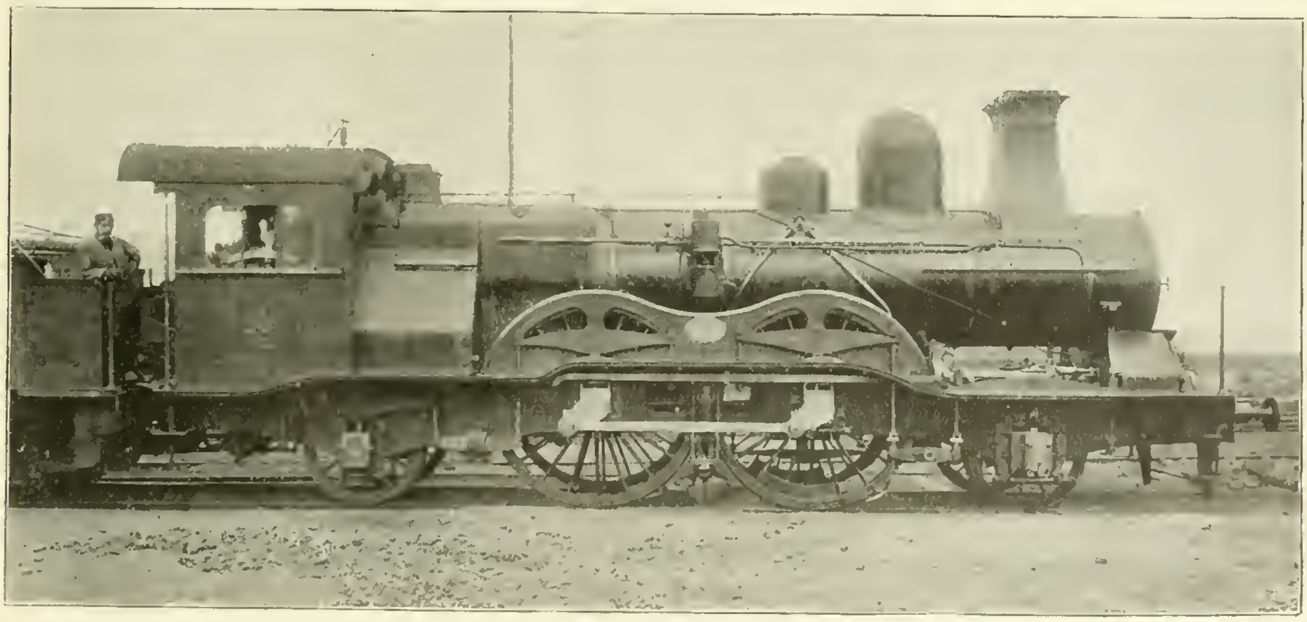
The "rapide" did not rush through



PARIS, LYONS & MEDITERRANEAN WIND-SPLITTER



ON THE ST. GOTHARD RAILWAY.



A BELGIAN EXPRESS LOCOMOTIVE.

RAILROAD STATION AT GENEVA

RAILROAD STATION AT MILAN.

RAILROAD STATION AT TURIN—FRONT AND REAR.

space at the speed the name might imply, but we got over 270 miles in about eight hours, making stops about every 30 miles. The line is double-tracked, and has as fine a roadbed and rolling-stock equipment as anything which I found on the Continent of Europe. The rolling stock, not only of the train I was in, but the freight and other cars seen at stations, was particularly good and substantial, and I noticed that steel underframing was largely used for all kinds of cars and tenders. The road is equipped with block signals throughout, and the switches at stations are operated by an interlocking system. In many particulars the signals and interlocking differ from the systems used in Britain and America. We are accustomed to associate with the French and other Latin races finer art perceptions than what prevails among the British and Americans; but these attributes are certainly not made manifest in their railway appliances.

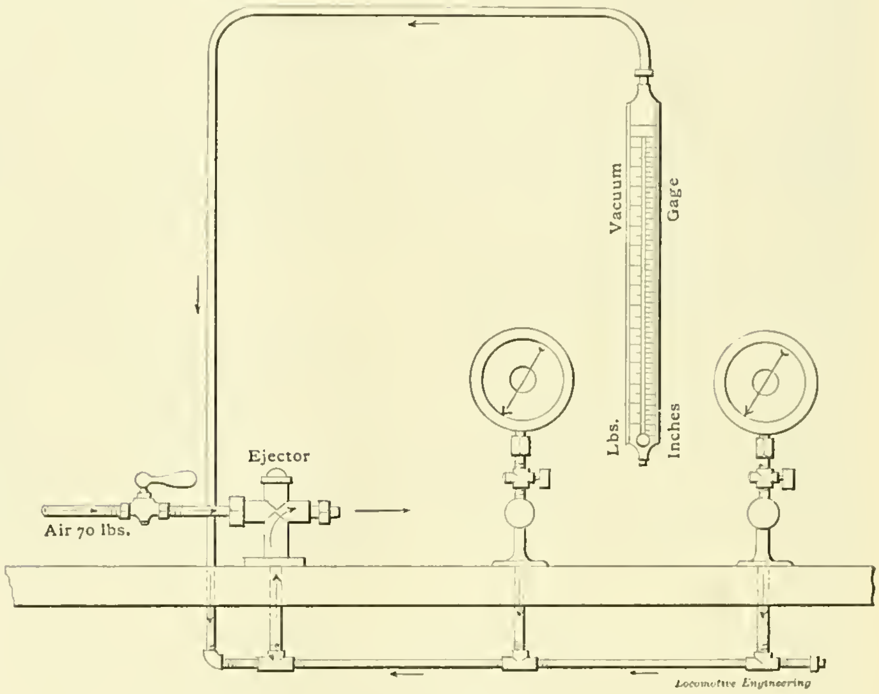
There was a curious display of combining advertising with decorative art seen in the carriages of this and other railways in France and Italy. The figuring on the upholstery and ornamental work inside the cars was formed principally from the initials of the road. Small initials, large initials, initials made of various fashions of lettering, were dotted on every plush surface, which had a strange effect. You would look a panel over and conclude that it was odd, without being very pleasing; and then, as your eyes got analyzing details, they resolved themselves into "P. L. M.," or such-like.

The Paris, Lyons & Mediterranean took us through a most attractive and interesting country—attractive, from the stamp of Nature; and interesting, from man's handiwork and from the events of which the recurring scenes, towns and buildings were the theatre. France has no regions more fertile than the valleys of the rivers that feed the Seine and the Rhone. Besides being naturally fertile, they are lands of wood and water and hill and dale. A fertile country develops a thick population who accumulate worldly goods, which are coveted by those who have not got any savings ahead. A beautiful country develops patriotism in the natives, and they display a dislike to moving. When lean and lazy outsiders heard about the fatness of the lands of the Seine and Rhone valleys, they naturally thought that those in possession were enjoying more than a fair share of the world's goods. They had no fine abstract theories to offer for taking the other people's possessions and savings; but they had swords and pikes and other deadly weapons, which they did not hesitate to use. Then there were wars and sieges and stormings, and the whole long route from Paris to Geneva is studded with relics and monuments of devotion and valor on one side, and of rapacity and reckless brutality on the other. Sometimes the robbers were victors, and their children settled down to be food-raisers and were spoiled in turn by new robbers; but the land remained, and towns and castles and churches multiplied, and the country waxed stronger every generation to repel the spoiler. This has been the history not only of the fertile valleys of France, but of every region in the world which offered accumulations of labor, thrift and industry as attractions to cupidity.

In traveling from Paris to Geneva, the physical features of the country do not seem to be more rugged than those encountered in going from New York to Buffalo by the New York Central, until the Jura mountain region, traversed in the last fifty miles of the journey, is reached; yet the whole of the route is dotted with tunnels, deep cuttings, heavy embankments and high bridges. The tendency of the locating engineers has been to go straight through hill and valley. By very slight curvature they might easily have avoided tunneling and gained much easier grades. But first cost seemed to be no object; and the equivalent in France of our General Passenger Agent seems to think he holds a winning card over competitors when he can boast about the number and the length of tunnels on his line.

Geneva is not a railway center, but it is a good point from which to visit mountain railways and magnificent scenery. The lake is beautiful beyond other waters, and has a blue color that has harassed science to define the cause. There has been a town here for about two thousand years, and many a sanguinary struggle there has been between contending robbers of high degree to gain possession. By the falling-out of covetous rogues, the town was left to enjoy privileges accorded to few communities in the evil times that succeeded the break-up of the Roman Empire. The city was the cradle of many mechanic arts; it was long the refuge of persecuted thinkers, and it was at times a theatre of intolerance as grim as anything the world has ever seen.

My journey from Geneva was over the Alps by the Cenis Tunnel route to Turin, from that city to Milan, and thence by the St. Gothard tunnel route to Zurich. Particulars of the journey must stand over for another letter. A. S.



VACUUM TESTER.

First-Class Gage-Testing Appliances

At the Wilmington shops of the Philadelphia, Wilmington & Baltimore Railroad, is to be seen one of the most complete and thorough arrangements for testing the accuracy of pressure and vacuum gages possible to conceive in railroad practice.

Master Mechanic Turner has made special efforts to the end of keeping all steam gages on a truthful basis and give an accurate registry of boiler pressures. To do this, considerable ingenuity has been shown in the combination of the separate indicating devices shown in the illustration, and which can be worked singly or together, thus furnishing a reliable check on each other.

Arranged on a bench at a convenient height for manipulation while the operator is comfortably seated in a chair, is an Ashcroft weighted testingapparatus which is known to give accurate results. Next to this is a Shaw mercurial column, registering up to 250 pounds by pressure on a diaphragm. A large Utica test gage completes the indicating devices for pressures, and these are all piped to an air cylinder of peculiar construction, consisting of an 8-inch piston which is secured to a rod on the lower end of which is a 3-inch piston; the larger piston receiving air pressure at 70 pounds, and the smaller piston transmitting this pressure through glycerine to the several registering devices.

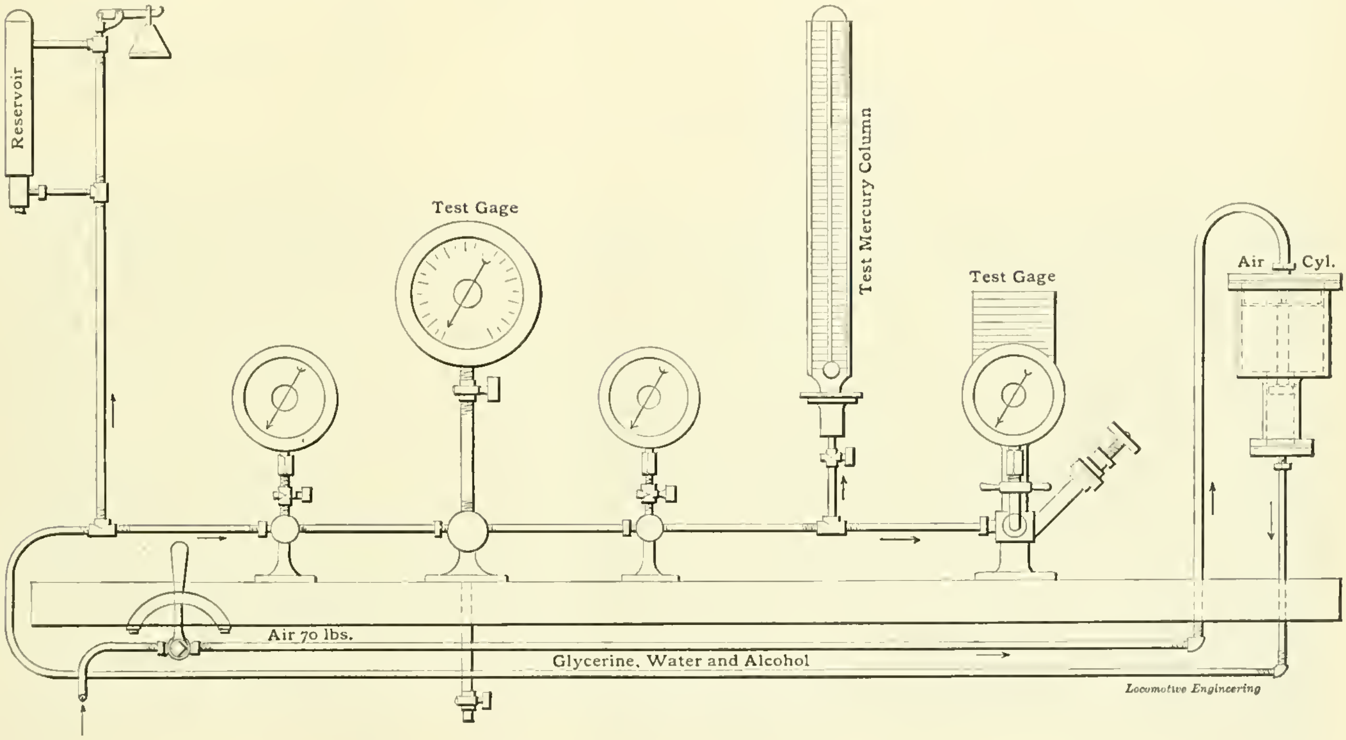
A small lever controls the pressure from the air cylinder, and the position of the gages on trial, which are secured to the same system of piping as the master gages, is such that they are easy to handle and rectify any trouble while the pressure is on.

Our illustration shows the air cylinder at the right with a total pressure on its piston of 3,500 pounds; and since the ratio of the areas of the pistons are about seven to one, there is a pressure of 495 pounds per square inch transmitted to the gages, neglecting friction on the packing. There is sufficient force left, however, to test the gages to their limit of 250 pounds.

The little reservoir at the left of the engraving is filled with glycerine, which flows through a valve opening downward into the pressure system, and keeps the pipes constantly filled up to the gages. The little weighted valve seen at the top of the reservoir is there to prevent the pressure from going above the limit, and is set at 250 pounds.

At the extreme left is a mercury column, graduated to pounds on one side of the tube, and inches of vacuum on the opposite side. This is used for testing the vacuum gages, and is one of the best schemed things in the exhibit. It is operated by connecting a pipe to the top of the column and exhausting the air from above the mercury by means of an induced current, on the principle of an ejector. While this looks like an extremely simple thing to accomplish, it was found when experimenting to get satisfactory results, that not above 10 or 12 inches of vacuum could be had without the discharge nozzles in the ejector were of a certain size and had a certain relation to each other. This all had to be found by trial, and is only what all mechanics have to cope with when exploring new fields for results.

Perhaps the best feature about the little testing plant is the fact that it is used to keep up the gages to their proper safe status. A mechanic who knows his business, being engaged on this work constantly, and who is responsible for the condition of all gages, surrounds the work with a character of truth that breeds confidence.



PRESSURE TEST APPARATUS.

Qualifications of Shop Foremen.

Mr. Geo. W. Stevens, superintendent of motive power of the Lake Shore, has been conspicuously successful in the handling of his department, which has been due in a great measure to judicious selection of subordinates. Some years ago he wrote a short letter to the Western Railroad Club, giving his ideas concerning the selection and qualifications of shop foremen, which is still worthy of the attention of officials who have to promote men to positions of this kind.

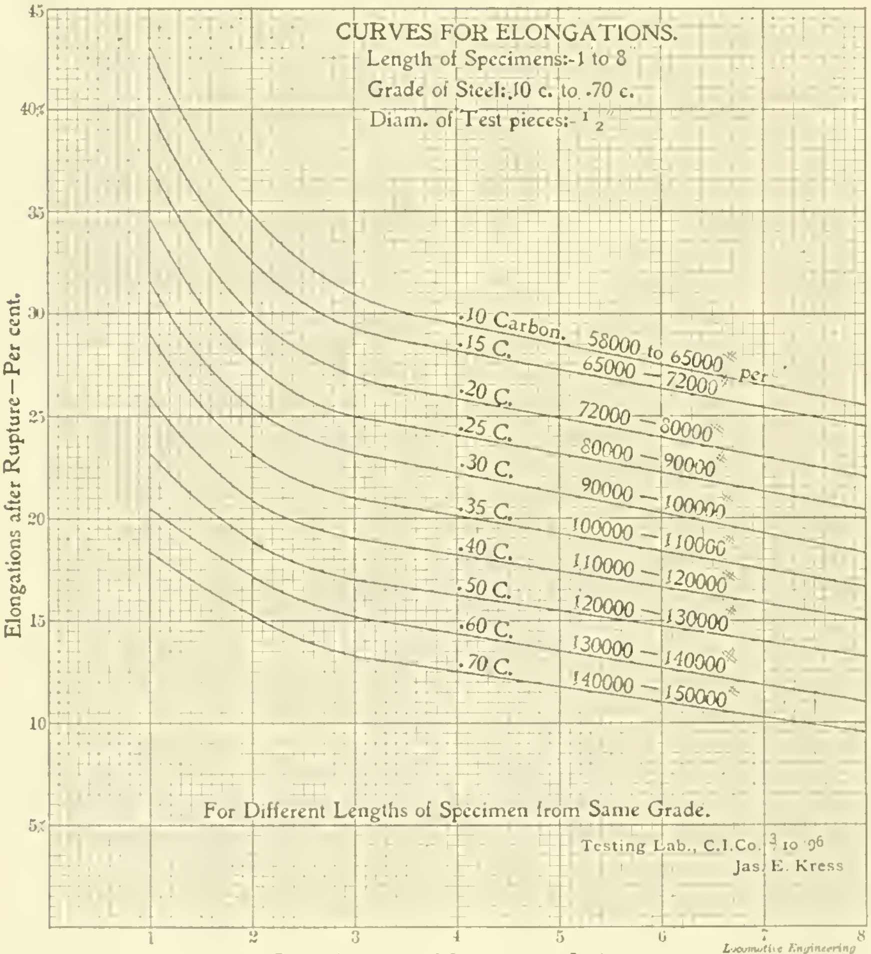
He said: "The selection should be made from the shop force and from the class that are active, energetic, conservative and progressive, with moral character predominating, giving preference to the oldest man if merits are equal. In qualifications, knowledge of figures and reading and writing are essential. While he should be able to comprehend orders clearly and quickly and possess mechanical skill, executive ability, estimate the thoroughness of work and a full knowledge of what should be done as well as how it should be done, too much value cannot be placed on ability to impart knowledge to others, and it should be constantly the aim of foremen to explain clearly and directly. Many fail in this particular, especially when they attempt to perform themselves what should be done by workmen. The old saying, "As with the captain so with the soldier," is especially applicable to shop foremen, and any foreman can quite fairly be judged by the performance of the men."

The Buffalo Forge Company have recently built some of the largest fans in use in this country. The plant includes three steel fans 170 inches tall, having inlets 79 inches in diameter and outlets 63.5 x 70 inches wide. The wheels are 120 inches in diameter and 66.5 inches wide at the periphery. Each of the three fans is driven by a 12 x 14 engine, and will deliver at the outlet 150,000 cubic feet of air, one ounce pressure. Each fan is supplied with an immense heater, for properly heating the air which is to be used for drying glue. When it is considered that the combined capacity of these fans is 450,000 cubic feet of air per minute, it will be seen that the glue-dryer is probably a full-grown one.

Graphics in Physical Tests.

The chart we illustrate herewith shows a most convenient method of comparing the percentage of elongation of test pieces of same grade of steel, from one to eight inches in length, having different percentages of carbon and subjected to varying stresses per square inch of section.

The horizontal figures at the bottom represent the length of the test specimen in inches. The curves are plotted for given stresses and percentages of carbon, which are shown to cover cases from .10 of one per cent. to .70 of one per cent., and have stresses ranging from 58,000 to 65,000 pounds per square inch for the upper, and 140,000 to 150,000 pounds per square inch for the bottom curve. The elongations are shown in the vertical column at the left.



To read the chart, the perpendicular lines cutting the inches in length of the test piece are traced to their intersection with the curves, as, for example, from 4 to the .70 carbon curve, and from there following the horizontal line at this intersection out to the left, and thus reach the percentage of elongation, which is found to be 12.5 per cent. at rupture, for a test piece having .70 of carbon and length of 4 inches. For any other length the readings are, of course, taken similarly.

Notes from the Wilmington Shops.

Master Mechanic Turner, of the Philadelphia, Wilmington & Baltimore Railroad shops at Wilmington, has a device on his wheel press, designed by himself and used for raising and lowering the machine with reference to the floor level, in order to bring ram of the machine in line with the center of an axle on any diameter of wheel, from the largest driver to the smallest truck wheel, or a movement of about 30 inches.

The device, entirely home-made, consists of a clutch arrangement placed on the press near the pulleys driving the plungers, the clutch actuating bevel gears which transmit motion to a pair of screws by which the machine is raised or lowered at will. It is a most ingenious device and a convenient way to avoid blocking up, giving the machine the scope of both a large and small press.

Mr. Turner's arrangement of water service pipes is a good one. All pipes for feed-water purposes in the plant are above-ground, where their condition can be seen at all times. This is an admirable plan when a plant is located at tide level.

At these shops is to be seen what is believed to be the original air hoist, designed and built by Mr. H. D. Gordon, who was then master mechanic at this point, in 1884. The hoist is still doing its regular work out in the yard, loading and unloading heavy material from flat cars. This progenitor of one of the most useful of labor-savers does not suffer by comparison with the modern tools of its kind, because it was built right by its designer, who had full knowledge of what the needs were that called it into life. This is history, and the facts will be of interest to somebody one of these days.

Stresses on Bridges.

In a report made by a committee to the Association of Railway Superintendents of Bridges and Buildings the statement is made that Professor Robinson found that the increase of strain due to vibrations caused by unbalanced locomotive drivers is 28 per cent. of the maximum strain caused by the passing train when statically considered. He observed also that the increased strains due to vibrations caused by the body of the train were 50 per cent. greater than the corresponding part of the train statically considered. Moreover, since he found certain cases in which the dynamic strains produced by the train load itself were greater than those caused by the engine, he was of the opinion that in designing bridges 50 per cent. should be allowed for impacts, instead of the 28 per cent. which he found in his diagram. He also found that the cumulative vibrations, depending upon certain relations between the load and bridge, were particularly prejudicial. Among these are the relation between the circumference of the driver and the panel length, and the relation between the wheel spacing and the panel length.

In actual practice it is the custom of different engineers to make variable allowance for the effects of impact. For example, some roads will assume that bridges under 100 feet span are subjected to impacts of varying amounts, while spans of greater length are subjected to no impact. Others assume that the strains caused by live loads are twice as great as those caused by the dead load only, regardless of the length of span. Some specifications allow a certain impact varying from 100 per cent. for very short spans to nothing for spans of 500 feet and over. Others, again, will allow for varying impacts, depending upon the ratio of the minimum stress to the maximum.

All these attempts to establish a law of impact, and the assumption of such laws as given in the various bridge specifications, while undoubtedly indicating the unsettled knowledge of the subject, are nevertheless more or less valuable, and tend toward safe construction.

A Technical Index for the year 1896 will be found with this paper.

The Burlington, Cedar Rapids & Northern Railway Locomotive.

The annexed engraving shows a remarkably handsome form of ten-wheeler recently built by the Brooks Locomotive Works for the Burlington, Cedar Rapids & Northern Railway. The engines are intended for hauling the heavy fast passenger trains over a somewhat hilly road, and they are reported to be doing the work very satisfactorily.

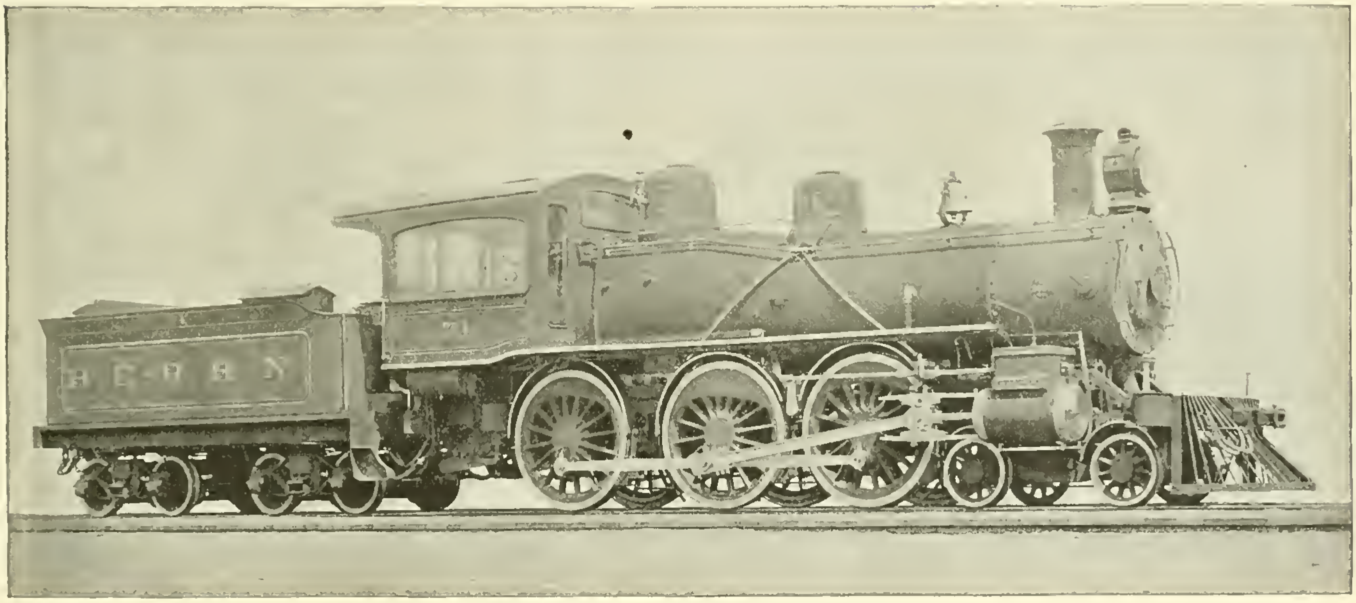
The engines have cylinders 18 x 26 inches, and driving wheels 69 inches diameter. This make an engine capable of exerting 122 pounds of tractive force per pound of cylinder pressure. As the boiler pressure is 180 pounds per square inch, the engine can be depended on to exert over 18,000 pounds tractive force in starting a train. The boiler, as will be seen from the engraving, is of the wagon-top type, and the crown is secured by crown bars, special provision being made for washing out any sediment that may settle upon the crown sheet. The boiler is 58 inches diameter at the smallest ring, and has 224 2-inch tubes, 12 feet 7⅛ inches in length. The boiler is steel throughout, the waist sheets being ½, $\frac{9}{16}$ and ⅝ inch thick, the throat sheet ⅝ inch, and the flue sheet ½ inch thick. It is covered with magnesia sectional lagging and jacketed with painted iron.

The firebox is the deep kind, with double-riveted mud ring, going between the driving and trailing wheels; is 108 inches long and 33 inches wide inside mud ring. The crown and back sheets are of ⅜-inch steel, and the side sheets are $\frac{5}{16}$ inch thick. There is a water space of 3 inches at the back and sides, and of 4-inch space in front. The staybolts are of Ewald iron, 1 inch diameter and spaced 4 inches apart, screwed and riveted over sheets at both ends. There is a brick arch supported on water tubes, and the mud ring is double-riveted. The Smith triple exhaust pipe is used.

The engine has been fitted up with all the most improved appliances for promoting economy and durability in service and convenience in handling. It has alligator cross-heads, balance valves, fixed wedges, French springs, Monitor injectors, Nathan triple cylinder lubricator, Leach sanding apparatus and chime whistle. The Westinghouse automatic brake is applied to the tender, and the American outside-equalized is applied to the drivers. The air pump is 9½ inches diameter, and the Westinghouse train signal is used.

The boiler provides 1,635 square feet of heating surface, 1,465 feet of which is in the tubes and 170 feet in the firebox.

The weight of the engine in working order is about 137,000 pounds, 108,000 pounds being on the drivers and 29,000 pounds on the truck. The wheel base is 24 feet 4 inches, 14 feet of that being rigid. The tender holds 4,000 gallons of water.



A MODERN TEN-WHEELER FOR HEAVY SERVICE.

Computing Horse-Power from the Indicator Diagram--Approximate Water Consumption.

BY F. F. HEMENWAY.

One of the important functions of the steam engine indicator is to afford ready means for determining the horse-power developed in the cylinder of a steam engine. In the formula $\frac{A \times S \times P}{33{,}000} =$ horse-power, A = area of piston in square inches, S = speed of piston in feet per minute, and P = the mean effective pressure (M. E. P.); that is, the average pressure urging the piston forward less the average pressure that, *in the cylinder*, resists its forward progress. By observation and calculation, the numerical values of A and S are of easy determination. The value of P may be determined from the diagram. For this purpose we have to consider only that part of the diagram which is included within the continuous circumscribing line 1, 2, 3, 4, 5, 6, Fig. 1. The mean distance apart of the upper and lower parts of this line, in inches, multiplied by the scale of the spring employed in taking the diagram, is the mean effective pressure. By the upper part of the continuous line is meant all that part that is traced by the indicator pencil while the piston is moving ahead in its stroke; and by the lower part, that part that is traced while it is returning. The foregoing is strictly true of any diagram taken in the ordinary working of a locomotive. The matter will not be complicated by the consideration of abnormal diagrams.

For measuring the distance apart of the two parts of the line referred to, the following is old and very good practice. Modifications of this practice will suggest themselves, and if the planimeter is used, the necessary instructions for its use accompany the instrument:

Divide the length of the diagram, Fig. 1, into ten equal (in length) sections, as represented, and bisect these sections as represented by the broken lines. Cut a strip of paper, Fig. 2, of sufficient length for the purpose. Place the end and edge *a* of this strip at *a* on the diagram, and with a well-sharpened pencil mark on the strip the distance *a—b*, the length of the first broken line. Similarly, transfer the distances *c—d*, etc., until all these distances—ten in number—have been transferred to the strip. The distance *a—t* is the combined height of the ten subdivisions of the diagram. Say this is 10.25 inches (10¼ inches): Then 10.25 ÷ 10 = 1.025, the average height. This multiplied by the scale of the spring, which assume to be 1″ = 60 pounds, gives 1.025 × 60 = 61.5, which in pounds is the M. E. P. to be substituted for P in the formula $\frac{A \times S \times P}{33,000}$ = horse-power.

It would be fortunate if, knowing the horse-power developed, we could read from the diagram the quantity of water that must be evaporated in the boiler to produce this power. This we cannot do, for we cannot tell how much water is exhausted *as water*, and not as steam. The determination, however, of the *steam* exhausted is very important, as affording means of comparing the performance of one engine with that of another, or with its own performance under different conditions.

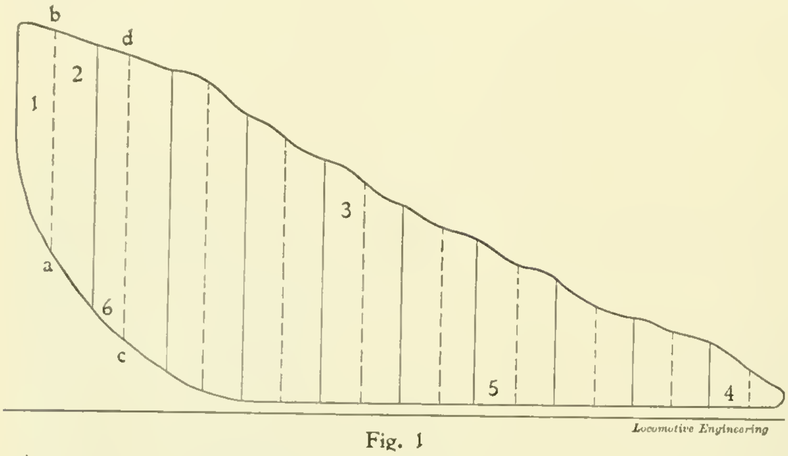


Fig. 1

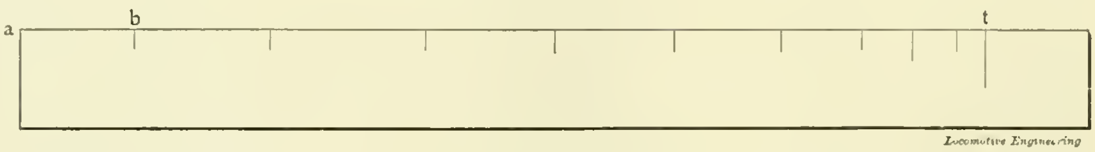


Fig. 2

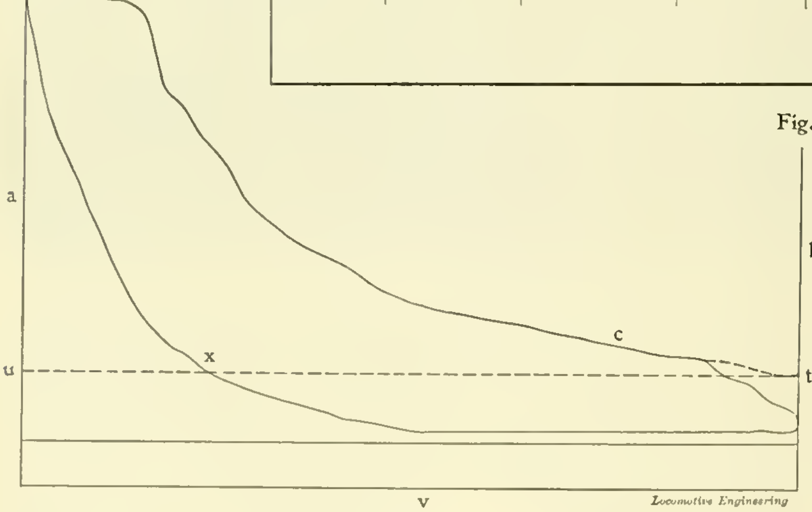


Fig. 3

It is not necessary for this purpose that we go into highly refined calculations; in fact, however far we may go in this, the only thing we are quite sure of is that the result is not absolutely correct. For present purposes the following plan, which is in the main the one employed by the Buckeye Engine Company,* is excellent. In the table I have omitted fractions, selecting the nearest whole number:

Draw two vertical lines a, b, Fig. 3, exactly defining the length of the diagram. Extend the expansion curves, by the indication of the eye, as if the exhaust had not opened. From the point t, where the extension of this curve meets line b, draw the line t—u parallel to line v (the line of perfect vacuum). Measure the distance, in pounds, of point t to line v. This is the terminal pressure (T. P.); it is, say, 36 pounds. Compute the mean effective pressure (as in Fig. 1); say it is 50 pounds. In the table of water consumption, against 36 and under W, find 1185. Divide this by the mean effective pressure: $1185 \div 50 = 23.7$. This, in pounds, would be the *steam* released per horse-power per hour were it not for the fact that some of it is saved by early exhaust closure. To account for this, measure the distances t—a and t—x. The former is 4 inches and the latter 3.1 inches. Multiply 23.7 by 3.1 and divide the product by 4 : $\frac{23.7 \times 3.1}{4} = 18.4$, in pounds, the steam exhausted per horse-power per hour. To this add not less than 20 per cent. for water of condensation present at exhaust: $18.4 + (18.4 \times .20) = 22$ pounds of steam per horse-power per hour, 3.7 pounds of which was condensed after entering the cylinder.

In the instance of compound locomotives, let the cylinders be, for example, 18 inches and 29 inches diameter, their respective areas being 254.5 inches and 660.5 inches, and the mean effective pressures 80 pounds and 30 pounds. First reduce the pressure acting against one piston to an equivalent pressure acting against the other: $660.5 \div 254.5 = 2.6$. Each pound pressure acting against the larger piston is the equivalent of 2.6 pounds acting against the smaller piston. Then, $30 \times 2.6 = 78$, the mean effective pressure in the low-pressure cylinder reduced to terms of the high-pressure cylinder. In other words, the work done in both cylinders is the same as if it were all done in the high-pressure cylinder under a mean effective pressure of $80 + 78 = 158$ pounds, which pressure is to be used in the calculation instead of the actual pressure, 80 pounds. Otherwise the calculation is the same as in the instance of Fig. 3.

Or the steam consumption can be computed from the low-pressure diagram, in which case the equivalent pressure to be added to that of that cylinder is that of the high-pressure cylinder divided by 2.6: $80 \div 2.6 = 30.8$ pounds, making the mean effective pressure to be considered as acting against the low-pressure piston $30 + 30.8 = 60.8$ pounds.

The steam consumption, when computed from each diagram, will be found to differ somewhat, one from the other, owing to natural causes which need not be here discussed. It is customary to take the mean of the two results as the nearest approximation.

WATER CONSUMPTION.

t. p.	*W.*	*t. p.*	*W.*	*t. p.*	*W.*
10	340	48	1567	86	2758
11	373	49	1599	87	2789
12	405	50	1630	88	2820
13	438	51	1662	89	2851
14	471	52	1604	90	2882
15	504	53	1725	91	2913
16	536	54	1757	92	2944
17	569	55	1789	93	2974
18	602	56	1820	94	3005
19	634	57	1851	95	3036
20	667	58	1883	96	3067
21	700	59	1914	97	3098
22	732	60	1946	98	3128
23	765	61	1977	99	3159
24	797	62	2009	100	3190
25	830	63	2040	101	3221
26	863	64	2071	102	3252
27	895	65	2103	103	3282
28	927	66	2134	104	3313
29	960	67	2165	105	3344
30	992	68	2197	106	3374
31	1024	69	2228	107	3405
32	1057	70	2259	108	3435
33	1089	71	2290	109	3467
34	1121	72	2322	110	3497
35	1153	73	2353	111	3528
36	1185	74	2384	112	3559
37	1217	75	2416	113	3589
38	1249	76	2447	114	3620
39	1281	77	2478	115	1651
40	1313	78	2509	116	1681
41	1345	79	2540	117	1712
42	1377	80	2571	118	3742
43	1409	81	2603	119	3773
44	1440	82	2634	120	3804
45	1472	83	2665	121	3834
46	1504	84	2696	122	3865
47	1535	85	2727	123	3895

* For anything in this that may have been abridged or deducted from that company's publication, I have its courteous permission.

