RAILROAD GAZETTE

FRIDAY, MAY 4.

CONTENTS.

Contributions.

Adhesion and Friction—A Correction.

TO THE EDITOR OF THE RAILROAD GAZETTE:

There are a couple of pen errors in my communication on this subject in your issue of April 20, page 247, one of which reverses my intended meaning. The words "the co-efficient of" should be stricken from the sixth line of the first paragraph. The other error is unimportant. Both were in copy. G.

Six-hole Angle Splices.

Michigan Central Railroad Co.,
Chief Engineer's Office,
DETROIT, Mich., April 27, 1888.

TO THE EDITOR OF THE RAILROAD GAZETTE:

As considerable attention appears to be directed just now to the six-hole angle splice, it may be of interest to railroad men to know what experience we have had on the Michigan Central with the six-hole splice.

When we adopted it many railroad men considered the three holes in the rail a source of weakness. While I did not anticipate any trouble from the extra holes, still I did not claim the drilling of these holes would materially decrease the breakage of rails at the bolt holes, but such has been our experience.

In 1885, 1886 and 1887 we laid 255 miles of main track, with the six-hole splices. On this mileage we have had only one rail break at the bolt hole and that was at the first bolt hole instead of the third. In my experience I have never known so favorable a record for an equal length of track.

The long splices break very much less with us than the short splices, the breakage on well ballasted track being practically none.

J. D. HAWKS,
Chief Engineer.

Fuel Consumption in Car Heating.

CINCINNATI, April 30, 1888.

TO THE EDITOR OF THE RAILROAD GAZETTE:

In your editorial on the last meeting of the New England Club you speak of the remarkable lack of exact data on steam heating of cars. This complaint is quite just, and there is little doubt but that the continuous heating companies have made a mistake in contenting themselves with general statements as to the certainty and economy of their methods.

One concern at least, the Sewall, realizes this, and is now making exact experiments on the subject to determine, not the possibility of heating cars, which is of course already granted, but to find the comparative values of steam, coal and gas in their combination heaters, and to determine just how long a time exact quantities of each will take to do their work. These experiments will be fully reported and discussed later, and as they are being made in such a way as to secure practical and impartial results, they will be of great value to all parties interested in the matter of continuous heating.

Professor Lanza, in his study of the subject, made an attempt to do this, but, like most men who deal too exclusively with theoretical matters, he overlooked some important details, and his results are therefore of comparatively little value. An examiner who requires that not a drop of water should escape the couplers ought at least to take some notice of the character and size of the cars heated, the condition of the ventilators, etc., particularly when the coaches experimented on are—at least locally—reputed unusually large, open and hard to heat.

The Professor's facts are all quite favorable to continuous heating, when carefully analyzed, but it is unfortunate that the results of an "impartial" observation should be presented just as these were, and doubly so when, as in this case, all discussion of them was prohibited. JOHN B. PORTER.

Tie Plates.

Intercolonial Railway of Canada.
Office of the Chief Engineer,
MONCTON, N. B., April 23, 1888.

TO THE EDITOR OF THE RAILROAD GAZETTE:

Referring again to your letter of the 10th instant in regard to our experience with the Servis tie plate, I have to say that we have had about six miles in use for four years, and about 40 miles in use for about one year.

The first six miles laid were of iron, and were 7½ in. long, 2¾ in. wide, 3/16 in. thick, with a flange ⅝ in. deep. Those ordered last year were of steel, 8 in. long, 3¾ in. wide and ¼ in. thick, and much stiffer than those first used. The first lot were rather light, and were not bedded very carefully; they bent up slightly at the ends. They have, no doubt, preserved the life of the ties.

Cedar ties are used for about 400 miles on the northern divisions of our road. It is the most durable wood we have as far as affected by the weather. A cedar tie will probably last from 15 to 20 years if not cut through by the wear of the rails and the repeated driving of the spikes into it. The tie plate prevents the wearing of the ties by the rails, but does not prevent the sleepers from being cut up by spikes; the wood being soft, there is a tendency for the spikes to work loose.

