Electro-Pneumatic Interlocking at the Boston Southern Station.*

By J. P. Coleman.

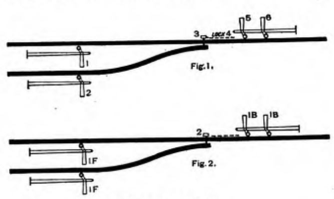
The Interlocking Machine.

The evolutions through which the design of a piece of mechanism passes from its first conception to the period of its greatest utility often render it difficult of interpretation to those not familiar with its development.

The interlocking apparatus used in the electro-pneumatic system has been no exception to this general rule. Those well versed in the art of interlocking, outside of this particular branch of it, have been more or less mystified by the radical departure from former methods of construction that was made in the first pneumatic machine built. Failing to fully realize the benefits resulting from the construction of that apparatus, it was but natural that each succeeding modification in it intensified rather than diminished the original feeling.

The growing necessity for power interlockings has at the present time created a desire on the part of many to fully understand the most modern methods and devices used therein.

The switch and signal operating mechanisms and the general equipment of such a plant have been dealt with in a description of the interlocking at the new Boston Southern Station. An attempt to render equally comprehensive a description of the interlocking machine there would be difficult and scarcely successful without some preliminary remarks and assumptions relating to an apparatus and to a system already well understood by many, hence this seeming departure from the text.



Figs. 1 and 2.

Fig. 1 represents a junction of two single track roads signaled and interlocked by a "mechanical" apparatus in accordance with present practice; distant signals being omitted for simplicity's sake. Each signal is operated by a separate lever, the switch by one lever and its lock and detector bars by another, making a total of six levers necessary.

The locking of this machine would be as follows:

1 locks 3 normal.	4 locks 3 normal and reversed.
1 locks 4 reversed.	5 locks 3 normal.
1 locks 5 normal.	5 locks 4 reversed.
2 locks 3 reversed.	6 locks 3 reversed.
2 locks 4 reversed.	6 locks 4 reversed.
2 locks 6 normal.	

It is possible to operate the above with but two levers, however, under favorable conditions and by means of mechanical appliances in common use, but not with the same degree of safety, nor with the same muscular effort on the part of the leverman or freedom from strains in the operating connections.

A switch and lock movement may be used to perform by means of one lever the work here assigned to levers No. 3 and No. 4. Signals 1 and 2 may be operated from one lever through a "selector" controlled by the switch lever. Signals 5 and 6 may likewise be operated through a selector from the lever operating signals 1 and 2, if the lever is made to stand normally in a central position and to move forward in operating signals 1 and 2 and backward in operating signals 5 and 6.

The load on the signal lever will be doubled by this arrangement, as will also that of the switch lever, but the number of levers is reduced one-third, (See Fig. 2) while the locking reads simply:

1 forward locks 2 normal or reversed.
1 backward locks 2 normal or reversed.

Were it not for the fact that extreme distances, and other conditions affecting mechanically operated switches and signals, would render this practice prohibitory, frequently; and, were it not true that well-founded objections exist to the use of selectors and switch and lock movements in mechanical interlockings, this assumed method might be employed to great advantage in large plants where tower space is valuable and where extreme complications in locking and lever movements are serious considerations.

If, therefore, some means be secured by which the load on levers so connected is easily handled by the operator; if the objectionable feature of switch and lock movements is overcome, and if the selector be discarded, or so modified as to avoid the present danger of false operation of signals through it, the means would find justification in the ends attained.

The objection to switch and lock movements in mechanical interlocking, as stated in a previous article, is directed against the small part of the lever's stroke that is available for locking the switch; and hence the risk incurred in forcing home (through lost motion in connections) the lever without accomplishing this important duty.

If the switch lever of such a machine were so controlled by the switch during operation that unless the latter became fully locked the catch rod of the lever could not be lowered (and hence its locking of other levers not released), the use of a switch and lock movement would not be objected to in the mechanical interlocking, where otherwise practicable.

Selectors are objected to almost solely on account of possible entanglement of the operating wires leading from them to the signals, resulting in danger of the pull wire of one signal clearing with the latter a signal conflicting with it—the "back wires" of all signals operated through a selector being necessarily joined in common to a single wire extending from them to the selector and hence being "slack" to all signals of the selector but the one engaged by it for legitimate operation.

This and minor considerations—such as difficulties in the matter of adjustment, fitting, and in the general arrangement of selectors in a manner consistent with the advantages intended to be secured by them—discourages their use, and it is pretty generally conceded that where used they are as expensive as, and are more troublesome than, the levers they would supplant.

The prime objection to them is, however, the danger incurred from the possibility cited, which may be said to result broadly from the fact that the motion of one wire may be accidentally transmitted to another during operation.

In the Railroad Gazette of November 10 and December 1, 1899, appeared a description of the switch and signal movement used in the electro-pneumatic system at the Boston Southern Station, with sectional drawings illustrating these devices.