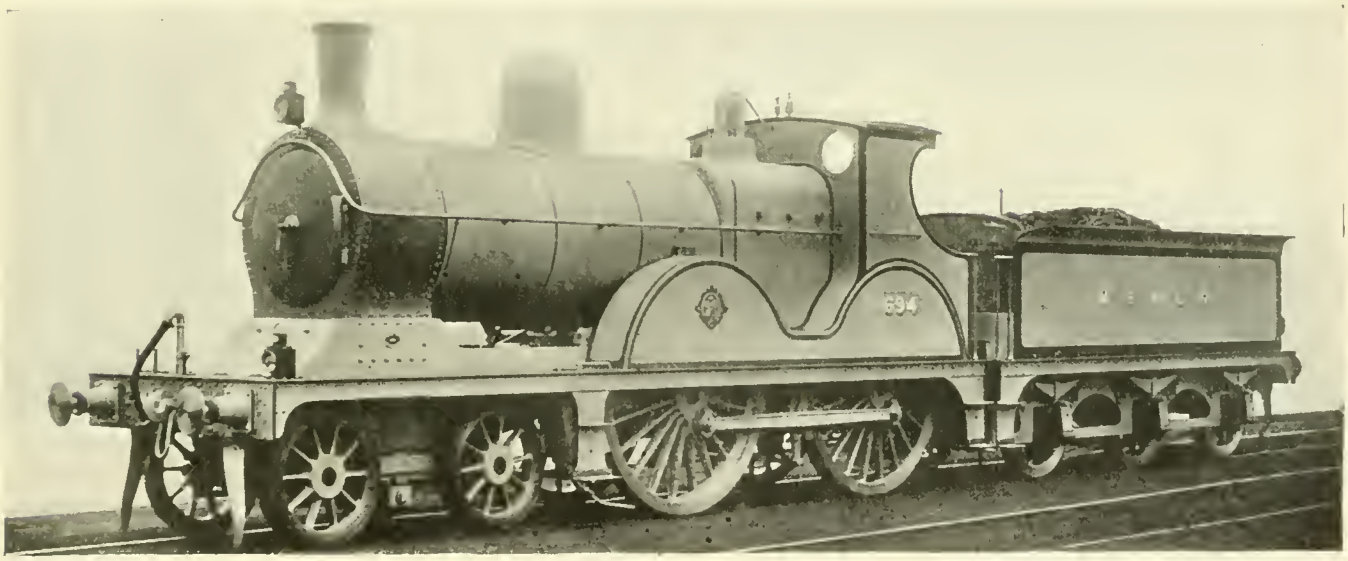
The Manchester, Sheffield & Lancashire Railway Locomotive.

On this page we illustrate a remarkably well-designed form of English locomotive designed by Mr. Harry Pollitt, locomotive superintendent of the Manchester, Sheffield & Lancashire Railway, for pulling fast heavy trains over a fairly level road. Like most of modern British locomotives, this one has a remarkably smooth appearance outside, nearly all the working parts being covered up.

The engine has inside cylinders 19 x 26 inches; piston valves placed under the cylinders. The driving wheels, which have cast steel centers, are 7 feet 6 inches in diameter, and the truck wheels are 42 inches in diameter. Steel axles are employed throughout, the driving axles having journals 8 x 9 inches, and the truck axles 5½ x 9-inch journals. The frames are all steel plate, 1 1-16 inch thick. The driving wheels are 9 feet apart, and the truck wheels 5 feet 9 inches apart. The total wheel base is 22 feet 2 inches.

The boiler is steel throughout, is 51 inches diameter at the forward ring, and is 11 feet 1½ inches long between tube plates. The height of the center of the boiler from the rail is 7 feet 11 inches. The barrel of the boiler is made of plates ½ inch thick, the smokebox tube plate being 1 inch thick. There are 231 copper tubes, 1¾ inches outside diameter and 11 feet 4½ inches long. The firebox is of copper, 5 feet 8⅝ inches length at the bottom, inside width 3 feet 6 inches, and mean depth 5 feet 5 inches. The back tube sheet is 1 inch thick, and the crown and side sheets are ½ inch thick. The heating surface of the tubes is 1,209 square feet, and the firebox 109 square feet, giving a total of 1,318 square feet. The grate area is 20 square feet; the diameter of the exhaust nozzle is 5⅜ inches.

Mr. Pollitt mentions that they use very good coal and burn 24 pounds per mile. This engine is of a capacity equal to that of the most modern passenger locomotives in America, and pulls trains that are equal in weight and speed to many of those handled by our first-class locomotives. It would be very interesting to find out how an engine with 1,300 feet of heating surface is able to make steam with a nozzle 5⅜ inches diameter, and how she can haul a fast train on a coal consumption of 24 pounds to every train-mile. As far as we can learn, there are very few locomotives on this side of the Atlantic which use less than double 24 pounds per mile when working fast express trains.



THE LATEST ENGLISH EIGHT-WHEELER.

Ratio of Grate to Flue Area.

In connection with the paper read by Professor Goss at the New York Railroad Club, on the effects of high rates of combustion upon the efficiency of a locomotive boiler, we have been looking up notes of the experience of early investigators in this line of experiment. A few years ago a very interesting report was submitted by Mr. J. Davis Barnett to the American Railway Master Mechanics' Association, on the best proportion of grate and flue area. In that report he submitted a great deal of valuable information received from members of the association, all of which tended to show that below a certain point of combustion per foot of area it was not economical to increase the grate area. In the deductions of Mr. D. K. Clark, published in 1852, he said that the evaporative work of a locomotive decreased directly as the grate area increased; that it increased directly as the square of the heating surface with the same grate area; that the necessary heating surface increased directly as the square of the performance—that is to say, for example, for four times the water evaporated with the same efficiency, only twice the heating surface is required. The necessary heating surface increases directly as the square root of the grate with the same efficiency—that is to say, for instance, if a grate be enlarged to four times its first area, twice the heating surface would be required for the same evaporative performance with the same efficiency of fuel. He, in fact, stated that there can never be too much heating surface, but there may be too little, and that, on the contrary, there may be too much grate area, but cannot be too little so long as the required rate of combustion per square foot does not exceed the limit imposed by physical conditions.

Mr. J. Longridge made very exhaustive experiments and calculations to ascertain the proper ratios between grate area and heating surface, and his investigations brought him to the following conclusions:

1st. That no fixed rule can be established as to the best relative proportions for fire grate, firebox and tube surface.

2d. That length of tube has nothing to do with an economic effect.

3d. That the diameter of the tube is also a matter of indifference.

4th. That the economy of fuel does not depend upon the rate of firing.

5th. That when the quantity of fuel burned is moderate, say 50 or 60 pounds per square foot of grate per hour, the combustion is nearly perfect. On the other hand, with hard firing a considerable loss results from carbon-monoxide passing away unconsumed.

6th. That a large increase of heating surface in proportion to coal burned only slightly increases the economic effect. In fact, within the limits of practice in locomotive engines, the economic effect is in proportion to about the fourth root of the heating surface.

In speaking of his report, Mr. Barnett said: "We understood our duty to be to see if we could find out some arithmetical proportion between grate surface and full heating area that was best for a given class of engines. The few replies received, and the tendency of conversation with members of this association, all go to show that such a proportion does not exist." He expressed the opinion that when the smokebox vacuum is low, when there is very little draft, the outer end of long flues has very little evaporative efficiency; but if you go up to 4 or 5 inches of vacuum, then the efficiency of the forward or smokebox end of the flue is increased from 200 to 300 per cent.

In answers to the circulars sent out by the committee, Mr. Henry Schlacks, then of the Illinois Central, reported lengthening grates from 60 to 66 inches, keeping every other point unchanged, but could not note any appreciable difference in the efficiency of the engines. He expressed the opinion that it was possible to give the boiler too much grate surface.

Mr. Wm. Garstang increased the length of grate from 72 to 78 inches. The steaming of the engines was improved, but the consumption of fuel was about the same. There was about 9 per cent. more flues in the boilers that had the short grates. On the general question of grate surface, he believed it possible to get too large a surface for good coal.

Mr. O. Stewart reduced the grates of some consolidation engines from 120 to 80 inches by the use of dead plates. The experiment was so satisfactory that the whole class were reduced to these dimensions, with a reduction in the consumption of fuel.

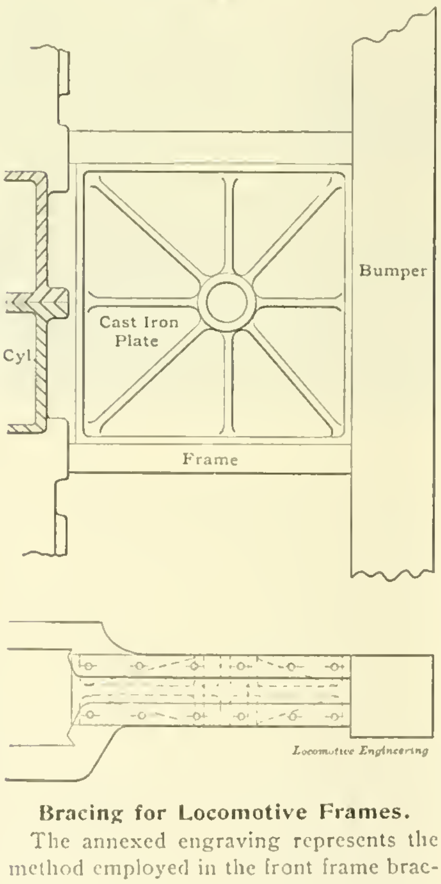
The report mentions that there is a practice in the exhibition contests with portable engines, of reducing grate area as a favorite means of jockeying to reduce the consumption of fuel.

Corn as a Motive Power.

There is a certain class of philosophers of a speculative, prospective turn of mind, who are always making themselves and other people uncomfortable by talking about events which will in no way affect any living person. These people are constantly talking about what will happen to the earth when the energy of the sun diminishes, and what will happen on the earth when the supply of coal is all used up. The exhausting of coal mines is a favorite theme of discussion by certain writers in different parts of the world, and their remarks sometimes set people shivering, although there is plenty of coal in sight to last thousands of years to come.

In regard to the exhausting of the coal fields, Professor Reynolds, in one of his lectures, made the following remarks:

"It must not be forgotten that, after all, the most important source of energy is not coal, but corn and vegetable matter. The power developed in the labor of animals exceeds the power derived from all other sources, including coal, in the ratio of 20 or 30 to 1; so that, after all, if we could find the means of employing such power for the purposes for which coal is specially employed, such as driving our ships and working our locomotives, an increase of 10 per cent. in the agricultural yield of the earth would supply the place of all the coal burned in engines. The energy which may be derived from the oxidization of corn has as yet only been artificially developed in the form of heating, and this may be the only possible way; but physiology has not yet advanced to the point of explaining the physical process of the development of energy consequent on the oxidization of the blood, and it is, at all events, an open question whether the energy of corn may not be really a form of directed energy, in which case corn would yield six or eight times as much energy as coal does at present, consumed in our engines. As consumed in animals, it yields a larger proportion of energy—two or three times as much, and maybe more; whereas by burning it in steam engines we cannot get half as much. Should we find the artificial means of developing anything like the full directable power of corn, a problem which has not yet been attempted, coal would no longer be necessary for power."



Bracing for Locomotive Frames.

The annexed engraving represents the method employed in the front frame bracing of cylinders of consolidation locomotives for the Baltimore & Ohio, built by the Pittsburgh Locomotive Works and designed by Mr. Harvey Middleton, superintendent of motive power. The object of the bracing is to counteract the twisting motion in the front end, which so often leads to the loosening and breaking of frames. It is a remarkably simple contrivance, and looks as if it would prove entirely efficient for the purpose.

Popularity of the Master Mechanics' Decimal Gage.

Nearly all the leading railway companies of the country have adopted the decimal gage for sheet metal, wire and tubes, made standard by the American Railway Master Mechanics' Association, and there is good reason for believing that their action will be the means of making this decimal gage the standard for all kinds of industries in this country.

At a meeting of the Association of American Steel Manufacturers held recently, action was taken which would indicate that the association named favors the Master Mechanics' standard. A committee had been appointed to investigate the desirability of urging all steel manufacturers to adopt the United States sheet-metal gage, but the committee reported against such action. They said that the only argument in favor of the United States standard gage was that it had been adopted by a great many manufacturers of sheet iron. The report concludes:

"1. The American Railway Master Mechanics' decimal gage will soon be the only gage used by the railroads and railroad supply houses in ordering sheet metal and wire.

"2. The decimal system of gaging greatly simplifies the measuring of all gaged materials. Sheets of all thicknesses, whether iron, copper, brass, zinc, tin, glass, paper, etc., as well as all kinds of wire, rods, rivets, nails, screws, etc., can be measured by ordinary micrometer gages in thousandths of an inch, or, if desired, by notched gages, the notches being simply numbered by the number of thousandths of an inch that measure them.

"3. The indorsement by the association of the decimal system of gaging will materially aid its more speedy and general adoption, and thus help to end the inconvenience, delay and confusion which have prevailed in the past, owing to the use of the various 'standard' notched gages, which do not agree either among themselves or with each other as to the actual thickness of their arbitrary gage numbers."

The committee's report includes two tables—one a comparison of the Master Mechanics' decimal gage with the gage numbers of four standard gages; the other giving the values of the notches of the Master Mechanics' decimal gage in inches, millimeters and weights per square foot of both iron and steel. These will be found of value in the practical use of the new decimal gage, which, it would appear from the recent action of the railroads, will be generally adopted in the near future, even by the sheet manufacturers, who originated and are now selling their product by the United States standard gage.

In indorsing the above report, the Association of American Steel Manufacturers passed the following resolutions:

"1. *Resolved*, That we, the Association of American Steel Manufacturers, indorse the decimal system as the proper standard for measuring all materials.

"2. *Resolved*, That the secretary be requested to forward a copy of the committee's report to the secretaries of the American Institute of Mining Engineers, the American Society of Mechanical Engineers, the American Society of Civil Engineers and the American Master Mechanics' Association, as an evidence of their appreciation of the work accomplished by these societies toward the establishment of the decimal system of gaging, and as a proof of the hearty cooperation of this association in this movement."

Japanese Locomotive.

The double-ended side tank engine shown in the annexed engraving is one of an order received by the Brooks Locomotive Works from the American Trading Company of Japan.

It is a 3 feet 6 inches narrow gage engine, and has cylinders 15 x 22 and driving wheels 48 inches diameter. The boiler is large for an engine of that size, being 54 inches in diameter, having fire box 78 x 29 inches, giving a total heating surface of 978 square feet, 83 square feet of which is in the firebox. The boiler and firebox are of steel, and the tubes of drawn brass. The engine is equipped with all the conveniences usually put upon first-class American engines. The cab is roomy and the appliances very conveniently arranged, a thing that is likely to help the reputation of the engines in the far-off country where they are going to work.

Guessing Speed.

Guessing at the speed of a railroad train seldom comes within 33 per cent. of the truth, unless the guessers have watched and made notes on speed until they become as expert as a locomotive engineer. While riding in a railway train in France lately, we heard several gentlemen guessing on the speed, and they waxed very hot over the differences of opinion. It was a small car, very loose in the boxes, and the track was far from being perfect. The way the car jumped and rolled justified novices in saying that the speed was seventy miles an hour. The passengers discussing the subject varied in their estimate from 75 to 100 kilometers—that is from 44 to 62 miles an hour. They did not seem to know enough to watch the kilometer posts. The writer did that and found the speed 56 kilometers, or about 35 miles an hour.

It is not on speed of trains alone that ignorance prevails where accurate knowledge might be expected. Most machinists understand how to set the machines they are handling for the kind of metal to be cut, but very few men know anything about the speed in feet per minute.

We heard of a dispute that arose lately about the speed of a large planer. The machinist who was in charge of the tool, on being asked its speed, said 25 feet while cutting and 55 returning. Several other machinists guessed at the speed, and the lowest was 22 and 50 feet per minute. It was sold as an unusually powerful tool that could do work at maximum speed. By actual measurement the speed was found to be 16 and 34 feet per minute.

A man who knows nothing and cares nothing about the speed of the machine he handles may do as good work as one who is familiar with every detail connected with the appliance, but he is never likely to acquire the knowledge that pushes men to the front as leaders. The eye of an efficient foreman tells him when a tool is not running at the proper speed for the work on hand. Those who wish to acquire this skill ought to begin early making close observation of all shop operations. Industry of this character pays in the end.

DOUBLE-ENDER FOR JAPAN.

Engine No. 600, Lake Shore & Michigan Southern Railway, running on the Buffalo division, is a Brooks 10-wheeler. She handles their heaviest passenger trains and heavy through freight service. On August 17, 1894, she was equipped with a set of United States metallic packing for her air pump. On October 1, 1896, she had made a mileage of 123,886 miles, and the air-pump packing had received no repairs and had worked perfectly during that entire mileage. The packing is still in service. Think of the time, trouble and waste of oil packing and patience this saved the engineer, to say nothing of a scored and scratched piston rod caused by packing tools and petrified asbestos, old rubber hose and candlewick. An air pump without metallic packing is not complete.

The Denver & Rio Grande have recently put a variety of new tools into their shops at Burnham, Denver. Among them are a 54-inch 4-headed planer, a heavy punch and shears, and a fine car-wheel grinder—all supplied by Manning, Maxwell & Moore, New York.

CAR DEPARTMENT.

Conducted by ORVILLE H. REYNOLDS, M. E.

Baltimore & Ohio 60,000-Pound Box Car.

In July of the present year the Baltimore & Ohio Railroad had some new 60,000-pound cars built, which we now illustrate by the courtesy of General Superintendent of Motive Power Middleton and Superintendent of Car Department Grieves.

The half-tone engraving shows the car ready to commence its career of usefulness as a carrier, and gives a good idea of its finish and shapely points, which are seen to be in accord with the best present practice. Prominent among these will be noted the Schoen steel bolsters on body and trucks, conveying the impression of strength, and also the businesslike appearance of the truss rods, with a depth of truss that tells plainly of a correct knowledge of the function of a truss rod.

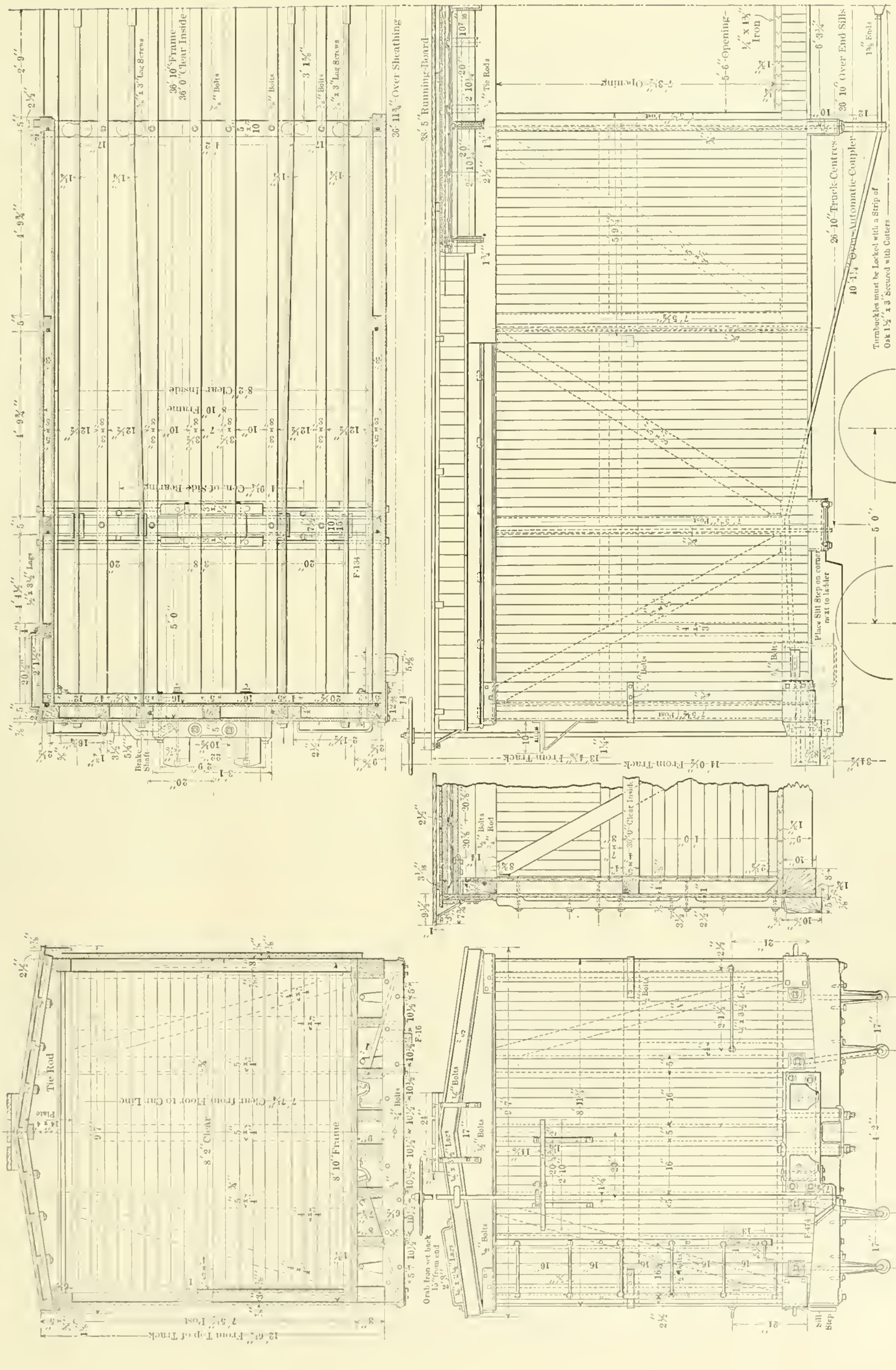
Our line engravings of the working drawings of this car and truck show wooden bolsters; but aside from the adaptation of the steel bolsters, they represent the cars as built. There are eight longitudinal sills, the outside being 5 x 8 inches, the intermediates 3 x 8 inches, and the center sills 3½ x 9 inches. It will at once be noted that this arrangement of light sills in the center is in direct opposition to old-time practice, which looked upon a heavy center sill as an absolute necessity, to safely receive and absorb buffing shocks. The long buffer blocks show why heavy center sills are not needed in this car, they extending over the ends of four sills, and the idea is that they will absorb a blow with less harmful results to the car than will two heavier sills of the regulation size. The end sills are 8 x 10 inches at the center, and 8 x 8 inches at the ends.

An exceptionally strong end construction is made with the 5-inch corner posts, and the 4 x 5-inch end posts, there being one of the latter between the intermediate posts, a practice that will commend itself to all carmen who have ever been called upon to provide against end bulging. The braces are made on the same liberal plan; those at the end being 4 x 4 inches, and those at the sides 3 x 5 inches. The side posts are also 3 x 5 inches. The girths, side and end are 4 x 5 inches, and in addition thereto at the sides is an auxiliary piece 3 x 7 inches, resting on the girth and cut in between posts and braces from the corner to the door; the top edge of this piece is beveled to 4 inches on the inside face.

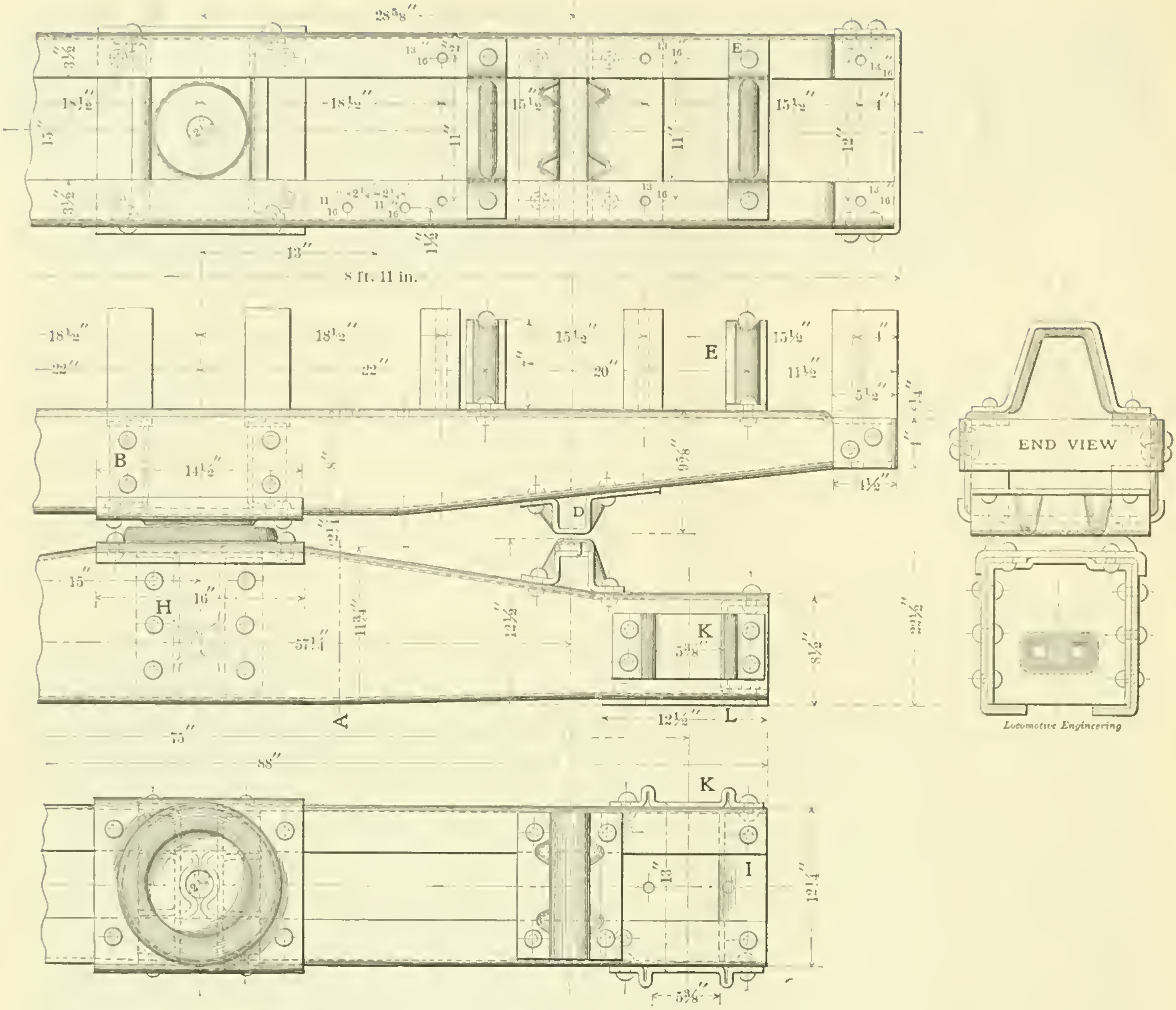
NEW FREIGHT CAR FOR THE BALTIMORE & OHIO.

End plates are 4 x 14 inches at the center, and 4 x 6 inches at the ends, with a special reinforcement against bulging, in the shape of a strap bolt with the flat side turned up and secured to the center rib, the bolt passing through the plate. A ¾-inch rod binds the framing laterally at the end plates, and there is a ⅝-inch rod at each carlin for the same purpose. Side plates are 3 x 6½ inches, and bound to the sills at each side and corner post by ¾-inch rods.

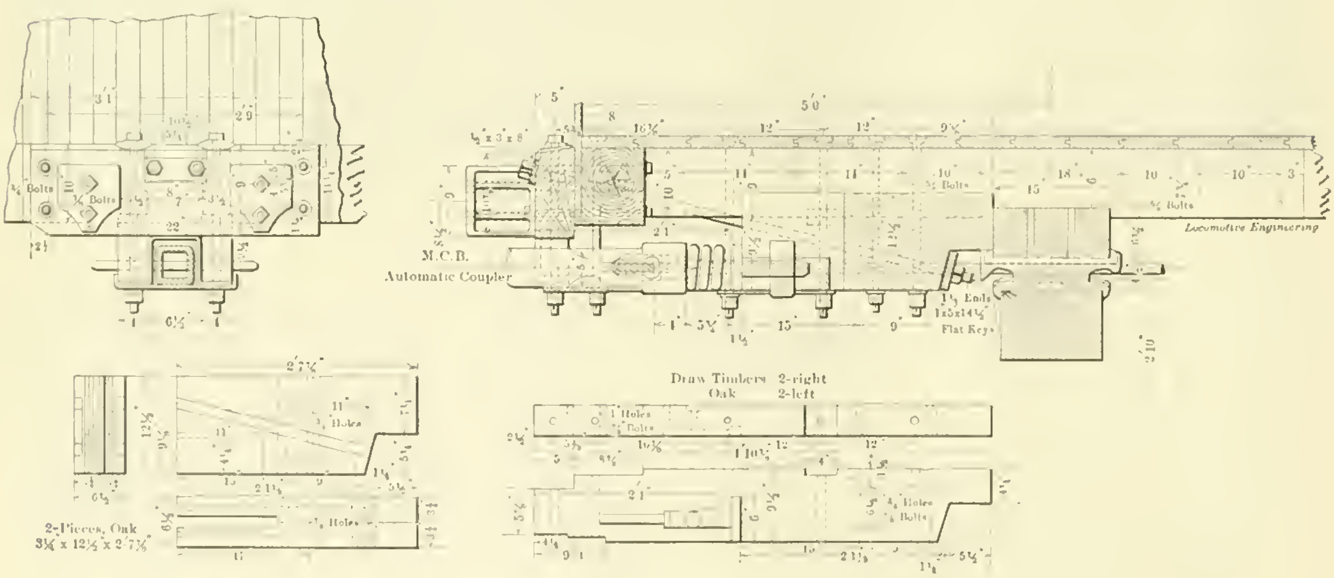
The truss-rod posts at the 5 x 10-inch tie timbers are cast with a ring at their



DETAILS OF BODY CONSTRUCTION—BALTIMORE & OHIO 60,000-POUND CAR.



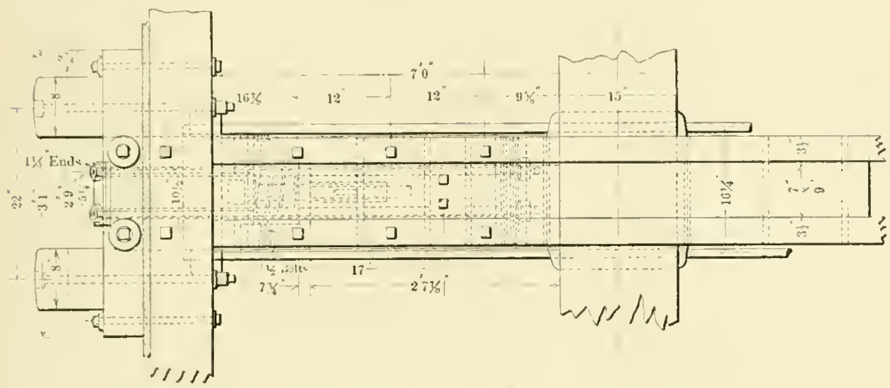
DETAILS OF BOLSTERS—BALTIMORE & OHIO CAR.



DETAILS OF DRAFT GEAR—BALTIMORE & OHIO CAR.

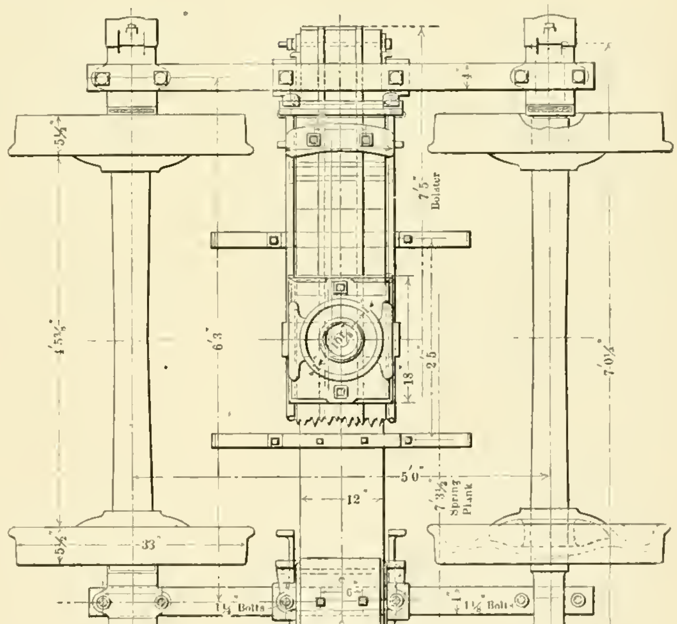
lower end to receive the truss rods, thus insuring permanency in their places. This is quite different from the ordinary method of a deep seat and cotter to accomplish the same thing.

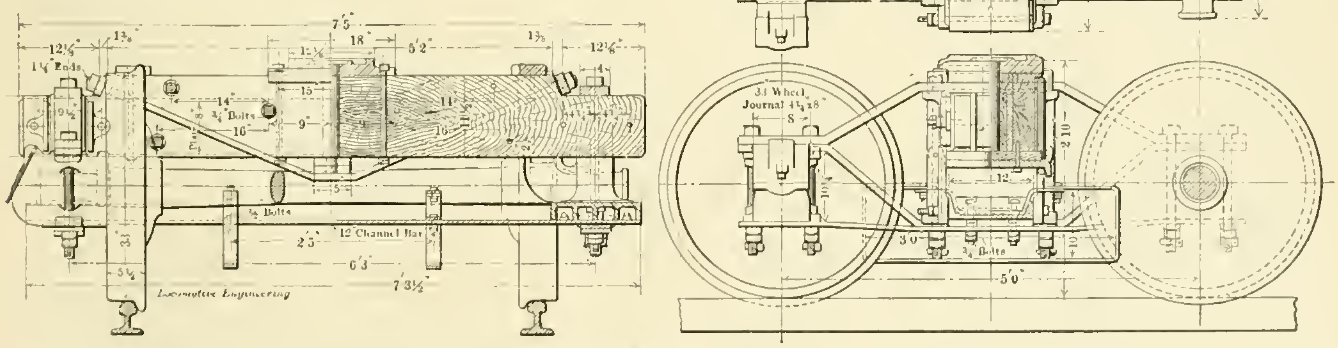
In the way of a thoroughly substantial arrangement of draft rigging, the engraving shows the American continuous drawbar applied in a way that practically defies destruction, or as near an approach to that much-sought condition as can be found in a union of iron and wood. Contributing to this end are seen two oak blocks filling the space between the draft timbers, to which they are bolted with ¾-inch bolts. The rear end of the blocks abut against the body bolster, and are grooved for two 1-inch truss rods with 1¼-inch ends, which pass upward through the end sill and buffer block, with heavy wrought-iron bar washers under heads and nuts. This trussing principle is patented.



PLAN OF DRAFT GEAR—BALTIMORE & OHIO CAR.

The bolsters for body and truck are shown in detail, and in their proper relation, one to the other. There is an appearance of rigidity in these bolsters that is borne out by their performance in practice, and their introduction in the heavier equipment shows that the days of weak bolsters are numbered.





DETAILS OF TRUCKS—BALTIMORE & OHIO CAR.

The arch-bar truck is of the rigid type, and is put up to stay, making with the steel bolster an all-metal truck that shows ability to stand up under the severest service. There is one admirable feature connected with this truck that should be found on every freight car—we refer to the brake-beam safety straps. They look right, and convey an impression of safety, even if they are never called upon to perform in an emergency.

A Timely Move.

The Ohio Falls Car Manufacturing Company has made a move in the direction of securing uniformity in constructive practice for 60,000-pound capacity freight cars, by inviting, by circular, the co-operation of all interested, but more especially the car manufacturers, master car-builders and the railroad clubs.

This is unquestionably one of the most progressive events in car history, looking as it does to the discouragement of monstrous creations by tyros, and to the establishment of lines for future guidance, by those ripe in experience gained by a life study of the requirements of freight rolling stock. Out of this will come uniformity in design—a consummation we have hoped for and written about many times, as a reference to our files will bear witness.

The effect of these efforts for uniformity in the construction of freight cars will be to head off all those who are too ready to continue the hopeless entanglement of the present diversity in dimensions and details of cars having the same nominal capacity, and it will be felt in the equipment of the future. We predict that a hearty response will be given to the circular referred to, which is given in full below:

"Dear Sirs—Would you care to unite with us in establishing a standard 60,000-pound box car, having as a basis all the Master Car Builders' Standards and Recommended Practices? If so, please send us your preferences as to following named parts:

Length, width and height in the clear, inside.
Door opening.
Center to center of cross-tie timbers.
Section of each sill, end sill and plates.
Height of lining.
Diameter of body and ends of truss rods.
Wheel spread.