From year to year we are taking up our 56-lb. rails and replacing them with rails 67 lbs. to the yard. The heavy rails we are laying down have a base half an inch wider, and consequently the tie plate suitable for the 4 in. rails is not suitable for the 4½ in. This is the chief reason we have not used more of them.

The new plates laid about a year ago have done better than the old ones where they are properly laid. On curves particularly, it is much easier to keep the track in line and to gauge with them than without them, and they effectually prevent the rails from canting on the curves, which in many places has given us considerable trouble.

I may tell you that our cedar ties only cost us from 12 to 14 cents each, and the tie plate to preserve them is not so much an object to us as it would be with many roads in the United States where the same cedar ties cost from 35 to 45 cents each.

I note your editorial remarks on "American Genius" letter in the *Gazette* of the 13th inst. As far as our experience goes the noise is not objectionable. When sitting in a car passing the over track, it is impossible to say where the plates are used and where not. This might not be the case where other than cedar ties are used. The other point raised by you seemed to me the most objectionable feature of the device when it was first introduced. In practice, however, we have not experienced any difficulty. The two spikes acting together would, it appears to me, more than compensate for the tendency of the rails to slip on the tie plate.

P. S. ARCHIBALD, Chief Engineer.

Transportation of Immigrants.

PHILADELPHIA, April 30, 1888.

TO THE EDITOR OF THE RAILROAD GAZETTE:

I am glad to see that you have an eye to the troubles of the poor immigrants, as is shown by your editorial of April 27, but I am somewhat doubtful about your remedy. You say that a passage to Chicago costing, say $8, should be charged for at the rate of $13 and the profit used for improving the facilities; but in the same breath you say that the immigrant does not appreciate improved facilities. If that is the case, why not reduce the price?

I admit that some of the money could be used for improving the cars so that the poor, tired immigrants could get some sleep on their weary journey, and for providing better waiting rooms and more comfortable transfer through the cities, but the most of the money would have to go for indivisible expenses, such as interlocking signals and abolition of grade crossings. Is it fair to make the immigrant, who is going west to stay, pay such a large share of the cost of improvements of this latter kind? You say it is fair for a railroad to carry passengers at an unreasonably low profit because the same passengers have to make it up to the road on the food, clothing, etc., they consume, which has been transported over the road a relatively high profit; but it seems to me that this rule is a very crude one. Take the case of the New York Central with its immense export traffic; is not the European consumer of bacon and cheese paying an undue share of the expenses of the road to enable it to carry local passengers too cheaply?

Consumers in Europe and immigrants for the west are not fairly a portion of the "community" served by the New York Central. But whatever may be the right of these questions, common humanity demands that the plain and comfortable immigrant sleeping cars used by the roads west of Chicago be introduced on the eastern roads. To make women and children ride 36 or 48 hours, or even more, in "sitting-up" cars is barbarous, especially as it is unnecessary. The old passenger cars now used for immigrants could be cheaply fitted up and without spoiling them for day travel. This would be a "facility" which the most ignorant foreigner could appreciate. H. T. C.

[An immigrant will appreciate good facilities while he is on the journey. Of that we never had any doubt. The question is whether he will appreciate them when he is buying his ticket. In the great majority of cases we think he will not. A dollar's difference in present expense by one route will count for more than two dollars' difference in probable comfort by another. The result necessarily is that active competition for immigrant business sacrifices every other consideration to that of mere cheapness. Now, if the condition of the country were such that it was desirable to attract the lowest grade of immigrants by mere cheapness of rates, something could be said in favor of such a system. But such is not the case. It is a general feeling that low-grade immigrant traffic needs to be checked rather than stimulated. If this feeling is justified, considerations of public policy demand that immigrant rates should be relatively high. We are not talking of questions of distributive justice between different classes of people who use the road, but of the interests of the American public as a whole. We believe that these will be much better subserved by high immigrant rates and good facilities, rather than by low immigrant rates and cheap facilities; so much better, that it is worth while to let the railroads make a large profit—disproportionately large, if you please—under the former system, instead of a small one under the latter.—EDITOR RAILROAD GAZETTE.]

Interlocked Switches and Signals.

BY CHARLES R. JOHNSON, C. E.

I.