Assuming that the construction and operation of these individual parts were made clear in that description, an effort will be made to render clear the advantages they possess in overcoming the objections cited as peculiar to the arrangement shown in Fig. 2, if they were so applied to that arrangement as to control from the two-lever machine the one switch and the four signals shown. The only connections that would be required between these two levers and the electro-pneumatic devices mentioned, were the latter substituted for the mechanical appliances ordinarily used in connection with these levers, would consist of electric wires suitably insulated and protected from injury.

The usual pipe and wire lines, cranks, compensators, wire and pipe carriers, rocker shafts, and the numerous foundations required for their support, together with much labor in installation and attention in maintenance would be entirely avoided in the lead-out of such a plant if it were thus equipped.

Problems as to the loads that are practicable of operation from one lever under the varying conditions met with in practice would cease to longer be a subject for controversy, and the ability to operate through any distance desired by this means the lightest or the heaviest switches, or the combinations of switches, with equal ease, is at once apparent, since their operation would involve, on the operator's part, only such muscular effort as would be necessary to shift the electric contacts by which their motion is indirectly affected, and incidentally such mechanical locking between levers as would by local conditions be required attached to them.

The use of selectors of the usual mechanical design would be avoided under such a system, as would also the objections common to them.

The use of switch and lock movements would, however, be retained and their use would be extended on all switches operated, owing to the fact that switch locks and detector bars constitute attachments essential to the proper protection of every switch, and that this device affords the simplest means of operating the switch and these appliances by a simple acting cylinder.

Some positive means must be provided, however, of detecting failures of switch and lock movements to respond fully to the motion of the levers operating them, when these movements are not shifted mechanically by the levers, since the nature of the power and the appliances used for shifting them otherwise is necessarily of an elastic nature, and, were precautions not provided for preventing it, a full movement of the lever might be made without the switch necessarily responding. Such a movement of the lever would (through the mechanical locking of the machine) release the levers which control signals leading over the switch operated by it, and if the latter failed to respond, disaster might result. To prevent this condition, the switch lever may be arranged to shift the switch completely by a partial lever movement; its complete movement, then, at that stage, being prevented by electric locks, engaging it and so controlled by the switch that until the latter has fully shifted the locks will not release the lever.

Switch and lock movements operated by air pressure, from levers so controlled, may be used with greater safety than they are when shifted mechanically by levers which have no other means of detecting failures of the movement to properly shift, than that furnished by the operating rods connecting them.

The precautions cited as essential to the safe operation of switches by compressed air also apply to a like operation of signals, and the many advantages of the electrical method by which both may be controlled when so operated will become apparent with a clearer understanding of the means through which it is accomplished in the electro-pneumatic system.

[TO BE CONTINUED.]

* Continuation of a series of articles published in 1899, as follows: May 12, July 21, Nov. 10, Dec. 1.

Signaling as it is and as it Might Be.

BRIEF HISTORY OF SIGNALING.

BY A. H. RUDD,

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The first known fixed signals for land work in America were two lights displayed from the belfry of Old South Church, Boston, forming a "distant signal," and indicating to Paul Revere "proceed to the homes." From his time until the close of the Civil War, the subject was little thought of here, although in England as early as 1844 the dangers of time spacing were recognized and on some roads block sections of varying length were established, protected by semaphores, communication between towers being effected by the needle telegraph and in some cases by bell code. The operators were instructed, but not forced by any mechanical or electrical device, to restore the signals to danger after the passage of each train, establishing in effect the telegraph block, as it here exists to-day.*

As early as 1865 a number of "turn towers" were installed on the Philadelphia & Reading. These towers were located always on sharp curves, at the point of intersection of the tangents, being often several hundred feet from the track, but giving the engineer a good line of sight in a clear atmosphere. A large fan arrangement on top of the tower revolved, displaying red until a train had passed out of sight of the operator, at all other times showing white. While most of these devices have been supplanted by automatic signals, two of them still remain in service.

Omitting (as they are not properly block signals) any description of the banners, balloons, Dutch clocks, flip-flops, red balls, windmills and various other fantastic and unique shapes, varieties and systems (?) of signals, some of which are still extant, we find that in 1866 Thomas S. Hall of Connecticut began work upon an automatic block indicator. In 1871 he installed a crude but ingenious apparatus on the New York & Harlem, and the Eastern (now the Boston & Maine), operated on an open circuit. After a number of years of constant labor and many improvements he evolved the "banjo" signal of to-day, in which a closed electric circuit is employed to raise a disk, so that any broken or crossed line wires or defective battery will allow it to drop by gravity and indicate danger; this circuit being opened at a relay by the passage of the train.

In place of track instruments, whose treadles were depressed by the wheels of passing trains, and which if broken or set too low would not operate, we now have track circuits which keep the signal at danger as long as a pair of wheels is in the block; while non-fusing relays, with lightning arresters, guard against sudden heavy currents. This system appears to be capable of but little farther development.