Section and set of arch and tie bars.
Diameter of column and oil-box bolts.

"We are addressing this inquiry to several car builders, and will tabulate the replies and communicate the result by letter or through some railroad paper.

"It is believed that this movement will result in creating a uniformity among the contract car works, primarily, of the parts mentioned, and later of many of the less essential parts, as well as of fruit, coal, stock and flat cars. Modernness will be maintained by incorporating all the standards as successively adopted or recommended by the Master Car Builders' Association, or by the united judgment of the manufacturers. The labor is slight, and we trust you will deem it expedient to act upon this suggestion."

Roller-Bearing Axle.

The car axle with roller bearings is again under trial—this time it is in Chicago. This principle has been given exhaustive trials times enough to demonstrate what there is in it for street-car lines, and from our knowledge of its performance in that work we are led to the conclusion that it will do equally as well in railroad service when properly adapted to the conditions.

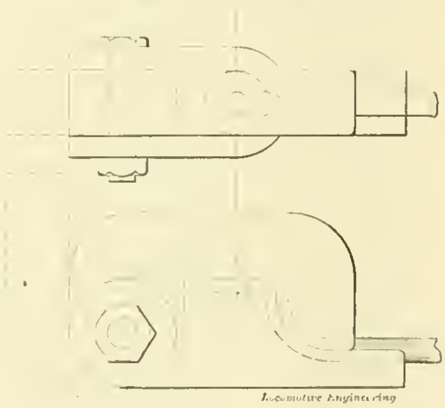
Among the advantages are greatly reduced resistance, less cost for lubrication, and longer life to the wearing parts. The principal drawback to its adoption, however, is the abnormal size of the box or case to hold the rollers; the dimensions of which for a 4¼-inch axle making it practically impossible to use on the present freight-car truck.

Compressed Air in Car Shops.

In a paper read at the Western Railway Club, on "Some of the Uses and Advantages of Compressed Air," by Mr. J. H. McConnell, superintendent of motive power of the Union Pacific, he says:

"In car-shop work, air plays an important part. Jacks for passenger and freight car work are indispensable, and any shop can have them if they can buy the castings. They are easily and cheaply made, and can be built in any shop having a boring mill or a 30-inch engine lathe. A small jack for raising drawheads, another for pulling down old draft timbers, do not cost much, and they save time and labor in doing the work. Sandpapering the surface of a passenger coach by an air machine makes better and is cheaper work than can be done by hand. On roads using gas in coaches, an application of a jet of air and gas through a Bunsen burner removes the paint in a very quick and clean manner, with no danger from fire. Attach a ½-inch hose to the gas pipe in the car and another hose to the air supply, connect them both to the burner, and see how cleanly and quickly you can burn off a coach. If you mix any paint, make a galvanized iron tank to hold fifty gallons—or make two if necessary—bend a piece of ½-inch gas pipe in a circle 2 inches smaller than the inside of the tank, drill about fifteen holes on the top side of the pipe, plug up one end, put an elbow on the other, screw in a piece of ½-inch pipe about 4 feet long, put on a globe valve, couple on the air, fill the tank with lead and oil or paste and oil, turn on a small quantity of air, and see how quickly it will mix it. The material becomes agitated, as if it was boiling. It is superior to any other way of mixing paint and it runs itself.

"The use of air for painting buildings and freight cars has been successfully carried on for the past three years. Applied to a machine for white-washing, it will cover a great amount of space; a twenty-stall roundhouse can be white-washed in twenty hours. I have seen a machine shop 150 x 200 feet, with a trussed roof, whitewashed, over the walls, the roof and the trusses, in ten hours. For crossings, fences and bridges it is the cheapest and quickest way; it makes a smooth surface and drives the whitewash into places which a brush will not reach."



Die for Handhold and Ladder Irons.

The steam hammer is filling a very important place in blacksmith economy, especially in shops not possessed of the smaller hammers suitable for light work. Dies are the mediums through which the heavy hammers produce results, and our line engraving shows one designed at the West Shore shops at Frankfort, New York, for handholds and ladder irons, which are turned out by its means at a remarkably low cost.

It consists of a lower die which is simply a matrix of the finished form of the boss and hole, with the die extended and curved to give the correct bend. The opposite end has two jaws to receive the upper section of the die, which fits loose enough to turn on the bolt passing through the jaws. The side view and plan show the dies closed with a finished end as taken from the hammer. The position of the upper half of the die when swung to release the job, and preparatory to working on a new piece, is shown by the dotted lines.

United States Consul-General Crittenden, at the city of Mexico, has informed the Department of State that, in order to facilitate the shipments of oranges from Mexico to the United States, and reduce the loss by decay, the Mexican Central Railroad and the Atchison, Topeka & Santa Fé Railroad have arranged to run through fast freight trains twice a week from the city of Mexico to Kansas City, Chicago and St. Louis. This train will make Kansas City in about six and a half days, a clear saving of about forty-eight hours, and will not only bring into the market the oranges from the vicinity of the city of Mexico, but also La Barca and Guadalajara, whose output and quality fully equal that of any district in Mexico.

At the November meeting of the Western Railway Club there was a discussion on the repair of cars on foreign roads which brought out a curious action of one railroad company. The company was said to have established a rule to the effect that when a car was found with two longitudinal sills and one end sill broken, the longitudinal sills should be repaired by the company, but that the expense of renewing the end sill should be charged to the owners. As the breakage of both longitudinal and end sills would be undeniable signs of unfair usage, it seems to us strange that any railroad company should try to get out of the responsibility of doing the whole of the repairs.

"The Most Economical Brake Shoe" is the title of an illustrated catalog issued by the Schoen Brake Shoe Company, of Pittsburgh. The catalog gives considerable interesting information about brake shoes, and shows up the advantage of using steel as the material. It is said that the wear on wheels is less with Schoen pressed-steel shoes than it is with cast-iron, while they are more effective for stopping the train. Another important point made is that delays on the road from broken brake shoes are removed, as the pressed-steel shoe will not break, and it wears so long for a slight decrease of thickness that even after reaching the minimum limit it can be safely run to a terminal point.

The electric power plant, at Baltimore, of the Baltimore & Ohio Railroad Company is now being used not only to furnish the power for the tunnel motors, but to run 180 street cars of the Baltimore Traction Company, to light the Camden station and yards, the Baltimore city tunnel, the Locust Point freight houses, warehouses and yards, Mt. Clare shops and the new Mt. Royal passenger station. The Baltimore & Ohio, so it is rumored, will adopt blue for their passenger-train color—the color on the Royal Blue trains having been found satisfactory.

PRACTICAL LETTERS FROM PRACTICAL MEN

Adjusting Eccentrics With Drivers on Shop Floor.

Editors:

The main driving wheels of a locomotive stand on the shop floor; the old axle has been replaced by a new one, and we have to adjust the four eccentrics and key them so they will have the angular advance according to lap and lead of valves, and we do this before we put the wheels under the engine.

The first thing to find out is whether the center of the cylinders is in line with the center of the axle, or whether it is above or below that center.

It is a straight-in-line one, and Fig. 1 shows it. The valve in steam chest *B* is now in central position, and we see *A A A A* all come in one line, and for this reason we call it a straight-in-line engine.

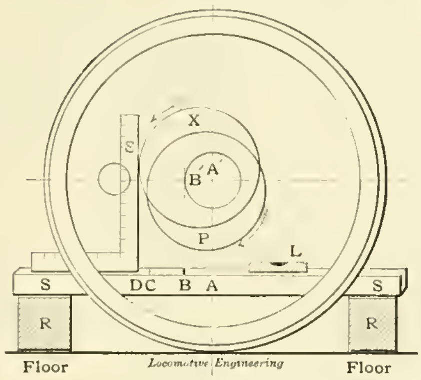


Fig. 4

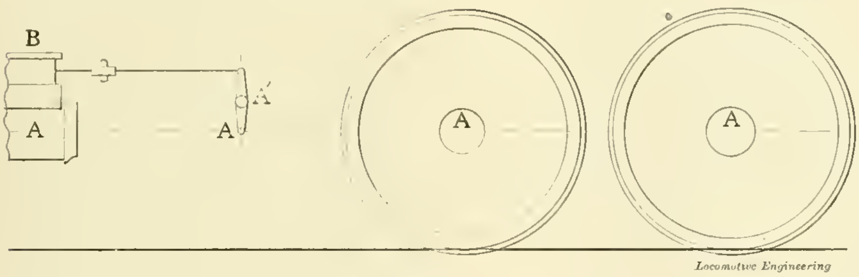


Fig. 1

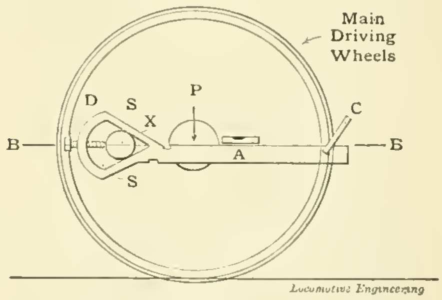


Fig. 2

We now put on the alligator plate *A*, as shown in Fig. 2. The plate is made so that the jaws *S S* are equal distance from center line *B B*. The opening is put on crank pin *X*; the 3-16 set screw *D* is slightly screwed up, and the plate *A* is then raised to the fine center mark of axle *P*, and then clamped on tire with a small wooden clamp *C*. We then turn the wheel until plate *A* is level, and in this way we will have the crank pin *X* on its exact dead center, the same as it would be when under the engine.

Now we measure valve, and we find that it has ¾-inch lap, and we are told to give 1-16-inch lead.

We are working on the left-hand side, and we now look after the left side rocker arm A^1, Fig. 1. We find that it is a straight-in-line one; but the upper arm is 10 inches from its center A^1, and the lower one is only 9½ inches from the center, a difference of ½ inch, and in this case we are now obliged to make a little calculation.

We take a board or strip of paper; draw line *A A*, Fig. 3; then draw part of a circle *B* 10 inches from center A^1; then draw part of a circle *C* 9½ inches from center A^1. Now we measure off 13-16 inch (this is ¾ lap and 1-16 lead) from *D* to D^1; then we draw a line from center D^1 through center A^1 and through circle *C*, and measure distance between centers *E X*, and find it is ¾ inch. Now, remember this ¾ inch is very important; it is the amount of angular advance we must give to the eccentrics.

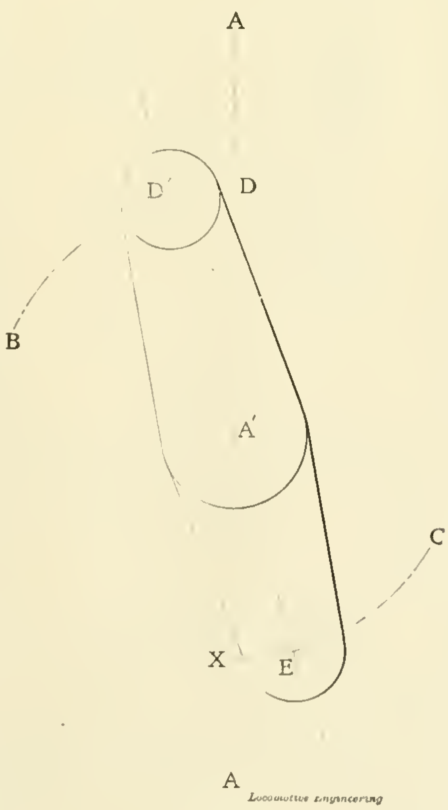


Fig. 3

We now take a wooden parallel straight-edge *S S*, Fig. 4; mark a line *A* with a sharp pencil, and call it center line of axle A^1; then we caliper axle (between or near eccentrics), and half of that we lay out from *A* to *B* and call it outside line of axle B^1; then we caliper diameter of eccentric, and half of that we lay out from *A* to *C* and call it eccentric line *C*; and then we lay out ¾ inch from *C* to *D*, and this is the advance.

We now place the straight-edge under one eccentric on a couple of wooden blocks *R R*, and level straight edge *S S* with level *L*; we then put the square *S* in line with *B* first, and shift the straight-edge so the square just touches outside of axle *B*; this will bring mark *A* in line with center of axle A^1.

We now put the square in line with *D*, and turn eccentric *X* close up to the square *S*, as shown in Fig. 4; and then fasten with set screw lightly, and we have one eccentric in proper position. We then adjust eccentric *P* in the same way, and we have both ready for marking the keyways on axle.

We next take off alligator plate *A*, Fig. 2, and place it on the other wheel, and do the same as we did before. Always see that mark *B* comes in line with outside of axle B^1, and that the straight-edge is level before the square is put on.

After we have all the keyways cut on axle, we key eccentrics, fasten up screws, put straps on, and the wheels are ready to roll under engine.

Eccentrics are the fundamental parts of the valve motion. They must be in their proper position on axle. All it needs, then, is to lengthen or shorten eccentric rods, and the valves will show equal lead on both ends when crank pin is on front or back center.

J. A. EISENAKER.

Elmira, N. Y.

Eccentric Strap Experience in Brazil.

Editors:

As a subscriber to your valuable paper, I beg to offer some remarks upon the subject of brass liners for eccentric straps in your issue of September, under the head of "Kinks from the Omaha Road."

I cannot by any means agree with the advantages claimed, "that brass and iron give better wear and longer life than iron." In 1871 the first four locomotives that arrived for the Paulista Railroad, Santo Paulo, were built by John Fowler, of Leeds, England. They had wrought-iron eccentric straps, fitted with brass liners; at the end of seven years they were all worn out, after giving a great deal of work to the fitters, letting them together. These brass liners were substituted with liners of cast iron, and the same liners exist today, and the locomotives are still in service, and no comparison between them as regards keeping them up; consequently, they have been in use about eighteen years. These are facts after more than two year's trial.

W. J. Johnson.

Rio Claro, Brazil.

Experiment to Determine Best Location for Air Gage.

Editors:

As the best location for the air gage in the cab is to be discussed at the next convention of the Air Brake Association, I would like to suggest that those members who have the facilities for experimenting, remove the copper pipes now used to connect the gage and brake valve, and substitute therefor a flexible rubber tubing, made of sufficient length to reach any spot desired in the cab.

Brackets of a convenient design could be placed in the cab so as to allow the gage to stand or hang at any angle desired; and as the flexible tubing would allow of a change of position without any inconvenience, a little experimenting would soon determine the best location for the gage on each particular class of locomotive, and the class of service the locomotive might be engaged in. Will somebody try it?

John P. Kelly,
New England R. R.

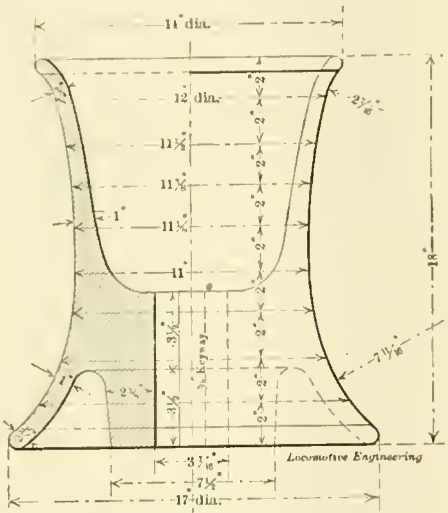
East Hartford, Conn.

The Shape of a Capstan.

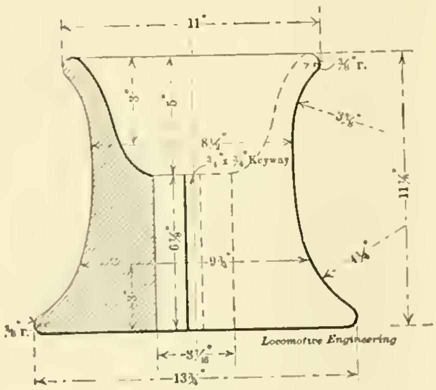
Editors:

The annexed engraving shows the old capstan on a transfer table of the Chicago car shops of the Chicago, Rock Island & Pacific Railway.

For moving cars on and off the transfer table a 6-inch hemp rope was laid around the capstan in the usual manner, and by tightening the rope sufficiently, to prevent slipping when capstan rotated, the car moved. The difficulty was that it generally took two men to keep the rope tight, and in extreme cases four men were required. In studying this capstan it will be noticed that the rope entered on a diameter larger than the diameter where the rope left, and the consequence was that the rope loosened its grip after the first turn and the slack had to be taken in by the men pulling in the rope. The capstan shown on Card 1124 was then designed to remedy this, and with satisfactory result. It will be noticed that the rope enters on the smallest diameter, and as the coils travel along, the diameter gradually increases and thereby tightens itself, and the man simply has to take care of the slack end.



NEW PATTERN



OLD CASTING

This illustrates very well the importance of studying details before they are applied to machinery, or whatever it may be.

A. G. Akerlind.

Chicago, Ill.

What Ailed the Lubricator?

Editors:

Recently I was on an engine equipped with a "Nathan three-feed oval lubricator, Class 1893." I had just filled the lubricator and started it when I noticed that the hinge of the guard over the glass to the right cylinder was broken. I shut off regulating valve *C* and safety valve *F*, tight; then commenced to loosen the packing nut preparatory to taking off the guard. After screwing the nut out three or four threads it commenced to leak slightly, and the feed glass immediately filled with oil. I screwed the nut back to place and looked at gage glass; it showed neither oil nor water, and the other two feeds had quit working. I opened the waste cock, and not over a tablespoonful of oil came out; refilled the lubricator, and it worked all right. I moved the engine ahead and back four or five car-lengths, but no oil showed at cylinder cocks.

How did the oil get out of the lubricator?

Where did it go to?

What would be the effect of a broken sight-feed glass?

F. C. Emery.

Allegheny, Pa. P. L. W.

Boiler Feeding.

Editors:

I have been very much interested by articles in your paper, in regard to who should pump the engine, and about putting both injectors on the right-hand side. I say this, from experience, that from a point of economy in coal and a smooth-running engine without back pressure, it should never be done. I have fired a 19 x 24 that was very deficient in heating surface, but could be got along by the slickest kind of running and pumping, but otherwise would lie down on the hills for steam. The same engine would run with ¼ inch larger nozzle by being pumped on the left-hand side than by pumping on the right-hand side.

Increase in nozzle means decrease in the velocity of gases through the flues, consequently decrease in coal consumption. Even with the same sized nozzle she would burn less coal by pumping on the left side. In pumping an engine on a road full of hills and sags, an engineer will have an injector cut fine, and let it feed a certain quantity for miles, but at some places it will be gaining one inch per mile, which necessitates forcing of the fire to keep up steam. Probably in going the next mile the water will lose one inch, and the engine will pop with the door held open. Then, in making a short stop or shut-off down a short hill, he will leave his injector working, which necessitates putting on the blower to keep her hot and not make black smoke. I have taken an engine with an injector one size larger on the left side, and, by judicious pumping fine and shutting off and putting on the injector at the right moment, would consume less coal than by pumping on right side with small injector, and prevent black smoke and the engine from popping without opening the firebox door, therefore getting all the benefit out of the coal that was put in the firebox.

Some engineers on runs where there

are frequent stops are compelled to make the pumping a kind of secondary duty, shutting injector off and putting it on in making their stops and starts, whenever they get time; and the harder an injector is to handle and the more inaccessible it is, the less it is regulated. The water-glass is nearly always situated so it is not in plain sight of an engineer (something like the air gage), so he guesses where the water is and goes ahead.

A fireman can practice economy by exercising good judgment in putting coal in the firebox, but it takes better judgment to practice economy after the coal is in the firebox.

This trouble is worse on a ten-wheeler, where the engineer sits alongside the boiler.

A. A. Lindley,
Iowa Central Railway.
Oskaloosa, Iowa.

New Express Engines for the North-eastern Railway.

Editors:

I notice, on page 764 of your September issue, a statement that the above locomotives, with 91-inch coupled driving wheels, are of the two-cylinder compound type. This is incorrect. They are single-expansion engines with cylinders 20 x 26 inches. Nor have fifteen of the class yet been built, as stated. Only two are at present out and running. Some other engines, also simple, but having drivers 7 feet 1¼ inches in diameter, and cylinders 19 x 26 inches, were built at Gateshead Works at about the same time as the former larger type, which has no doubt led to the errors referred to.

As very possibly some further particulars of the latter will be of interest to your readers, I subjoin the principal dimensions of the engines:

Cylinders—Diameter, 18 inches; stroke, 26 inches.

Wheels—Driving and trailing, 7 feet 7¼ inches; bogie, 3 feet 7¼ inches.

Boiler (steel)—Center line from rail, 8 feet 2 inches; length of barrel, 11 feet 6 inches; outside diameter, 4 feet 4 inches; thickness of plates, 9-16 inch.

Inside firebox (copper)—Length at bottom, 6 feet 3½ inches; breadth at bottom, 3 feet 2¾ inches; depth at front, 6 feet 4½ inches; depth at back, 5 feet 9 inches.

Tubes (brass)—Number, 201; length between tube plates, 11 feet 10⅛ inches; diameter outside, 1¾ inches.

Heating surface (total)—1,300 square feet.

Grate area—21 square feet.

Diameter of exhaust nozzle—4¾ inches.

Weight of engine in working order—On bogie wheels, 16 tons 8 cwts; on driving wheels, 18 tons 14 cwts; on trailing wheels, 15 tons 14 cwts. Total, 50 tons 16 cwts.

The tender weighs, with 5 tons of coal and 4,000 gallons of water, 39 tons 10 cwts; the total weight of engine and tender being, therefore, 90 tons 6 cwts. The latter is also fitted with a pick-up water apparatus, to enable the engines to run 124½ miles (Newcastle to Edinburgh) without a stop.

F. W. Brewer.
London, Eng., Sept. 15.

P. S.—Mr. Wilson Worsdell is the engineer.—F. W. B.

Locomotive Boiler Tool.

Editors:

It is often the case that flues are taken out of boilers, and to do this, a main hole (or somewhat larger hole) is made in front sheet, where the flues are shoved through, and in that way taken out. The engraving represents an adjustable boring tool, for enlarging holes, which in a few minutes time can be set to required size.

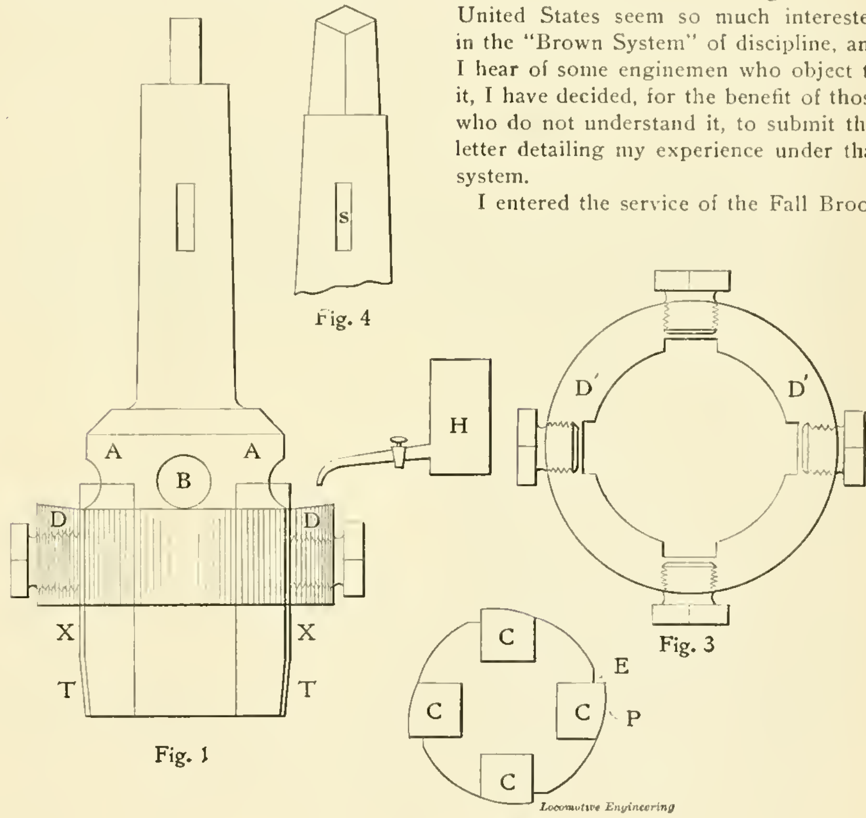


Fig. 4

Fig. 1

Fig. 3

Fig. 2

Fig. 1 consists of body A A and shank; collar D D or D^1 D^1, Fig. 3; and cutters, C C C C, Fig. 2.

Four holes are drilled like B, Fig 1, with 11/16 inch bit drill, and ½ inch deep. Then we plane or mill four grooves where cutters, ⅝ inch square steel, are put in, and collar D^1 D^1 slipped on. Then we turn cutters at X X, and taper the end T T whatever size we want. We can have three or four sets turned up, whatever size is likely to be needed, and have them on hand.

E, Fig. 2, is clearance for oil and chips, and cutters want to be backed off a little at P, and cutters sharpened at E only.

If we have no socket ratchet for shank, Fig. 1, we make shank can use it on drill pres the key S will hold it.

H is oil tank. When to drill press, the oil drops on D and finds its way down where it to be. When the master mechanic orde flues taken out of an engine, and the 154 holes in back flue sheet want to be enlarged, the cutters are put in in a few minutes and the tool is ready for use.

J. A. Eisenaker.
Elmira, N. Y.

An Engineer's Experience with the Brown System of Discipline.

Editors:

As the great railroad managers of the United States seem so much interested in the "Brown System" of discipline, and I hear of some enginemen who object to it, I have decided, for the benefit of those who do not understand it, to submit this letter detailing my experience under that system.

I entered the service of the Fall Brook Railroad Company in 1871 as an apprentice; after working nine years in the shops as an apprentice and journeyman I was made a fireman and served the company in that capacity two years and a half; then I was made an engineer, in which capacity I served ten years. On October 23, 1889, I left Corning on my regular run South. At Stokesdale Junction I met and checked off on my time card the last train I was to meet, forgetting the fact that there was another of the same number as one of those I had checked off, which was late from the day previous, and which, if it had been on time, would have reached Corning before I left there. I soon discovered this, however, as we met just north of Paducohi; it was a "head-ender," and, I am told, cost the company about $4,200. Strange to say, the men of both crews escaped without injury. It was a fearful sight.

When we finished picking up the wreck I went to Corning, called on General Superintendent Brown and explained my unfortunate error. When I had finished he looked up and said: "Jim, I am awfully, awfully sorry." I replied: "You can't regret it more than I do, as I lose all—my reputation and my wages." He said: "No, not so bad as that," and he was as good as his word. He put me back in the shops, where I worked about a year, then took my place on the road again, and have run steadily since.

I believe that I have helped to prove that it is useless to lay men off for anything; the fact that I know my record contains a full account of that wreck is sufficient punishment and will stand there to warn me against another such mistake, to say nothing of the fact that my company's consideration for me was fully known to the working men about here, and encouraged them in the belief that all they had to do was to tell the truth and honestly perform their duties, and they would never lose a day's time.

Men are not infallible, and the company takes this into consideration; if they show a disposition to do their whole duty, so far as is possible for a human being to do, and profit by any mistakes they make, they are given a chance to do so, but no wilful carelessness is tolerated for a minute. When I went to work for this company very few of the engineers or conductors owned any property. Now it is not anything unusual to meet brakemen and firemen who own their homes, and the majority of the engineers and conductors own their homes, some of them having nice farms, houses that they rent, etc., besides. My father and one of my brothers died in the service of this company; two of my brothers and myself are working for it now and expect to die here.

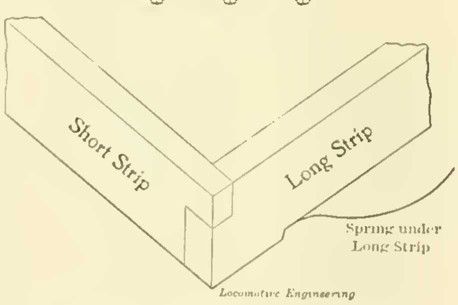
We all feel proud of the fact that so many great railroad men are adopting the "Brown System," and I am sure that it is only a question of time when they will all fall into line. Under the old "Suspension System" of discipline an employé was laid off for all mistakes, and during that enforced idleness generally squandered any little savings he had accumulated while at work, to say nothing of the fact that bad habits were often acquired under such circumstances. The adoption of the "Brown System" by any corporation demonstrates to its employés that good service is all that is required, and that, instead of seeking opportunities to punish men, premiums are offered them when their services are satisfactory. Talk is cheap, but money counts; when premiums are offered men to encourage them to improve their own condition, there is a genuine ring to it that is unmistakable. Corporations that use such methods as these must have the sympathies and voluntary co-operation of their employés; when a man's pocket feels the weight of his employer's arguments each year, he is convinced that it is a good one and not altogether selfish, and this is what the "Brown System," as applied here, does for Fall Brook employés.

One year's application of this system will do more to perfect the discipline of men than all the threats, punishment or persuasion that might be used to accomplish that end. Men engaged in handling trains on a single-track railroad are forced to do their own thinking while doing so, and it is safe to say that no one interested so keenly appreciates all the advantages and disadvantages of a system of discipline under which they work as if for themselves.

Every possible feature of its present and future effect upon them is thought over and discussed among them, and if there are any "holes" in such a system they are sure to find them; but during all the years that the "Brown System" has been in operation here I have never heard an intelligent man raise an objection to it. All reflective men are hoping, for the sake of all concerned, that the barbarous "Suspension System," like stocks, whipping-posts, etc., is to forever hide its ugly head, and reliquish the firm seat it once had in this land of enlightenment to the humane and effective "Brown System."

JAS. N. ROBINSON.

Corning, N. Y.



Improved Balanced Valve Strips.

Editors:

Herewith I send you sketch of standard balance valve strip as used on the Gulf, Colorado & Santa Fé Railway. The long strip supports the short one as shown, thereby dispensing with the short spring, consequently reducing the wear on shields and strips to a minimum. We have engines fitted up in this manner that have run three years without any attention being given to the balanced parts, and are still in good shape.

T. L. STEVENS.

Temple, Tex.

Notes of Early Railroading.

Editors:

"Locomotive Engineering" has published during the current year some very interesting illustrations of old-time engines, and the following bits from my historical scrap heap may be a not unfitting supplement: and although, as an unqualified statement, "Comparisons are odious," there are some which are not only not odious, but are amusing and instructive. I have at hand some such relating to the early days of railroading which the editor may find of sufficient interest to accept.

We are usually led to believe that the first example of steam railway locomotion was that on the Stockton & Darlington Railroad, in England, on the 27th day of September, 1825. There is, however, good reason to consider that antedated by a few years by the Hetton coal railroad, extending from Sunderland on the river Weir to the Hetton collieries, something over 7½ miles; and, for the matter of that, long before, by the steam road at Merthyr Tydvil, in South Wales, in 1802.

The Hetton road was operated by a combination of locomotive and stationary engine; the latter at the highest point of the road, to drag the cars or "wagons" up the grades—called "planes" in those days. Quoting from an account of that time, "a single loco-motive engine, with twenty-four wagons, has drawn six hundred tons a day, going nine gaits—i. e., thirty-five miles forward and return." Two items of information to be gathered from this bit are—that it is not at all new to "get a gait on," and that hyphenated engines did duty before the days of "Chordal."

Mr. Wm. Strickland, C. E., from whose account, written seventy years ago, I have made the foregoing quotation, informs us further: "The loco-motive engines are made of thick sheet iron, and are obviously of the high-pressure kind . . . . are for level lines of road only, for the engine itself in any material ascent consumes a great portion of its power in the movement of its own weight and that of its fuel, and any sudden rise would annihilate its object and use. . . . The rails are of cast iron, and four feet long. . . . The engine is of twelve horse-power, weighs five tons, and cost £600."

An account in 1826 assures us that a locomotive can be made which will be able to move on a level track, "without a rack and pinion, its own weight and eight (!) times as much besides." What a pleasing little comparison there is right here with to-day, using as the object-lesson, say, the Erie "decapod," with its 96 tons weight and hauling capacity of 4,600 tons!

Concerning the Hetton road, further, Mr. E. Hazard wrote at Philadelphia, under date of March 27, 1827: "On the Hetton railway they are abandoning the locomotive. The jar caused by the wheels over the ends of the rails, although apparently trifling, is found to destroy the joints so fast as to make it cheaper to maintain stationary engines at two miles apart, with ropes extending between, to draw the wagons. . . . . When the railway crosses a public road, the rope is bent down by friction rollers, and carried under a plank bridge to the other side of the road, where it rises again above the ground. When the wagon comes to the public road, the boy who rides on it releases the rope from the vise, the velocity of the wagon carries it over the road, and the boy hooks up the rope with the vise while the wagon continues in motion. . . . . By declining the use of locomotives, a great proportion of the expense of the railway may be saved, since wagons carrying 1½ to 2 tons can be used with as good economy as those of larger burthens, and they will require a railway of only one-fifth the strength of those on which steam engines are to travel. It does not appear to be decided as to whether cast or wrought iron rails are to be preferred. . . . . I am decidedly of the opinion that in this country a railway of wood, sheathed with iron, would be preferable to any other, and could be kept constantly in order at the least expense." Springs, hangers and equalizers were then things of the foggy future.

Having fresh in mind some of the details as to speed of the famous run made just a year ago on the Lake Shore & Michigan Southern Railway, when 33 consecutive miles were made at a rate of over 80 miles an hour, and one mile run at over 92 miles an hour, what a broad, healthy smile it provokes to read the following from the "Manchester Mercury" of 1831: "It has often been a subject of doubt whether the distance from Liverpool to Manchester, 30 miles, could be traveled by a locomotive engine in the space of one hour. This extraordinary feat was performed on Tuesday morning, November 23d, by the "Planet," one of Mr. Stephenson's most approved engines, the time occupied being sixty minutes, of which two were taken up in oiling and examining the machinery about midway. There were no carriages attached to the engine; the only persons on the tender were the engineer, the fireman and Mr. Williams, the principal clerk in the Liverpool, Crown street, station."

Referring again to the Liverpool & Manchester Railway, a report of 1833 says: "Before the establishment of the railway there were twenty-two regular coaches between these cities, carrying 688 people per day. The railway in eighteen months carried 700,000 people, equal to 1,070 a day. The fare was, by coach, 10s. inside and 5s. outside. By rail, it is 5s. inside and 3s. 6d. outside. By coach, it took four hours; by rail, one and three-quarters, and people now go back and forth in one day." It seems that outside travel is older than some of us think, if we associate that method of transportation only with our nomadic gentlemen of leisure who affect second-class trains.

Here is an interesting point regarding locomotive power, as brought out in the report of Engineer Wright, made to Governor Dix, of this State, in 1835, after the survey of the Erie road had been made: "The steepest acclivity encountered along the whole line (excepting the plane near Lake Erie) will be 100 feet to the mile, and having been furnished with satisfactory evidence that by recent improvements in the locomotives on the Baltimore & Ohio Railway they have been enabled to ascend an acclivity of 176 feet to the mile—drawing between five and ten tons weight—I rely upon that fact in stating that locomotive steam engines may be advantageously used on the whole of the proposed route from the Hudson River to the head of the plane near Lake Erie; that they will pass its steepest grades, drawing at least seventy or eighty passengers with their baggage" (!)

The richest scrap in the whole heap, though, is this: In 1836 there was granted to M. W. Baldwin a patent for a *removable* firebox for locomotives. A supply of these was to be kept along the road, and when a train reached the end of a division, instead of our present-day, liberal plan of sacrificing an entire engine to the rapacity of a hostler, the idea was simply to unship the firebox, and hang in its place another with a fresh fire!—"and we send missionaries to China."

Wm. F. Monaghan,
M. A. S. M. E.

104 W. 61st St., New York.

Locomotive Piston Remover.

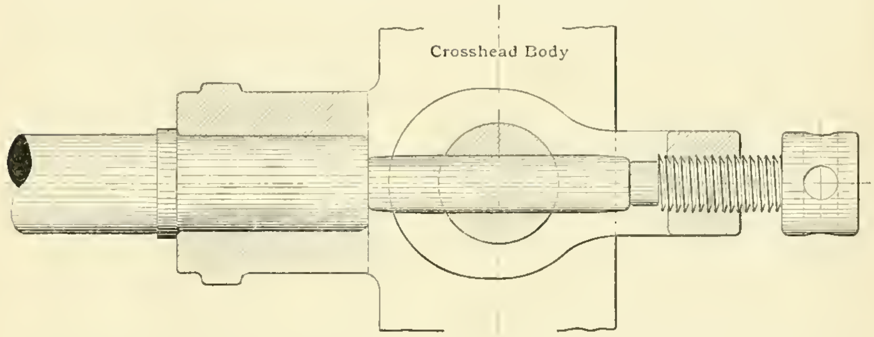
Editors:

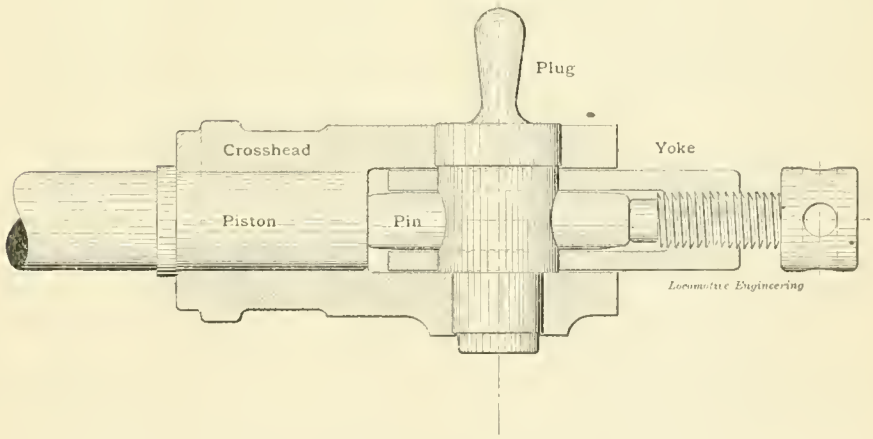
I have from time to time noticed a great many cuts and descriptions of locomotive piston removers in your paper, operated by both hydraulic and screw power, and it occurred to me that yo[u] ested in one devised by [ ] four years ago, and which g[ ] faction where it was put in us[e].