In the *Railroad Gazette* of Nov. 20, 1885, was published a table showing the number of interlocking plants then in use in the United States. At that time there were in operation some 227 machines aggregating 2,659 levers. Since that time great progress has been made in the use of interlocking, and it is our purpose in this and some succeeding articles to show what has been done, not only in the addition of interlocking plant, but in modifications of practice. It is well, however, to state at the outset some general facts which are well known to a few, but are not so generally understood as they should be.

Generally speaking it may be said that wherever there is any doubt as to the practical value of interlocking or block signaling it is due either to defective appliances or want of proper maintenance, and chiefly to the latter cause. The reason for this is easily explained. A railroad company in introducing such a new system is almost certain to be without employés familiar with the use and maintenance of the numerous parts used in signaling appliances. This trouble is being remedied on several roads by the appointment of men whose sole duty is to take charge of signals. Signal departments are being created, in fact. The drawback in many cases, however, is that men are put in charge who have had no previous experience of the subject, and no reflection is made on their intelligence in saying that it is impossible for them to at once become competent to superintend maintenance, and still less so to design and execute plants. It is generally supposed that the art of signaling is very simple, and can be easily and quickly acquired; but those railroad officers who have gone into the matter most deeply, and have had the most work done, will bear us out in the statement that the more they look into the matter the more there seems to be to look for.

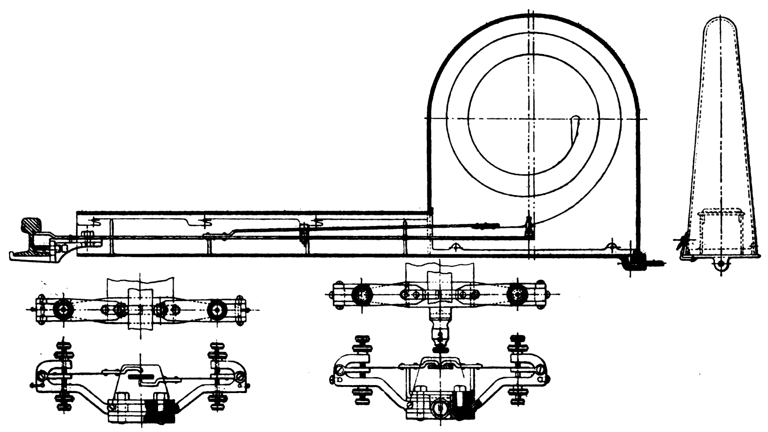
In interlocking the principle is indeed simple. It is that at all points of danger to traffic by the use of switches, which take trains from one track to another, such as at junctions, sidings and terminals, and also at grade crossings, where there are no switches, visible signals shall be displayed on all tracks requiring them, and that they shall be worked in such a way that conflicting signals cannot be given at the same time. For instance, at a single track junction we must insure, not only that signals for the converging tracks, or those being used in the trailing direction, shall not be given at the same time, but also that the switch shall be set for the track for which the signal is to be lowered, so as to prevent its being run through and probably broken, and also that the switch cannot be turned again until the signal has first been placed to danger. For trains using the junction in a facing direction the switch must be not only in its proper position for the corresponding signal, but also locked in that position to prevent the possibility of having a clear signal and a partially closed switch. The lock also must have connected with it a detector bar of sufficient length to prevent an operator from first throwing his signal to danger and then moving his switch while the train is passing over it. All railroad men will understand how easy it is without a detector bar to move a switch between cars, or between the wheels of a car. Although, therefore, the principle is simple and easily understood, it is much more difficult to understand the details of an interlocking apparatus, the proper positions of signals, the most suitable kind of signals for various purposes, the best and most economical connections for signals, switches and locks, the means for counteracting the varying length of the connection caused by variations of temperature and the best general lay out for complex yards or stations.