On February 1, 1881, the first patent was issued to George Westinghouse, Jr., for electro-pneumatic signals. This was followed by five others to him and two to other parties during that year; also two reissues and three new patents, prior to 1887, in which year Mr. Westinghouse took out ten additional patents on these devices. The system has since been constantly improved by employees of his company, and to-day the automatic block semaphores, notably on the Pennsylvania Railroad, give evidence of its perfection. The first signals of this class were installed in 1882. In recent years a number of other devices have been evolved, and some are being perfected, but the results achieved by the two above noted and their extensive use warrant us in taking them as examples of American practice.

No successful automatic systems, I believe, have originated abroad. Although automatic signaling has thus far made little or no progress outside of America, there is still the possibility of a wide and profitable field for American inventions.

In manual controlled block signaling, however, English inventors were early in the field, the Sykes system being perhaps the most widely adopted and best known among them. This device was brought to our shores about 1882, but had several defects, chief of which was the lock falling free by gravity, instead of being pulled out by the electric current; there was also the liability to unlock by the action of lightning or by crosses of foreign wires. Here

* In fact the principle of the telegraph block system appears to have been fully recognized by the English as soon as the telegraph was put in use, and experimental block signaling is reported as early as 1839.

again our inventors set to work and the Patenall and Union lock and block instruments are further proofs of their ability and perseverance.

The electric train staff was originated in England and improvements on it or useful additions to its facilities have been devised in this country.

At the present time, however, many of our large roads, as a matter of economy, or for other reasons of policy, cling to the time interval as a method of spacing trains, and the following incident actually occurred on a large double track line not a thousand miles from New York, as late as 1887. On a day of extra heavy travel Father Time was represented by section men stationed at convenient intervals armed with five minute sand glasses to mark the fleeting minutes and with red flags in lieu of scythes, with instructions to display the latter as soon as each train passed, turn the glass, and stop all trains until the sand ran out. The first *down* special passed a timeboard, indicating that the preceding train was over an hour ahead, only to be stopped by the next red flag. An examination of the glass showed that the sand had run about two minutes. "Where is the other train?" thundered the Superintendent, who was aboard. "Just gone up, sor!" That block station was abolished, the flag was replaced by a pick, and the "aisy job" discontinued for the day. This line now has a complete block system, and trains are not stopped by the propinquity of those on the opposite track.

In interlocking, Great Britain was in the lead for many years. Our first machine was devised and installed by Messrs. J. M. Toucey, General Superintendent, and William Buchanan, Superintendent of Motive Power, of the New York Central & Hudson River at Spuyten Duyvil Junction, N. Y., in 1874. It was replaced in 1888 by a Saxby & Farmer machine of American make. In 1875 the Pennsylvania Railroad imported from Saxby & Farmer of England a complete plant for Newark Junction, N. J., and soon after erected a large tower at Broad Street Station, Philadelphia. The elevated railroads of New York City were also early in the field.

With the exception of the Pennsylvania, few roads accomplished much until 1887, when the persistent efforts of the Railroad Gazette and other agencies in calling the attention of Managers to the advantages of these devices began to bear fruit, and improved financial conditions began to permit their adoption.

Until 1888 the Union Switch & Signal Co., successor to the original Jackson Manufacturing Co., dominated the field, furnishing a modified Saxby & Farmer machine, and employing the old gridiron flop locking. In 1888 the present Stevens locking, with patented swing dog special, was invented by Mr. J. T. Hambay. Soon the Johnson Railroad Signal Co. entered the field, putting on the market the Johnson machine, which was patented in 1885, 1888 and 1892, and using vertical locking invented by Mr. Arthur H. Johnson. Later the National Switch & Signal Co. was organized, languished a while, was reorganized, then absorbed the Johnson Company and was in turn amalgamated with the Union Switch & Signal Company, leaving as its record of contribution to the general good the National machine, with its beautiful special locking. This also is of the vertical type, and was patented by Geo. H. Pfeil in 1892.

During the later period of the above changes in organization the Standard Railroad Signal Co. entered the field, and in 1896 the Standard machine was put on the market, with locking designed, I believe, by Messrs. Henry Johnson and John T. Cade. Meanwhile the Hall Signal Co. was pursuing the even tenor of its way, confining itself to the manufacture and sale of the electric signals only.

Under the head of interlocking machines to be used with switches and signals worked by other than manual power, there is first to be noted the electro-pneumatic, manufactured by the Union Switch & Signal Co., brief mention of which has already been made in connection with automatic block signals. The first machine (1876) was purely pneumatic. The electro-pneumatic was tried in 1877. Also, the hydro-pneumatic was developed, and quite a number of plants of that kind were installed up to and including 1890. In 1891 other experiments were made with the hydro-pneumatic.

In 1892 the electro-pneumatic, with many improvements, was brought out, and in 1893 the patented Hambay tongue locking was adapted to this machine, and substituted for the purely electric locking which was in vogue up to that date—a great step in advance. In 1897 the final mechanical locking was used in this machine, and other improvements were made, the result being the electro-pneumatic machine which is the standard to-day. Recently, also, power machines operated wholly by compressed air, or entirely by electricity, have been devised, and a few installed, but they can hardly be said to have as yet passed the experimental stage, although they also will doubtless be rapidly perfected, and much may be expected of them.