I inclose you herewith a p[ ] device, which was made to be used [ ] cipally in removing pistons from cross heads of the skeleton type. By reference to it, it will be seen that the tool is composed of three parts—a plug to be inserted in the hole for the wrist pin, a yoke with jack screw, and a steel pin.

The method of applying the tool is clearly shown on the print and needs no description.

The use of the tool requires the disconnecting of the front end of the main rod, which may be an objection to its use in roundhouse work, where the work has to be done expeditiously; but for shop use, in stripping engines, it cannot be excelled,





as it is guaranteed to remove the most refractory piston.

There is no patent on the device, which is free to be used by all, and it will be found to be a most valuable adjunct to the shop tool-room.

William Wright,
Chief Draftsman.

Altoona, Pa.

Ornamentation of Locomotives.

Editors:

Whence the origin of the disposition of man to ornament himself and his possessions will not be discussed in this paper, but suffice it to say that he has shown it forth in every race and clime, from the fig-leaf garment in days of Eden to the present closing years of a notable century. Nowhere, perhaps, was this disposition so much in evidence as in the practice of locomotive builders and railway companies within comparatively recent years.

Early locomotives were quite devoid of ornaments, probably owing to the experimental character of many of the machines; but as soon as their efficiency was assured, those coming after them began to show more elaborate finish of parts. Cylinder heads, steam chests, rods, and the upper portion of the haystack domes, were polished, while railings of somewhat intricate design protected the sides of the uncovered foot-plates. The wooden lagging which was used on many boilers without any outer covering of sheet iron, was soon carefully finished and oiled, besides being held in place by highly polished bands of brass, and these bands were still used to encircle the Russia iron which at a later date was placed over the wood.

With the introduction of cabs, the designers seemed to give full play to their fancy, and in a little while these structures appeared of all known types of architecture, together with many other types never seen before nor since. Columns, capitals, scrolls, arches—Gothic, Norman, etc.—fretwork, panels, all united to impress the beholder and add to the company's expenses.

In many instances paint was discarded, and the natural wood was highly polished and varnished. This latter practice was followed with passenger engines on many roads, the Pennsylvania using black walnut for this purpose until 1867.

Sandboxes, whistle stands, hand rails, bell frames, headlight brackets and wheel covers were all objects of the designer's decorative skill, and were of the most varied and intricate patterns imaginable. Even the huge conical smokestacks of those days did not escape the craze, and the top edge was often cut in scollops around its entire circumference. Casting one's memory backward, or looking at engravings, fortunately retained, of those engines, it seems as if the designers racked their brains to find places on which to place a bead and a base, a band or cornice; and when this was achieved, then set about designing ornament for these beads, bases, bands and cornices themselves!

But all this ornamentation of wood and iron was simplicity itself compared to the unbridled license with which painters plied their arts upon the unoffending locomotives. All the hues of the rainbow, and many which would cause a rainbow to fade away in despair, often appeared on one engine; and upon the various solid colors or ground were spread out most amazing arrays of lines, curves, arabesques, landscapes and what not!

Vermilion was the favorite color for wheels, and the spokes were picked out in shaded stripes of gold leaf; while the centers of all, and the faces of plate pony wheels, were usually covered with stars of gold. Frames were painted and striped, even behind the driving wheels; and truck frames, both of engines and tenders, were similarly treated. Tenders often were painted of one color on the guard; the cistern of a brilliant color in the centers on each side, and this surrounded by a darker hue; and a fourth color was used for the frame.

I recall several engines which had burnt umber, green, Prussian blue, and vermilion used prominently for groundwork on various parts of the same engine, and these not passenger engines, either! Headlights, sandboxes, cab panels, centers of wheel covers, and sometimes tender sides, were generally selected as favorable places upon which to paint landscapes.

Polished sheet brass was extensively used in useful and ornamental combination, for dome, steam chest, cylinder and check valve casings and for bands around the Russia iron casing of boilers. It also was used on wheels in the form of circular embossed disks, to cover the ends of axles, and on the outer faces of wheel covers, besides being frequently used for hand rails, bell-frames, and sandboxes.

In the early sixties, R. Norris & Son built a few "Phleger" engines, which, although for freight service, were probably the most highly "ornamented" engines ever built. Dome, sandbox, steam chests, cylinders and square front of firebox casing were covered with highly polished brass; the straight smokestack had a flared brass cap and three oval brass rings; the boiler and its surmounting incased steam pipe were covered with a fine grade of Russia iron, held in place by six or seven fluted brass bands—that at the front being the largest. The cow-catcher, wheels and cistern of tender were painted in emerald green; the frame of tender, base of dome casing, center panel of cab and bell frame were painted in vermilion. The cab, excepting panel named, was of varnished black walnut, and contained three large windows on each side, and landscapes were painted on each side of the tender and in the cab panels.

About this time reaction set in, and at first freight engines, as built or overhauled, came out devoid of brass ornaments or lagging, and painted in dark colors relieved by a few stripes and shaded lettering. A year or two later passenger engines began to appear in the same style, and, with the exception of an attempt by the Baldwin people and a few others to revive the brass and bright color style about 1866, the tendency to plainness of finish continued, until about 1881 or 1882 it culminated in the adoption by the Pennsylvania, and later by other roads, of the pleasing English style, which dispenses with cornices, bases and all angles, substituting therefor curves of real beauty. The dark colors introduced in the sixties soon were replaced by black, which has since become general on American roads, while on many no stripes whatever are used, and the only relief to the ebony hue is formed by the initial of the company and the number of the engine in plain white or yellow characters, although the Pennsylvania and a few lines still add a few neat stripes; using for these and the lettering, gold leaf on passenger engines and yellow on freight engines—the stripes named in each case being supplemented by smaller ones of white.

Though probably more general in America, the use of polished brass for lagging seems to have had some advocates abroad as well. The writer recalls seeing during a visit beyond the sea, in 1878, several engines on English lines with brass dome and manhole casings, and a number of fine engines in the Waverley station, Edinburgh, with the iron buffers and coupling gear on the forward buffer plate all highly polished, and several engines of the Crampton type, on the Northern Railway of France, which had the entire exteriors of their boilers lagged with glittering brass. This latter practice I believe was followed on the Paris & Orleans Railway also; while the bright greens with which boiler laggings and all other parts of many English engines and tenders are painted, and the ultramarine picked out in gold and vermilion of the Caledonian Railway, are sights well remembered by all railway men who have been abroad.

The trait referred to reveals itself in the enginemen and firemen, who often lay out no little money in handsomely mounted deer antlers, or ox-horns, which they place upon the tops of headlights; or in various designs made from sheet brass, to be fastened in convenient places; or in clocks and mirrors for the cabs. On some roads some of the firemen of passenger engines formerly added to the general neatness of their cabs by oilcloth and rugs placed on the foot-plates, but the general use of engines with fireboxes extending to the back end of the cab prevents this display of elegance at the present day.

Then follow "decorations" of a more simple type, such as stars in the waterproof preparation spread over Russia iron in damp weather, or in imitation curtains made of whiting on cab windows. In this class we may also include the bow of ribbon often seen fluttering from the bell frame or knob on the end of hand rail, and the evergreen bush or huge branch of dogwood with clusters of cuplike flowers, often plucked from the mountain side during a stop of unusual length, and placed prominently on the front buffer beam.

Occasionally, when these decorations become too numerous, sweeping orders are issued from headquarters for their removal, and for a while all vanish like the warriors of Roderick Dhu on the side of Ben Ledi, but unlike those famous Scotchmen, after a time reappear in a sort of timid way, one by one at long intervals.

If the official eye does note this evidence of a return to forbidden pleasures, it evidently looks in another direction very quickly; as its owner, no doubt, remembers his own earlier days on the foot-plate, and recognizes a common bond of fellowship, which is better undisturbed so long as it is not indulged in to excess.

Pittsburgh, Pa. C. H. CARUTHERS.

New Denver & Rio Grande Locomotives.

Editors:

In regard to your information as to the Denver & Rio Grande having a new very heavy passenger locomotive on this railroad, would say it is correct.

The weight of the engine proper is 148,000 pounds; and while we have made some heavy pulls with the engine, the scientific test has not been made. Therefore, I am not prepared to make a report on this engine, and we only have to say that the daily papers were a little ahead of time. HENRY SCHLACKS,

Superintendent of Machinery.

Denver, Col.

Should the Pump Governor be Attached to Main Reservoir When D-8 Valve is Used?

Editors:

Being an air-brake man and a machinist, as well as a subscriber to "Locomotive Engineering," I watch with particular interest all discussions on air-brake questions, and would like to take exceptions to the answer you give to H. C. E. in Question No. 68, in October issue.

I have had this question asked quite a number of times, and have always answered substantially the same way.

Westinghouse says the pump governor is connected to the train line because of its sensitiveness to slight differences in pressure, thereby causing the train line pressure to be always maintained at the same limit.

I have had an air-brake experience of quite a number of years, and I must say that I have never been able to see any reason for attaching the pump governor to the train line in connection with the D-8 valve; and even before the E-6 valve came into use I had tried repeatedly to get the road I worked for to attach the governor to the main reservoir, but was not allowed to do so, "because it was against the Westinghouse instructions."

In the first place, a D-8 valve, properly looked after, controls its excess pressure practically the same as the E-6 valve. The excess pressure spring maintains 20 pounds more pressure in the main reservoir than in the train line.

How could the governor, being attached to the main reservoir, affect the valve and cause it to allow too high pressure in the train line, and be almost useless as a governor in its operation? I do not see how it could affect it; but, on the contrary, if the governor were attached to the main reservoir with the D-8 valve, when the valve was on lap the pump could not accumulate a pressure in the main reservoir equal to the steam pressure in the boiler, as it does connected according to instructions.

With the governor connected to the main reservoir with both valves, there would be no difference in the handling of the two valves, and no difference in the effect on the brakes; and the only difference in the two valves would be that the D-8 valve accumulates its excess pressure first, and then its train-line pressure; while the E-6 valve gets its train-line pressure first, and then its excess.

Someone may say that it is very difficult to keep the excess pressure spring in the D-8 valve so that it will maintain 20 pounds excess in the main reservoir; but then it is almost as difficult to prevent small particles of dirt and gummed oil from lodging on the supply valve seat of the E-6 valve; and in both cases a little care and exercise of vigilance is all that is required.

Then, again, with the D-8 valve and the governor connected to the main reservoir, when the valve is on lap, as is the case in descending hills and stopping for water plugs on grades, the pump could not accumulate such a high pressure and burst hose and cause all the troubles incident to an overcharged train line.

I may be exceedingly blind; but I cannot see what is to prevent the excess pressure spring in the D-8 valve from being just as sensitive to reductions of pressure as the feed valve spring in the E-6 valve, or the diaphragm and regulating spring in the pump governor.

While, of course, any injury to, or weakness of, the excess pressure spring would allow too high pressure in the train line and vice versa, too strong a spring would cause too low pressure. The same things easily happen to the E-6 valve.

The main reservoir being cut out, with both valves, in the application of brakes, and opened direct into train line in full release, of course the governor would have its full effect on both valves, and in each case the feed valve would control the train-line pressure.

The feed-valve attachment is only an improvement on the excess pressure valve, whereby the train line pressure can be obtained first, and the excess can be regulated at will.

Another point is that, if the pump governor were connected to the main reservoir, the excess pressure could not leak away completely before the pump would start, as is the case where the train line is tight and the valve in good condition. If I am wrong in my reasoning in this case, I wish to be corrected; but I would like to have good reasons, well explained.

Huntington, W. Va. C. O. MIKLE.

Treatment of Axles and Journals.

Editors:

In the November number of "Locomotive Engineering" is an article on the treatment of axles and journals. In our shops we do the wheel and axle work in machine shop. We adopted the system of rolling journals two months ago, and are well pleased with the results.

Now, the first thing some master mechanics and master car-builders will do will be to figure the cost of rolling journals, and weigh that with the benefits to be derived from the process, which is just what they should do, and just what we have done; and we are of the opinion that the results would outweigh the cost. But to be sure it did not, we at the same time devised a plan of centering the axles that more than made up for the time consumed in rolling them. We take a hundred or more axles on the floor in line with the wheel press; lay down two pieces of rail three feet long, track gage apart; roll an axle on these rails, with a straight-edge on the floor and coming up to center of axle as near as possible; roll them once over, making a scratch at each quarter close enough to prick punch; this can be done very rapidly. Then with a heavy center 4 inches diameter, with a convenient length handle, center two degrees larger than lathe centers, we press the center in with 40 tons pressure on wheel press. This makes a hard, smooth center, and is much faster and better than square centering. So now we are able to turn out more steel axles per day and roll them, than heretofore and not roll them; so the rolling process costs this company nothing. We also employ the rollers on piston rods and valve stems.

D. P. KELLOGG,

Mach. Shop F'man, D. & I. R. R. R.

Two Harbors, Mich.

"Horizontal Steam Engine" is the title of an illustrated pamphlet sent us by Mr. Thos. Whittaker, 2 Bible House, New York. It contains a variety of illustrations, showing details of a steam engine furnished with Mayers' variable expansion gear and several plates with movable parts to illustrate the various connections of the engine, similar to our educational chart of the Westinghouse engineer's valve. The pamphlet will be found an excellent aid to those who are studying the Mayers' valve gear. It can be obtained from Mr. Whittaker.

S. N. Clarkson & Co., of Chicago, have recently made a statement showing that five thousand railroad men running in and out of Chicago are carrying watches supplied by them. This concern has been in business about twelve years, and has its trade almost exclusively with railroad engineers, firemen and conductors.

AIR BRAKE DEPARTMENT

Conducted by F. M. NELLIS.

Air-Brake Items.

Attach a pressure gage to the driver-brake cylinders, and note how long an application from a 5-pound reduction will hold. Then release, charge up, and make a full 15-pound service application. Note the pressures at intervals of five, ten, fifteen, thirty, forty-five and sixty seconds. Surprises will probably follow. You may find out something you don't wish to know, but this is the only way to ascertain the true condition of the leather packing.

Of the eight thousand copies of the report of the Air-Brake Association's proceedings less than one thousand remain unsold. The sale has been phenomenal; yet when it is considered that the book is up to date and is the product of the best air-brake men in the country, assembled in convention, it is not surprising that there should be such a demand for it by men who wish to be fully informed on air-brake subjects and keep up with the times.

The use of the Le Chatelier or water brake, as it is commonly known, is general on the heavy grades of the Pacific and Rocky Mountain roads. It has no doubt saved many runaways, and could be advantageously used on those of our Eastern roads that have trouble in controlling trains with air brakes on long, heavy grades.

Endeavoring to procure interesting and instructive matter for our readers, we published, quite some time ago, a request that parties having such matter send it to us for illustration and description. In response to this request we have received many meritorious things from senders, for which we are duly thankful. We have also received cuts and descriptions of devices that would surprise anyone else except the attachés of the Patent Office or the keeper of a museum. Henceforth we will draw the line on devices of the following kind: First—Quick-release triple valves. A larger exhaust port would do that work if it were so desired. Second—Quick-charging triples. A larger feed groove would do that work. Third—Air-brake systems with two lines of train pipes. One of our readers fitly summed up that device recently by saying: "Yes; you can do anything with a double train-line air brake"—then he added—"except sell it to a railroad company."

Improper Test of Driver Brakes.

One of the poorest excuses for a test of air brakes is the practice of trying to push the driver-brake shoes away from the wheels with the foot after the brake has been applied. Such a test(?) is a burlesque and a farce, although it is common and popular, and is thoughtlessly accepted as sufficient by many air-brake men and others who ought to know better. It gives no information of value, and merely tells, as it shows on its face, that if the shoe is not shoved away that the air pressure in the cylinder is exerting a greater force than the foot of the man shoving.

But can the holding power of a driving brake on a locomotive be compared to the push of a man's foot? Could there be a more foolish act or ludicrous spectacle than that of a man standing on a railroad track with his foot raised and pointed at an approaching locomotive, expecting to stop it, or even reduce its speed, when it met the resistance offered by his foot? Yet are not the cases analogous, and is not the man who would attempt to stop a locomotive with his foot equally presumptuous and short-sighted as he who tests with a push of his foot the appliance that exerts the force which stops the locomotive?

If the holding power of the driver brake when in first-class condition and fully applied be rated at 100 per cent., the lowest that would withstand an attempt to push the brake shoe sidewise upon the wheel tread would represent a retarding force less than 1 per cent. A test of this kind creates and establishes too wide a range of efficiency, and would qualify all brakes that ranged anywhere between 100 per cent. and 1 per cent., leaving only the very worst of poor brakes to be classed as imperfect.

Screwing a pressure gage into the brake cylinder at reasonable intervals of time is the only way to ascertain how the packing is holding, which is the milk in the cocoanut. It is not meant that this pressure gage process should be gone through with each trip, but once in a certain period which shall be determined by character of service and found by experience. Once in a while will do, but no multiplied frequency of the slip-shod, burlesque method of testing with the foot will add value to its worthlessness or atone for the shortcomings of the practice.

The Seven (St)ages of (the Air-Brake) Man.

The correspondent who comments in this issue upon the scarcity of air-brake questions asked, calls to mind the troubled path traveled by the usual air-brake man, unless he is environed by liberal and healthy influences. We cannot resist the temptation to write, under the above caption, our thoughts and reminiscences on this subject as they crowd upon us. The Seven Stages of the air-brake man may be truthfully classed as follows:

First—In this stage he realizes that the air brake is a wonderfully clever and ingenious piece of mechanism, and his admiration for the genius who invented it is unbounded.

Second—This is the "know-it-all" stage. Here is where a little learning is a dangerous thing. The traveler, on the edge of the thicket, fancies he is in the depths of the forest. This is a dangerous period. He wouldn't ask for information for fear someone might suspect that he did not know it all. His admiration for the inventor of the brake has ceased. He would now give him weight for age and beat him in a walk. He don't care to know other air-brake men. When he does meet one he will seek to establish a superiority over him by "sticking" him with a "puzzle." Reason to be happy has he who passes quickly through this stage.

Third.—In this stage he first aspires to write a book, and usually gets as far as "What is an air pump?" In unusually violent cases this desire to become an author makes its appearance in the preceding stage, and is the forerunner of a correspondingly poor book.

Fourth.—This is the "hair-splitting" stage. He strains at a gnat and swallows a camel. The "Stager's" friends are sorely tried, and await with much patience and anxiety for his feathers to grow. He spends hours figuring on unimportant and impossible things, and meanwhile neglects his practical work. He lies awake nights figuring whether a shorter stop would be made by the usual emergency application or by the rotary valve suddenly evaporating and vanishing. While problems of such gigantic moment occupy his brain, the emergency has grown popular at water tanks, the brakeman tests the brakes from the rear end, the air pump becomes a fit subject for the Keeley cure, and the hostler uses the emergency nine times in moving the engine for coal and water and across the turntable. The superintendent complains of the rough handling given passengers. Stock and merchandise are knocked down in freight trains. The train crews are busy chaining up break-in-twos. The claim agent is busy while the "Stager" dreams. This is a very dangerous stage, and lucky is the "Stager" if he is not dropped onto and fired before he wakes up to hard business practice that brings results.

Fifth.—Don't tell all you know. Hold back enough to keep the whip hand. Don't make so many air-brake men. This is an unfortunate and pitiful condition. It is the first sign of degeneracy. In this stage he has stopped and is already out of the procession. He seeks to maintain his speed by holding others back. But they will not be held back; they are strong and persistent, and will get around him. There is room at the top, and they are going to reach there in spite of the "Stager."

Sixth.—This is the period where the "Stager" realizes that there are others who know just as much as he, and who will know more if he don't keep his eyes open and apply himself. He finds, however, that the others are willing to exchange ideas and tell all they know, and expect the same of him. There is a realization that there exists a vast storehouse of knowledge from which all may draw without restriction, and there is no excuse for trying to "corner" air-brake information. The glow of health of a man in this class dispels the suspicion that he was ever a grumbling dyspeptic in the preceding stage. He has a right to feel comfortable in this class.

Seventh. — Perfection. We are up against it. All we can say about this stage is that we have not yet arrived there, and this article must either go unfinished, be finished by someone else, or wait that era of perfection when

"The night will be filled with music,
And the cares which infest the day
Shall fold their tents, like the Arabs,
And as silently steal away."

Reduced Efficiency of Air Pumps Through Heating.

At the November meeting of the New York Railroad Club, Mr. W. L. Saunders, the eminent authority on air compression, stated that if a volume of air were heated it would increase 1 per cent. in pressure with every 5 degrees increase of temperature.

It is also true that if the temperature of a volume of air under compression be reduced, the pressure will be decreased 1 per cent. with every 5 degrees fall in temperature. If a volume of air be delivered at a certain pressure while heated, and afterwards cooled, the pressure will be reduced 1 per cent. for every 5 degrees drop in temperature. The efficiency of a heated air pump would thus be reduced anywhere from 1 per cent, to 20 and 25 per cent. This is somewhat startling information, but it is corroborative of results experienced in actual practice, and is a good reason why especial care should be taken to reduce the heating of air pumps.

Worn packing rings in the air piston of the pump is one of the greatest causes for heating and lost efficiency. Many pumps will create pressure quite rapidly up to 60 and 70 pounds, but are very slow from there up, and will heat considerably. This is the reason why some air pumps will not pump as high pressure as others.

As the loss of efficiency is at least 1 per cent. for each 5 degrees increase in temperature, it would seem that especial care should be taken to remove all causes for heating. The packing rings should not only be replaced by new ones when worn, but the cylinder should be rebored when the ends are so worn that new packing rings will allow the pressure to escape past the rings at the end of the stroke, where the diameter is larger than the middle, and where the rings have been fitted. Putting new packing rings in a piston whose cylinder is larger at the ends of the stroke than the middle, is like fitting a square plug into a round hole, and is just about as sensible.

The Water Brake in the West.

Out of the West comes the latest air-brake information of distinctive value in the shape of indicator cards taken from the Le Chatelier or water brake, shown on page 986. That Mr. J. H. McConnell, superintendent of motive power of the Union Pacific road, upon which these cards were taken, is a penetrating investigator, desirous of being fully acquainted with what is going on, is evidenced by the character of the work. Between the lines we can discern the fine Italian hand of his trusty lieutenant, T. A. Hedendahl, who kindly furnished us with the blue-prints of the cards.

It seems but meet that out of the West should come the earliest information regarding air brakes, their operation and maintenance, shop uses of compressed air, etc.; for the freight brake really received its initiation on the mountain grades of the Far Western roads, and compressed air for general shop uses had its birth in the Omaha shops of the Union Pacific.

At the Master Mechanics' Convention, held in Saratoga two years ago, the first discussion of real value on compressed air for shop uses was held. We have a pleasant recollection of hearing Mr. McConnell's maiden speech before that body, made on this subject. In a plain, comprehensive manner he modestly and unhesitatingly went through the category of the many uses for which his shops had, for quite some time past, employed compressed air. We have not forgotten, as he resumed his seat amid the applause of the members, the surprised expression his features took on. He appeared bewildered and embarrassed by the applause, and seemed totally unconscious that he had said something that everybody didn't know. But his speech really opened up their minds to the possibilities of compressed air for shop uses. When shop uses for compressed air is now mentioned, reference is almost invariably made to Mr. McConnell and the Union Pacific shops at Omaha.

Shop Tests and Repairs for Triple Valves.

The following circular letter has been sent out to the members of the Air Brake Association:

"In order to have the report on 'Shop Tests and Repairs for Triple Valves,' to be read at our next convention, as complete as possible, the committee thinks it advisable to get to work at once.

Below you will find a list of questions. Please give all the information you can pertaining to the subject. Answer the questions as fully as possible, and the committee will do all necessary pruning.

You will do the committee a favor by acting promptly in sending all the information you can.

QUESTIONS.

1. (*a*) What is your method of cleaning and examining the triple valves on engines and tenders? (*b*) On freight and passenger cars?

2. What is your system of keeping record of cleaning and repairing triple valves?

3. (*a*) In what way do you locate the different defects that occur in the plain triple valve? (*b*) In the quick-action triple valve?

4. How do you locate the cause for a blow from the exhaust port of a quick-action triple valve?

5. How do you tell when the check valve in the quick-action triple valve is tight?

6. Do you practice grinding in the four-way plug in the triple valve? (*a*) If there is a leak at the exhaust port, how do you determine whether it is due to the plug or the valve seat?

7. What is your experience with the special driver-brake triple valve (Plate E, 38)?

8. (*a*) Do you find many of the graduating pins breaking in either the plain or quick-action triple valves? (*b*) Do you find any repairs necessary to the graduating stem, spring, or nut?

9. Have you had any trouble from improper thickness or defective triple-valve gaskets?

10. Are the hose on your road allowed to hang down, or are they properly caught up in the coupling hooks, when not in use?

11. What is your opinion and experience

of the effect as regards to wear of triple valves by allowing hose to drag?

12. What repairs do you consider the most important on quick-action triple valves?

13. Have you any special method of doing triple-valve repair work?

14. (*a*) Do you scrape and in a measure re-seat the slide valve before grinding it in? (*b*) What is your method of re-seating worn slide valves? (*c*) What material do you consider the best for grinding?

15. (*a*) What is your experience in taking out packing rings from the triple piston? (*b*) In what instances do you find it necessary to remove packing ring from the piston? (*c*) What is your experience with boring out cylinders in which this piston works.

16. (*a*) Do you ever press out the bushings and replace with new ones? (*b*) What is your method of fitting piston packing rings?

17. Do you make any bushings for the triple valve, or do you order them from the manufacturer?

18. (*a*) Do you send triple valves to the manufacturer to be repaired, or do you do the work yourself? (*b*) Do you purchase from the manufacturer the parts requiring frequent renewal, or do you make them?

19. Have you ever taken any figures of the cost of repairing triple valves? (*a*) If so, please submit them.

20. Do you replace many emergency rubber valve seats?

21. What is your experience with loosely fitting emergency pistons?

22. Do you have any trouble in dislodging that part of the triple valve upon which the emergency valve seats?

23. Do you grind the emergency valve check?

24. How do you remove the filings and grinding compound that remains in the ports after repairing?

25. (*a*) What is your experience in testing triple valves after repairing them in the shop? (*b*) What pressure do you use for testing? (*c*) What apparatus do you use for testing purposes? (*d*) Kindly send sketch of same.

26. With what kind of oil or grease do you lubricate the triple valves after repairing in the shop?

27. What parts do you find wear the most rapidly in the triple valve? (*a*) What parts give the most trouble? (*b*) What parts do you think should be modified or changed to obtain longer wear and give more satisfactory performance?

Any additonal information you can give, not touched by the questions, will be thankfully received.

Please send sketch of any special tools you may have for doing triple-valve repair work."

Very truly yours,

WM. MULTHANER, Chairman.

CORRESPONDENCE.

"What is a Water Brake?"

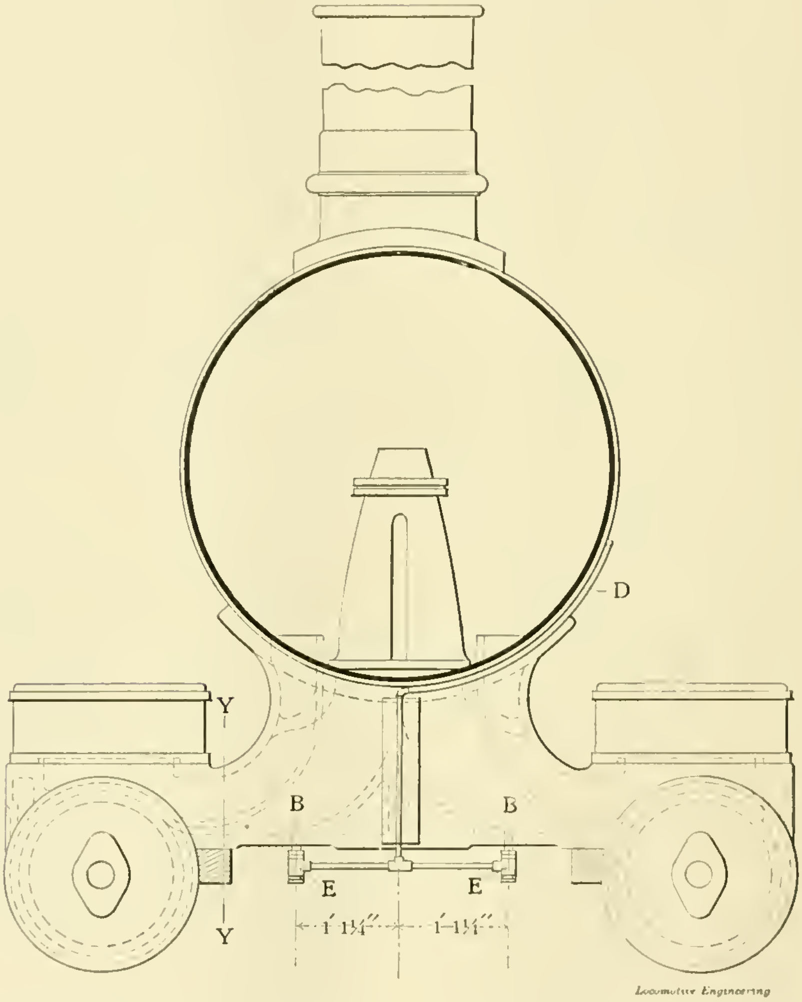
Editors:

The above query is not infrequently advanced by different men in various branches of railway service, in reply to which the following is respectfully submitted:

The water brake is not, as is frequently supposed, a device of modern railroading, but it dates back to the time of infantile railway and locomotive construction, when, nearly a half century ago, one Le Chatelier, of France, an eminent scientific engineer, conceived and put into effect the water brake for use on the (at that period) heavy grades of the French railways, proving it to be a fair success when worked in conjunction with the very primitive methods of train-braking then in vogue. But as more effective train brakes were subsequently introduced, the Le Chatelier water brake was almost wholly lost to view in the railroad world for a great many years, due mostly to lack of appreciation on the part of engineers and mechanical heads, who seemed to want all the braking done at the expense of the car department.

After the construction of some of the early mountain railways in the Rocky Mountain regions, having long continuous and exceedingly heavy grades, frequently exceeding four per cent., a demand was created for all known and effective brake devices. Among others, the quite ancient Le Chatelier "hold-back" was dug up, and, needless to say, has proven a very valuable auxiliary braking device, standing as it does in great favor with the mountaineer "engine driver," who fully appreciates its value.

Among its many commendable features is simplicity of construction; hence, inexpensive in application and maintenance.



The equipment consists of an ordinary angle or globe valve, placed in the boiler on a level with the crown sheet, and conveniently near to the engineer. From this valve is carried a ⅜-inch or ½-inch pipe, according to the size of the engine, to the cylinder saddle, where it branches and enters each exhaust passage, as is shown by the accompanying sketch.

The operation of the device is as follows:

1st. Open the cylinder cocks. Be certain all are open.

2d. Open the valve in the boiler (usually not more than one half turn) to admit water from the boiler to the exhaust passages.

3d. Immediately reverse the engine one or two notches back of the center; then note the condition of the pressure escaping at the cylinder cocks, which should be wet steam, and regulate the supply of water accordingly. If too much wet steam issues from the smokestack, reduce the flow of water at the valve.

4th. Regulate the holding power by locating the reverse lever as when working steam. Less braking power is had by locating the reverse lever near the center notch. The greatest power is obtained by placing lever in the back corner notch.

To discontinue operation, close the water valve first; then place reverse lever in forward motion notch.

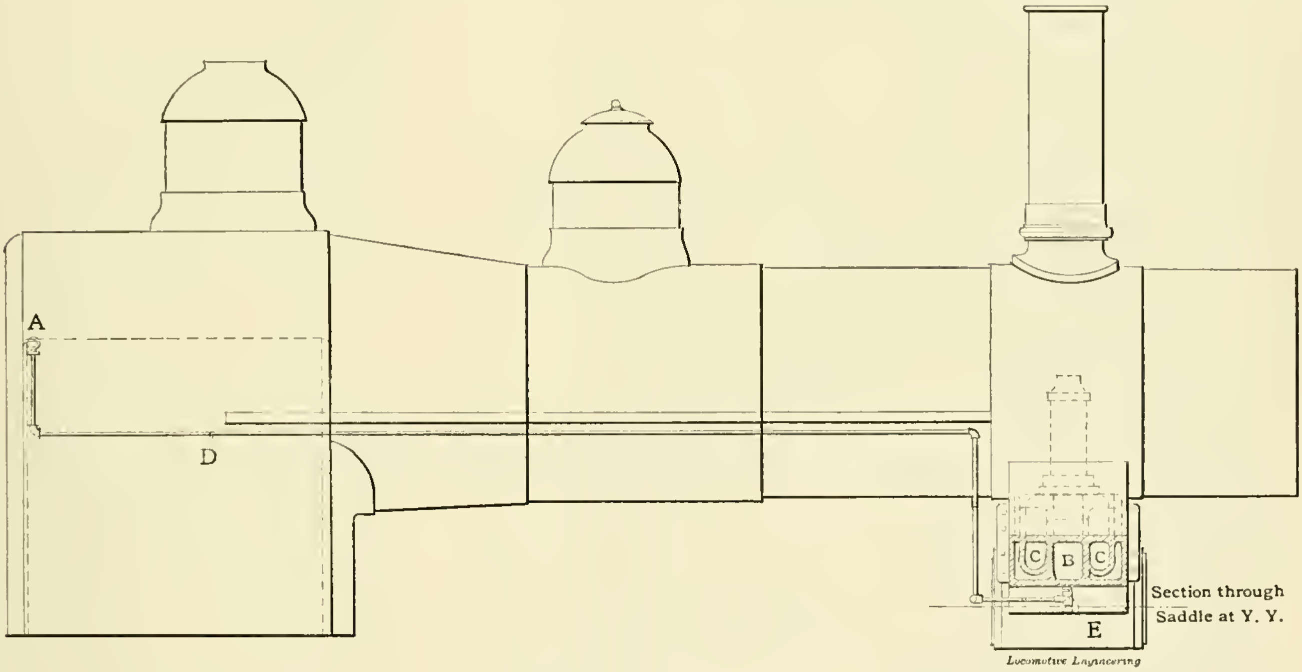
The term "water brake" does not appear any more appropriate in name than if the modern steam engine were named "water motor" or "water engine." While it is true that water is the fundamental element in the production of power with the water brake, it is none the less so with the steam engine, as in either case the water must have absorbed a sufficient amount of heat to convert it into steam; and we believe if the device were known under another name, the new beginner engineer would have less hesitation in using it where occasion required, as the very thoughts of water entering cylinders will frequently cause chills, until demonstrations have proven that no harm will follow the use of the water brake.

A glance at the construction of the device resolves itself plainly as follows: In a locomotive with valve motion reversed, the steam cylinders are converted into pumps and the exhaust passages into suction pipes; hence, the gases and heated air from the smokebox are drawn into the cylinders and compressed, causing intense heat to be generated, which, needless to say, is seriously injurious to cylinders, packing and valve seats. The object of the water brake is to substitute wet steam for the gases by admitting a proper quantity of water from the boiler into the exhaust pipes, which, when liberated from pressure, will convert into steam and supply the demand of the cylinders, and thereby exclude the injurious gases. The effect upon the cylinders is about the same as though steam was being worked in its natural manner.

It may be added that no harm can come to engine from a superfluous amount of water entering exhaust pipes, as all vapor not absorbed by the cylinders finds an unobstructed exit through the exhaust nozzles and smokestack; but it may not always improve the conditions of a clean engine or the temper of the fireman.

In conclusion, it may not be improper to advise the locomotive engineer not to undertake to operate the Le Chatelier water brake with only cold water in the boiler.

T. A. Hedendahl,
Gen. A. B. Inst. & Insp., U. P. Ry.
Omaha, Neb.



Glass Window to Show the Emergency Feature.

Editors:

I note in your October issue a device for showing movement of the emergency valve, with a rod and stuffing box. In the Dillion street roundhouse of the Big Four may be seen the emergency valve movement through a glass. A portion of the check valve case, No. 13, is cut away opposite the check valve, and a piece of glass fitted neatly with gaskets, ring and two screws. This makes a very satisfactory method of "seeing" what is going on inside. It was designed by Mr. Asa Hoy, air-brake repairman.