One great difficulty of the signal engineer is to convince officials that partial interlocking is almost as bad as permissive block, for the reason that the men to be governed by one or the other are apt to think that they have complete protection when it is only partial. In a word, they rely partly on a system and partly on the exercise of their own judgment, and the result is often disastrous. The chief reason why partial signaling is so often done is that it is not considered necessary to signal movements that are not often made, and as the danger is not understood, the signaling is cut down and the first cost saved at the expense of greater cost eventually. It is often considered not necessary to give a fixed signal for using a grade crossing in the wrong direction, or for backing through a cross-over, or from a junction in the face of traffic, or into a siding, because main track signals are supposed to be enough. Plans for partial signaling have frequently been prepared and the work executed, with the result that in many cases railroad companies thought themselves in a measure imposed upon because they found they had not attained absolute perfection. A more careful examination of the plans at the outset would have prevented this misunderstanding. It is gratifying, however, to know that several important roads now insist upon interlocking being complete wherever it is put in; that is, that a signal shall be given for every traffic movement that can be made. Wherever this is done interlocking is appreciated as it can be in no other way.

As a rule, the proper signaling and interlocking of any given point requires more study in its design and more time in its execution than is commonly thought necessary, and probably managers do not often give it the necessary attention, but are constrained to leave to the expert more responsibility than he can fairly assume. This can only be an entirely successful way of dealing with the problem if the expert is thoroughly competent and is allowed to prepare his own plan of tracks after obtaining full particulars of present and probable future traffic movements, and can decide what money is to be expended, but this can seldom be practicable.

To get a notion of the time which must almost inevitably be consumed in executing any comprehensive scheme of interlocking let us consider the case of a division to be equipped, with ample appropriation of money, and every officer of the company ready to facilitate the work. The first work is to fix the location of the towers, and this may often involve the purchase of land. The towers located and designed, the design, construction and erection will follow with such rapidity as circumstances permit, but even the distribution of the material for a number of towers, under the most favorable circumstances, over a division crowded with traffic, is a work of considerable time and trouble, particularly where there is no officer familiar with the work, whose sole duty it is to look after it. Only after the location of the tower has been settled can the working plans be prepared for the signaling, and when these are made they have to be sent to an inspector who takes them to each point and reports as to the best run of connections, the location and height of signals and other particulars necessary in ordering material. While considerable material can be carried in stock the interlocking machines and most of the signals have to be made specially. When material has been made, shipped and arrived at its destination men may be sent to do the erecting. This is one of the most important parts of the business; for no matter how excellent the design may be or how well manufactured, unless the parts are properly fixed the finished signaling shows poor results. It may seem an easy matter to overcome the difficulties in the way of doing quick work, and it would be so if they were better understood, as they are certainly becoming on many roads. Delays are costly and can only be avoided by having everything in readiness for the execution of the work. This is a matter which depends almost entirely on railroad officers. Innumerable delays result from a want of knowledge of the business. Erecting men are often sent on the ground prepared to commence work, and then it is found that the tracks have to be moved, new switches and frogs put in, some drainage to be done, signal bridges to be built, and so forth, all of which should be done before the interlocking men arrive on the ground.

Street's Highway Crossing Signal.



STREET'S HIGHWAY CROSSING SIGNAL.

The illustrations given herewith show a device for operating an electric circuit for the purpose of ringing a bell at a highway crossing to warn teams and pedestrians of the approach of a train. The cut shows side and end sections of the track instrument, and plans and sectional views of the circuit breaker and cut-out. The lower left-hand figure shows the circuit breaker,* which is fastened to the horizontal steel spring (shown in the larger figure) at its end furthest from the track, an insulator block placed between them keeping them electrically separate. The lower right-hand figure shows the cut-out, similar in principle to the circuit breaker, which is placed at the point of danger (as a road crossing) to stop the ringing of the bell the instant the train has passed it.

The first track instrument closes the electric circuit and keeps it closed (ringing the bell) such length of time as may be desired. The cut-out, actuated by the train as it passes the crossing, opens the circuit (preventing the ringing of the bell). This is used on single track roads and is adjusted to keep the circuit open until the train shall have passed the circuit breaker on the other side of the crossing, which, of course, should be operated only by trains moving in the opposite direction.

The principle of the operation of the circuit breaker is very simple, as will be seen by the cuts. A flat horizontal steel spring is fixed to a bracket, clamped to the under side of the rail, and extends out about 5 ft. at right angles to the track. The inner end of this spring or lever presses against the under side of the rail head, and is adjusted so that the jar of the train imparts considerable motion to the far end, the fulcrum being about 6 in. from the rail. The vibrations of the lever cause the circuit breaker fastened to, but insulated from, its outer end to move vertically.