Thus, after early struggles against adverse circumstances of every sort, obstacles seemingly almost insurmountable in the way of defects in the systems themselves, new conditions to be met in every installation, lack of financial support, narrow markets and infinitesimal returns, which only those men who bore the brunt of these burdens can ever realize, the American systems of to-day are established; and their universal adoption must be only a matter of time.

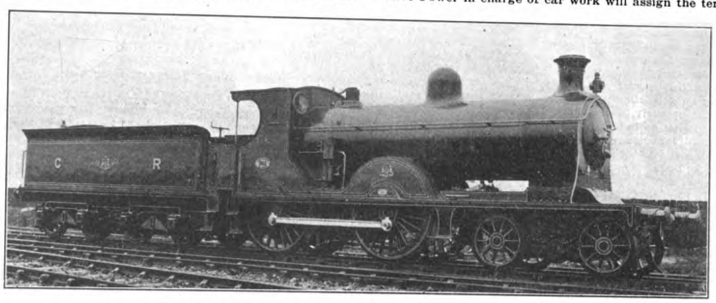
When the history of this work is some day written, the names of a score of modest men, little known at present outside their own small circle, will be honored as the pioneers of a science which has added as much as any single branch of engineering to the safety of passengers and property. It is this science or art that has made possible the tremendous increase of train manipulations at great terminals; the decreased safe time interval between trains, and the consequent increased capacity of the lines; and the greatly enhanced peace of mind of operating officials.

Signaling is a science not at present appreciated at its true value by one manager in a dozen, nor by one of the general public in ten thousand, because they do not understand it in detail or adequately appreciate its difficulties, its demands upon the men who pursue it (compensated in large measure though they are by the fascination of the study), or its great and absolute advantages to the railroads themselves, through safeguarding traffic and rendering possible its advantageous increase. But in the near future interlocking and block signaling will receive due credit, for it will be seen that traffic may be doubled, yes, quadrupled, by the use of signals.

[TO BE CONTINUED.]

Eight-Wheel Express Engines for the Caledonian Railway.

An eight-wheel engine has recently been built at the St. Rollox Works of the Caledonian Railway Company, intended for heavy and fast service. It is built from the designs of Mr. J. F. MacIntosh, Locomotive Superintendent of the Caledonian, whose reputation as a locomotive designer is not confined to his own country, engines built after his plans being in use on the State Railroads of Belgium. On the Caledonian is a combination of heavy and fast trains with heavy grades, and the weight of the West Coast expresses increases year by year, as is common experience in our own country. These new engines have been brought out to meet these conditions. The principal dimensions and weights are given below. These engines are fitted with steam sanders, Westinghouse brakes and apparatus for steam heating of the trains. An engraving is shown, from a photograph.



Eight-Wheel Express Locomotive for the Caledonian Railway.

Cylinders	19 x 26 in.
" c. to c. of	28½ in.
Wheels, diameter, truck	3 ft. 6 in.
" " driving	6 ft. 6 in.
Boiler, center above rails	8 ft.
" diameter of barrel	4 ft. 9½ in.
" thickness of plates	9/16 in
Firebox, length	6 ft. 11 in.
" breadth	4 ft. ½ in.
" depth, front	5 ft. 9 in.
" " back	5 ft. 3 in.
" thickness of plates	⅝ in.
Tubes, number	269
" length	11 ft. 7 in.
Heating surface, tubes	1,462 sq. ft.
" " firebox	138 sq. ft.
" " total	1,600 sq. ft.
Grate area	23 sq. ft.
Steam pressure	200 lbs.
Weight on driving wheels	79,968 lbs.
" of engine	115,808 lbs.
Tender, tank capacity	4,125 gals.
" coal capacity	5 tons
" wheels, diameter	3 ft. 6 in.
" weight	100,800 lbs.
Total weight of engine and tender	216,608 lbs.

Packing and Lubrication.

At the last meeting of the New York Railroad Club the discussion of the evening was on the subject of lubrication. In the course of the talk Mr. Waitt told something of the recent instructions put in force on the New York Central & Hudson River Railroad. We print below, in full, the general instruction circular No. 2, issued Jan. 1 of this year, governing the practice on the New York Central system.

Passenger Equipment Cars.

Packing.—The journal boxes in passenger equipment cars belonging to this company are to be repacked with waste saturated with winter oil each year, beginning the work on the 15th day of November and completing it as quickly as possible after that date.

All good, clean waste removed from the boxes at this time will be used again in repacking, after having the summer oil thoroughly squeezed out by pressure, and after it has been resaturated with winter oil.

In addition to the above repacking, all passenger equipment cars will be repacked when passing through shops for general overhauling, all waste in the boxes being removed, and that which is good and clean being resaturated.

In repacking boxes, preferably, new waste should not be used alone, but should, where it is practicable, be mixed with the old, the two being mixed in the proportion of one-half old and one-half new.

