

rectly says that the arithmetical mean of the three quantities above it is 5.32; but the means given in the table are not arithmetical means, but an independent computation of the average train resistance over the whole distance of 6,560 ft., which had previously been divided into sections of 500 ft., and again into sections of 2,500 ft.

The "striking difference in average resistance" of the different trains is explained, so far as it is explicable, in another column.

The manner of determining the rotative energy of the wheels would take too much space to explain again. It is always in constant ratio to the energy in the train, at all velocities, and is determined by fixing the radius of gyration of wheels and axles and the ratio of their mass to the total of the car or engine.—EDITOR RAILROAD GAZETTE.]

A New Steel Chain Tape.

LAKEVILLE, Conn., July 26, 1886.

TO THE EDITOR OF THE RAILROAD GAZETTE:

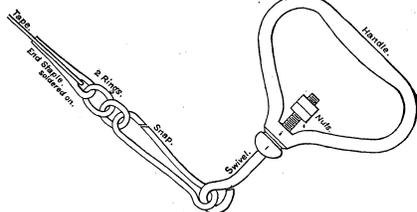
In response to an inquiry in your paper last spring, I inclose a blue print of a "chain steel tape," which most any one can make at a cost of not over \$6.

The steel ribbon tape, as first introduced, was an expensive luxury, and however precise it might be in the hands of careful attendants, it was one of those children of misfortune which, by reason of breaks, rents and twists, was notoriously always out of order. No provisions were made to keep it from getting twisted. Its temper was very high and liable to break, and it was rolled out so thin, that for mending breaks it was of little or no value.

Little, if any, progress was made in introducing them for ordinary and general service until they were given a greater thickness, a softer temper and a less marked-up face, and, of course, were produced at a less cost.

With such other conveniences as were associated with the wire link chain, as handles for holding, snaps for taking them off and on, swivels to prevent a twisting of the tape, and one or more rings at each end of the tape to prevent kinks between end fixtures and the tape part, the apparatus has received the popular name of steel chain tape.

The material mostly used for these tapes is steel. For this



Pettee's Steel Chain Tape.

purpose it is one of the strongest and most durable, capable of almost any desired temper, and not expensive.

Everybody concedes that steel chain tapes are of far greater precision than wire link chains, because they are so little affected by stretching, and have their graduations marked and numbered in a more precise and intelligible manner. In fact, the only advantage a wire link chain may be said to have over a steel tape chain is that the former may be done up a trifle the quicker.

With graduations at every foot lesser distances are taken off with such foot pocket rules as have the necessary graduations on them.

Graduations are made by different makers in almost as many styles, the most common and least expensive of which is by either etching them on by acids or by having solder floated on the tape and then stamping marks in the solder. The objection to either of the above methods is that the graduations are the most short lived of any that are made.

Riveting or crimping on graduated plates is a process that weakens the tape, and not only is liable to fracture it, but such plates are the worst of all kinds to get loose, peel up and get caught.

Filing graduations in the tape is also a questionable method, and most productive of breaks.

The method adopted by the writer in 1877 to obviate all possible defects so far as possible, was to solder on brass stencil plates, that they can be read off from either side or end of the tape thus: 37 x 39 38 x 29. This method also possesses the advantage that all fractional measures are taken and noted ahead of the figuring as they naturally run and read.

Where intermediate graduations can be dispensed with, a round steel wire is undoubtedly the best to use, as it is perhaps the least affected by wind, mud and gravity, and for the amount of material in it the strongest and most durable.

But as such a form or shape is one of the most inconvenient for immediate graduations and their ready discernment, the form for such a use becomes of a necessity a ribbon. Ribbons for this purpose vary in width and in thickness from 1/8 to an inch or more in width, and from No. 20 to 40 gauge in thickness. The narrower styles being generally the thickest, the question of width is generally decided by the size of the figuring on the graduations that are desired and the thickness by the strength and pliability that is desired.

A tape should be tempered so that it will bend around a circle 3 in. in diameter without taking a set or breaking, and of other dimensions, so that it will have sufficient strength.

Wind, mud, frozen snow and ice and gravity, generally affect wide more than narrow tapes.

For a general purpose chain tape the style and construction possessing the most convenience and utility is one made from a steel wire and flattened out to No. 23 wire gauge thick, 3/8 in. wide, of low spring temper, graduated with brass stencil plates soldered on at each foot and with end fixtures as herewith shown.

I shall be happy to afford any further information to your readers. WM. E. PETTEE.

Piece Work.

VII.—IN THE PAINT SHOP.