At a point about one-third of the length of the lever, measuring from the rail, is mounted on it a similar but smaller vibrating arm, which has mounted on its outer end a large coiled brass spring, which passes between the contact points of the circuit breaker, and in its normal position rests between and entirely free from contact with either of them. The contact springs of the circuit breaker are electrically connected. One pole of the battery being connected with the coiled brass spring the circuit is permanently broken while the circuit closer is at rest. The jar of a train on the rail sets the large coiled spring in motion, this causes the two vibrating rods to work alternately against each other, causing the arm of the coiled spring to strike rapidly against the contact points of the small contact springs on the insulator block, each contact closing the circuit, thus ringing an alarm at a distant point.

As the train passes more or less rapidly over the track, the recoil of the brass spring becomes more pronounced, and continues its motion long enough for the train to reach the point of danger, when it ceases striking the points which close the circuit, and the alarm stops sounding, the time being graduated by the distance the contact points are adjusted above and below the arm of the coiled brass spring. As the spring ceases its motion the vibrating rods come to a state of rest, and the circuit is permanently broken. The device can be so constructed and adjusted that it will ring an alarm from a few seconds to 10 or 15 minutes or more, and ring continuously while a train is running a distance of a few rods to a number of miles. It will be seen that the device is secured to the bottom of the rail in such a manner that no wheel strikes any part of it.

The advantages claimed are: Cheapness—The cost of manufacture not exceeding $5. Efficiency—"It never makes a false alarm or fails to give an alarm at the proper moment." Durability—It is made very strong and no train or car can injure it except by derailment. Cheapness of maintenance—This being practically confined to keeping the battery in order. It is not affected by the weather, and works equally well throughout all seasons of the year. Should a train stop over it, it stops its motion and causes the alarm to cease. When the train starts it instantly begins sounding an alarm at the point of danger. It is a perfect annunciator for draw bridges, from station to station or between stations from a single block, or a series of blocks, as the train runs from one to another.

This signal has been used for some time on the New York, Lake Erie & Western, and we understand has been adopted as the standard of the company. It is also in use or to be tried on the Old Colony, Boston & Providence, New York, Ontario & Western, Pennsylvania, New York & Northern and New York, Chicago & St. Louis. The inventor and owner is Rev. S. T. Street, Deposit, N. Y.

*"Circuit *breaker*" is a misleading term, as the effect of the action of the instrument is to keep the circuit closed (not broken) while it is in operation.

Maintenance of Track, and the Steel Rail in Track Economy.

BY JOHN M. GOODWIN.

In a late equity suit, between two railroad companies, in which I was a witness, each party presented "expert" testimony relative to the cost of maintaining railroad track per mile per year. The plaintiff, seeking to enforce upon the defendant the building and maintenance of a certain projected branch railroad, represented the cost of maintenance as a merely nominal charge. His witnesses were not unanimous, by any means, as to just what the cost would actually be; but the highest estimate was very much below the lowest put in by the defendant, who wished to avoid building the branch in question.

Here were several "experts" on one side, giving testimony regarding this matter of annual cost of maintenance of track, largely contradicting that of about an equal number on the opposing side. The Master in this case, and in like cases, in treating details regarding which testimony such as that above described has been given, might, perchance, hit somewhere near the truth by "splitting the difference" between the opposed statements, but he might better say, simply, that the statements are irreconcilable, and that the testimony as a whole affords no satisfactory evidence in any matter at issue.

In a review of the case alluded to I have, for the purpose of illustrating some general principles, made an exhibit exemplifying actual cost of maintenance of the tracks of a railroad in the periods from 1873 to 1878, both years included; and from 1880 to 1884, both years included. The road on the accounts of which the exhibit is based (the Lake Shore & Michigan Southern) has considerably more than 2,000 miles of track, all told; of which main line tracks (including second track) constitute about 37 per cent., branches about 36½ per cent., and sidings and yard-tracks about 26½ per cent. of the whole. It is centrally situated, and does a general business; no particular traffic largely predominating.