When the boxes are repacked, tin tags (1 in. x 3½ in.), having stamped on them in ½-in. letters and figures, the station abbreviation for the place where repacking is done, together with the month and year, are to be attached to two opposite inner corners of each truck frame. The tags applied when the boxes are repacked with winter oil are to have four dots marked after date, thus: M. H. 12-99. : : These tags will indicate to foremen and others at terminal yards where repacking is done, whether the boxes have been repacked within the specified time, and whether they have been repacked with winter oil after November 15, and will prevent any duplication of work. The tin tags should be painted standard truck color.

Oiling.—All through passenger trains on the main line will be oiled at New York and Buffalo, and on the West Shore at Weehawken and Buffalo, and no oiling at intermediate points will be done, except in case of warm or hot box, or other emergency. Journal box lids should not be opened at intermediate points unless box is found to be above running heat, as indicating by feeling it with the hand.

All local and branch passenger trains and cars not in main line or through service between New York and Buffalo are to be oiled once in every 3,000 miles run, the date of oiling all cars in such trains to be marked on the under side of the side sill over each truck, giving the month and day of the month.

In case of cars having no regular run, inspectors are expected to use their judgment in seeing that they are given sufficient oiling when at their station, care being taken to avoid using oil unnecessarily, and when such cars are oiled, the month and day of the month is to be chalked on the under side of the side sill over each truck.

Master Car Builders and Division Superintendents of Motive Power in charge of car work will assign the terminals at which regular oiling of passenger equipment cars in local and branch trains will be done, and they will file with the Assistant Superintendent of Rolling Stock a statement of such assignments.

Freight Equipment Cars.

Packing.—All freight equipment, work train and miscellaneous cars belonging to this company are to have all the waste removed from the boxes, and the boxes repacked, whenever they are placed on shop repair tracks for repairs. All waste removed that is good for further use is to be picked apart and resoaked in the tanks provided for saturating waste. Such waste is to be saturated in oil for not less than forty-eight (48) hours, then drained, after which it can be used again in repacking boxes in freight equipment, work train and miscellaneous cars. Such waste removed from the boxes as is found poor and dirty, is to be placed in proper receptacle and later is to be burned up.

The above practice of repacking boxes of cars placed on repair tracks is to be carried out at inspection points to as great an extent as possible consistent with the surrounding conditions.

All cars received from connections at interchange points, also all cars set out at stations where inspectors are located, and all foreign cars placed on shop repair tracks, are to have the lids of the journal boxes opened and the packing put in proper condition to run over this company's road without question, unless it is already in such condition. Well saturated packing only is to be used and applied in the boxes for this purpose. If in such cars the packing is found very dry, and not in good shape to carry the car over this company's line properly, it is all to be removed and the poor packing thrown away, and such as is good saved and resaturated for future use. The boxes from which packing is removed should be repacked carefully with freshly soaked packing. In addition to putting the packing in good condition, an examination must be made to see that the journals, journal bearings and keys are in proper condition.

Caboose cars are also to be taken care of by the use of saturated packing, in the same manner as other freight equipment cars. The boxes are to be examined after each trip, and when needing oil are to have saturated waste applied. This should not ordinarily be required more than at intervals of once each month.

In treating boxes having a sufficient quantity of packing, but which are lacking in oil, a small amount of many a line of that article, although there was nothing of the sort there. The writer still believes that the method of treatment in the article of Jan. 12 is more simple than one involving the use of formulas at every step. He cannot object to the use of any formula for train resistance or any formula for traction which any engineer may find to represent the facts. All such considerations can have effect given them in fixing the rate of grade which shall represent the ability of the engine at about the average speed, and this grade may be made to lie as far on the conservative side as seems best to each engineer, and if desirable may easily and intelligently be made more conservative in some cases than in others. In this way the method allows greater elasticity than a rigid formula.

C. FRANK ALLEN.

Signaling As It Is and As It Might Be.

THE EVOLUTION OF THE SIGNAL DEPARTMENT.

BY A. H. RUDD.

(Continued from page 50.)

It will be noted from the preceding article that the preliminary and experimental work was largely done before 1888, and that the last 12 years comprises the period of actual development.

In the early stages of railroad operation, the division superintendent was supreme, having under his immediate personal control all the operating branches of the business. He was superintendent of transportation and of motive power, traffic manager, car accountant, chief engineer, road master and superintendent of buildings. As business increased, and the roads developed, it soon became evident that no man could carry this burden in detail and improve the service as the public and the stockholders demanded.

One after another the different great departments were organized, and specialists were sought and established as the responsible heads. The telegraph revolutionized the work of the transportation department, the chief dispatcher becoming an important man. Lastly, not over a dozen years ago, the signal department, the baby of the family, had its birth. By reason of its late advent it is still in short trousers, and, in many cases, not yet out of its swaddling clothes. But is it not almost time now that it be given a voice in the councils of the family? Although young in years, it has demonstrated itself to be a very precocious youth, and has developed fast.