In painting locomotives and tenders by piece work, it will be best to prepare a list of the operations involved and assign a price to each. In case the condition of the paint is such as to require scaling and general repainting, such repairs may be designated as "Class 1."

If the paint, striping and lettering are worn only in spots, and simply require touching up and varnishing, the work may be known as "Class 2."

If, again, parts only require varnishing, let such repairs be designated as "Class 3."

These classifications are very convenient, as it not infrequently happens that one or more of the parts require general repainting or Class 1 repairs, while others would only require Class 2 or Class 3 repairs. After an examination of the locomotive or tender by the foreman, he will decide what class of repairs each part is to receive and instruct the workmen accordingly, who will be paid the fixed prices for the operations involved.

The operations incident to each class of repairs may be conveniently recorded in the following form and in the manner shown.

Table with columns: NATURE OF SERVICES, CLASSIFICATION OF SERVICES (Class 1, Class 2, Class 3). Includes sections for Cab: Outside Operations and Cab: Inside Operations.

The following service card illustrates the application of piece-work to repainting a locomotive and tender:

M. P. No. PAINT SHOP. SERVICE CARD. Date 1886.

Table with columns: DESCRIPTION OF PARTS, Operation, Charge, Hours, Rate per Hour, Earnings, Remarks. Lists items like Driving wheels, Air brakes, Bell frame and head, etc.

Table with columns: NAMES OF WORKMEN, Hours, Rate per Hour, Earnings. Lists names like C. Krimer, W. Shopka.

The operations of scaling, sand-papery, giving a coat "B," glazing, puttying, giving two coats "C," rubbing, sand-papery, striping, varnishing, etc., are all given on other service cards, which are similar in form and therefore need not be given in full here. F. D. CASANAVE.

Hardcastle's Embossed Firebox Plates.

The accompanying illustration represents some fire-box plates embossed by means of a machine recently patented and exhibited at the Liverpool International Exhibition.

As will be seen from the illustration, the plate is thickened round the stayholes, so as to give holding for several addi-

tional threads. The stayholes, instead of being punched as usual, are formed by a hydraulic plunger acting on a peculiarly formed head which raises the metal round the hole instead of detaching it in a button as in ordinary punching.

The machine used to effect this is of very simple construction, and consists mainly of a frame-work of wrought-iron joists on which an hydraulic punching or embossing machine can be traversed in any direction.

The machine forms a rim round the depression, as shown in fig. 2, and does not entirely punch the hole through, as shown in fig. 3. In the case of a plate 3/8 in. thick, the embossing punch makes the hole nearly through, leaving only 1/8 in. to be removed by punching or drilling. To emboss a hole for a 3/4 in. stay in a Thomas-Gilchrist basic steel plate requires a pressure of 70 tons, while from 80 to 96 tons are required for the harder Siemens open-hearth steel plates. The time required is about 20 seconds.

Embossing adds 50 per cent. to the thickness of the plate at the edge of the holes. A plate 3/8 in. thick, which can take but five complete threads, can thus have eight, an important advantage.

Embossing does not seem to weaken the plates, as a test recently made shows very conclusively that embossed plates are stronger against internal pressure than plain plates. Two plates 3/8 in. thick, one with a plain and the other with an embossed hole, were placed on supports 4 in. apart, with a screwed stay rod 3/4 in. diameter, with riveted head inserted in each hole. The rod pulled through the plain hole with a pressure of 15,232 lbs., while the embossed plate sustained a strain of 16,352 lbs. The deflection of the embossed plate was only 1/8 in., while that of the plain plate was 3/8 in.

Another test was made with a steel plate 12 in. long, 3 1/2 in. wide, 3/8 in. thick, with two holes 2 1/2 in. centres, one hole drilled 3/4 in. plain, the other bossed and drilled 3/4 in. The plate broke across the plain hole at 56,800 lbs.; the part with the bossed hole being again tested, broke at 61,330 lbs. through the bossed hole. The remaining piece broke in the solid at 73,600 lbs. It will be understood that the above fig-



Fig. 3.

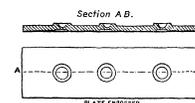


Fig. 2.

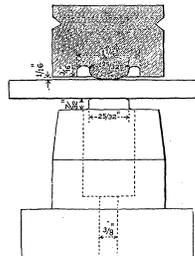


Fig. 1.

Hardcastle's Embossed Fire box Plates.

ures are the gross strain on the plate, and not the strain per square inch. The tensile strength per square inch of the plate so tested was 62,720 lbs.