Ralph E. State,
Big Four Shops.
Bellefontaine, O.

Field Notes.

Editors:

While we are having a run of air-brake problems it might be well to give one that turned up some time ago, as it is liable to happen to someone else if the proper combination is arranged for.

We had an engine that had just come out of the back shop that was equipped with a D-8 brake valve. Her air equipment was "O. K." before she went to the back shop. This valve was of the usual standard pattern sent out by the Westinghouse Company. It was in perfect order, and did not have a leak anywhere. It worked "O. K.," both in setting and releasing the brake. Carried 20 pounds of excess pressure; but its operation had some peculiar features. The duplex gage was in good order and registered the exact pressure carried to the red and black hands, the red hand registering main reservoir pressure at 90 pounds. The governor was set for 70 pounds and worked promptly at that pressure. There were no leaks or blind joints or obstructions in the piping.

Now, when this brake equipment was set with service application, the black hand fell back, but did not stop when the valve handle was lapped as it should do, but continued to fall till train-pipe exhaust closed. When brake was set with full emergency application, the black hand would drop to nothing at once and stay there till brake was released.

If this brake valve was moved with handle on emergency ledge about half way, in which case train pipe would be empty, the governor would stop the pump instantly, and hold it stopped till handle and rotary was placed in service application, when the pump would go to work again.

I think this case has been stated so there are no points left out—except the solution—and no outside ones brought in to tangle a man up.

Now, what was the reason the governor and black hand of gage worked so peculiarly?—[Mr. Conger requests us to publish the problem and answer simultaneously. The answer therefore follows below.—Ed.]

ANSWER.

When the piping in the cab was coupled up in the back shop, the small copper pipe leading to the black hand was coupled to the governor connection in train-pipe port *l*, and the air pipe to governor was coupled to the black hand connection to chamber *D*. A reduction in chamber *D* would not affect the black hand till the train-pipe exhaust opened, and this hand would then drop back till train-pipe exhaust closed after valve had been lapped. Of course, with a full emergency application the train pipe was empty, the pressure dropped to nothing, and the black hand showed it. With D-8 valve on the emergency ledge, where equalizing port *g* and feed port *J* registered with each other, chamber *D* was charged up from main reservoir to 90 pounds, which, of course, shut off the governor, and it did not open up again till the pressure there was reduced to below 70 pounds; this was done very quickly on service application.

The pipes were coupled up properly and this peculiar action stopped at once. During this time an air-brake expert (?) for another brake company was on the engine, "showing us how." This puzzle "floored" him, which shows that air-brake puzzles are too much for the experts (?) to solve sometimes.

C. B. Conger.

Grand Rapids, Mich.

Controlling Slack in Air-Braked Freight Trains.

Editors:

I have just been reading the article in the October issue of "Locomotive Engineering" by Mr. L. D. Shaffner, of the Northern Pacific Railway, under the heading of "Practical Observations and Suggestions."

I agree with him in the single application of the air brake in all cases, if it can be handled thus; but on a division like I am running on, where half of it is on levels and half on down grades, and we are required to haul double trains, frequently running to seventy and eighty cars to a train, it is rather a difficult matter to always stop just right with the first application.

With such heavy trains and railroad crossings on down grade, it is quite natural for one to commence braking in ample time to be sure and make the stop. Probably we find that we are going to stop twenty or thirty car-lengths too soon, and the brake is released. About the time the slack has run out of the train we commence braking again, and, of course, there is a severe shock on the rear end. But to avoid this, before the first application is released I take up all the slack on hand brake on tank which keeps train bunched, and they cannot tell on the rear end how many applications are made.

If four or five of the retaining valves are turned up on the head cars it will answer the same purpose; but in a good many cases nowadays it is more trouble to get a brakeman out on top, if you have air brakes enough to do the work, than it is to set tank brake yourself. I do not wish to advocate this idea as the best way to stop a big train; but if it becomes necessary to release before coming to a full stop, I think it better to try and avoid causing bruised heads and unnecessary cusses from our friends on the rear end if we can.

Fred M. Taft,
P., C., C. & St. L. Ry.

Richmond, Ind.

Leather Gaskets—Good Driving Brakes.

Editors:

For the benefit of your readers I would be pleased to say that I have been using leather for gaskets in all unions, for more than a year, with splendid results. It is particularly desirable in pipe connections to the brake valve. Rubber becomes soft and works its way into the pipes, with bad results. Leather remains firm and intact, and gives much better service as gaskets than rubber. Our brake valves have no leaky joints and give very little, if any, trouble. The parts are kept clean.

We find, by keeping our driver brakes in order, that slid flat wheels on tenders have almost entirely disappeared. It pays to keep them in order.

Fred Hain,
A. B. Insp., W. N. Y. & P. R. R.

Buffalo, N. Y.

Why Are Not More Questions Asked?

Editors:

In looking over the Air-Brake Department from time to time, I am led to believe that many of your readers do not avail themselves of the excellent opportunity this department affords them to thoroughly familiarize themselves with air brakes as we find them. Certainly this department is well conducted, and the answers given to questions invariably stand strictly correct. Consequently, I cannot conceive why so few questions are asked.

Is it because all the readers are so well posted they need no further instructions, or are they afraid to ask questions for fear of being ridiculed? Certainly, it is not the former, or railroad managers would have found it out, and dispensed with the services of the air-brake instructor on many of our leading roads. Possibly the men are afraid of offending the head of that department on the road with which they are identified, and consequently they remain a silent partner and wait for the other fellow to ask the questions.

However, I notice the Air-Brake Department is of much interest to us all, and especially so to those who have not had the benefit of a modern instruction car, conducted by a gentlemanly, competent instructor.

I wish to express my appreciation of the kindness of Messrs Conger and Synnestvedt, who answered many questions for me before our road appointed an instructor and "Locomotive Engineering" made a distinct Air-Brake Department. I consider their books among the best on Air that are published.

In conclusion, I wish to state that in submitting questions to this department, it should not be considered that the man asking the question don't know the answer. Possibly he has seen it plainly demonstrated in the instruction car, and wishes to have it verified, or to learn if the experience of others is similar to his. Let us have more questions and answers. Let the new beginner and the more advanced student ask more questions.

H. C. Ettinger,
Wabash Railroad.

Springfield, Ill.

Another Record Breaker.

Editors:

On April the 1st, 1893, a 9½-inch Westinghouse air pump was placed on D. & H. C. Co. Engine No. 21, and from that date until June 27, 1896, the engine had run 176,575 miles in regular passenger service, and made 81,944 stops. Since June 27, 1896, no record has been kept of mileage or stops made. On October 4, 1896, pump was removed from engine, and upon examination was found to be in very fair condition, with the exception of a leaky slide valve. The pump could have continued to run for some time to come.

During all this period of time the pump has not cost one cent for repairs of any kind. The air cylinder received one teaspoonful of oil (32° West Virginia well oil) each week. Piston rod was lubricated by a swab. This record, no doubt, may be of interest to many, as it goes to show what a 9½-inch pump can do when it is properly treated, and to not overdose it with oil, or run it at a seventy-mile an hour gait to supply three or four cars in a passenger train, where a more moderate rate of speed would do the same work with more ease. All that is required is a little judgment to be exercised, which will increase the life of the pump and decrease the expense attached to keeping up repairs on it.

Harry A. Flynn,
D. & H. C. Co.

Wilkesbarre, Pa.

Triple Valve that Recharges Auxiliary Reservoir While Brake is Set.

Editors:

In looking over the October number of "Locomotive Engineering," I notice in the Questions and Answers on Air-Brake Subjects where J. W. C., Waco, Tex., writes that he has a device for recharging auxiliary reservoir while brakes are set. You will find inclosed a patent that was granted to me for the same purpose. The patent has been tried, and made a very good showing.

I claim when this improved valve is seated it is a balanced valve, or so near so that when the exhaust from the triple comes in around the central part of the valve it makes no interference with the degree of pressure the spring is set at. If the spring is set at 65 pounds, the trainline and auxiliary reservoirs will charge to 70 pounds. If the engineer wishes to close the exhaust, to recharge after making a service application, and reducing, say, to 50 pounds, he places the engineer's valve in the release position for a moment, and then brings it back to lap. In doing this he has forced the triple valve to the release position, opening the necessary ports for recharging auxiliary reservoir, and permitting the exhaust to come in around the central part of my improved valve. In this case, if black hand don't show the required amount, he may repeat the same operation, being careful, however, to not let train-line pressure go above 65 pounds, or whatever the spring is set at in the valve. If the engineer don't wish to hold brake set, I claim he can obtain a quick release any time by carrying an excess pressure in the main reservoir on the locomotive.

E. E. Kerns.

Bradford, Pa.

[The following descriptive extracts from the patent papers accompanying our correspondent's letter will serve to make clear the operation of his invention.—Ed.]:

"This invention pertains to fluid-pressure brakes, and relates particularly to that class of brakes in which the pressure is retained in the brake cylinder until the same is restored in the auxiliary reservoir, when the air in the brake cylinder is automatically released."

* * * * *

"Referring to the accompanying drawings, Fig. 1 is a perspective view showing the relative position of my improved valve mechanism and the triple valve. Fig. 2 is a longitudinal sectional view of the releasing valve. Fig. 3 is a cross-sectional view on line 3-3 of Fig. 2.

"*A* designates the triple-valve mechanism of familiar construction. The cylinder *B* of my improved valve is connected by pipe *C* with the lower end of the triple-valve casing at a point adjacent the connection of train-pipe *F*. The exhaust of the triple-valve mechanism engages with the side or periphery of the cylinder *B* at the point *G*, through the medium of pipe *H*. At the end of cylinder *B*, opposite the pipe connection *C*, is the enlarged circular cavity or auxiliary cylinder *I*, made integral with cylinder *B* by vertical web *I'*, and adapted to move in this enlarged cavity or cylinder is piston head *J*, secured on stem *K*. Cylinder *B* is lined with bushing *L*, the latter being beveled, as indicated at *L'*, upon the extremity extending into enlargement *I*, and adapted to move within this bushing-lined cylinder is the reamed-out spool-valve *M*, which is also mounted upon the valve stem and abuts the piston head *J*.

"The inner bulb-shaped end of the valve *M* is larger than its opposite end, and the inner end *L'* of bushing *L* forms a seat for said enlarged end, as clearly shown in Fig 2. Thus, cylinder *B* is effectually sealed at its inner end, and the exhaust of the triple valve is confined until said valve

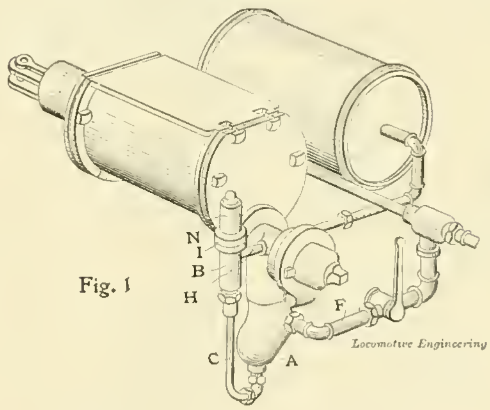


Fig. 1

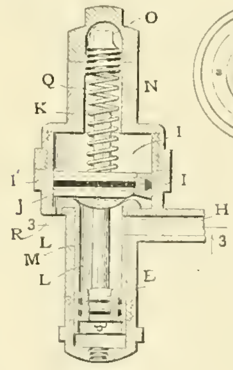


Fig. 2

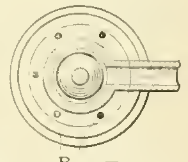


Fig. 3

is moved from its seat, when it is instantly released into chamber *J*.

* * * * *

"The outer end of the screw-plug is provided with a wrench hold, and by this means the tension of the spring upon the piston head is regulated so as to obtain the desired number of pounds resistance, holding the said piston head and spool valve firmly against the beveled end of the bushing of cylinder *B*, so as to completely close or seal the latter until said pressure has been overcome by the restored pressure in the train-pipe and auxiliary reservoir acting against the opposite end of the spool valve through pipe *C*. When this occurs, the valve mechanism will be moved longitudinally, and the air from the triple-valve exhaust permitted to escape between the end of the bushing and the piston-head, and rush outward through the plurality of apertures *R* in web *I'*."

* * * * *

"By means of the construction here shown and described, the air in the brake cylinder is retained with the brakes set even after the train pipe has been opened for the restoration of the pressure in the auxiliary reservoir until the pressure in the latter has been restored to the number of pounds desired, and then the exhaust will be effected practically instantaneously and automatically. As the pressure in the auxiliary reservoir and train pipe again becomes reduced, the exhaust will be automatically closed by the action of the spring, and the same retained in this position until said pressure is restored, as will be understood."

Neglected Driver-Brake Packing—Peculiar Antics of a Quick-Action Triple Valve.

Editors:

In the care and maintenance of air-brake apparatus it seems to be a fact that driving-brake cylinders are less cared for, and more neglected, than any other part of the equipment. This is the case on many roads where air brakes are kept in good condition.

No doubt, the trouble with driving-brake cylinder packing is aggravated in many cases by engineers not reporting them properly, but instead they report: "Driving brake only works with an emergency application"; "Clean out triple." Nine cases out of ten there is nothing the matter with the triple; but the whole trouble is leaky cylinder packing.

The trouble seems to be more with the "pull-up" than with the "push-down" type, probably owing to the piston-rod packing in the former leaking, but we have experienced trouble with both types. We now make it a practice to oil these cylinders two or three times a week, and find that by so doing we have a brake that will set and stay set, whether with or without a train.

It has been our experience with the continuous driving brake that in many cases it would work all right with a light engine, and also, perhaps, with a few cars; but with the same reduction on a long train the pistons would not move, owing to the larger volume of air to be reduced, and the consequent slower flow of pressure to the brake cylinders, which allowed the air to flow as fast past the packing as it was delivered by the auxiliary through the triple valve. Doubtless, the heavy oil or grease prescribed by the Air Brake Association will obviate much of this difficulty, especially where driving-brake cylinders are stuck up under running boards, where it is nearly impossible to oil them.

A driving brake is a splendid thing and an air-saver when in proper condition, but a waster of air and a nuisance when neglected. Moral—Keep 'em up.

Saw a pecu iar antic of a car brake some time ago, on a train we were pulling. During a stop at a station where the train crew was unloading way freight, we walked back along the train, fixing a few minor leaks in the train pipe. Noticed a car with triple cut-out—stop cock in cross-over pipe being closed. Upon opening the bleeder on the auxiliary, we found it empty, of course. Not having a full train of air, and wishing to know why this brake was not working, we reached under the car and opened the cut-out cock, when, bang! on went the brake, startling us for a moment, as we knew the auxiliary to be empty. We had been educated in the belief that "straight air" could not be used on a car having a quick-acting triple and in proper condition; but here was a car that went on à la emergency, and that "P. D. Q." The trouble will be quickly apparent to many, but may make a slight puzzle for others. Half of the emergency-valve gasket was gone, allowing full train-pipe pressure to go direct to the brake cylinder.

L. D. SHAFFNER,
Missoula, Mont. Nor. Pac. Ry.

Water-Brake Cards, U. P. R. R.

The indicator diagrams shown above were taken from actual service, and are given, with the following description and instructions, to illustrate graphically the force exerted in the cylinder as braking power, the distribution of that power throughout the stroke, and the variation of power due to the location of the reverse lever.

Card No. 1 was taken with reverse lever just back of center notch.

Card No. 2 was taken with reverse lever well down in back corner.

To Operate.

1st. Open cylinder cocks. (Be sure they will open.)

2d. Open water valve in boiler to admit water to exhaust pipes, before reversing engine.

3d. Put reverse lever a notch or two back of center, and note the vapor escaping through cylinder cocks, which should be damp or wet steam. If dry and of a blue color, the supply of hot water entering the exhaust pipes is insufficient or the water pipe has become stopped.

If too much wet steam issues from the stack, reduce the flow of water at valve. A surplus of water has a tendency to bespatter the engine, but otherwise will do no injury, and a little care will avoid all trouble from this source.

The location of reverse lever back of center notch regulates force of brake, as when working steam.

In a locomotive running forward, with its valve motion reversed, the cylinders become pumps, the exhaust pipes become suction pipes, and by compression in the cylinders the temperature of the com-

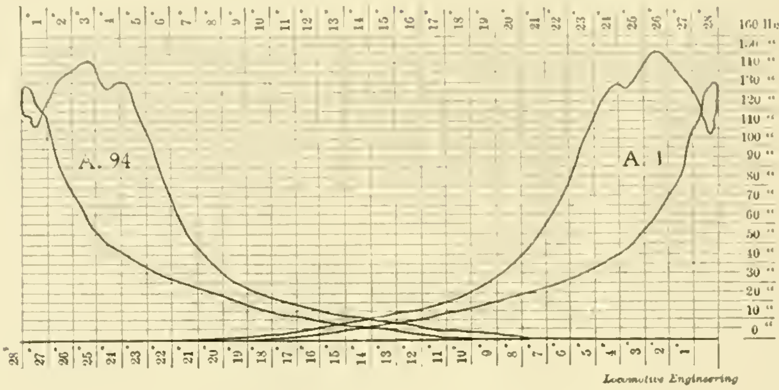


Fig. 1

Indicated pressure—Maximum, 153 pounds; mean, 17½ pounds.
Speed—11 miles per hour.
Indicated horse-power 60.9.
Cut-off—15 inches back motion (outside edge).
Location—Between Borie and Corlett.
Maximum grade—1.51 per cent.

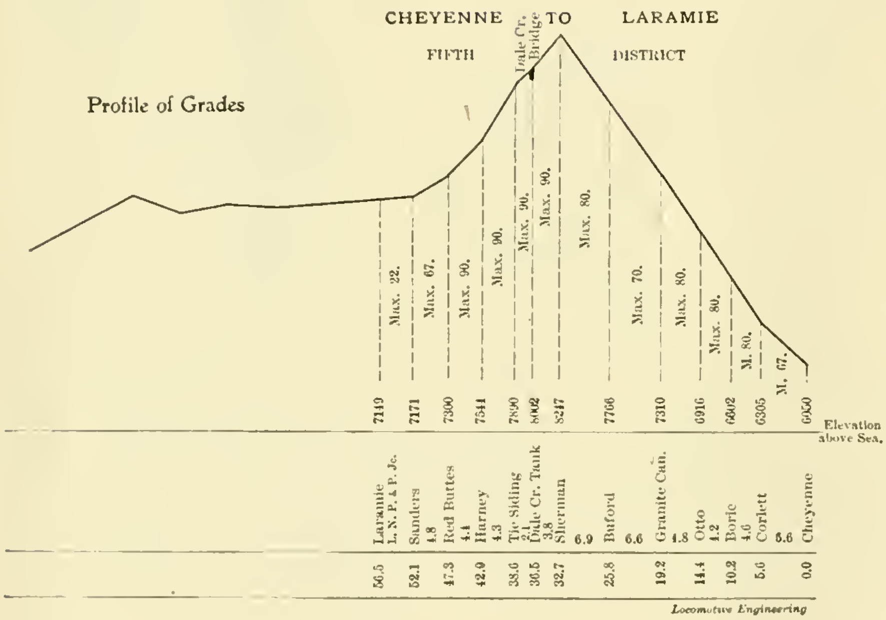


Fig. 3

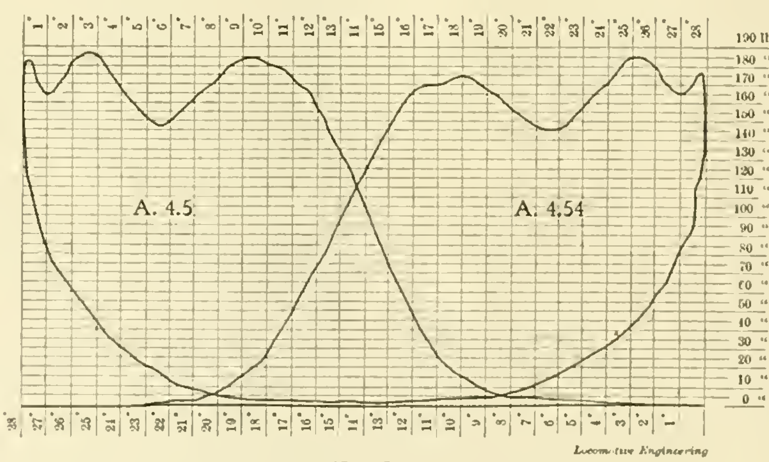


Fig. 2

Indicated pressure—Maximum, 188 pounds; mean, 81½ pounds.
Speed—6 miles per hour.
Indicated horse-power—154.9.
Cut-off—23 inches back motion (outside edge).
Location—Between Borie and Corlett.
Maximum grade—1.51 per cent.

pressed gas increases much more rapidly in degrees than in pounds per square inch, thereby causing more or less injury to cylinders and valve seat by overheating.

The object of the water brake is to substitute vapor or wet steam for the heated gasses which would otherwise be drawn in from the smoke box.

To accomplish this, a sufficient quantity of hot water from the boiler is liberated in the exhaust passages of the cylinders. This water, when relieved of its pressure, flashes into steam or vapor, and is pumped into the cylinder from the exhaust passages. During a portion of the piston stroke, the slide valve opens communication from cylinder to the steam chest, and the accumulated pressure in the cylinders is forced into the steam chest, steam and dry pipes (except that escaping through the cylinder cocks).

This pressure in turn is admitted back into the cylinders when the valve is first opened, as is evinced by consulting the indicator diagrams shown above, causing the rapid rise in the compression line. The irregularity or fluctuation in the high-pressure line is due to the same cause, producing pulsations as shown.

GENERAL DATA.

Train No. 20, June 13th. consisted of 32 loaded cars and 1 empty; pulled by Engine No. 1600.

ENGINE.

Cylinders—22 inches diameter by 28-inch stroke.

Drivers, diameter—51 inches.

Weight of engine and tender—135.5 tons.

Weight of train hauled—888 tons.

Total weight of train—1,023.5 tons.

Note—Diagrams were taken from right-hand cylinder of Engine 1600, with a Tabor indicator, using No. 80 spring. The indicated horse-power shown is for right side, the horse-power developed by the engine = I. H. P. multiplied by 2.

QUESTIONS AND ANSWERS

On Air-Brake Subjects.

(81) C. J. H., Milwaukee, Wis., asks:
Will you please explain through the "Locomotive Engineering" what this "high-speed air brake" is that you mention on page 852 of the October number? A.—Please note answer to A. H. G. on this same subject in this column.

(82) A. H. G., St. Paul, Minn., asks:
1. What is an E-6 brake valve? A.—It is the same as the D-5. In the Westinghouse "D" catalog the cut of the valve appeared on page 5, and was therefore called D-5. In the "E" catalog (the latest) it is placed on page 6 and is designated as E-6.

(83) B. M. D., Cleveland, O., writes:
Give piston travel of driver brake, cam-type, 45-ton engine, 12 x 33 auxiliary reservoir, two 8-inch cylinders; to equalize at 50 pounds on full application. A.—Will vary with amount of piping used between the triple valve and brake cylinders, but should be somewhere between three and four inches.

(84) M. M. H., Burlington, N. J., asks:
1. What makes the hand on air gage move up and down while the pump is working? A.—See reply to same question to M. M. H. in November issue. 2. Please state what kind of oil you would recommend for air end of pump. A.—West Virginia ground oil, 33-degree gravity, or any good oil that will lubricate and not gum.

(85) A. H. G., St. Paul, Minn., asks:
What is the high-speed brake? A.—It is used on passenger cars only, and is an attachment screwed into the brake cylinder which, with an increased leverage and pressure, will stop a train in 25 per cent. shorter distance than the ordinary quick-action brake. A full description of the high-speed brake is given on page 184 of the February issue of "Locomotive Engineering."

(86) B. M. D., Cleveland, O., asks:
Has the Loughridge brake proven successful, and where could I obtain a cut or explanation of the working of it? A.—The Loughridge brake was a plain straight air brake, supplied with pressure by a pump connected to an eccentric on the axle of the locomotive, and was fairly successful in its day. It is not used anywhere now, and we do not know where you could get a treatise on it.

(87) J. G., Kincardine, Ont., asks:
What holds up the plain triple-valve piston when running along after the train pipe and auxiliary resevoir pressures have equalized? I claim that the shoulder on triple piston, when bedded against the case, makes the area on top of piston smaller than that on the bottom, and that, as well as the pressure on back of slide valve, holds it up. Others say that has nothing to do with it, and that it is just the pressure on the slide valve. A.—The pressure on the back of the slide valve is calculated, and is depended upon to hold the piston in place when in release position, and no effort is made to make an air-tight joint between the shoulder on the piston and the case; but where the fit is good, there is no doubt that the effective area is that much reduced and has its effect. The friction of the piston packing ring also contributes.

(88) A. H. G., St. Paul, Minn., writes:
I notice in my paper that port "A" in rotary valve seat of D-8 valve was to make train-line pointer fall in emergency position, same as it does in E-6 or D-5 valves. I can't see that it falls in the brake valve of my engine, which is a D-5. I am told that it does not do it with any D-5. I understand the D-8 and D-5 valves well, and don't understand what should allow the air in chamber D to escape with D-5. Please explain. A.—Chamber D, in the D-5 and E-6 valves is emptied by the pressure passing through the grooves in the face of the rotary valve and rotary seat, which overlap each other, and escapes to the atmosphere through the emergency exhaust port in the back of the brake-valve body. Probably these grooves are partially stopped up with sediment, or, possibly, your valve may be one of the earliest issue of D-5 valves, which were not supplied with these grooves for this purpose.

(89) R. H. S., Brooklyn, N. Y., writes:
In reading W. B. Rogers' "Air Brake Primer," I observe that he does not correspond with one of the questions in the Association of Railroad Air-Brake Men's report of their April convention. Mr. Rogers says that a 5-pound reduction in train-pipe pressure will reduce the auxiliary pressure 5 pounds, giving 12½ pounds per square inch in the brake cylinder. While the Air-Brake Men's report says that in making a 5-pound reduction in train-pipe pressure about 5 pounds would leave auxiliary and flow to the brake cylinder, I would like to be informed just what pressure does go to the brake cylinder on a 5-pound reduction. A.—The answer in the Air-Brake Men's report is right. A 5-pound train-pipe reduction will cause about 5 pounds to leave the auxiliary and go to the brake cylinder. Just what this 5 pounds amounts to in pressure when it gets to the cylinder is governed by the piston travel. Look at table on page 26 of the Air-Brake Men's report for the pressure at all travels with various train-pipe reductions.

(90) H. B. W., Eastland, Cal., writes:
Will you kindly inform me why all 9½-inch Westinghouse air pumps groan continuously? Out of nine pumps now in use on four different roads, all using different valve oil, not one is free from continual groaning. The lubricator is set to feed one drop every two minutes; bleed cock of steam chamber is opened while standing, allowing most of condensation to escape before starting the pump. A.—All 9½-inch air pumps do not groan. It is the exception rather than the rule. In fact, they are much more free from this complaint than the 6 or 8-inch pumps, as the oil follows the steam to the top of the upper head, and is there distributed with the steam. Complaints of this kind have been located in a loose dry pipe to the pump throttle, and also to engines having a comparatively straight boiler with little or no wagon top, whose steam supply for the pump, injectors and other cab fixtures was taken from a turret which had no dry pipe. There is a peculiar gurgling sound in the injector when it is working if the latter cause exists. Possibly the water in that section is bad and causes foaming or priming. Try a faster feed of oil; say, a drop a minute in your case.

(91) M. M. H., Burlington, N. J., writes:
I have an 8-inch Westinghouse air pump and one of the late style of governors. The boiler pressure varies from 70 to 110 pounds. The main reservoir is 30 inches in diameter by 7 feet long, and usually has a pressure of 85 pounds. The governor sometimes sticks when it shuts the pump off, and the pressure runs down to 50 pounds before the pump starts up again. Sometimes the governor will not shut down the pump until after 120 pounds of air has been rammed up. There is a constant blowing at the little hole on the side of the governor. A.—Possibly the variation in the steam pressure has something to do with the trouble. If the constant escape of pressure is through the little port in the spring case, the diaphragm is cracked or loose, and does not allow the pressure to raise the diaphragm valve as it should. When it does rise, the piston is jammed down to the lower end of the cylinder, where it sticks until the pressure is considerably reduced. If the blow is at the hole in the body of the governor, it foretells a short or poorly seating diaphragm valve. The piston is probably loose at the top and tight at the bottom of the cylinder. When the steam pressure is up and the pump is working hard, pressure may be accumulated sufficiently rapid to overcome the leak past the piston to the hole, and cause the piston to descend and shut down the pump. If the piston is tight in the lower end of the cylinder, it may be a long while in starting up again.

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Short Cut-Off Not Always Best.

A correspondent of the "Locomotive Engineers' Monthly Journal" writes: "Professor Goss, of Purdue University, finds that the consumption of steam is less while the locomotive 'Schenectady' is linked to cut-off at 8 inches than it is when linked to cut-off at 6 inches. I suppose Professor Goss acquired this information by applying the indicator. Now, this is contradictory to the teaching of common sense."

The correspondent who stands forth as the champion of common sense is in the position usually spoken of as "going off at half cock." He evidently does not understand that there is a process of steam condensation and re-evaporation going on in the cylinders of steam engines, which, under certain circumstances, produces waste of steam at short cut-offs. For this reason, steam engineers all agree that a slide valve or link motion engine cannot cut off shorter with economy than 25 per cent. of the stroke. In many cases that is too short for the best results, as every old intelligent locomotive engineer knows. When an engineer insists that his engine steams better in the 8 or 9 inch cut-off with the steam partly throttled, than she does while cutting off at 6 inches with the throttle wide open, he probably knows very well what he is talking about, although he may not understand why the engine steams best with the longer cut-off. The steam engineer would tell him that in the longer cut-off the throttled steam was slightly superheated, which tended to elevate the temperature of the cylinder before any of the steam turned into water. In short, the cylinder condensation was so much less with the longer cut-off that less live steam was used in filling the large space behind the piston in the 8-inch cut-off than was needed for the smaller space represented by the 6-inch cut-off.

The writer who raised this question was mistaken in supposing that Professor Goss employed the steam engine indicator alone to find out the volume of steam used under the different cut-offs. The indicator is always used incidentally in the tests of the "Schenectady;" but as all mechanical engineers are aware that the indicator does not render any account of the steam lost by condensation, its record is not taken into consideration by those figuring on the amount of steam used per horsepower, except to ascertain the exact power developed. The volume of steam used is found out by the weight of water fed to the boiler. All the water fed to the boiler is carefully weighed, the waste from the injector is collected, and that weight deducted from the total supply. This provides the means of telling with accuracy how much steam has been generated. The indicator shows what volume of real steam has passed through the cylinders. The difference between the volume of steam represented by the feed water and the steam accounted for by the indicator is usually taken as the loss due to cylinder condensation. It may surprise many people to learn that the loss from this condensation ranges from 15 to 30 per cent. with some locomotives.

While standing up for the accuracy of the statement made by Professor Goss, we are not advocating the practice of throttling or of running with a longer cut-off than what is necessary. We merely take the ground that there are some engines which use steam more economically when cutting off at 33 per cent. of the stroke than they do when cutting off at quarter stroke. The judgment of the engineer must be depended upon to find out what method of working is productive of the best results. The experience with the Purdue locomotive, and the tests made with locomotives on the Chicago & Northwestern testing plant, have proved that no hard-and-fast line can be laid down as to how an engineer should regulate the cut-off.

Value of Grate Area.

The locomotive engine had been only a few years in use when the owners began to realize that an important share of the expenses incurred in operating a railway was due to keeping the fires burning in the firebox of locomotives. The first order to "curtail expenses" directed searching attention to the fuel account. Those responsible for the expense of locomotive performance proceeded to find out if it were possible to perform a given volume of work on less fuel, and their successors are still wrestling to solve the same problem. Among the details that have received much careful investigation, in connection with the question of fuel economy, that of the most satisfactory grate area in relation to the heating surface has been conspicuously prominent.

There are so many variables to be taken into account in recording the operation of a locomotive in train service, that naturally enough the conclusions of different experimenters with locomotives differed very materially concerning the value of large grate area. The famous engineer, D. K. Clark, whose investigations were remarkably thorough, concluded that the most economical grate area was the smallest in which the fuel could be properly consumed. His experiments convinced him that a high firebox temperature was conducive to economy of fuel, and that the grate area should be designed to entail a large consumption of fuel per square foot of grate area. In a table published in "Railway Machinery," on page 156, showing data relative to the performance of locomotive boilers, it appears that those which burned from 80 to 150 pounds of coke per hour evaporated more water per pound of combustible than those burning a smaller quantity. The data were taken from a great variety of locomotives belonging to the principal railways in Great Britain. In a chapter on "The Performances of Locomotives," beginning on page 311, he gives many more facts supplied by a variety of investigators. The data are arranged in convenient tables, and they appear to show that a consumption of from 80 to 120 pounds of coke per square foot of grate area per hour produced the most satisfactory results. Commenting on these data, Clark says: "These abstracts contain a remarkable confirmation of the author's doctrine of a limited fire grate, no larger than necessary for the proper combustion of the fuel, and extended heating surface."

Clark's engineering "doctrines" were long accepted as gospel by the men who designed locomotives, and his influence is still potent in many quarters. American engineers were the first to be a law unto themselves in proportioning grate area to heating surface, but those who broke away from the old rules were not generally considered safe guides. Several papers and reports read before the Railway Master Mechanics' Association seemed to prove that it was easy to have too much grate area in proportion to heating surface, and an influential minority of our designers have displayed a preference for curtailed grate area. Experiments that would be positively conclusive as to the relative value of small and large grate area were really impracticable with road service, and so the question remained unsolved. It appears to us that the period of conflicting opinions has been ended by facts given in a paper by Professor Goss, of Purdue University, read at the New York Railroad Club, on "The Effect of High Rates of Combustion upon the Efficiency of Locomotive Boilers."

The paper describes experiments made with the locomotive "Schenectady," at Purdue University, for the purpose of ascertaining evaporative effects which resulted from contracting the grate area while performing a uniform amount of work. The experiments were conducted in the masterly style that all the practical locomotive problems are worked out at the institution named, and as there are really no disturbing variables in carrying out tests of fuel on a stationary locomotive, the data obtained may safely be accepted as conclusive. The conclusions arrived at are certainly as accurate as those obtained from well-conducted tests of stationary boilers, and they indicate that the boiler of a locomotive acts very much the same as a stationary boiler when it is forced to make steam very rapidly per unit of grate area.

The tests on the locomotive "Schenectady" were arranged so that the same work should be done by the locomotive and the same amount of fuel consumed per hour on a grate of varied area. The first test was made with the engine working under the ordinary conditions, with a cut-off of 25 per cent. of the stroke, and at a speed representing 25 miles per hour. The whole of the grate was covered with fuel, and it was found that 61 pounds of coal per square foot of grate area per hour were consumed in keeping up steam, and that 8.26 pounds of water were evaporated per hour for each pound of coal burned. For the second test they bricked up one-quarter of the grate, worked the engine the same way as in the first test, and found that 84 pounds of coal per square foot of grate were burned, and that the evaporation of water to the pound of coal was 7.84 pounds. For the third test the half of the grate was covered with brick, and under the same conditions of working the engine 124 pounds of coal per foot of grate were consumed to supply the necessary steam, and the evaporation of water per pound of coal was 7.52 pounds. In the fourth test only one-quarter of the grate was used, and the coal consumption per foot was 241 pounds, and the evaporation of water 6.67 pounds per pound of coal. With one-quarter of the grate cut off, the loss in evaporative duty was 5 per cent.; with half the grate area the loss was 8.95 per cent., and with three-quarters cut out the loss in the evaporative value of the fue was 19.2 per cent.

To make the engine generate the same volume of steam for each of the tests, it was necessary to keep reducing the exhaust nozzles every time the area of grate was lessened. This induced increase of spark-throwing, and the heat loss represented by the extra sparks passed through the tubes, represented more than half the loss of efficiency due to the contracted grate area.

The heat losses were due principally to the waste of fuel by sparks, and by the greater velocity of the fuel gases through the tubes, due to the higher smokebox vacuum required to burn all the coal necessary for steam generation and to the greater volume of fuel gases that had to be passed through the tubes in a given unit of time. This, of course, produced a higher smokebox temperature.

The manner in which the heat losses take place is not of so much consequence to railroad men as the prominent fact that it is decidedly more economical to burn 60 pounds of coal per foot of grate than it is to burn 200 pounds on the same area each hour. These tests are likely to be accepted as quite conclusive about the necessity for making the grate area of locomotives as large as possible when the engine is generally worked hard.

In one respect the experiments are rather disappointing. Many locomotives do the greater part of their work with a coal consumption that is probably less than half of that which was the minimum in the tests. It would be interesting to find how far down in fuel consumption a locomotive must go to keep gaining in evaporative efficiency. In cases where bituminous coal was burned in Wootten fireboxes, it has generally been found economical to reduce the grate area. It would be interesting to demonstrate by tests how far this reduction can be carried with advantage. While regretting that the experiments described by Professor Goss did not go farther, we acknowledge that they constitute the most valuable contribution presented to locomotive engineering science for many years.