For many years fixed signals were regarded entirely in the light of luxuries. At present they are looked upon in many quarters as a necessary evil, and not even the most liberal managements regard them as an entirely unalloyed blessing. In most cases the signal department "was not born, it growed." The exceptions to this are few. There have been some lines on which the signal engineer was appointed, and the work installed under his direction, largely by contract and covering whole divisions at a time; but the usual development has been the installation of isolated plants, and, after the number of them had for some time warranted it, the establishment of a department. This is about the way matters stand to-day.

Referring now to interlocking, how familiar to contractors is the plan of tracks submitted for signaling. No consideration has been given by the engineering department, in its arrangement, with a view to making simple and perfect signaling easy, and a "forest of masts" arises (on paper) as one signal after another is added, absolutely necessary for proper working, but which might have been easily dispensed with by a slight rearrangement of the tracks. The additions made, the transportation department steps in. "This will cost too much money; there are too many signals; this move is rarely made; cut out that signal; this move will never be made except in emergency" (when signals are most needed); "we will give hand signals at such times. Now cut off 10 per cent. and we will talk with you." The revised plan goes through, and the work is installed, usually without supervision, or at best under that of some official entirely unfamiliar with the work. The signal companies, let it be said to their credit, usually give good return for the money expended, but either the ten per cent. deducted must be made up in some way, or their profits are nil.

After being put in service, the plant, if an isolated one, is cared for by the road department, whose man oils it semi-occasionally and sweeps out the sand when it gets working too hard; or by the motive power department, whose shop mechanic, a good man in his own line, makes repairs when absolutely necessary, or more frequently after a break down has caused a tie up; or by the carpenters of the bridge or building force, who perhaps built the tower, and consequently must understand all about its contents! The person in charge, not understanding the first principles of safe signaling, sometimes proceeds, if a wire breaks, to tie the arm in a clear position until repairs are made, because "we must get our trains over the road."

Then the impossible occurs, and movements are found necessary that "never will be made." Hand signals are resorted to, with the inevitable result; a switch run through trailing perhaps, a case of rattles, or attempt to shift responsibility, a back up move over the broken switch, something on the ground, and—more repairs. The signal company's agent, always on the alert, then appears upon the scene. "Let us complete the signaling for you at this point, and these troubles will be avoided in future." The reader can guess the reply: "We want no more of your apparatus; it is always out of order."

We buy magnificent locomotives. Are they inspected by competent men before being accepted? Are they allowed to run without further inspection until they break down? Are they repaired by track or bridge men? When purchased, are they required to be complete, or do we leave off the head lights because the engines will be used only on day runs? Do we dispense with whistles because city ordinances prohibit their use, while in the country they are seldom needed, and in emergencies the bell can be sounded or the engineman may yell? Some dollars could be saved in this way, but the method is not employed. Signal plants are, however, installed incomplete for similar reasons. Hand signals are given where none should ever be resorted to except in the rarest emergencies, which have their parallel in the breaking of the headlight or the whistle.

Does anyone consider two bolts to an angle bar and one of them broken the proper thing in good track? Why are tracks inspected daily and trestle bridges patrolled frequently? Because, although it all costs money, it is the safest way and the cheapest in the end.

Why, then, in the name of common sense, should signal plants be installed without inspection and turned over to the tender mercies of men skilled in their own lines, but absolutely incompetent to perform work for which they have received no training?

This condition has existed, and it exists to day, in many places. The remedy lies with the managing officials, and no one else.

At the next stage in signaling development we find a signal fitter from the contracting company detailed as repairman. He fills the bill, but if he is disabled or leaves the service, no one is qualified to take his place. If additions are required they must be made by contract, for how many fitters can apply the proper locking until the plans have been provided for their guidance? How many shop men can build even a part of a locomotive offhand?

The reason for this state of things is, as already intimated, that the intricacies of the work are not realized by the higher officials because the development has taken place since they were graduated from the school period of their railroad careers. And this does not imply any failure to keep abreast of the times either. Details of other departments are left to their heads; but with no department and no head, signals are in a sorry plight.

A case is known to the writer where a Pennsylvania Steel Co.'s machine was used to operate derails with lock and switch movements at the crossing of two double track trunk lines. As a wheel was revolved the derails were closed and locked and a further revolution cleared the home and distant signals in both directions on one line simultaneously. The detector bars were removed in the fall to avoid cleaning during the winter. In the same tower with this machine was a four-lever old-style Johnson, in no way interlocked with the other, but controlling a crossover and switch within the limits of the derails, said crossover being protected (?) by dwarf signals normally clear when levers were home. Enginemen received both high signals and the dwarf for one move, and the high signals only for another, running against the dwarf.

This is a fair sample of signaling under the conditions just described. Fortunately such work is now largely a thing of the past, though there are some cases as bad still to be found in actual practice.

With electric signals, if of simple form, the problem was less difficult. These, as soon as installed, were usually placed under the supervision of the Superintendent of Telegraph. His line men, being familiar with the care of batteries, relays and wires, easily learned in a few weeks to take ordinary care of the signal apparatus, and they did it if nothing more important was on hand.