The manner in which this ingenious punch works is best shown by a reference to fig. 1. The lower die is forced against the plate, penetrating it and driving the plate against the upper die, the central portion of which is slightly in advance of the ring surrounding the annular recess which is formed round the upper part of the penetrating die. This causes a displacement of metal, which flows into the recess and forms a boss or hub. Fig. 2 shows the appearance of the plate after this process, and fig. 3 shows through in the ordinary method and the hole completed.

This embossing can be performed at any angle to the plate, so that a stay entering a plate at an angle can have the same number of threads all round.

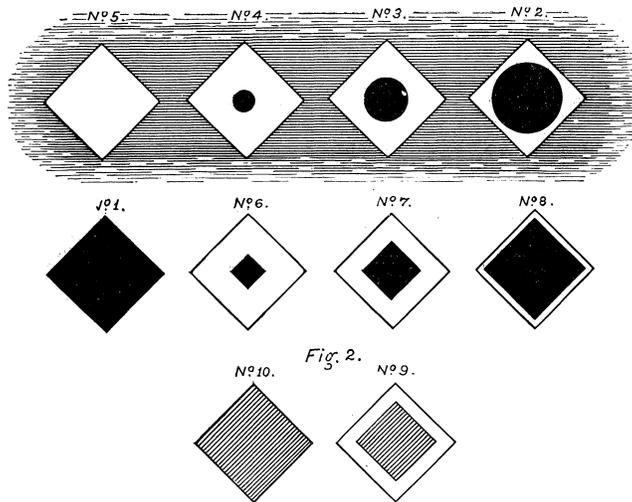
The Engineer, to which we are indebted for the accompanying engraving, says that these embossed plates, though of very recent invention, have been successfully used in several steel fire-boxes made for blowing engines by John Fowler & Co., of Leeds. Any further information can be obtained of the inventor, Mr. R. A. Hardcastle, Hyde Terrace, Leeds, England.

The Comparative Visibility of Railroad Signals.

Many little details of railroad practice, as of everything else, continue to be done in a bad way, simply from lack of attention being drawn to the right way. We apprehend that this is the case on many roads in respect to the painting of railroad signals, since many are violating the practice which has been shown to be best by a little investigation recently made on the Chicago, Burlington & Quincy Railroad, which resulted in a change in the practice there. The substance of this investigation is set forth in the accompanying illustrations.

The investigation was confined chiefly to switch targets, but it will be obvious that its results are of general application to any form of target or visible signal. The Burlington road had, and still has, in use a switch target of not very good design, which showed a diamond similar to No. 9, fig. 2, when the

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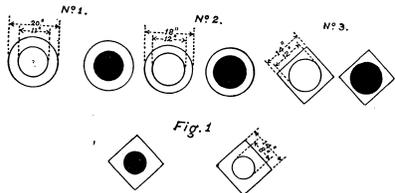
Experimental Test Targets, Chicago, Burlington & Quincy Railroad.

switch was right for main line, and a broad arrow (not shown) pointing in the direction of the side track, when set for the latter. Both the arrow and the diamond were painted the same colors, so that the form only distinguished them, and moreover, by what is now generally admitted to have been very bad practice, both the arrow and the diamond were painted a combination of red and white, a red centre and a white border, as in No. 9.

This practice has now been radically changed, and the process by which it was decided to do so is instructive, carrying conviction of what is proper practice. Consideration of the question was begun by one of the officers suggesting that the above practice was bad, and that "it would be a good idea to paint the 'diamond' white to correspond with the white light used at night and the arrow or dart red, to correspond with the red light."

This was followed a day later by an independent suggestion from another officer, through a different channel, to the same effect. In this it was urged that although form and not color was the greatest guide in the day time, yet that it was well to educate the eye to the feeling that red meant "danger," and that it was wrong in principle to make a safety signal chiefly red, or a danger signal partly white. To this was added the rather trivial consideration that white paint cost only 5 cts. per lb., and vermilion 55 cts., so that to use white would be cheaper.

This suggestion was forwarded with approval, but returned



Signals on the Kansas City, St. Joseph & Council Bluffs Railroad.

back with a query whether "it would not be better in adopting the suggestion to use a black spot on the white ground of the diamond," similar to No. 2 or 4, fig. 2, or those in No. 1. Reference to another officer brought out a second concurring opinion that "the white signal will show up sharper and more distinct if there is a black spot in the centre." Observations on the actual signals shown (with separate diagrams for dimensions) in fig. 1 was added in proof of this. A signal like No. 1, fig. 1, was seen a half a mile off, while only half as far off were signals like No. 2 and 3 seen, and yet the latter were not nearly as distinct; while No. 3, which was the nearest, was the least distinct of all. From this it was recommended that the black spot should be a little over half the smaller diameter of the diamond, as shown by the lower cut in fig. 1.