Does First-Class or Inferior Coal Give the Better Economical Service?

For a year or two past, under the pressure of hard times, quite a number of railroad companies have displayed a desire to reform their methods of purchasing coal. There have been so many discussions at railroad clubs and engineering societies about the reckless practice of purchasing coal without finding out what its steaming qualities were, that the various managers have taken it up with their purchasing departments. We now find it a very common practice to make calorimeter tests and base the price upon the heat-producing quality found by the test. We are afraid, however, that the calorimeter test is going to give false information very often, for recent discoveries seem to show that the best calorimeter in use is very unreliable.

Mr. A. W. Gibbs, assistant engineer of tests of the Pennsylvania Railroad, may be taken as a very fair authority on the value of tests of fuel, and some particulars which he wrote for the Western Railroad Club, on testing coal, will be read with interest. He said:

"The writer has had occasion to tabulate the results of a number of coal tests made with the same locomotives, under similar conditions, in which tests, in addition to data usually given, a chemical analysis and a calorimeter test were made of the coal used each day. It soon became evident that the results of the latter tests were often in conflict with actual results—so much so, in fact, as to make it a question whether much reliance is to be placed upon laboratory tests of this kind. The chief criticism of the chemical test is that it is not sufficiently thorough. The composition of the volatile matter not being fixed, its constituents may be already partially oxidized, in which case the available heat value is reduced. The calorimeter, as a means of determining the heat value, is, I think, little more than a scientific toy—very interesting, but very misleading, because the conditions governing the combustion in the calorimeter differ so widely from those of actual service. I think that the most that can be said for this test is that it gives an idea of the relative possible heat values. There appears to be room for improvement in this method, regarded solely as laboratory tests, because the discrepancies in the results obtained by different instruments and different men are too great.

"As an instance of the conflicting results obtained by the calorimeter, and from service, take one of the coals high in volatile matter: In the former the coal is burned in a submerged crucible, a stream of oxygen gas blowing down upon the coal, which burns only on top. As fast as the volatile part is set free it is completely burned, and finally the fixed carbon is also completely burned. Thus, if the manipulation is perfect, the different constituents of the coal should give up to the water their full heating value. This same coal, in service, is thrown upon a bed of red-hot fuel, where it is first roasted, the volatile parts passing away largely unconsumed, while that part of the fixed carbon which is not carried away bodily by force of the draft is more or less completely burned. The completeness depends upon the depth of the bed, the force of the draft, the proper admission of air, and the time given to gases to burn before they are cooled. Is it wonderful that with such different conditions the results are discordant? In the case of high-carbon coals, which are often very friable, the method by which they are burned principally determines their heating value commercially, and a coal having a very high calorific value may give lower results than one having more ash, because the force of the draft is such as to carry away unburned much of the more friable coal.

"I think that the only way of determining the commercial value of coals is by testing them under conditions similar to those of the proposed service. For railway purposes a test similar to that at Purdue University would settle this question, giving results which can be obtained in no other way. The results not being complicated by invaluable operations of service, would be quickly and cheaply obtained."

It appears to us that the suggestion made by Mr. Gibbs presents a new and highly important reason why the principal railroad companies should establish a locomotive testing plant at their headquarters, similar to that used by the Chicago & Northwestern Railway. Those who have not experimental work enough to make a locomotive of that kind pay, might have their fuels tested at Purdue University, and the expense incurred would certainly be a good investment. All practical men realize that information beyond the chemical constituents of coal is necessary to demonstrate what quality is the most suitable for locomotive purposes. Pocahontas coal is about the best steaming coal found in this country, when used in marine and stationary engine boilers, and it does very well with locomotives; but, under certain circumstances, coals that are of a much inferior quality will cause a locomotive to steam just as freely as Pocahontas coal will do, and there will be no greater quantity of the inferior coal used to do the work. If an experimental locomotive were employed largely in testing the value of different fuels, a great deal of valuable information would come out as to why some coals fail to evaporate the quantity of water which might be expected from their chemical constituents. It would also be an interesting subject of investigation to find out why the poor qualities of Western coal, when burned in some locomotives, will produce steam as freely as the highest quality of coal that can be brought from a distance. Coal deficient in fixed carbon and hydro-carbon compounds is not of so much commercial value as the higher qualities of coal, and consequently railroad companies, as a rule, do not pay a first-class price for them; and yet, under proper management, the inferior coal will sometimes go as far, weight for weight, as that which theoretically has greater value.

Reliable information is very badly needed concerning the conditions under which first-class coal will pay better than inferior coal when burned in the fireboxes of locomotives. Many railroad men think that the best coal to be found is none too good for locomotive use, and we have always sympathized with their sentiments in this respect, but it is possible that they may be mistaken in their views. We are aware of one case where a railroad company in the Northwest was paying a very high price for Hocking Valley coal, and the officers in charge insisted that no cheaper quality of coal could be burned satisfactorily by their locomotives. A new superintendent of motive power investigated the case, and decided that there would be no difficulty in making the engines burn Western coal, for others on neighboring roads were doing it without difficulty in keeping time with trains. The first attempt to burn Illinois coal was not a sucess for a variety of reasons, the principal one being that the grates were not adapted for burning inferior coal. A new design of grate was made with a much larger percentage of air openings, and with that change, and a little extra supervision at first, the engines steamed as freely as they did with the higher grade of coal, and the quantity burned was very little greater than what they used with the other coal. The saving to the railroad company was over 25 per cent. of the fuel bills incurred with the Hocking Valley coal.

It is very likely that there are other railroad companies throughout the country that might save largely on their coal bills if they knew the conditions that were best adapted to the burning of inferior fuel. There is, at any rate, no subject at present before railroad men which is likely to produce better returns than the securing of reliable information as to how different qualities of fuel can be most economically burned in the fireboxes of locomotives.

The Schenectady Locomotive Works are building for the Northern Pacific Railway Company four mastodon or twelve-wheel compound locomotives, which will be the most powerful engines of this type ever constructed. The engines are of the Schenectady two-cylinder compound type, the high-pressure cylinder being 23 inches and the low-pressure 34 inches in diameter, with a stroke of 30 inches. The cylinders are fitted with the new intercepting valve, designed by the Schenectady Locomotive Works, which enables the engine to be operated as simple or compound at will, this device now being in very successful use. The weight of the engine will be about 180,000 pounds, with 148,000 pounds on drivers. The driving-wheel centers are of cast steel, 48 inches in diameter, which with 3½-inch tire makes the diameter of drivers 55 inches. The boiler is of the extended wagon-top type, 72 inches at front end; has a larger heating surface than ever used in locomotive practice, and is built to carry a working pressure of 200 pounds.

We understand that piston rings made of steel are coming largely into use in Great Britain for stationary engine purposes. This material is reported to be pushing out the use of cast-iron, brass and phosphor bronze rings. The reason for the change appears to be that the steel ring can be made much lighter, is less liable to breakage, and wears as well as rings made from other material.

PERSONAL.

Mr. T. H. Russom has been appointed general car foreman of the Mt. Clare shops, B. & O.

Mr. H. T. Woods has been appointed general manager of the Tabor & Northern, with headquarters at Tabor, Ia.

Mr. A. M. Stark has been appointed superintendent of the Pecos River Railroad, with headquarters at Pecos, Tex.

Mr. P. F. Smith has been appointed master mechanic of the Pittsburgh, Ft. Wayne & Chicago shops at Crestline, O.

Mr. W. W. Tomlinson has been appointed chief engineer of the New Orleans & Western, with headquarters at New Orleans, La.

Mr. W. G. Wallace, a well-known engineer on the Chicago & Northwestern Railroad, has been made traveling engineer of the Madison division.

Mr. Thomas F. Butler, master mechanic of the Pennsylvania lines at Wellsville, O., has been transferred to Columbus, O., as master mechanic.

Mr. Bernard Fitzpatrick, master mechanic of the Pennsylvania lines at Columbus, O., has been appointed master mechanic at Fort Wayne, Ind.

Mr. P. F. Smith, Jr., assistant master mechanic of the Fort Wayne shops of the Pennsylvania Company, has been appointed master mechanic at Crestline, O.

Mr. W. H. Stocks has been appointed division master mechanic of the East Iowa division of the Chicago, Rock Island & Pacific, with headquarters at Rock Island.

Mr. George P. Sweeley, master mechanic of the shops of the Pennsylvania Company at Crestline, O., has been transferred to Wellsville, O., as master mechanic.

Mr. S. M. Dolan has been appointed master mechanic of the Wiggins Ferry Company, with headquarters at St. Louis. He was formerly assistant master mechanic.

Mr. R. H. Organ, general storekeeper of the Butte, Anaconda & Pacific, has resigned, and his place has been filled by Mr. Wm. Wood, formerly clerk of the store department.

Mr. C. H. Spencer has been appointed assistant general manager of the Quincy, Omaha & Kansas City, and will be particularly intrusted with the purchasing of material and supplies.

Mr. George C. De Young, heretofore trainmaster, has been appointed superintendent of the Sabine & East Texas division of the Southern Pacific, with headquarters at Beaumont, Tex.

Mr. Allan J. Smith, chief clerk to Superintendent Sullivan, of the Kansas City, Memphis & Birmingham, has been appointed trainmaster of that road, with headquarters at Birmingham, Ala.

Mr. William W. Noble has been appointed purchasing agent and paymaster of the Huntingdon & Broad Top Mountain, in place of Mr. S. B. Knight, resigned. Headquarters, Philadelphia, Pa.

Mr. James A. Davis has been appointed industrial commissioner of the Santa Fé. His duties will be to look after the various industries owned by the road, they being separated from the management of the main property.

Mr. J. J. Thomas, Jr., has been appointed master mechanic of the Mobile & Birmingham Railroad, with headquarters at Mobile, Ala. He was formerly master mechanic on the Birmingham & Atlantic Railroad.

Mr. W. de Sanno, a well-known contributor to "Locomotive Engineering," has been appointed master mechanic of the Chicago & Southeastern Railway, with headquarters at Lebanon, Ind. The road is 110 miles long.

Mr. Joseph McWilliams, superintendent of the Marietta & North Georgia, has been appointed general manager of the Atlanta, Knoxville & Northern, which is a reorganization of the Marietta & North Georgia. Headquarters, Atlanta, Ga.

Mr. James Gannon has been promoted to be general engine dispatcher of all divisions of the New York Central terminating in New York. He is a brother of Mr. Frank S. Gannon, general manager of the Staten Island Rapid Transit.

Mr. F. C. Humphrey has been appointed general foreman of the locomotive and car repairs of the Kansas City, Pittsburgh & Gulf, with headquarters in Kansas City. He was formerly foreman on the Fremont, Elkhorn & Missouri Valley at Superior, Neb.

Mr. James A. Egan has been elected vice-president and general manager of the Central of Georgia Railroad, with headquarters at Savannah, Ga. Mr. Egan has been general manager of several Northwest roads, and he is considered a man of high executive ability.

Mr. J. T. Odell, the well-known railroad manager, has entered upon his duties as president of the Butler & Pittsburgh Railroad, a line which is under construction for the purpose of facilitating the transportation of ores and other material from Lake Erie to the Carnegie Works at Pittsburgh, Pa.

We have to acknowledge a pleasant call last month from Mr. L. P. Ligon, master mechanic, and Mr. Jos. Longstreth, road foreman of engines of the Norfolk & Western, at Bluefields, W. Va. Both these gentlemen have been making a tour of railroad shops looking out for information that may be of benefit to their employers.

Mr. W. W. Atwood has been appointed superintendent of the Charleston, Clendennin & Sutton Railroad, with headquarters at Charleston, W. Va. Mr. Atwood is a well-known railroad man, having formerly been superintendent of the Bradford, Bordell & Kinzua Railway, and afterwards general manager of the Middlesex Valley Railroad.

Mr. R. H. Johnson has been appointed master mechanic of the Atlanta & West Point Railroad, with headquarters at Montgomery, Ala. Mr. Johnson was formerly master mechanic for the Wiggins Ferry Company at St. Louis; when he left, the employés of the locomotive and car departments presented him with a handsome watch chain and charm.

Mr. James McCrea, Jr., son of First Vice-President McCrea, of the Pennsylvania Company, has been appointed engineer of maintenance of way of the Indianapolis & Vincennes. Mr. McCrea is a graduate of Yale, and is said to have been a very bright engineering student. If he is energetic, industrious and ambitious, he may become a successful railroad man in spite of the drawbacks of being the son of a general manager.

Mr. J. S. Chambers has been appointed master mechanic of the Paducah shops of the Illinois Central Railroad, with jurisdiction over the affairs of the machinery department on the Louisville division and the Fulton district of the Memphis division. His headquarters will be at Paducah, Ky. Mr. Chambers has been for some years master mechanic for the Illinois Central at Clinton, Ill., and has been noted for the able management of his division.

Mr. Oscar G. Murray, receiver of the Baltimore & Ohio, appears to appreciate the value of advertising and the financial benefit of keeping the merits of the railroad before the public. According to a recent circular, he has appointed Mr. James H. Maddy press agent of the road, with headquarters at Baltimore. The officers and employés of the road are directed to respond to his requests for information and aid him in every way to secure such matters as he may require; all events that if published would be of interest and tend to favorably advertise the road must be promptly reported to Mr. Maddy.

Mr. William W. Atterbury has been promoted from the position of master mechanic of the Western division of the Pennsylvania Railroad to be superintendent of motive power at Altoona, in place of Mr. Wallis, promoted. Mr. Atterbury learned the machinist trade in the Altoona shops and gradually rose through various steps to the position of master mechanic, which he has held since 1893. He is an exceptionally able shopman, and many of the labor-saving appliances in use in the Ft. Wayne shops were devised under his supervision. He is a very active, energetic young man, and will doubtless make a success at Altoona.

A general order issued by General Manager Green announces the following official changes on the Baltimore & Ohio: Mr. J. E. Spurrier, superintendent of the Baltimore division, will hereafter have charge of the First division, including Brunswick Yard, Curtis Bay, Washington, Alexandria, Metropolitan and Frederick branches, and Washington County Railroad. Mr. F. A. Husted is hereby appointed superintendent of the Second and Third divisions, including the Berkeley Springs and Potomac and South Branch railroads, which will hereafter be known as the Middle division. Mr. R. M. Sheats, superintendent of the Parkersburg and Wheeling division, will have charge of the Fourth and Fifth divisions, including Grafton Yard and Grafton and Belington division.

About the time we went to press last month, Mr. John M. Wallis, superintendent of motive power of the Pennsylvania Railroad at Altoona, Pa., was appointed general superintendent of the Philadelphia & Erie and Northern Central railroads of the Pennsylvania system, with headquarters at Williamsport, Pa. The duties of general superintendent will not come strange to Mr. Wallis for he acted in the capacity for several months during the sickness of Mr. Sheppard. Mr. Wallis has been very successful in the various positions he has held in railroad service, and is a man of very strong personality. After graduating from a technical college he entered the shops of the Northern Central at Baltimore and learned the machinist trade. In 1879 he was appointed assistant road foreman of engines of the Baltimore & Potomac division. Two years later he was made assistant engineer of tests of the Pennsylvania Railroad at Altoona, from whence he was promoted to be superintendent of motive power of the Northern Central. After that he was for some time superintendent of motive power of the Philadelphia, Wilmington & Baltimore, and since 1890 has been superintendent of motive power at Altoona.

A somewhat ingenious monogram has been made by Mr. A. D. Thomas, of Lima, O., on the name of the Colum*bu*s, Ho*c*king Vall*ey* & Tol*e*do Railway. He arranged the words in a column, and made the letters printed in italics stand out prominently to spell "Buckeye," a word the company delights to use.

English people say that wire nails were first made in Russia, and that they were introduced into Great Britain during the London Exhibition of 1851. The thing looks so much like a Yankee invention that we are inclined to give Connecticut the credit without knowing who made wire nails first. Can any reader advance a better claim?

Tabor Molding Machine Stolen.

The Illinois Central Railroad Company purchased a Tabor molding machine some time ago and set it up in a foundry near Chicago, where it was used for molding brake shoes and other castings of uniform size. The foundry is situated in a lonely part, with few buildings near it. As there seemed to be so few things in the building that would excite the cupidity of thieves, no night watchman was employed in the place.

One morning lately, when the man in charge reached the foundry, he found that the Tabor molding machine was gone. It was a big machine, weighing about 3,000 pounds, but some enterprising thieves carried it off and left no trace of where they had taken it. They carried off all the attachments and left behind only the foundation. The owners of the machine have employed detectives to try to trace it, but up to the time of writing they have met with no success. All the foundries in the neighborhood of Chicago where molding machines are in use have been searched in vain. The machine has disappeared as utterly as if it were some article that could be carried away in a thief's pocket.

Wisconsin University Bulletins.

"Emergencies in Railroad Work," by L. F. Loree, American Society of Civil Engineers, is the title of one of the bulletins of the University of Wisconsin. It is a remarkably interesting number, and gives a great many particulars about dealing with wrecks and railroad disasters. There is a remarkably good description of the Johnstown disaster and the methods adopted to open the road promptly for traffic. It also gives a great many particulars about the Chicago riots of 1894 and the means pursued by the railroad companies to keep their tracks open.

Among other bulletins published by the University of Wisconsin, that have recently reached our desk, are "Electric Engineering in Modern Central Stations," by Louis F. Ferguson, S. B.; "Railway Signaling," by W. Mc C. Grafton, C. E.: "The Problem of Economical Heat, Light and Power Supply for Building Blocks, School Houses, Dwellings, etc.," by G. Adolph Gerdtzen, B. S., and "A Complete Test of Modern American Transformers of Modern Capacity," by Arthur Hillyer Ford, B. S. Any of these bulletins can be obtained from the University of Wisconsin, Madison, Wis., price 35 cents each.

Give the Apprentice a Chance.

Ever since the Railway Master Mechanics' Association undertook to investigate the status of the apprentice boy, there has been a great deal of discussion on the subject in newspapers and by railroad clubs. This is very proper, but there is a tendency in the helpful sympathy to move in impracticable directions. The apprentices in many railroad shops are suffering from grievances that could be easily remedied by the men in charge of the shops, at very little expense or inconvenience to the employers; but instead of urging practical remedies, the reformers are calling for technical education for the boys — a measure not easily carried out. The most urgent reform needed is the giving of the boys the opportunity to learn the trade they went into the shop to learn.

We know of a case where a young man came to the newly appointed superintendent of one of the largest railroad shops in the country and asked to be moved from a drill press to another tool. "How long have you worked on the drill press?" asked the superintendent. "Three years and eleven months," was the answer. The apprentice had been working on a drill press ever since he entered the shop, and his apprenticeship was one month from being ended. No amount of importunity had succeeded in getting him moved to other work. This kind of practice prevails in many shops, and the change demanded is the introduction of some system that will call for apprentices being given the opportunity to learn the trade, not to learn one operation.

Among the various public expressions of views concerning the betterment of the condition of apprentices, we have seen none that seemed to fit the case so well as remarks made by Mr. William Forsyth at the Western Railroad Club. He said:

"I think that nearly every railroad hop has in its superintendent of motive power and in its foreman the opportunity to do a good work for the apprentice boy, but they are shirking it, they are avoiding it. When I was learning my trade I was given an old lathe, with a worn-out lead screw, and a rickety tail-stock, and a slippery belt, and I was kept there turning bolts for several months. The foreman did not take any interest in me, there was nobody in the shop who tried to teach me anything, and if I learned anything it was because a boy absorbs something from his surroundings in four years, and he may be able to pick up something for himself if nobody helps him. That really is the condition of the apprentice boy of most railroad shops in this country to-day. So that if we want to do anything to help him, do not start with an ambitious scheme of giving him a technical education, but let us look after him a little in the shop, and in the first place try and make a good mechanic of him. As a practical suggestion in this line I should think that we ought to try and find some one in our shops who is a natural teacher, if we can, some good mechanic who has a faculty of imparting his knowledge to others, and let him have some oversight of the apprentices. Let him be one that they can go to and ask questions, find out something about what they are working at, and after that establish a class of some kind and get started at a night school and gradually develop an attempt at some of the education.

"I should think, too, that there ought to be two kinds of apprentices, one whose aim is to be a good mechanic, and another who is ambitious to be something of an engineer. The course of the two should be slightly different. The mechanic would probably spend most of his time in the machine shop and be given a general course through the erecting shop and with all the various machine tools. The engineering apprentice ought to have in addition to that some time in the pattern shop, and then in the foundry if possible, and in the testing room and in the drafting room.

"As for the regular machinist apprentice, there is a greater necessity now for some reform in this direction than there has been in the past, on account of the piece work system. I believe that the tendency is to specialize work, and nothing is going to do it more rapidly than piece-work, and if you are not careful we will have our apprentices making one thing for months at a time, and they will not become skilled mechanics. So I hope that in the ambitious schemes for education which have been mentioned in connection with the apprentice boy since the Master Mechanics' Convention, and at that convention, we will not lose sight of his mechanical training in the efforts to make him a skilled mechanic."

H. K. Porter & Co., of Pittsburgh, builders of light locomotives, have issued a new pamphlet illustrating their locomotives operated by compressed air and the purposes for which they are principally employed. The field for operating locomotives by compressed air is extending very steadily, and very satisfactory results are obtained from the engines. Two of the illustrations show compressed-air locomotives working in the Chalmette cotton warehouse and yards of the New Orleans & Western Railroad. The cotton is brought to the yards in ordinary loose bales, loaded in standard-gage cars of usual construction. The bales are then handled by the air locomotive, and after being compressed so that two bales take up about the same space as one ordinary bale, they are hauled to the wharf and loaded for export. The plant occupies about 250 acres, and contains 80 cotton warehouses, hydraulic presses, air presses, electric light plant, receiving and shipping sheds, elevators, etc. The locomotives have a very novel appearance, and the catalog gives many interesting particulars about their work.

EQUIPMENT NOTES.

The Illinois Central has contracted for 1,000 more box cars.

The Gulf, Beaumont & Kansas City is in the market for box cars.

The Lake Erie & Western is said to be in the market for locomotives and cars.

The Chicago, Hamilton & Western is in the market for box cars and refrigerator cars.

The Wason Car Company is building twenty passenger cars for the Central Railway of Brazil.

The Jackson & Woodin Car Company has received an order for 200 cars from the Vera Paz Railway.

The Green Bay & Western Railway has ordered two locomotives from the Dickson Locomotive Works.

The Bangor & Aroostook Railroad has ordered 600 freight cars from the Jackson & Woodin Car Company.

The Vera Paz Railway has placed an order with the Baldwin Locomotive Works for one locomotive.

Both the Delaware & Hudson Canal and Fall Brook Railway companies are reported to be in the market for locomotives.

The Wabash people have sent out specifications for fifteen 10-wheel freight engines and five 10-wheel passenger engines. Prompt delivery is demanded.

The Baltimore & Ohio has contracted for 1,000 more freight cars, and it is reported that they expect to order several thousand more in the near future.

The Rio Grande, Sierra Madre & Pacific Railroad of Mexico has ordered 150 freight cars, 8 passenger, and 3 caboose cars from the Ohio Falls Manufacturing Company.

The air appears to be charged with rumors about the ordering of railroad rolling stock, but the actual orders given out have not been very numerous during the month.

The Mobile & Ohio has placed an order for six locomotives with the Rogers Locomotive Works, and twenty-five refrigerator cars of 60,000 pounds capacity from the Mt. Vernon Car Company.

The Baltimore & Ohio has received ten passenger cars, recently ordered from Barney & Smith. They are very handsome cars, 60 feet long, painted blue, and fitted up with all the most recent equipment for first-class cars.

The officers of the Lehigh Valley Railroad have granted the engineering students of the Lehigh University the privilege of visiting all their repair shops for the purpose of study. They also enjoy similar privileges from the Bethlehem Iron Company.

Praise for the "Nickel Plate."

"The Railway Agent" publishes the remarks we made some time ago about the dining-car service of the "Nickel Plate," and adds other remarks which we can indorse from personal experience. It says:

"In conjunction with the above article we feel justified in adding our compliments to the painstaking management of the Nickel Plate Road. It has been our good fortune to have occasion to use this line in our frequent trips from Chicago to New York City and Boston.

"While traveling in one of the day coaches in a little jaunt from a local station into Buffalo, I was impressed with the cleanliness of the car. The secret was soon divulged. Along came a colored porter in uniform, dust cloth and brush in hand, and with a polish here and a wipe there, the seats, window sills, and floor were kept scrupulously clean.

"The schedules of their fast trains are convenient, and the sleeping cars placed in the regular daily service are of the most luxuriant type of modern car construction. Solid trains are run between Chicago, Buffalo and New York City, and through sleepers to Boston.

"A fact worthy of note yet remains to be pointed out to the readers of this journal, which, perhaps, had not come to the notice of many. Rates are offered between the same points lower than those quoted by competitors of the Nickel Plate Road, and from my experience their passenger facilities are excelled by none."

The Nicholson File Company, of Providence, R. I., report that the additions, repairs and extensions upon which they have been engaged throughout their four factories during the past few months are nearing completion, and that they will soon be in a position to handle with ease the increasing volume of business. The constantly growing export business of this firm, together with the prospect of a considerably enlarged demand from the home trade upon the return of commercial activity and prosperity, necessitated some material changes about their works. Consequently, an increased force of designers and draftsmen have been engaged in designing and plotting improvements in both buildings and machinery—the capacity of the former has been increased by a more judicious distribution of some of the machinery; while the large new annealing house, completed but a few months previously, has been perfected. Other minor extensions have also been made. As for the machinery, a considerable number of new machines have been added to both the forging and cutting departments; while the product of the machines on hand has in many instances been doubled, and in some even tripled, by improvements. A new idea in rasp machines has been conceived and perfected, that will enable a vastly increased number of more efficient rasps to be turned out daily. Altogether, the dull season during the past few months has proved valuable, they state, in enabling them to prepare more completely for the future.

A new illustrated catalog called "Modern Methods" has been published by the Link-Belt Engineering Company, of Philadelphia. The catalog is got out in very handsome style and illustrates a variety of purposes for which the link-belt machinery is used. The link-belt apparatus appears to be employed for a great many purposes—many more than we had any idea of. We find pictures of it in connection with the operating of coal breakers, moving a continuous molding system, acting as a carrier for logs, supplying coal to power houses, conveying supplies to locomotive coal stations, elevating coal out of docks, elevating ice, sugar and a great many other kinds of material. It is to be seen acting as a conveyor for the "Ladies' Home Journal" and for distributing papers in a large newspaper office. Besides supplying conveying material, the company handles a great many mechanical articles, such as clutches, friction gearing, log jacks, shaft hangers, journal bearings, pillar blocks and a great variety of other articles. Parties interested in these kinds of articles ought to send for the catalog, which will be found a very useful reference.

The Niles Tool Works have been fairly busy all summer, foreign orders having made up for dullness in the home trade. They are doing some exceedingly heavy work on home orders. There is on the floor of the erecting shop an exceedingly heavy planer, 12 x 25 feet, for the Watervliet Arsenal. There is also a set of Government rolls for inch plate, 24 feet wide; and two immense boring mills, one for the Westinghouse Machine Company, the other for a Milwaukee firm. They are meeting with a good demand for their new turret lathe.

The Buffalo Forge Company, Buffalo, N. Y., have recently been awarded a contract for two 15 x 15 Buffalo center-crank automatic horizontal Class "A" engines, to be direct-connected to card generators, for the Lakeside Hospital, Cincinnati, O. The plant also involves the use of one 8 x 8 for belt connection to smaller dynamo.

There is a steam launch in New York harbor which has the water glass on the boiler upside down; *i. e.*, the cock by which it is blown out is at the top of the glass instead of at the bottom, so that the glass is blown out by water instead of by steam, and the result is that the glass is kept much cleaner than when steam is used.

Persons watching the big freight locomotives belonging to the Jersey Central Railroad, handling a train of about one hundred Jimmey coal cars, are liable to think that the engineer has an easy job, yet he needs to be possessed of more skill in handling an engine than what is called for by any other kind of service that we are acquainted with. A train of that kind has about two hundred feet of slack, owing to the chain couplings used. In starting, the engine may easily be going ten or twelve miles an hour before the caboose begins to move, and making a jump from nothing to ten miles, is not healthy for even chain couplers, to say nothing of their connections. After the train has been started without accident, extreme care and judgment are required to prevent shocks that are little less than collisions. Sags and hog-backs combine to make one part of the train crush together with a force that tries the strongest resisting material, while other parts have to withstand violent forces tending to tear them asunder. Yet the men handling the engines do their work so skillfully that breakages in two and other accidents are very rare. They go on, day by day and night after night, without the least mishaps, and get trains over the road with promptness and regularity. First-class engineers, not accustomed to this peculiar work, would have the trains broken in two every mile.

The Ohio Machine Company, Middletown, O., report that they are making considerable progress in putting the Schlieper system of feed-water heater and purifier upon the market. The combined purifier and heater takes the water in at the top of a vertical cylinder, where it drops into a series of troughs that can be very conveniently removed. The solid matter contained in the water, when subject to a certain temperature, settles in these troughs, and the purified water drops down into the body of the vessel, from which it is pumped into the boiler. It is a very simple arrangement, costs little, and is said to do its work very satisfactorily.

The Westinghouse Air-Brake Company has bought the buildings and grounds for a manufacturing plant at Hamilton, Ont., Canada, and will soon begin the manufacture of air brakes at that place to fill the large orders coming from the Canadian railroads. The plant will be permanent. A Canadian company has been formed, and Mr. Geo. F. Evans, of New York, will be general manager. The Canadian duty on air brakes is about 33 per cent., and it is to avoid this duty that the plant is being installed. Mexico admits air brakes and similar railway supplies free of duty.

The interesting spectacle of an engine of a fast express hustling toward Boston while the train stayed 9 miles behind was produced on the N. Y., N. H. & H. R. R. last Monday night: The engine of the "Colonial Express" broke away from the train at Canton Junction. The act of doing this set the air brake, stopping the cars and putting just enough drag on the engine to make the weight seem about the same as before. In consequence, the engineer pegged steadily away toward Boston, never once realizing that his train was miles behind in the woods. The railroad people at Readville saw him go by and telegraphed Forest Hills to stop him, which was done. Had this not been done, he undoubtedly would have pulled into the Boston station with nothing but the car-brake pressure to show for his journey.—Ex.

A contract for twenty-five air compressors and twenty-five air receivers, of medium and small sizes, has been closed by the Clayton Air Compressor Works, Havemeyer Building, New York, with one company, delivery of the entire order to be made within six months from date. They also report sales of five air compressors of standard pattern during the first week in November, and the indications point to a decided revival of trade in air compressors, many orders having been held in abeyance, pending the result of the Election.

We have received from Mr. W. T. Chamberlain, Norwich, Conn., patent papers describing a petroleum-burning furnace which he has invented. As shown in the patent papers, the invention is applied to a locomotive firebox and consists of a series of pipes placed outside the firebox, from which oil is to be injected through hollow staybolts. The drawings show the pipes extending up the side almost to the top of the flue sheet. The inventor proposes to have the exhaust steam from the cylinders pass out without causing any draft on the fire, a special blower being used for draft purposes. We have not heard of the invention being applied to any boiler.

On many railroads it is the practice to take ordinary air-brake hose and paint it red for use in connection with the train-signal system. The paint is injurious to rubber goods, as the oil has a tendency to soften and crack rubber. To overcome this objection, the Boston Belting Company, Boston, introduced their red signal hose, the distinctive features of which are its natural red color and a peculiar rough surface, which enable the trainmen to instantly distinguish the signal from the air-brake hose either night or day.

At a recent meeting of the Western Railway Club, statements were made concerning the number of breakages-in-two of trains caused by the Master Car Builders' coupler working itself apart, which indicate that the vertical plane coupler has introduced a new source of annoyance to trainmen and of delay in train operating. We believe that the proper remedy against this evil would be strict gaging of all knuckles to see that they conform exactly to the standard lines. The rules of the Master Car Builders' Association call for knuckles being gaged, but the rule is more honored in the breach than in the observance. Rejecting cars at interchange points for trifling defects is an annoyance that railroad companies will not submit to, but we think that raids should be made on the companies equipping their cars with couplers that have knuckles not conforming to the Master Car-Builders' lines. The fact that cars were refused on this account would bring the owners into undesirable prominence for senseless management, for it would cost no more to have couplers conforming to standard lines, only a little more care, and that belongs to doing things on business principles.

It is said that during the past summer about 600 old horse-cars, that had been pushed into disuse by the introduction of electricity on street railways, had been utilized as cottages for hunters, camps, lodges, etc. These cars make a very convenient portable hut, and are not difficult to move from one place to another. Their use during the last season has been confined mostly to Long Island and the coast of Connecticut, but the indications are that old horse-cars will be used for this purpose all over the country.

The Leather Preserver Manufacturing Company, of Chicago, are meeting with much success with a process they have for cleaning and preserving leather belting. The process removes all oil and grease from belts, and puts on a soft glossy polish which is impervious to grease and moisture and makes the belt highly flexible. Parties interested in the preservation of belts should send for the circular issued by the company.

There is a standing order in one of the largest engineering establishments in Pittsburgh, Pa., to employ any workman who has learned his trade in the Pittsburgh Locomotive Works, no matter whether men are wanted or not. Men trained in the Pittsburgh Locomotive Works have invariably proved themselves such good workmen that it pays to employ them.

Proposes a Locomotive Foremen's Association.

A locomotive foreman employed on one of our leading trunk lines writes:

"I would like to see the locomotive and shop foremen employed on the railways of the United States and Canada come together and form an association similar to the Traveling Engineers' Association, where they could meet once a year and discuss matters pertaining to the work of their positions. I am sure an association of this kind would be a great benefit to the foremen, and also to the railway companies. I would like to hear from some of the foremen in regard to this matter."

Graphite Lubricator.

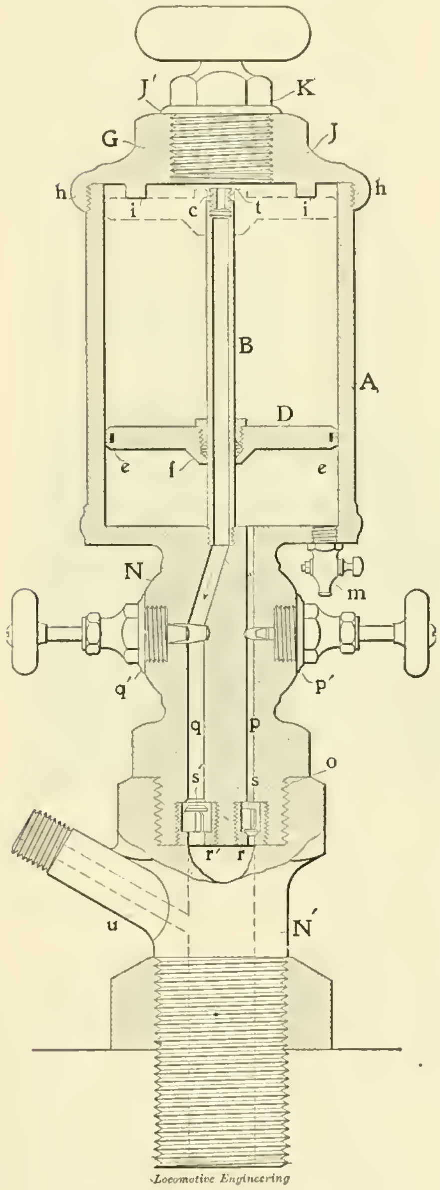
The object of the invention shown in the annexed engraving is to provide a lubricator for using flake graphite on locomotive valves and cylinders. As a lubricant for steam valves in locomotives, the flake graphite referred to is a very superior article; but it has been found difficult to use, and very unsatisfactory results have been obtained with the various lubricator cups now in use, because of the tendency of the graphite to settle in a solid mass in the bottom of the lubricator cup. By the use of this lubricator, the difficulties referred to have been overcome, and flake graphite may now be used for steam valves and cylinders with the very best results.

The engraving shows a vertical section of the lubricant, and the position it will occupy on a locomotive. The letter *A* designates the cup or receptacle to contain the graphite. A stationary feed tube *B* is secured in the bottom of the cup, and projects upward at the center. At the top, this tube has an internal screw thread, and an inlet nozzle *c* is fitted therein and is vertically adjustable. The space *t* above the inlet nozzle will be filled with flake graphite. By vertically adjusting this inlet nozzle, the space may be reduced or increased, and the quantity of graphite that will accumulate over the nozzle to be fed may be regulated.

A piston *D* fits within the cup, and on its rim has packing-rings *e* to make it fit steam-tight. The center of the piston on its lower side has an enlargement *f*, something like a hub, and is bored to fit and slide on the central feed-tube. On top, piston *D* is bored out to receive fibrous packing and gland nut, in order to have the same steam-tight. The flake graphite is to be placed in the cup *A* upon this piston, which latter serves as a movable bottom.

When steam is admitted below the piston, the piston will be lifted and the entire bulk of lubricator above the piston will also be lifted.