This was a good organization and is carried out in several instances to-day. The natural increase of the work in time outgrew this arrangement entirely, necessitating the appointment of a separate official, or at least modifying it so as to have a foreman in direct charge reporting to the Telegraph Superintendent. But the latter, when called upon, in addition to his other duties, to supervise the erection and care of interlocking plants, is sure to be overburdened, and at all events is usually beyond his depth. In short, the whole business resolves itself into the old saw of the shoemaker and his last.

Let us now consider the third stage of the game; when the shoes to be repaired are so numerous that the shoemaker must be found, and some division superintendent "wearied and ill at ease" decides to appoint a signal foreman to take the load off his shoulders.

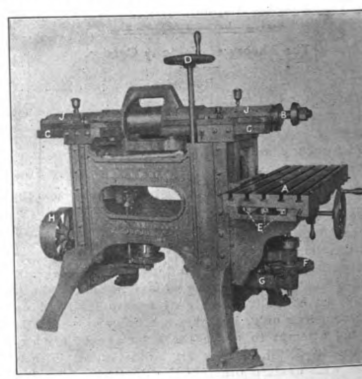
Where is the man to come from? Is he to be one of "our own men" or an "outsider"? The preference is usually given to the former, in which case the appointee must learn the business through actual experiences, and meet troubles as they appear. Not being acquainted with the work, he is liable to make costly, and at times dangerous mistakes. If an experienced signalman is desired, he is usually found with the manufacturers, and as the railroads generally pay lower wages than the latter, the only inducement for him to change is the promise of a "steady job" and the hope that he may not have to continually "live under his hat." While he has perhaps made a record on construction, he may fall by the wayside when maintenance problems confront him, and then he either loses his "steady job" or the company suffers. Only in exceptional cases will the signal companies part with their best men. The demand for good men is large, the number of them few, and so in many cases the policy obtains of employing mediocre talent, because it can be obtained at a lower price; and this in the face of the fact, that most of the roads—at least those which memory of actual examples now calls to mind—can amply afford to pay high wages, and their managements well know that the best is the cheapest in the end.

[TO BE CONTINUED.]

The Newman Emery Planer.

The Tanite Co., of Stroudsburg, Pa., recently built for the Pennsylvania Railroad shops at Altoona a Newman emery planer, larger, heavier and more substantial than those which have been for some years in use. The increased size of locomotives has called for this bigger machine, which is used for grinding parallel rod straps, slide valves, links, shoes and wedges for driving boxes, etc. It is especially useful in repair work.

A peculiarity of this machine is that while the bed A moves slowly, like the bed of an ordinary planer, the emery wheel, which is mounted on the sliding frame C and on the revolving spindle B, has a traverse motion at right angle to the motion of the bed. The table has three feeds, giving motions of $3\frac{11}{16}$ in., $5\frac{5}{32}$ in. and $8\frac{1}{32}$ in., each in two minutes. The piece to be ground is held in a chuck on the table and has a slow backward and forward motion while the emery wheel spindle revolves at such a rate as to give a speed of 5,500 ft. per minute to the circumference of the wheel whatever the diameter may be. While the planer bed is thus moving slowly backward and forward and the wheel revolving at



The Newman Emery Planer.

over a mile a minute, the frame C, with the emery wheel spindle, makes 31½ throws per minute each way across the table. This variety of motion results in a kind of shear undercut, and it is claimed that the wheel will cut deeper and with less heat and friction than by any other method of application. An emery wheel thus mounted and run has made a throw of eight inches, cutting a depth of one-quarter inch. This, however, is an extreme case. The proper use of the Newman planer is to take light cuts and do approximately correct work on case-hardened or other very hard metal.

The machine, including the chuck, weighs about 3,029 lbs. and the weight of the overhead work is 526 lbs. The table is 15 x 42 in. and intended to grind 14 x 40 in. The spindle has a 15-in. throw and is 2½ in. diameter in the boxes. The table has through the hand wheel D a vertical adjustment of 13 in. The racks E are of steel with cut teeth. The large gear F, which controls the table motion, is of iron with cut teeth and the small cut gears G are of steel. The cone pulley H at the left of the machine makes 145 revolutions a minute. The pulleys of this cone are respectively 12½ and 13¾ in. diameter and are driven by a cone on the countershaft. By running this cone shaft at 550 revolutions a minute an emery wheel 10 in. in diameter will be driven at about 5,500 ft. per minute and the various motions described above will be secured through the cone pulley H.

RAILROAD GAZETTE

FRIDAY, MARCH 9, 1900.

CONTENTS.

Contributions.

Cast-Iron Wheels for Locomotive Trucks.

Western Maryland R.R. Co.
Union Bridge, Md., Feb. 21, 1900.

To the Editor of the Railroad Gazette:

In reading over the discussion by the Master Mechanics in Convention at Old Point in June last, I notice that cast-iron wheels are not considered safe for engine truck wheels.

I have been in charge of the Motive Power and Rolling Stock of the Western Maryland Railroad for more than twenty-three years, and I believe my experience with cast iron wheels for locomotive trucks will be interesting, at least to some of your readers.