This was accompanied by a recommendation that the switch-stands, as well as the targets, be painted white, as on the Kansas City, Fort Scott & Council Bluffs road.

These concurrent opinions in favor of the spot came very near settling the question in favor of it, but fortunately the habitual caution of the successful railroad man led one of the powers that be to suggest that it "might be well to have the laboratory make some experiments with a view of determining what size the spot should be, to be most clearly distinguishable." The laboratory did, by the method outlined in fig. 2, with the result that the best size for the spot was found to be no size at all.

Some targets were prepared, 10 in all, each 14 in. square, as shown in fig. 2, in which the shaded parts of Nos. 9 and 10 indicate red. It was then assumed that the proof of the pudding was the eating, and the targets were set up in line and viewed at various distances by a number of the officers of the road. "The result showed conclusively that the two signals

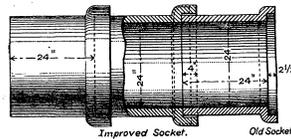
which held their color and distinctness the best were Nos. 5 (all white), and 10 (all red)." The style shown in fig. 9 "appeared pink in the distance." As to cost of paints, it was added that white lead costs about 5 1/2 cts. per lb., and the cheapest lamp-black 3 1/2 cts., and that instead of vermilion at 55 cts., a red chromate of lead at 11 cts. should be used, the latter being less brilliant when first applied, but about equally good after a little exposure to the weather and dust.

The further question came up as to how a pure white signal would answer in winter just after a fall of snow; but it was concluded, first, that these conditions exist only for a few days in the whole year, and secondly, that the snow only confuses vision of the safety signal, making the danger signal more conspicuous.

After the investigation was all completed and the conclusion reached, it was found that it corresponded exactly with the practice of the Pennsylvania Railroad, which had likewise given consideration to the matter at an earlier date. It looks, therefore, as if those roads which mix colors on such signals with the intent of making them more distinct by contrast, were making a mistake.

Improved Sewer-Pipe Socket.

The simple little improvement which we illustrate, which is rather a mere strengthening in an "improvement" in the ordinary sense, has been introduced by Messrs. Blackmer & Post, of St. Louis, Mo., to remedy the difficulty which has been found to exist in the sewer-pipes used by railroad companies, that they are too weak, especially at the joints. It consists simply in increasing the depth of the socket or bell



Improved Sewer-Pipe Socket for Culverts

to make it equal to one-sixth of the diameter of the pipe, increasing its thickness correspondingly. The difference is shown exactly in the following table:

Diameter of Pipe.	Depth of Old Socket.	Depth of Improved Socket.
12 inches.	3 1/4 inches.	2 5/16 inches.
14 "	4 "	2 3/8 "
16 "	4 1/2 "	2 1/2 "
18 "	5 "	3 "
20 "	5 1/2 "	3 1/2 "
21 "	6 "	3 3/4 "
22 "	6 1/2 "	3 1/2 "
24 "	7 "	4 "

The heavier socket makes the whole pipe stronger, much as a buttress stiffens a wall, and the annoyance not unfrequently experienced from broken pipes shows that this is by no means unnecessary. The danger of accidental displacement is likewise much reduced, less care is needed in making the connections, and cement may be more safely omitted, while a perfectly water-tight joint may be more easily made with cement. There is also less likelihood of breakage in handling, and, altogether, a socket of the dimensions shown will no doubt be found to be a very desirable improvement.

Foreign Railroad Notes.

A native company is building a horse railroad in the ancient city of Damascus, the first in Syria.

In Paris, in 1885, the number of passengers carried by all the horse railroads, omnibuses, the Belt Railroad and the steamboats on the Seine was 277,944,000.

Saxony, which is thickly peopled, with 5,657 square miles of territory and 1,893 miles of railroad, has no less than 472 stations, or one to every 2.95 miles of railroad and 1.2 square miles of territory. If they were evenly distributed, no place in the country would be more than about two miles from a station. The population is 3,179,168, which is 2,287

per mile of railroad and 6,736 per station—the latter vastly more than many of our Western roads have.

The vast extent of the Prussian State Railroad system enables it to escape some of the wasteful running of cars required when there are numerous small connecting lines. The Prussian system is divided into systems of moderate size worked by separate managements and with separate accounts, and as a general thing the relations of these with each other are much like the inter-relations of railroads belonging to different companies. But on these state roads the rules for interchange of cars of the German Railroad Union are modified. These rules require that a car which has been taken loaded to destination over a foreign road must be returned empty unless a load can be obtained at the place where it is unloaded, or within 125 miles of it on either side, or at some station on the way back, and then loads must be taken only for places which can be reached without lengthening the trip back to the lower road more than 25 per cent. This rule is not applied at all between different systems of the state railroads, and as a general rule every one of them can use any state railroad cars that may happen to be empty on it at the time for use anywhere.