The operation is as follows: When the engine is working, the steam pressure will raise and close the check valve *s'*, and thus close the graphite feed passage; and at the same time will raise and open the check valve *s*, and allow the steam to pass to the cup below the piston, and cause the piston to move upward and force the flake graphite to fill the space at *t* above the inlet nozzle *c*. When steam is shut off, the steam check valve *s* will drop to its seat, and thus retain the pressure below the piston. At the same moment the graphite check valve will unseat, and



Locomotive Engineering

by the suction action of the locomotive valve and piston the graphite in the space *t* will be drawn through the feed tube *B*, passage *q*, and through the unseated check valve *s'* into the locomotive steam chest and cylinder. This operation will be repeated each time the steam is used and shut off by the engineer while the locomotive is in motion.

The cup was designed and patented by A. D. Homard, Massillon, O., an engineer on the Wheeling & Lake Erie.

Mixing Compressed Air with Steam.

Among the many delusions which the engineering world has been asked to believe in, and which obtained a large number of converts at different times, was a theory that steam would do more work when it was mixed with air than it would do as mere vapor of water. Professor Denton, of the Stevens Institute of Technology, has given the killing blow to this fallacy. He directed students to make tests of an engine in which compressed air was supplied along with the steam. The "Stevens Indicator" publishes the following remarks from Professor Denton on the subject:

"Previous to the period when the performance of steam engines was generally studied by aid of the indicator cards, and a measurement of the actual weight of steam used, the admixtion of air with the steam supplied to engines was believed, by some engineers of considerable prominence, to be attended with remarkable results.

"For example, in 1854, Horatio Allen, a leading authority on American steam-engine practice, reported the witnessing of experiments with an 8 x 12-inch steam engine, driving four printing presses, in New York City, which would run but one printing press when receiving steam at 80 pounds pressure, cut-off at 3 inches of the stroke; whereas, when the engine received air compressed at 20 pounds pressure during the first 1½ inches of the piston travel, and then took steam at 80 pounds pressure up to 3 inches of the stroke, all four of the presses could be driven.

"Mr. Allen was so strongly impressed with this performance that he prophesied the general adoption of such a system as embodying a substantial improvement in steam-engine practice.

"The idea attracted considerable attention for many years, during which the same paradoxical results were occasionally reported, without any explanation of them being offered, other than the opinion that they were due to the application of the air to engines whose action was crippled through a deficient supply of steam, so that the introduction of the air simply rendered such engines capable of the normal performance due to a proper steam distribution.

"Later, the injection of air into steam boilers of locomotives was urged as affording economy, by allowing the air to pass through coils in the smokebox on its way to the boiler. A trial of this idea was made on an English railway, and it was considered by the Pennsylvania Railroad. The results, however, were too indefinite to prove any advantage from the use of air, and competent discussion showed that any sensible gain was inconsistent with physical principles.

"When, however, the indicator and feed-water measurements had exposed the existence of the waste due to the phenomenon of cylinder condensation, the idea arose that perhaps the admixtion of air with steam resulted in a reduction of this waste. This idea received authoritative support in 1872, from a paper in the Proceedings of the Royal Society, by Prof. Osborne Reynolds, which detailed experiments showing that the introduction of a comparatively small proportion of air into a glass vessel containing steam, under a partial vacuum, largely retarded the condensation of the steam upon a cold metallic surface located within the vessel.

"Eminent modern practical steam authorities, therefore, have assumed the possibility of an economical influence due to the introduction of air into the steam chest of a steam engine, by virtue of the reduction of the percentage of cylinder condensation, which applies with the use of steam alone.

"A somewhat unsatisfactory trial, to test this theory, was made by the Pennsylvania Railroad in 1884, with their shop engine at Altoona, which showed a small loss by the use of the air.

"So far as I know, however, the idea has never been investigated completely by the exact measurement of all the elements concerned. I therefore suggested the inquiry which Messrs. Leber, Hewitt and Benedict have made as a thesis, and under the skillful direction of Professor Jacobus, their investigation has been a thorough one for quantities of air up to 9 per cent. of the steam by weight. The results are conclusive proof that for these proportions of air, the use of it does reduce the cylinder condensation, so that the water per indicated horse-power per hour is about 3 pounds in 32, less than it is with steam alone, but the power to compress the air more than compensates this gain in economy."

The Baltimore & Ohio are reported to be so well pleased with the appearance and wearing quality of the "Royal Blue" that they intend using the same color for their whole passenger equipment.

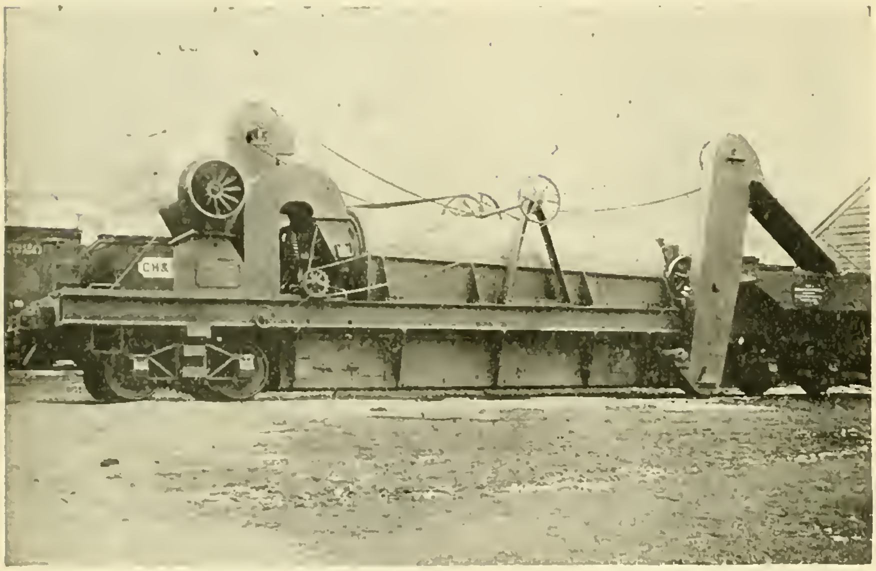
A Portable Dryer.

The annexed engraving shows an important invention to many classes of trade. It represents a portable drying and heating plant particularly adapted for drying and heating sand for asphalt, and for preparing crushed stone for contractors of different work requiring the stone in such a condition.

The apparatus consists of an all-steel car 48 feet long by 9 feet 3 inches wide over all; one patented Cummer dryer complete with its furnace, etc.; one 25 horse-power engine, and the necessary elevating and power-transmitting machinery.

The car is equipped with improved couplers, Westinghouse air brakes, and it, with the rest of the plant, has been passed upon and approved by the railroad authorities.

The dryer and heater is mounted and



bricked-in on top of car in a very unique and substantial way. The firebrick, and in fact all brick, are put in place in such a way as to make it impossible to crack or loosen.

The bottom part of furnace and combustion chamber—or, in other words, the lowest part of dryer—is above the cow-catcher on the locomotive, so there is no danger of trouble from this source. The cut is a little misleading on this point.

Two elevators are used in connection with the dryer, one to feed and one to deliver the dried and heated or simply dried material from the dryer to the screen, or to any point desired. The engine is of the Westinghouse pattern.

The operator of the machine has full control over the temperatures to which the material being treated is subjected, and it can be delivered dried and heated to any temperature desired between 150 and 600 degrees Fahr. uniformly.

This cut was made from a photograph recently taken of a plant built for a very large asphalt company, to be used by them as part of a portable plant. The sand drying and heating plant has capacity for turning out about 10 tons of sand per hour. The F. D. Cummer & Son Company, Cleveland, build these plants in several different sizes.

An Engineer Misread His Orders.

Several correspondents in the South have sent us newspaper clippings concerning a head-end collision which happened on the Florida Central & Peninsular Railroad last month, by which two trainmen were burned to death.

The Railroad Commissioners of South Carolina investigated the accident and reported as follows: "After a full and thorough investigation into the cause of the collision near Swansea, on the Florida Central & Peninsular Railroad, this board is of opinion that the collision was occasioned by the misreading of the order by Engineer H. J. Petit, of Train 35, reading 'Sweden' for 'Swansea,' which resulted in the death of two persons."

The commissioners recommended that Engineer Petit should be arrested and held responsible for the accident, and a Justice of the Peace held him on the charge of murder.

When the accident occurred, a stove in the combination baggage and mail car started a fire, which burned up the car, and the two men who were in it lost their lives.

When all the circumstances of this accident are taken into consideration, we believe that others are to blame beside the engineer, and a charge of murder, under the circumstances, is absurd. It was a very natural mistake in misreading the names of the two cities, since they closely resembled each other. All well-managed railroads follow the policy of changing names of stations that have resemblance close enough to cause danger of trainmen making mistakes in orders, and we consider that those who permitted names so much alike to exist on one division were as much responsible for the accident as the engineer who made the mistake. Another thing for which the company were to blame was that no frame was provided for holding orders in, that could be kept closely in sight of the engineer. We have commented several times about the danger of pushing train orders into an engineer's pocket. It has caused many accidents, it is contrary to the Standard Code of Train Rules, and men who make mistakes where the practice is in vogue ought to be very leniently treated.

The accounts of the accident indicate that there would have been no loss of life had it not been for the presence of the death-dealing stove in the car, which has been fatal in so many instances in the days before the stove was put aside for the safer method of heating cars by steam or hot water. If a just and rational view of the case were taken, the parties who were responsible for the stove being in that car would be held to account for the loss of life.

Mr. Johnston's Mistake.

BY GEO. P. WHITTLESEY.

It was the closing hour of the afternoon of a winter day. The whistles of the various shops and factories of a New England town had just finished their chorus of blasts, shrill or deep or medium, as the case might be, but blending into a sweet harmony in the ears of the mechanics, of whose hours of toil they told the ending. The streams of artisans poured out from the dingy brick buildings where steam and steel, furnace and forge, men and machines had worked all day transforming wealth of one class into wealth of a higher and more valuable class.

Among the throng went two young men. Their faces showed intelligence, though pale with the daily confinement in the machine shop where they worked. They walked briskly along the street, dogged by the black shadows thrown by the sparkling arc lights. The freshly fallen snow crunched beneath their feet in the crisp air.

"If you'll come over to the house tonight, Con," said one, "I'll show you the sketches of that invention I've been working at lately. Do you remember that I told you that I had an idea about an automatic lathe for turning bicycle hubs?"

"Yes, I remember it," said Con, "and I was just going to ask you about it when you spoke. How does it work out?"

"Fine," answered Harry Davis, "fine as silk. But I want to consult you about one or two points, so I wish you'd come over after supper and we'll talk it over."

"All right," replied Con, "I'd like to see it. How's your mother, Harry?" he added, as they paused at the gate in the picket fence before the story-and-a-half frame house where the Davises lived.

Harry's face sobered. "She's just about the same," he said. "The doctor says that she ought to go South for the winter. Mechanics all send their families South for the winter, you know," he remarked, with rather a bitter laugh.

Con looked thoughtful. "I'm afraid the doctor is right, though," he said slowly. "There was my Aunt Rebecca. She had some lung trouble, and so they sent her to Florida five years ago, and now she is as well as she ever was."

Harry did not point out that this was rather an ambiguous description of Aunt Rebecca's present condition; in fact, it did not occur to him. He only swung the gate to and fro slowly, watching the rise and fall of the ball and chain which served to hold it closed. "There's mother now," he said. "Guess supper's ready. Goodbye!"

Con Heselwood was a young machinist who had left a home in Old England to seek his fortune with his older brother in the New England of America. A year or two older than Harry Davis, a strong friendship had sprung up between the two, the older man admiring the keen mind and ready wit of the younger. The home-less Englishman found great comfort in the motherly attentions of Mrs. Davis, and showed his appreciation by an increased devotion to the son, to whom he imparted many a handy shop kink from the old country.

That evening he was able to draw upon his experience for some suggestions which cleared up all the difficulties with the new invention and after a thorough and rigid review of the device neither one could find any fault with it.

"I guess the boss will open his eyes when he sees this," exulted Harry. "I hope he will let me try it."

"The boss knows the size of a dollar," remarked Con. "If he thinks this scheme will save money, he won't turn it down without a trial."

It was, however, with some trepidation that Harry presented himself at the office door the next day during the noon hour. The proprietor gave him a nod and went on dictating to his stenographer. Having at length given her enough to occupy all her lunch time, he wheeled round his swivel chair and said abruptly:

"Well, Davis, what is it?"

"I have a little scheme for an automatic hub lathe, sir," said Harry, producing his roll of light-brown drafting paper, "and I thought I would ask you to look at it and see if it is worth being tried."

"Let's see your drawing," said Mr. Johnston, moving some papers on a table to make a clear space. Harry pointed out the various features of his machine with the enthusiasm of the true inventor, his first embarrassment fading away in his pride in the ingenious device he was explaining. Mr. Johnston said little, but was evidently impressed. "Joe, call Mr. Stubbs," he said sharply, and the office-boy jumped for the door. He knew Mr. Johnston.

The foreman appeared promptly; and though he was professionally jealous of any idea that was not his own, he nevertheless noted the unconcealed interest of the boss and took his cue. Yes, it might work all right, he admitted. Can't always tell about them paper inventors. Well, yes, it would cost quite a lot to try it; but if Mr. Johnston said go ahead, why, he would do all he could to keep down the expense.

Mr. Johnston figured awhile on a memorandum pad. Finally he said:

"Go ahead and fix it up, Stubbs, and give it a good trial. We are getting behind on our orders on these hubs, and perhaps this will help us out."

Harry was greatly delighted to hear this, but his fervent thanks fell on unresponsive ears. Mr. Johnston turned to his desk, and calling to his stenographer, "Miss Andrews, bring your notebook," plunged into his dictation again.

The experimental machine was finally completed, and after more or less tinkering and changing of gears it proved a complete success. After a sufficient trial, Mr. Johnston ordered Stubbs to build three more machines as rapidly as possible, and sending for Harry, he asked him if he had any more ideas about improved appliances, or "jigs," as he called them, for doing the various jobs he had under contract. Harry admitted that he was working at one or two such machines. Mr. Johnston then said:

"Tell you what I'll do, Davis. I'll engage you to spend all your time getting up improvements on my machines and processes, and on any of the goods we are manufacturing. There's all that line of builder's hardware. A few novelties would help us out in that; something to make good 'talkers' for our drummers, you know. What do you say?"

"I would like it first-rate, sir," said Harry, delighted. "But how about—what wages would I get, sir?"

"Oh, I'll pay you just as much as you are getting now," said his employer, with the air of one who was conferring a great favor in paying a machinist's wages to the man who was hired to increase his business and lessen his expenses.

Harry pondered a moment. "I'll lose nothing by it," he thought, "and if I give all my time to inventing, and take out patents on all my ideas, I can soon make enough to send mother South."

"I'll accept the offer," he said aloud. He flattered himself that he had done a shrewd thing. Mr. Johnston seemed to be satisfied, too.

"What do you think of that, mother dear?" said Harry, after narrating the event with great triumph. "Now I'm through with overalls and oil can, and I'm to have a desk in the drafting room, and do nothing but think up new ideas and work out new machines and trade novelties. Of course, I will patent all my inventions, and it won't be long before you can go to Florida every winter and live here in the summer. Won't that be fine?" and he patted the thin cheeks with loving enthusiasm.

His mother had great doubts about the Florida trip, but she did not dampen her son's joy. "The dear boy," she said to herself. "He is a good son and wants to do all he can for me. But I don't believe a man like Johnston would make such an arrangement if he expected Harry to get all the money out of it."

Con Heselwood, however, entered fully into Harry's plans, and they sat up late that night planning how to raise money to take out patents for the hub machine and other inventions which Harry was then at work on. They figured out astonishing results in royalties from the sale of territorial and shop rights. Con was to furnish three-fourths of the money for patent fees in return for a half interest in the patents. He finally hunted through the columns of a technical newspaper to get the address of a patent attorney, and wrote to him for a statement of his charges and the Government fees.

The days and weeks went on, and Harry found his new work more and more to his liking. During the day his time was fully occupied, either in the shops, studying over some machine to see if it could be improved, or at his drawing-board, working out the ideas which crowded his fertile mind. In the evening he devoted himself to a systematic course in geometry, mechanics, physics and chemistry and electricity. Con read with him, and the two fellows built many an ambitious air-castle in their moments of recreation.

Several months had passed before the subject of patents again came up. By this time Harry had a drawer full of sketches and drawings, most of them relating to Mr. Johnston's business. The ideas had not all met with the proprietor's favor, but a number of them had been adopted by him and were proving successful. One day Harry was called into the office. "Davis," said Mr. Johnston, "this is Mr. Brown, my patent lawyer. I want you to give him drawings of all the new things we have been getting up lately, so that he can prepare applications for patents."

Harry was astonished, but all he said was, "Very well, sir," and led the way to his desk in the drafting-room. Mr. Brown asked a great many questions, and carefully compared the drawings with the machines in the shops and the samples of new merchandise in the store-room. He took away with him a big roll of blueprints, telling Harry that the Patent Office drawings must be made by his own draftsman, because they had to comply with very strict regulations and were not ordinary mechanical drawings.

Harry reported to Con that night, the new turn affairs had taken. "I don't quite understand why the boss goes to all this trouble to take out my patents," said he. But he and Con agreed that it promised to save them a lot of money. "Of course," said Harry, "it will cost us something to get them introduced, and our agreement will hold as to dividing up expenses and profits in that regard. I guess mother can go to Florida next winter after all."

A month rolled by and Harry began to get impatient. One day he ventured to accost Mr. Johnston in the yard of the factory, and diffidently asked him when the applications for his patents would be ready for signing.

Mr. Johnston stared. "Your patents!" he exclaimed. "Well, that's cool. *My* patents, you mean. But I don't mind telling you that I signed the applications day before yesterday and sent them off to Mr. Brown to be filed."

"But I invented all those things," cried Harry, in dismay. "I thought the inventor was the one to sign the papers. Besides, I want the patents for myself."

"Oh, look here," said his employer, in a tone of disgust; "didn't I hire you to get up all those inventions for me? And if that is so, don't they belong to me, I'd like to know? I rather think they do, and what's more, I propose to have them. So let us hear no more of this."

Harry was now fully aroused. "I am perfectly willing to let you use my inventions for nothing, Mr. Johnston," he said; "but I don't see why you should have the benefit of all the royalties that may be obtained by selling these machines or the right to use them. I have been planning to introduce them in a number of places, and I expect to get a considerable revenue from them. I need the money, and I don't see that you have any right to deprive me of it. The inventions are all my own, and if there is any money to be made out of them I ought to have it."

"Davis," said Mr. Johnston, sternly, "I don't want to hear any more such talk from you. Go back to your desk."

"I don't understand why you have any right to patent all my inventions, sir," said Harry, still defiant.

"Because you are in my employ," roared Mr. Johnston; "that's why. I pay you for your time, and whatever you do belongs to me. Do you suppose I give you desk room, and supply you with desk, paper and drawing instruments, and pay you good wages, to make inventions for yourself? If you do, you are mightily mistaken."

"But"—began Harry.

"Look here, Davis," said Mr. Johnston, controlling his exasperation by a violent effort, "you don't seem to know the first thing about patent law. Now, I have had lots of experience, and I tell you that an employer is entitled to patent everything that his men invent. There's that buffing machine over in Shop G; Tom Hughes invented that, but I patented it. Then there's that egg-beater we sell so many of—that was gotten up by a fellow in the pattern shop. I patented that, and so it goes. Whatever my men get up I am entitled to patent, if I want to. You see you can't help yourself, so you'd better say no more about it. I must have men who trust in me, and whom I can get along with comfortably," he added significantly.

With this implied threat rankling in his soul, and greatly distressed at the sudden downfall of all his happy hopes, Harry recited to Con that evening all that had befallen him. They wrote a long letter to Mr. Brown, giving him the facts and asking his advice. In his reply he said that whatever Davis had invented while employed by Mr. Johnston as an inventor, would, as he understood the terms of the contract between them, belong to the employer, who also would have an equitable title to the patents. However, the matter required full investigation, and he would be in town on the following day to look into it.

This partially lifted the weight from Harry's heart. "The machines I invented while I was still in the shop are the most valuable of the lot," said he to Con. "If we can control those, I am willing to let the boss have the rest. But it seems pretty queer that I can't have the patents for them, too."

"Oh, it looks reasonable to me," said Con. "He pays me to run a planer, and whatever I make belongs to him. He pays you to run a drawing board, and whatever you make belongs to him. I guess that's right."

"Well, perhaps it is," sighed Harry. "But it batters down a whole city full of air-castles, don't it? and mother's trip, too," he added sorrowfully.

At the appointed time Harry found Mr. Brown consulting with his employer in the office. The latter looked red and irritated. "But I understood from you, sir," said the lawyer, "that you were the inventor of these machines and devices, and so I drew up the applications in your name. Now you say that Davis is really the inventor, and that you did not even make a suggestion in regard to any of them."

"Well, let him sign the applications, then, and assign them over to me," snapped Mr. Johnston. "I don't care so long as I get the patents."

"Very well," said Mr. Brown. Then, turning to Harry, he asked: "When did you make this arrangement with Mr. Johnston to invent new machinery and articles for him?"

"Nearly a year ago," replied Harry."

"And which of these inventions did you make first?"

"The hub machine," said Harry; "then the turret lathe; then the steel ball machine."

"You say in your letter to me that some of your inventions were made while you were working in the shop."

"Yes, sir; all three of these machines I invented there, and made the drawings at home."

"Any others?"

No, sir; everything else was gotten up after I made the new arrangement with Mr. Johnston."

"Is that your understanding of it, Mr. Johnston," asked the lawyer.

"Oh, guess that's straight enough," growled the proprietor. "But what difference does it make? He admits that he got up all these things while he was working for me."

"I know," replied Mr. Brown; "but it makes a great difference whether he was merely a machinist, hired and paid by you for running a lathe in your machine shop, or an inventor, hired and paid by you to devise improvements in your machines and merchandise."

"I don't see that," blurted out Mr. Johnston, while Harry began to take heart.

"Like the great majority of employers, Mr. Johnston," said the quiet lawyer, "you think that you are entitled to take possession of everything your employés do, whether at the machines in your shop, or at their drawing-boards at home. This is the theory upon which you have treated Davis here. Now, you are only partly right. The relations of employer and employé have given rise to many hotly contested law suits; but the matter is now well settled. If you hire a man to do a certain thing, such as running a lathe in your shop, you are not entitled to appropriate for your own use any invention he may originate. It is only when you hire him to invent for you, and make a definite contract with him, that you acquire any property in his ideas. Now, it appears that at least three of these inventions were made before you hired Davis as an inventor. This alters the case entirely."

Harry began to breathe freely and said to himself: "Mother, I guess your Florida trip is not postponed, after all." The lawyer turned to him and went on: "Your employer, Davis, has what is called an implied license to use all the machines he has built embodying your inventions; but he has no title to the patents, except those specially covered by your contract with him. Have you a copy of it with you?"

"Copy of what?" asked Harry.

"There was no written contract," interposed Mr. Johnston. "It was a verbal contract between Davis and myself."

The lawyer glanced keenly at the two men, concealing his astonishment admirably. "What were the terms?" he inquired, calmly.

"The terms were that I was to give my time to studying up improvements on the machinery and tools and goods, and was to have the same pay as when I worked in the shop," said Harry, quickly.

"Was there any agreement that Mr. Johnston should own the patents for whatever inventions you made?" asked Mr. Brown.

"Yes," "No, sir," said Mr. Johnston and Harry in the same breath.

"Well, how is it?" queried the lawyer. From his quiet manner neither of the other two had any idea that this was the vital point in the whole matter.

"Why there was an implied contract, of course," said Mr. Johnston, positively, "that I was to own the patents. Otherwise I would not have thought of taking him out of the shop to spend his time at a drawing-board."

"But there was nothing said about it," interposed Harry, "and I certainly never had any such idea."

"The contract, then," said Mr. Brown, "was simply that Davis should devote himself to improving Mr. Johnston's machinery and goods, without any express stipulation that Mr. Johnston should own any patents that might be applied for. Is that right?

"Yes, sir," said Harry. Mr. Johnston nodded.

"Then, sir," said the lawyer, turning to Mr. Johnston, "you have no title whatever to any of these inventions."

The proprietor turned pale with anger, and Harry's heart began thumping with hope and excitement.

"The Supreme Court of the United States," Mr. Brown went on, "decided in 1886, in the case of Hapgood against Hewitt, that where an employé is hired to devise improvements in the goods made by his employer, without any agreement that the employer was to have the title to his inventions, or to any patent he might obtain for them, the only right the employer had to the invention was a bare license to make and sell the improvement as a part of his business. And again, in 1893, in the case of Dalzell against the Dueber Watch Case Company, the Supreme Court held that unless the agreement to convey the patents to the employer is clearly proved a court of equity will not compel the employé to assign his patents. You are therefore entirely free, Davis, to apply for patents on these inventions, with the understanding that Mr. Johnston has the right to use the machines he has built, but no others."

"Why, that's all right," exclaimed Harry; "I don't want to interfere with Mr. Johnston's business. He has always treated me well. I'm quite willing to give him the right to make as many machines as he wants to use; all I am after is the control of the patents."

Mr. Johnston accepted his defeat with very poor grace, and even threatened to discharge Harry if he did not assign the patents to him. But Mr. Brown pointed out the impolicy of such a course, and it was finally arranged that Harry should formally grant to his employer the right to use all the patented machines, and to make, use and sell all the patented goods.

This would protect him against law-suits in case Harry sold his patents. Mr. Johnston also insisted that Harry should enter into a written agreement with him that the patents for all future inventions should belong to him, and Harry was shrewd enough to stipulate that in return he should have a much larger salary and that the contract should run for five years.

About a month later Harry received a letter from Mr. Brown, who had become greatly interested in the young inventor. To Harry's delight, Mr. Brown wrote that a syndicate of bicycle manufacturers had instructed him to purchase all of the Davis inventions relating to their business. He made Harry an offer which seemed a fair one to him and to the faithful Con, with whom, in due time, the proceeds were divided.

* * * *

All that long hard winter the young men greatly enjoyed Mrs. Davis' cheerful letters from the sunny, orange-scented glades of Florida, telling of renewed health and strength, and full of loving messages to her two "boys," the young inventor and his friend, the machinist.

Operation of the Locomotive Lubricator.*

The locomotive lubricator has been almost universally adopted as a means to lubricate the working parts of a locomotive that come in direct contact with steam Still, there has been a great deal of questioning and controversy about the real merit of the lubricator.

As a receptacle to hold oil, with water and steam behind it, and permitting oil to flow from oil well in a continuous stream, or in drops at any rate per minute, according to the wish of the operator, also delivering oil to oil pipe at connection to lubricator, we can say that in all this the lubricator is a complete success, and in addition would mention the important fact that the lubricator enables the operator to economize in the consumption of oil; this, no doubt, being due to the fact that the flow of oil can be seen by means of the sight glass and the flow controlled by regulating valve.

It is very encouraging and pleasing to look at a lubricator while engine is working steam, or steam shut off, and observe the regularity of the feed of oil as it passes through the water that fills sight glasses. If we could be assured that the oil was being delivered to the parts desired to be reached, with the same regularity and in the same condition, all doubts as to the real worth of a lubricator would be removed. So the question is directly connected with the delivery and condition of oil. Is the delivery to the parts regular? Has the oil, by being fed in drops and coming in contact with steam at a temperature of 350 degrees, lost any of its vitality? The latter question will depend entirely upon the quality of oil used; and as this can be determined apart from the lubricator, we will pass it by saying that our observations would enable us to conclude that, if a superior grade of oil is used, it will retain its vitality as a lubricant.

In order to enable us to speak with some degree of intelligence about the question of regular delivery, we concluded to take some observations, not at the lubricator, but directly over the steam chest. This was accomplished by placing a bracket at that point to hold a sight glass, giving a view of 4¼ inches—all matter passing from lubricator to steam chest, passing through sight glass. From a position on running board I was enabled to see what was taking place in glass, and I have traveled over 1,000 miles watching the glass.

We had bracket with glass on three engines, all equipped with Nathan No. 9 triple sight-feed locomotive lubricators, under various conditions, while on their regular trips between St. Paul and Duluth on passenger service. Work done by engines at times was heavy on account of

*Paper read by Mr Parker, of the St. Paul & Duluth, at meeting of Northwestern Railway Club.

grades, and speed was usually high, reaching at times one mile per minute. Four return trips were made between points already mentioned.

I will take up each trip in its respective order, the conditions of each, and what was observed. The first trip was on Engine 68, 17 x 24 inches, Richardson balance slide valve, 62-inch drivers, steam pressure 145 pounds, ½-inch copper pipe from steam box to condensation chamber on lubricator. The first 2 feet of oil pipe from lubricator were also ½-inch copper pipes. Oil fed at the rate of 5 drops per minute with steam throttle wide open, and 6½ drops when closed.

While engine was standing, and steam being admitted to lubricator, there was a constant flow of water down sides of glass at steam chest. After opening feed valve of lubricator, and giving oil sufficient time to reach glass, it could be seen flowing down glass in one streak, retaining its original color and separated from the water that accompanied it.

When engine steam throttle was opened and steam admitted to steam chest, the water and oil in glass were arrested in their downward course and moved upward. As slide valve covered and uncovered steam-port opening, this upward and downward movement in glass continued, keeping time with sound of exhaust. The agitation caused oil and water to combine and formed a milky liquid, and at times it was denser than others. The density increased as travel of slide valve was shortened. The longer these conditions were maintained, the less the agitation became, and the density of the liquid in glass became greater. The liquid near top of glass would come to a condition of rest and partake of a yellowish hue. There was a slight agitation at bottom of glass, and occasionally the matter at this point would go downward, and was immediately replaced by clear water, which would become milky and drop again. This condition of things continued as long as throttle and reverse lever remained undisturbed. When throttle was closed, the accumulation in glass would drop immediately, followed by oil that seemed to have collected above glass. Any time there was an accumulation in glass, and reverse lever was moved towards center of quadrant, this accumulation would also drop immediately and be replaced by clear water.

The second trip was made on the same engine, with the lubricator unchanged; but instead of delivering oil at steam chest, we drilled and tapped an opening into steam channel, between steam chest and saddle. At this point we placed oil plug with bracket and sight glass. We inserted a pipe into end of plug that reached to center of steam channel; end of pipe was bent at right angles and in the same direction as flow of steam. The results produced were about the same as on the previous trip; the only noticeable difference being less agitation in the glass, especially when speed was high.

On the return trip we changed the steam pipe from steam box to condensation chamber, from ½-inch copper pipe to ⅝-inch copper pipe; also connected oil pipe to steam chest. The change showed a marked difference in favor of the lubricator. Under all conditions of throttle and reverse levers, the agitation in glass was greater, and the matter in glass was reduced in volume and density. At regular intervals there was a continual change of matter taking place at bottom of glass. After engine had run 20 or 30 miles at a high rate of speed, and engine throttle closed, the glass, as usual, was emptied immediately; but the amount of matter accumulated above glass was small, comparatively speaking, with previous trips.

The improvement observed at glass is substantiated by engineer in charge of engine, as he reports using less oil. Previous to the change in piping, engine would show lack of lubrication. This difficulty has disappeared entirely.

The fireman, who supplies the lubricator with oil, has also expressed himself by saying that one filling would usually do one round trip, and sometimes it was not sufficient; but now it is sufficient, and has always some remaining, and is still reducing the amount of oil used. However, there is what we might call a happy medium; as lack of lubrication produces friction, it is possible to be saving oil at the expense of fuel.

With a view, if possible, of corroborating the above improved conditions, bracket and sight glass were placed on steam chest of Engine 69, of the same class, running on the same time, over the same district, as Engine 68, all conditions being the same, with the exception that oil pipe, while same size outside, was ⅛ inch smaller in bore. This pipe was put on the last time engine was in shop for general repairs.

When putting on oil pipes, we see to it that there is a gradual decline from connection at lubricator to same at oil plug on steam chest. If there should be an incline to some extent in line of pipe, it will form a pocket, and matter passing down pipe will lodge there; so that instead of pipe being merely a channel for matter to flow through, it becomes to some extent a receptacle to hold matter.

The action in sight glass during the outgoing trip of Engine 69 was, as a whole, the same as observed on the return trip of Engine 68; the only difference being, the change of matter near bottom of the glass seemed to take place oftener and the accumulation above glass seemed to be less.

On the return trip we put a choke valve in oil plug on steam chest. Valve occupied a vertical position and seated upwards. There was an opening through center of valve, the bore at bottom being the same diameter as bore of reducing plug in lubricator. We could not observe any difference in the action of matter in glass.

Engines 68 and 69 having balanced slide valves, we concluded to take some observations from an engine having unbalanced slide valves. We selected Engine 23, 17 x 24 inches, equipped with Nathan No. 9 triple sight-feed lubricator, connected the same as previous engines, with the exception that oil pipe was 5/8 inch copper pipe the entire length.

The action of matter in glass on the fourth and last trip was a complete substantiation of all that was observed on the last trip on Engine 68 and both trips on Engine 69. The feed, as seen at glass, was more frequent, and the matter in glass was much lighter in appearance, and there was absolutely no accumulation other than in glass. Oil would appear, but only in sufficient quantity to coat sides of glass. This oil, no doubt, instead of being allowed to pass slowly through oil pipe, was drawn by a vacuum created in steam chest, so that a larger supply of oil than usual reached the parts when steam was shut off. It was noticed, after stopping at depot and engine started immediately, that the matter in glass would remain clear for a longer time, showing that oil pipe had been cleared of oil and had to be replaced before it could reach glass.

There were some minor things observed, but they are not worthy of mention. We have given what we consider the most important; these observations have enabled us to reach conclusions that are very gratifying. They have settled many inquiries and removed many doubts as to the efficiency of locomotive lubricators, as used at present, for the service and steam pressure that these tests were made under. This can be accomplished by proper regard for piping, insuring volume being delivered to supply all demands, thereby maintaining boiler pressure at lubricator, also eliminating all obstructions in oil pipes.

The United States Consul at Liege, Belgium, reports that a great many people in Belgium are still engaged making Damascus twisted gun barrels by hand. The ingot for the production of the curled Damascus, which is the favorite design for fine guns, is composed of about thirty sheets of iron and steel. This forms a square mass, which is enveloped in a box of common thin sheet iron or secured by wires at each end. The package thus prepared is put into a furnace and welded together at the lowest possible temperature. Too great a heat destroys the metal and yields a burned Damascus. Each barrel receives 150 welding heats while being forged. If one of these welding heats is unsuccessful, the barrel may be a failure, either by the alteration of the Damascene appearance or by a trace of imperfection in welding. All the metal used for making these gun barrels is produced in Belgium.

Pneumatic Power Applied to Workshops.

At the last meeting of the Canadian Society of Civil Engineers, a paper by Mr. J. Davis Barnett, assistant mechanical superintendent of the Grand Trunk, on "Pneumatic Power Applied to Workshops," was read. In introducing the subject he said that in the early days of ironworking the tools were usually brought to the work and they were manual. Later, as tools increased in size and stiffness, the work was brought to the machine and moved with it under or against the tool. To-day, in many operations the bulk of metal to be handled is getting so unwieldy that it is again proving common practice to carry the machine tool to the work. Electric and air motors are certainly factors in this evolution, if not largely responsible for it. At considerable length the author discusses the efficiency and cost of compressed air, and gives particulars about air compressors and a variety of the tools operated by them, including hammers, riveters, hoists, forging machines, etc.

In an appendix he gives a list of pneumatic tools and machines used in the workshops of the Atchison, Topeka & Santa Fé Railroad. These machines are applied to fifty-three different purposes. He adds, in relation to them:

"Air is also used for testing brakes in shop and yard, cleaning boiler flues, cleaning the shops and engines, and in self-moving dead locomotives from erecting to paint shop.

"Although this makes a good show for one set of shops, it is far from marking the limit of compressed air as applied in railway service to-day. It is used for moving crossing gates; track interlocked derailers; single semaphores and semaphores interlocked with switches and gates, and this, too, at points eighteen miles away from the compressing plant; in timber preserving by injection; in moving capstans and winches for hauling and shunting purposes; in coaling locomotive tenders; in lifting their ashes out; in sifting, lifting and delivering sand to locomotives; in delivering sand to rail; actuating whistle signal; moving the rocking fire-grate; opening the fire-hole door; ringing the bell, and, perhaps the best known of all, in actuating the continuous automatic brake. Also, on other rolling stock for controlling snow-plow wings and aprons; ice flangers and scrapers; doors of dump and drop-bottom cars, and for tilting ballast cars; and inside shops for bending pipes: cleaning pipes from internal scale; testing pipes and their jointing; with gas jets for heating tires and other rings of metal; as a blowpipe for straightening bent wrought-iron frames; for spraying fuel into oil furnaces; for belt shifting on countershafts; for machine brakes to stop tools at a definite point; for supplementing the wheel and axle hydraulic press; for axle box and journal press; with sand as sandblast for cutting and scouring; and for scrap shears and scrap tumblers at far end of yard, where the noise is least annoying, and where there is ample space for scrap-sorting."

In conclusion the author says:

"To summarize, air is in practice proving to be a fairly cheap and most convenient transmittor of power, allowing fine subdivision and transportation to remote points, with the crowning and unique quality of suffering no appreciable loss when held in storage. For intermittent service it is of great value, allowing widely varying speed of tools, dispensing with long lines of shafting and belts, giving free head room, and increasing the shoplight as well as lessening the cost of roof frames when they have not to carry shafting. The pipes require no coating; they radiate no heat, and therefore can be put in close corners without increasing the fire risk; their direction is readily changed in any plane without risk of pocketing or water-hammer, and leaky joints are not a nuisance or risk. In no case are exhaust pipes required, and in most if not all cases the exhaust adds to the men's comfort."