I show as nearly as I can from the data supplied by the published reports of the company (which are more explicit than any others within my knowledge) the progress of substitution of steel for iron rails in the main line tracks; and generally give all details, deducible from the reports, which seem to me useful as means for making a fair estimate of cost of maintaining in good order, under an ascertained traffic in the region in which the L. S. & M. S. road lies, a first-class steel-rail track, with its road-bed. My examination of the matters treated has been directed so as to illustrate, as far as I might with the means at hand, the value of the steel rail in railroad economy. In furtherance of the ends had in view, I submit the subjoined tables and notes:

	Miles main line and second track	Miles branches	Miles all tracks and sidings	Miles steel track	Per cent. of steel in main line	Per cent. of steel in branches	Per cent. of steel in main line and branches aggregated	Per cent. of steel to all tracks aggregated
'73	770.36	640.39	1,799.30	413	53.61	....	29.2	23
'74	771.17	635.02	1,835.41	514	66.65	....	36.5	28
'75	771.17	635.02	1,852.89	604	78.82	....	42.9	32.6
'76	....	about	1,863.89	683	88.29	....	48.57	36.8
'77	776.02	686.48	1,874.88	843	all+66.98 M.	10.52	59.6	45
'78	776.02	686.48	1,877.84	1,002	all+225.98	35.5	70.9	53.8
'80	788.65	686.88	1,892.37	1,125	all+336.35	52.85	78.9	59.8
'81	806.73	686.83	1,946.66	1,238	all+431.27	67.77	85.8	63.6
'82	806.78	799.05	2,142.38	1,861.5	all+554 77	69.48	84.8	63.5
'83	806.78	799.05	2,150.88	1,440.83	all+684.1	79.85	89.7	67.0
'84	806.78	799.86	2,154.59	1,521	all+714.27	89.29	94.6	70.6
'85	806.73	799.86	2,155.82	1,595	all+788.27	98.57	99.27	78.98
							Per cent. in sidings.	
'86	806.73	799.86	2,161.49	1,674	all+867.27	all+67.41 M.	18.05	77.67
'87	806.73	800 89	2,190.30	1,734	all+927.27	all+126.88 M.	21.68	79.16

COST OF MAINTENANCE OF TRACK.

	Total miles track.	Gross cost of maintenance, including bridges.	Cost per mile, including bridges.	Cost per mile exclusive of bridges.
1873....	1,799.30	$3,765,219	$2,093	$2,051
1874 ...	1,835 41	2,344,982	1,278	1,246
1875....	1,852.89	2,483,637	1,340	1,304
1876....	1,874.89	1,805,058	963	905
1877 ...	1,874.89	2,011,768	1,073	984
1878....	1,877.84	1,491,665	794	701
1880....	1,892.37	1,572,614	831	717
1881....	1,946.66	1,805,434	927	856
1882....	2,142.38	1,946,423	909	852
1883....	2,150.88	1,789,317	833	772
1884....	2,154.59	1,326,957	616	565

In the period 1873–1878, both years included, the average annual cost of maintenance of track (including bridges), per mile of track, was $1,250.75; exclusive of bridges, $1,198.48.

In the period 1880–1884 (both years included) the average annual cost of maintenance, including bridges, culverts and cattle guards, was, per mile, $821.55; exclusive of bridges, culverts, etc., per mile, $752.39.

In the period 1873–1878 the per cent. of steel track to road tracks (*i. e.*, all tracks except sidings and yard tracks), averaged 47.94. In the period 1880–1884, averaged 86.76. Increase (in percentage), 38.82.

The average annual cost of maintaining track *per mile* (including bridges, etc.) in the period 1880–1884 was 34.32 per cent. less than in the period 1873–1878; exclusive of bridges, etc., it was 37.22 per cent. less than in the period 1873–78.

The average annual ton-mileage in the period 1880–1884 was 26 per cent. greater than in the period 1873–1878.

The average total mileage of track for six years, 1873–1878, was 1,850.7 miles, and for five, 1880–1884, it was 2,057.37 miles. Increase of annual average, 206.67 miles, or about 10.1 per cent.

The average annual gross expenditure for maintenance of