The Union rules provide for a *per diem* payment in addition to a mileage charge for the use of freight cars. Between different systems of the state railroads the *per diem* charge is dropped, and a charge of 0.78 cent per mile is made for freight, baggage and live stock cars (very nearly the same as our charge of 3/4 cents, which is for larger cars, however), and 1.12 cents for passenger cars. Repairs will be made at the nearest state shop for doing such work, and will not be charged to the home road, on the assumption that such expenditures will balance each other.

A Study of Rail Wear in Germany and France.

M. Couard, Chief Inspector of the Paris, Lyons & Mediterranean Railroad, has summarized in the *Revue Générale* for April the wear of rails from German statistics of last year's publication in the admirable table below, in which he has reduced the statistics of wear to the basis of trains per 60 square millimetres (= 0.093 square inch) loss of section, dividing the rails into classes according to their moments of resistance to flexure and their tie-spacing.

Wear of German Steel Rails on Wooden Cross-Ties.

No. of rails.	No. of ties per mile.	Length of rail.	Moment of resistance.	No. trains to a reduction of..		Rail Mill.	
				1 mm. of height.	60 mm. of section.		
I.—Moment of Resistance from 154 to 158.							
1	75.4	21.6	158,1,932	171,000	305,000	Upper Silesian.	
2	75.4	21.6	158,1,932	104,700	151,700	Krupp.	
3	75.4	21.6	158,1,932	56,400	82,700	Bochm.	
4	70.4	23.7	155,1,771	78,000	156,000	Ruhrort.	
5	70.4	23.7	155,1,771	71,500	112,000	Hörde.	
6	70.4	23.7	155,1,771	62,400	95,000	Krupp.	
7	75.4	21.6	158,1,707	65,000	138,000	Upper Silesian.	
8	72.8	21.6	158,1,707	62,600	104,700	Hörde.	
9	73.8	21.6	154,1,707	59,000	86,500	Krupp.	
10	72.8	21.6	158,1,707	44,200	77,500	Oberhausen.	
11	75	18.5	154,1,707	34,100	77,500	Hoesch.	
II.—Moment of Resistance from 134 to 139.							
12	70.4	21.6	136,1,932	77,800	128,000	Witkowitz.	
13	69.0	23.0	135,1,932	117,800	119,800	Rechtzka.	
14	74.4	21.8	135,1,932	28,700	39,300	Ternitz.	
15	73.8	21.3	139,1,739	108,000	150,000	Bochm.	
16	70.4	21.6	136,1,704	97,750	147,200	Witkowitz.	
17	66.6	23.0	135,1,835	70,750	114,500	Teplitz.	
18	73.8	21.3	134,1,739	81,700	105,600	Ruhrort.	
III.—Moment of Resistance 121 to 128.							
19	73.4	23.0	121,2,061	48,000	59,200	Witkowitz.	
20	62.4	21.3	125,1,980	21,400	29,000	Ternitz.	
21	65.6	23	123	1,980	18,600	27,700	Teplitz.
22	64.4	21.3	126	1,980	22,200	29,500	Zeltweg.
23	68*	24.7	125	1,707	40,400	67,700	Bochm.
24	68.4	24.7	125	1,707	23,700	35,900	Hörde.
25	62.2	21.3	122	1,739	12,300	12,500	Rechtzka.

* Double headed.

The difference in the wear of rails from the same mill is shown in the table below:

TABLE II. Comparative Wear of Rails from Same Mill.

Trains per 60 sq. mm. r-duction of section.	Moment of resist-ance.	Ties per mile.
Upper Silesian.....	305,000	158
".....	128,000	158
Krupp.....	151,700	158
".....	86,500	154 to 158
Ruhrort.....	150,000	155
".....	105,000	134
Hörde.....	104,700	158
".....	35,900	125
Bochum.....	82,700	158
".....	67,700	125
Witkowitz.....	128,000	139
".....	59,200	121
Rechtzka.....	119,800	135
".....	12,500	122
Ternitz.....	39,300	139
".....	29,000	125
Teplitz.....	114,500	135
".....	27,700	125 to 128

No one who examines these figures can fail to be impressed with the enormous difference in wear, produced by the greater or less frequency of supports and by the form and weight of the rail section.

As the author says, considering the difficulty of measuring the loss of section with precision, it is surprising that the results follow such a uniform law. The only notable diver

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