The Latest Invention for Revolutionizing Power.

It is fortunate for patentees who are anxious to obtain free advertising for their inventions to be living in some small town where a correspondent of one of the press news agencies is eagerly looking out for something to found dispatches upon. These conditions have led to the readers of newspapers being told about many wonderful inventions of a revolutionary character, which never revolved anything more than the expense of the patent out of the inventor's pocket. The latest revolutionary invention hails from Sleepy Eye, Minnesota, and has been duly exploited by the press agent.

A dispatch from that place, so suggestive of meditation, informed readers of all leading newspapers that Grant Brambel has invented a rotary engine which does away with the crank and is going to do wonderful things. The dispatch also adds that the president of an English engineering syndicate has offered $1,600,000 for control of the invention. We have no doubt that Mr. Brambel has patented a rotary engine that will operate without a crank, as many hundreds of other inventors have done in the last century, but the sum offered for the purchase of the invention is beyond our credulity. We have at divers times formed the acquaintance of rotary engines that appeared to be the perfection of prime movers. One of them with a rustic origin, just like the engine from Sleepy Eye, seemed to have millions in it, and not a few farmers and other men of low degree, including some shrewd engineers, put their small savings into a company formed to exploit the engine, and took out neither principal nor interest.

The only thing that alarms us about the Sleepy Eye engine is the news that the inventor had received the offer of a large sum of money for the invention and did not close the deal. We are afraid he is going generously to form a stock company, so that his neighbors in the Northwest may have an opportunity to invest their savings. During the recent political campaign the people of the Northwest heard a great deal about the wicked European capitalists who drain the life-blood out of American labor. This sentiment may be keeping the inventor of the Sleepy Eye rotary from closing the sale, but if so it is evidence of defective judgment. That, however, is his own business, but we implore the people in Minnesota who may be tempted to put their savings into a rotary engine company to content themselves with the meagre interest paid by savings banks. We have done some investing in highly promising enterprises of that kind, and give advice from sadly bought experience.

The Pond Machine Tool Company, of Plainfield, N. J., have availed themselves of the lull in business, caused by the hard times, to effect numerous improvements that will help them when prosperity returns to the machine tool interests. They have made entire new patterns for a variety of tools, and changed all obsolete forms to those of the most modern shape. Their boring mills and planers are now made with a very stiff box upright. Entirely new patterns of lathes have been designed for all lathes above 26 inches.

Eight beautiful etchings, representing scenery along the line of the New York Central, printed from steel plates on plate paper, 24 x 32 inches, are offered for sale at the office of George H. Daniels, general passenger agent, Grand Central Station, New York, at 50 cents each. Art lovers will appreciate this opportunity to secure at nominal cost pictures of high artistic merit, devoid of any objectionable advertising feature and suitable to hang on the wall of any room.

We are in receipt of a catalog from J. A. Fay & Co., Cincinnati, O., illustrating and describing the woodworking tools made by this well-known firm. The engravings are half-tones, showing off the tools to the best advantage, and are elegant samples of the art. The functions of all the tools are clearly explained, both in the text and pictorially, the latter feature being made especially interesting by means of showing the manual operation on each machine and examples of the work turned out. The Fay Company will be glad to send this new catalog to anyone desiring it.

The Pennsylvania Railroad has organized a number of personally-conducted pleasure tours to be made under the escort of a tourist agent and chaperon, embracing most of the points of interest in the South. An early Autumn trip will be made to include Gettysburg Battle-Field, Blue Mountain, Luray Cavern, Basic City, Va., the Natural Bridge, Grottoes of the Shenandoah, Richmond, Washington and Mt. Vernon. The start will be made from Boston on Monday, October 12th, from New York and Philadelphia on Tuesday, October 13th, and the trip will cover a period of ten days. The cost of the trip, including all necessary expenses, will be $55 from New York, $65 from Boston and $53 from Philadelphia. Detailed itinerary will be sent on application to Tourist Agent, 1196 Broadway, New York; 86 Fulton Street, Brooklyn; 205 Washington Street, Boston; or Room 411, Broad Street Station, Philadelphia. This trip is sure to be popular, and the fact that it is conducted by the Pennsylvania Company is a guarantee that everything possible will be done for the comfort of the tourists.

INDEX TO ADVERTISEMENTS.

WHAT YOU WANT TO KNOW.

Questions and Answers.

Correspondents wishing to have questions answered in these columns should send in their names and addresses, not for publication, but for evidence of good faith. We throw all anonymous letters into the waste basket.

(92) M. M. H., Burlington, New Jersey, writes:

Please state what shrinkage is allowed for shrinking tires on driving wheels? A.—At the twentieth annual convention of the American Railway Master Mechanics' Association, the recommendations of a committee which had been appointed to pass upon the subject of tire gages and shrinkage of tires, were adopted for sizes from 38 inches to 66 inches inclusive, by following diameters of wheel centers:

38 inches	—Tire to be 0.040 inch less.	
44 "	" 0.047	"
50 "	" 0.053	"
56 "	" 0.060	"
62 "	" 0.066	"
66 "	" 0.070	"

These allowances for shrinkages are well within the limit of elasticity of steel and are in general use among master mechanics. A safe approximation to these values can be had by taking 0.001 of the diameter, which will give a shrinkage slightly less than shown in the table, but will answer every purpose for many cases, especially those where steel has a high percentage of carbon.

(93) J. J. H., Montgomery, Ala., writes:

1. In the November issue, regarding the question I asked about an engine slipping on passing over the summit of a hill, I knew that it was due to too much throttle; but what I want to know is, why an engine will slip with the same throttle in turning over the hill after a hard pull as she had pulled up the hill. A.—We understand this question to be similar to the one answered, and cannot, therefore, modify the answer in the least. If, however, your engine still met with a resistance at the top of the hill—say a sharp curve, for example, which necessitated a full throttle—it is possible that the slipping was caused by a wet or greasy rail. 2. How far will a 16-inch engine run to one pint of valve oil, taking into consideration that the water is good and that the engine does not carry the water so as to work it through the dry pipe into the cylinders? The engine is pulling a passenger train. A.—The mileage possible to be made to the pint of valve oil, by your engine is hidden under too many variable conditions for us to make any attempt at an intelligent answer. Simply saying what has been done by other engines of the same class will not answer your question.

(94) J. B., Yonkers, N. Y., writes:

Will you kindly inform me in your paper, how many loaded cars a locomotive of the following dimensions will pull up a grade of 44 feet to the mile? Diameter of cylinders, 20 inches; stroke, 26 inches; diameter of drivers, 57 inches; boiler pressure, 180 pounds per square inch; light weight of car, 30,000 pounds; capacity of loaded car, 60,000 pounds; weight of car and load, 90,000 pounds. A.—The tractive power of the engine must first be found by the formula given in our article on "Drawbar Pull" in the November issue. Applying this formula to your conditions, and taking the mean effective pressure at 90 per cent. of the boiler pressure, we have, $(20 \times 20 \times .90 \times 180 \times 26) \div 57$ equals 29,557 pounds tractive power. From this is to be deducted a certain amount for internal friction of the engine, which reduces its pulling capacity. In the absence of definite knowledge of the amount of this friction, we may assume it to be equal to 10 per cent. of the tractive power as calculated, and we then have 29,557 — 2955.7 equals 26,600 pounds as the effective drawbar pull. To find the hauling capacity of the engine in tons, the resistances of engine and train must be known. These resistances being due to speed and grade in this instance, we may take the first at 6 pounds per ton, for a very slow speed, a figure that practice has demonstrated will cover most cases. The resistance due to grade always bears the same relation to one ton, that the rise in feet of the grade bears to its length; the 44-foot grade under consideration would therefore give a resistance equal to $(44 \div 5,280) \times 2,000 = 16.66$ pounds per ton. To this must be added the 6 pounds that was assumed for slow speed, and we then have $16.66 + 6 = 22.66$ pounds per ton for the total resistance. Dividing the 26,600 pounds pull on the drawbar by the resistance in pounds per ton, we have $26,600 \div 22.66$ equals 1,173 tons. If now the weight of the engine and tender be deducted from the tons just found, the net capacity of the engine will be obtained. Assuming the engine and tender to weigh 184,000 pounds when loaded, or 97 tons, we have $1,173 - 97 = 1,076$ tons of train behind the engine, including the caboose; if the weight of the latter is 15 tons, we have, by deducting this amount from the tonnage found, 1,061 tons of train. To find the number of loaded cars that can be hauled, it is now necessary to divide these tons by the weight of one loaded car; this we have seen to be 90,000 pounds, or 45 tons; then, $1,061 \div 45 = 23.57$ loaded cars as the capacity of your engine on a 44-foot grade at low speed on tangents.

The Q. & C. Company, of Chicago, have recently got out an improved form of pressed-steel brake-shoe key, which conforms to the Master Car Builders' standard and contains several valuable points that are all its own. The key is much lighter than average keys; it is made of the best material of uniform strength throughout, which increases its durability, and it is cheaper than the average. The Q. & C. Company keep a large stock of this key on hand and can supply any quantity ordered at short notice.

The Sinclair Construction Company, of Chicago, has had for two years a large Ingersoll-Sergeant air compressor at work night and day on a section of the drainage canal, and it has not cost a cent for repairs all that time. The manager of the company declares that it is as good and efficient to-day as it was when first started running.

The alligator plate illustrated in our correspondence columns, and the tube hole boring tool shown in the same department, were both designed by Mr. J. A. Eisenaker, of the Elmira shops of the Northern Central. They are valuable labor-saving tools, and the inventor deserves much credit for his ingenuity in getting them out.

INDEX TO ADVERTISEMENTS—*Continued.*

Buyers' Finding List.

AIR BRAKE FITTINGS.
Crane Co., Chicago, Ill.

AIR BRAKE HOSE.
Boston Belting Co., Boston, Mass.
N. Y. Belting & Packing Co., New York.

AIR BRAKES.
Westinghouse Air Brake Co., Pittsburg, Pa.

AIR BRAKE GAGE.
Utica Steam Gage Co., Utica, N. Y.

AIR-BRAKE PUMP GOVERNORS.
Foster Engineering Co., Newark, N. J.
Mason Regulator Co., Boston, Mass.

AIR COMPRESSORS.
Clayton Air Compressor Works, New York.
Ingersoll Sergeant Drill Co., N. Y. City.
Norwalk Iron Works Co., South Norwalk, Ct.
Pedrick & Ayer Co., Philadelphia, Pa.
Rand Drill Co., New York.
St. Louis Steam Engine Co., St. Louis, Mo.

AIR DRILLING MACHINE.
C. H. Haeseler & Co., Philadelphia, Pa.

AIR HOISTS.
Pedrick & Ayer Co., Philadelphia, Pa.

ARCH BARS.
Cambria Iron Co., Philadelphia, Pa.

ASBESTOS.
H. W. Johns Mfg. Co., New York.

AXLES.
Cambria Iron Co., Philadelphia, Pa.
Gould Coupler Co., Buffalo, N. Y.
B. M. Jones & Co., Boston, Mass.
Krupp (T. Prosser & Son, New York).

BALANCED SLIDE VALVES.
Am. Bal. Slide Valve Co., San Francisco, Cal.
D. H. Brown, McComb, Miss.
M. C. Hammett, Troy, N. Y.

(*Continued on page 1007.*)

BUYERS' FINDING LIST—*Continued.*

BEARING METAL.
Ajax Metal Co., Philadelphia, Pa.
Paul S. Reeves, Philadelphia, Pa.
U. S. Metallic Pkg. Co , Philadelphia, Pa.

BELL RINGER.
U. S. Metallic Packing Co., Philadelphia, Pa.

BELTING.
Boston Belting Co., Boston, Mass.
N. Y. Belting & Packing Co., New York.

BOILER AND FIREBOX STEEL.
Shoenberger Steel Co., Pittsburg, Pa.

BOILER CHECKS—INSIDE.
Foster Engineering Co., Newark, N. J.

BOILERS.
Pittsburg Locomotive Works, Pittsburg, Pa.

BOILER TESTERS.
Rue Mfg. Co., Philadelphia, Pa.

BOILER TOOLS.
Richard Dudgeon, New York.
Hilles & Jones Co., Wilmington, Del.
Long & Allstatter Co., Hamilton, O.

BOILER WASHERS.
Nathan Mfg. Co., New York.
Rue Mfg. Co., Philadelphia, Pa.

BOLT THREADING MACHINERY.
Acme Machinery Co., Cleveland, O.
Detrick & Harvey Machine Co., Baltimore, Md.

BOOKS.
H. C. Baird & Co., Philadelphia, Pa.
Philadelphia Book Co., Philadelphia, Pa.
D. Van Nostrand Co., New York City.

BOXES.
P. Pryibil, New York City.

BRAKE ADJUSTERS.
Q. & C. Co., Chicago, Ill.

BRAKE SHOES.
Ramapo Iron Works, Hillburn, N. Y.
Ramapo Wheel & Foundry Co., Ramapo, N. Y.

BRASS CASTINGS.
Ajax Metal Co., Inc., Philadelphia, Pa.
Paul S. Reeves, Philadelphia, Pa.

BUFFERS.
Gould Coupler Co., Buffalo, N. Y.
Pryibil, P., New York.

BULLDOZERS.
Williams, White & Co., Moline, Ill.

CARS.
Allison Mfg. Co., Philadelphia, Pa.
J. G. Brill Co., Philadelphia, Pa.
Lima Locomotive & Machine Co., Lima, O.
Ramapo Iron Works, Hillburn, N. Y.

CAR COUPLERS.
Gould Coupler Co., Buffalo, N. Y.
McConway & Torley Co., Pittsburg, Pa.
National Malleable Castings Co., Chicago, Ill.
St. Louis Car Coupler Co., St. Louis, Mo.
Sams Automatic Coupler Co., Denver, Col.
Smillie Coupler & Mfg. Co., Newark, N. J.
Standard Coupler Co., New York.
Trojan Car Coupler Co., Troy, N. Y.

CAR HEATING.
William C. Baker, New York.
Safety Car Heating & Lighting Co., New York.

CAR LIGHTING.
Safety Car Heating & Lighting Co., New York.

CAR ROOFING.
Warren Chemical & Mfg. Co., New York.

CAR SEATS.
Hale & Kilburn Mfg. Co., Philadelphia, Pa.

CAR VENTILATORS.
Harrington & King Perforating Co., Chicago, Ill.
M. C. Hammett, Troy, N. Y.

CAR WHEELS.
Krupp (T. Prosser & Son, New York).
Lima Locomotive & Machine Co., Lima O.
Ramapo Wheel & Foundry Co., Ramapo, N. Y.
Standard Steel Works, Philadelphia, Pa.
Washburn Car Wheel Co., Hartford, Conn.

CATTLE GUARDS.
Q. & C. Co., Chicago, Ill.

CHIME WHISTLES.
Crosby Steam Gage & Valve Co., Boston, Mass.
Star Brass Mfg. Co., Boston, Mass.

CLOCKS.
John I. McGrane, New York.

COAL HANDLING MACHINERY.
Link Belt Engineering Co., Philadelphia, Pa.

COAL CHUTES.
Williams, White & Co., Moline, Ill.

CORRESPONDENCE SCHOOLS.
Internat'l Corres. Schools, Scranton, Pa.

CORUNDUM WHEELS.
Sterling Emery Wheel Mfg. Co., Tiffin, O.

(*Continued on page 1008.*)

BUYERS' FINDING LIST—*Continued.*

CRANES.
Manning, Maxwell & Moore, New York.
Maris Bros., Philadelphia, Pa.
William Sellers & Co., Philadelphia, Pa.
R. D. Wood & Co., Philadelphia, Pa.

CRANK PIN GAGES.
M. C. Hammett, Troy, N. Y.

CRANK PINS.
Cambria Iron Co., Philadelphia, Pa.
B. M. Jones & Co., Boston, Mass.
Krupp (T. Prosser & Son, New York).

DAMPER REGULATORS.
Mason Regulator Co., Boston, Mass.

DRILLS.
Cleveland Twist Drill Co., Cleveland, O.

DRILLING MACHINES.
Gould & Eberhardt, Newark, N. J.

ELECTRIC LIGHTING AND POWER APPARATUS.
Westinghouse Elec. & Mfg. Co., Pittsburgh, Pa

EMERY WHEELS.
Sterling Emery Wheel Mfg. Co., Tiffin, O.

ENGINES.
St. Louis Steam Engine Co., St. Louis, Mo.

ENGRAVINGS.
Bradley & Poates, New York.

EXPANDING MANDREL.
Geo. L. Weiss, Cleveland, O.

FILES AND RASPS.
Nicholson File Co., Providence, R. I.

FILTERS.
A. Major, New York.

FLEXIBLE SHAFT.
Stow Flexible Shaft Co., Philadelphia, Pa.

FLEXIBLE STEAM JOINT.
Moran Flexible Steam Joint Co., Louisville, Ky.

FLUES AND TUBES.
Allison Mfg. Co., Philadelphia, Pa.
Tyler Tube & Pipe Co., Washington, Pa.

FORGES.
Buffalo Forge Co., Buffalo, N. Y.

FORGING MACHINERY.
Williams, White & Co., Moline, Ill.

FROGS AND CROSSINGS.
Ramapo Iron Works, Hillburn, N. Y.

GRAPHITE.
Jos. Dixon Crucible Co., Jersey City, N. J.

HANGERS.
P. Pryibil, New York City.

HEATING SYSTEM FOR SHOPS.
Buffalo Forge Co.
Gold Car Heating Co., New York.

HOLLOW STAYBOLTS.
Falls Hollow Staybolt Co., Cuyahoga Falls, O.

HYDRAULIC TOOLS.
Richard Dudgeon, New York.
Watson & Stillman, New York.
R. D. Wood & Co., Philadelphia, Pa.

INDICATORS.
Ashcroft Mfg. Co., New York.
Crosby Steam Gage and Valve Co., Boston.

INJECTORS.
Hancock Inspirator Co., Boston, Mass.
Hayden & Derby Mfg. Co., New York.
Nathan Mfg. Co., New York.
Rue Mfg. Co., Philadelphia, Pa.
William Sellers & Co., Philadelphia, Pa.

JACKS.
E. C. Boyer, Dayton, O.
Richard Dudgeon, New York.
A. L. Henderer, Wilmington, Del.
A. O. Norton, Boston, Mass.
Watson & Stillman, New York.

LAGGINGS FOR LOCOMOTIVES.
H. W. Johns Mfg. Co., New York
Keasbey & Mattison Co., Ambler, Pa.

LOCOMOTIVES.
Baldwin Locomotive Works, Philadelphia, Pa.
Brooks Locomotive Works, Dunkirk, N. Y.
Cooke Loco. & Machine Co., Paterson, N. J.
Dickson Mfg. Co., Scranton, Pa.
Lima Locomotive & Machine Co., Lima, O.
Pittsburg Locomotive Works, Pittsburg, Pa.
H. K. Porter & Co., Pittsburg, Pa.
R. I. Locomotive Works, Providence, R. I.
Richmond Loco. & Mch. Wks., Richmond, Va.
Rogers Locomotive Works, Paterson, N. J.
Schenectady Loco. Wks., Schenectady, N. Y.

LUBRICATORS.
Detroit Lubricator Co., Detroit, Mich.
M. C. Hammett, Troy, N. Y.
Nathan Mfg. Co., New York.

LUBRICATING OILS.
Galena Oil Works, Ltd., Franklin, Pa.
Leonard & Ellis, New York.
Signal Oil Works, Franklin, Pa.

(*Continued on page 1009.*)

BUYERS' FINDING LIST—*Continued.*

MACHINE TOOLS.
- Bement, Miles & Co., Philadelphia, Pa.
- W. D. Forbes & Co., Hoboken, N. J.
- Gould & Eberhardt, Newark, N. J.
- Hilles & Jones Co., Wilmington, Del.
- Jones & Lamson Machine Co., Springfield, Vt.
- Manning, Maxwell & Moore, New York.
- National Machinery Co., Tiffin, O.
- Newton Machine Tool Wks., Philadelphia, Pa.
- Geo. Place, New York.
- Pratt & Whitney Co., Hartford, Conn.
- Prentiss Tool and Supply Co., New York.
- William Sellers & Co., Inc., Philadelphia, Pa.

MECHANICS' TOOLS.
- Armstrong Bros. Tool Co., Chicago, Ill.

METAL POLISH.
- G. W. Hoffman, Indianapolis, Ind.

METAL SEWING MACHINES.
- Newton Machine Tool Works, Phila., Pa.
- Pratt & Whitney Co., Hartford, Conn.
- Q. & C. Co., Chicago, Ill.

MILLING MACHINES.
- Cincinnati Milling Machine Co., Cincinnati, O.
- Newton Machine Tool Works, Phila., Pa.
- Pratt & Whitney Co., Hartford, Conn.

MOLDING MACHINES.
- Tabor Mfg. Co., New York City.

OVER CLOTHES.
- H. S. Peters, Dover, N. J.

PACKING.
- Boston Belting Co., Boston, Mass.
- Gould Packing Co., East Cambridge, Mass.
- H. W. Johns Mfg. Co., New York.
- Jenkins Bros., New York.
- N. Y. Belting & Packing Co., New York.
- U. S. Metallic Packing Co., Philadelphia, Pa.

PAINTS.
- Detroit Graphite Mfg. Co., Detroit, Mich.
- H. W. Johns Mfg. Co., New York.

PATENTS.
- John Wedderburn & Co., Washington, D. C.
- George P. Whittlesey, Washington, D. C.

PERFORATED METAL.
- A. J. Beckley & Co., Meriden, Conn.
- Harrington & King Perforating Co., Chicago Ill.
- The Hendrick Mfg. Co., Ltd., Carbondale, Pa.

PHOTOGRAPHS.
- F. Moore, London, Eng.

PIPE THREADING AND CUTTING MACHINERY.
- Armstrong Mfg. Co., Bridgeport, Conn.
- D. Saunders' Sons, Yonkers, N. Y.

PISTON RODS.
- Cambria Iron Co., Philadelphia, Pa.
- B. M. Jones & Co., Boston, Mass.
- Thomas Prosser & Son, New York.

PNEUMATIC TOOLS.
- Chicago Pneumatic Tool Co., Chicago, Ill.
- C. H. Haeseler & Co., Philadelphia, Pa.
- Pedrick & Ayer Co., Philadelphia.
- U. S. Metallic Packing Co., Philadelphia.

PRESSURE REGULATORS.
- Foster Engineering Co., Newark, N. J.
- Newark Regulator Co., Newark, O.

PUMP VALVES.
- Boston Belting Co., Boston, Mass.
- N. Y. Belting & Packing Co., New York.

PUNCHING AND SHEARING MACHINERY.
- Hilles & Jones Co., Wilmington, Del.
- Long & Allstatter Co., Hamilton, O.
- Williams, White & Co., Moline, Ill.
- R. D. Wood & Co., Philadelphia, Pa.

RAILWAY FENCES.
- Page Woven Wire Fence Co., Adrian, Mich.

REGULATORS.
- Mason Regulator Co., Boston, Mass.

RETAINING RINGS.
- Ramapo Wheel & Foundry Co., Ramapo, N.Y.

RUBBER.
- Boston Belting Co., Boston, Mass.
- N. Y. Belting & Packing Co., New York.

SAFETY VALVES.
- Ashton Valve Co., Boston, Mass.
- Coale Muffler and Safety Valve Co., Baltimore, Md.
- Consolidated Valve Co., Bridgeport, Conn.
- Crosby Steam Gage & Valve Co., Boston, Mass.
- Star Brass Mfg. Co., Boston, Mass.

SANDING APPARATUS.
- Henry L. Leach, North Cambridge, Mass.
- Sherburne & Co., Boston, Mass.

SHAFTING.
- William Sellers & Co., Philadelphia, Pa.

SPARK ARRESTER PLATE.
- A. J. Beckley & Co., Meriden, Conn.
- Harrington & King Perforating Co., Chicago, Ill.
- Hendrick Mfg. Co., Carbondale, Pa.

(*Continued on page 1010.*)

BUYERS' FINDING LIST—*Continued.*

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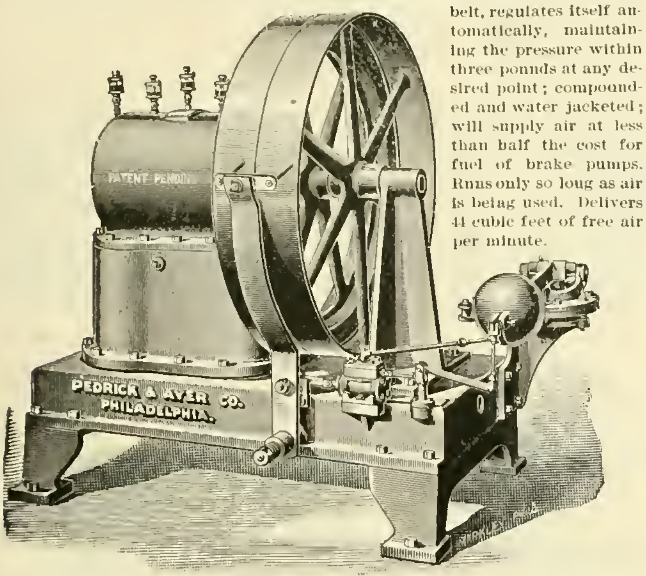

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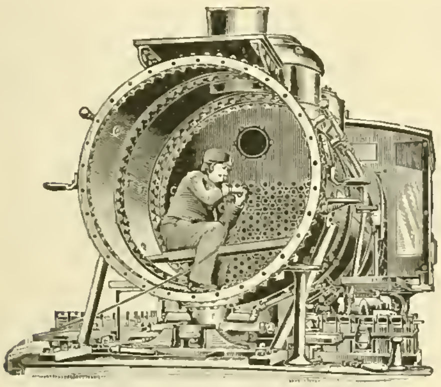

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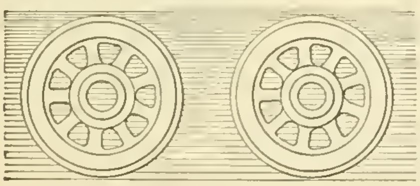

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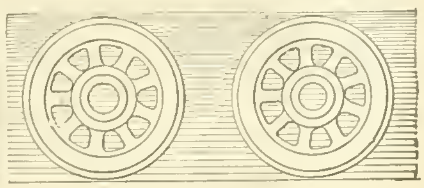

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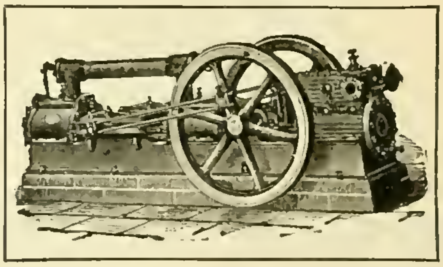

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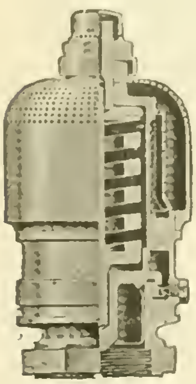

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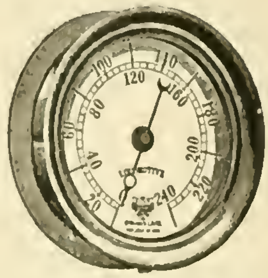

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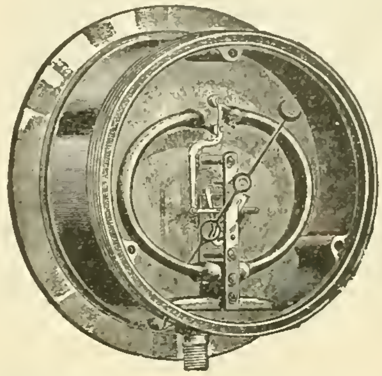

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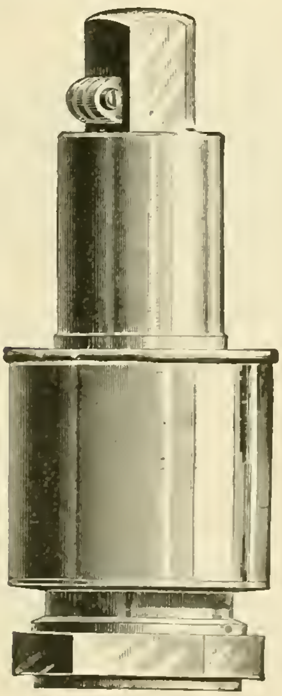

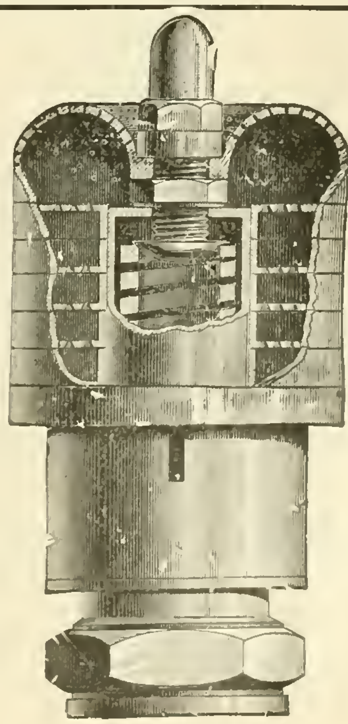

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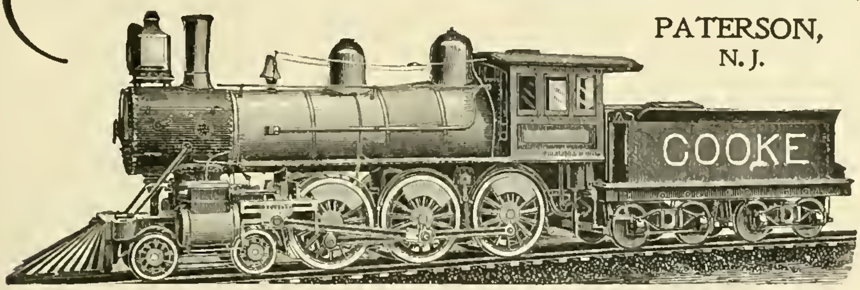

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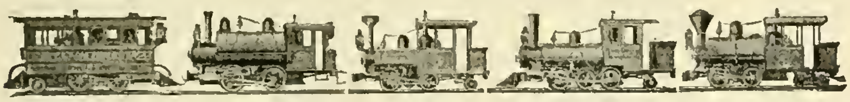

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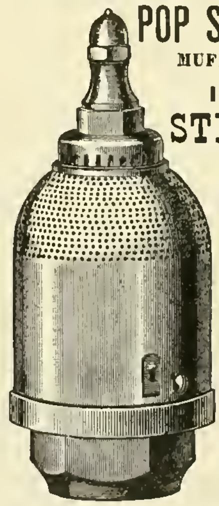

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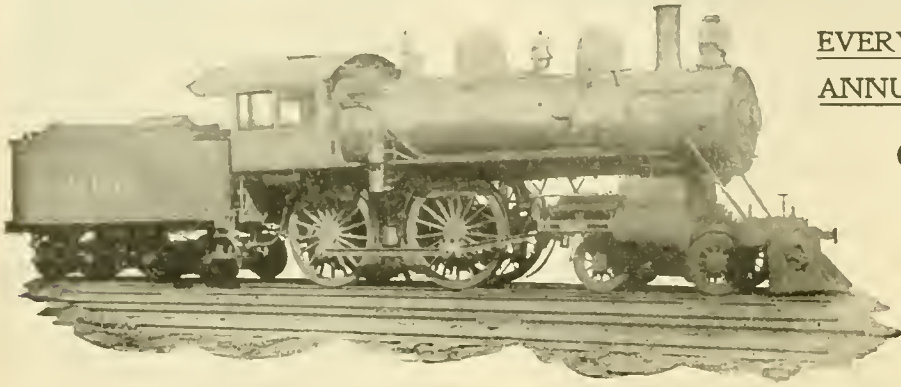

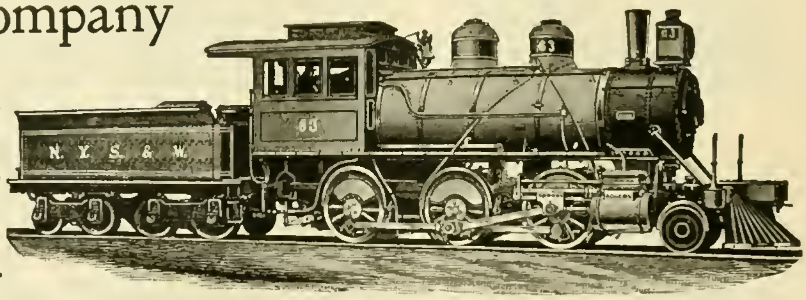
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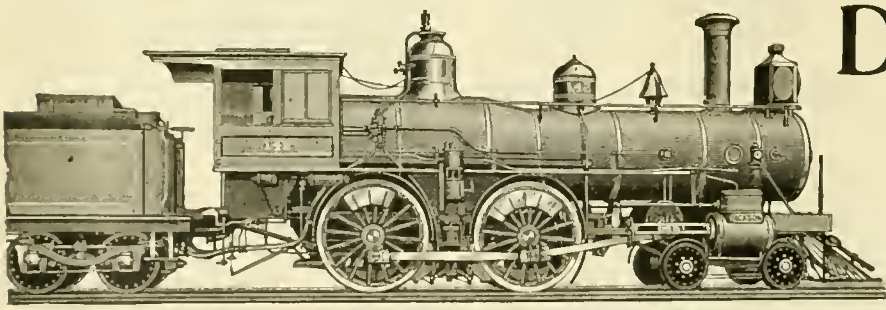

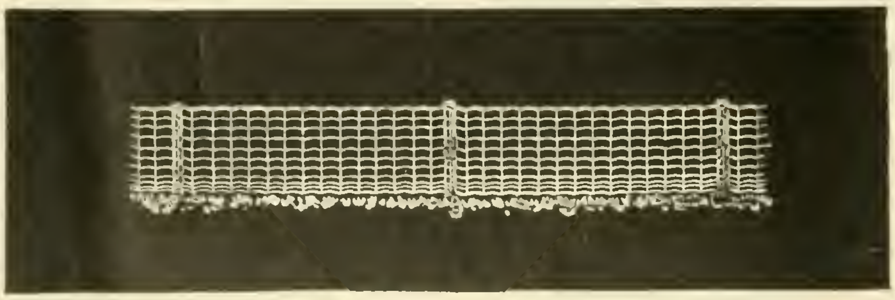

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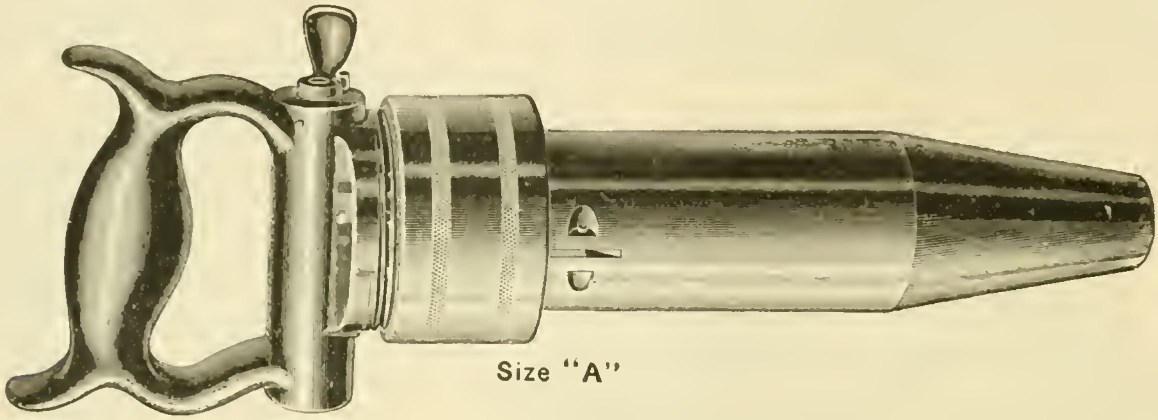

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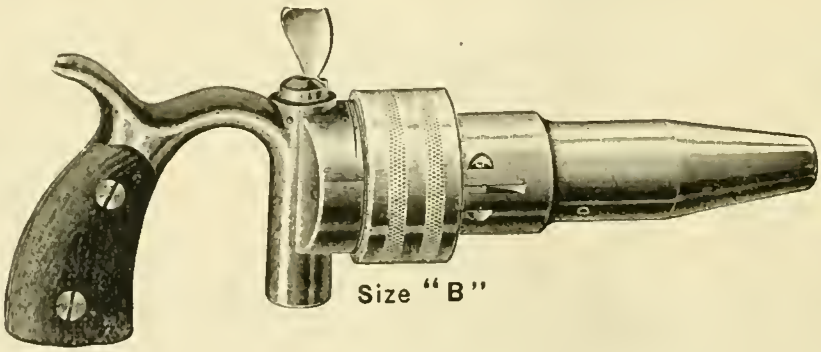

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