We have a hilly road, with several ten-degree, reverse curves, and 11 miles of grade from Thurmont to Blue Ridge Summit that average 95 ft. to the mile, part of it being 106 ft. On this mountain grade we have a horseshoe curve and a curve of 10° 30′. We have 61 locomotives weighing from 60,000 to 132,000 lbs., and in the twenty-three years we have had but one accident from cast iron wheels under engine trucks. This occurred with an 18 x 24 in. cylinder Mogul engine. As the truck wheel struck a frog, from some unknown cause, about nine inches of the flange was broken off. This being the only engine we have had to leave the track, there cannot be any other accident that could be charged to cast iron wheels. We use under all of our engines the swing motion truck, and have been using it from the time I entered this company's service. The swing motion truck may be the secret of our success with cast iron wheels under engine trucks.

At present we are using the Lobdell wheel. We have used the Baltimore Car Wheel, Scovill, Whitney, Jackson & Woodin and others with perfect safety. One of our Mogul locomotives with cast iron truck wheels ran a passenger train for three summers without any accident. It is but seldom we remove a truck wheel on account of worn flange; they generally wear through the chill or shell out in spots.

With this record I fail to see how this road can buy any other wheel that would give a result equal to this: One engine truck wheel broken in twenty-three years.

DAVID HOLTZ, M. of M.

An Economical Freight Train Speed.

To the Editor of the Railroad Gazette:

In a communication to the Railroad Gazette (Feb. 2) entitled "An Economical Freight Train Speed," Professor W. J. Raymond presents a very ingenious argument and reaches some interesting conclusions.

An analysis of the article presents the following characteristics: First, an assumption that for all speeds above ten miles an hour the locomotive may be expected to develop its maximum power. Second, that the resistance of a train is near its minimum limit when the speed is ten miles an hour. Third, that the rate of speed should never be lower than that which will allow the locomotive to develop its maximum power.

Justification for the first two of these assumptions is based upon an exhibit of formulae, while that of the third is deemed to be self-evident. Arguing from these assumptions, it is concluded that for maximum efficiency, the speed up the limiting grade should be ten miles an hour, the rate on other portions of the line being greater than this and always such as will permit the engine to develop its maximum power. Mr. Raymond further shows that with a speed of ten miles an hour up a ruling grade of one per cent., a speed of 26.2 miles an hour will be the most economical on the level, and a speed of 39.9 miles on a down grade of one-half of one per cent.

A serious defect in the argument would seem to arise in the assumed or deduced rate of speed up the ruling grade. On this question Mr. Raymond refers to Wellington's formula for train resistance and points out that the resistance as given by this formula is minimum for a speed of six miles an hour; also that an increase of speed to ten miles an hour increases the resistance by only seven per cent. Hence, he justifies assuming a minimum speed of ten miles an hour because it is a rate of speed which is attended by a resistance which is but little above the minimum and is the minimum speed which allows the locomotive to work at its maximum power.

Now, while it is true that an increase of speed from six to ten miles an hour is attended by a slight increase of resistance on a level, the conditions do not hold on an up-grade where the resistance is of two sorts: First, that due to friction, and, secondly, that due to the grade. The power required to overcome the latter varies directly with the speed, and when this increase of resistance is taken into account, it cannot be assumed that an increase of speed from six to ten miles an hour is accompanied by a slight increase in train resistance. The steeper the grade, the wider will be the divergence between the assumption and the fact, and since this assumption is fundamental in the argument which Professor Raymond presents, there would seem to be some question as to the validity of the conclusion which he has reached.

X.

The M W 100 Per Cent. Rail Joint.

Chicago, February 19, 1900.

To the Editor of the Railroad Gazette:

In your issue of January 19 a new rail joint is shown which is interesting to the writer, chiefly because a relation is established between the bending moment of the rail and the bending moment of the joint. The patentee does not state whether the bending moments are inch-pounds or foot-pounds, although it is presumed the latter is intended, and that they are for a concentrated load.

I do not see how the cutting away of the "inbent" portion of the splice ends relieves the ties of the stresses transmitted through the splice from rail to rail; or, if the "inbent" portions were left in the splices, how that would tend to transmit the stresses to the ties; for, in both cases, the stresses transmitted through the splice from rail to rail is transmitted through the central part of the splice which projects down between the ties.

I am also a patentee of a rail joint, but my conclusions differ from the figures of Mr. Thomson. Below are the data for four splices, the nearest to correspond to those of Mr. Thomson. In calculating this table, an excess of 10 per cent. was allowed in the joint above the strength of the rail.

Size of rail.	Length of joint.	Net. wt. of joint.	Rail, safe load in. ft. lbs.	Splice. Safe load.	I	A	C	S
100	14¼	58 66	58 333	63,700	66.88	15.64	4.2	12,000
90	13⅛	45.90	48,866	49,695	49.96	12.57	3.9	12,000
80	12⅛	36.46	39,400	41,283	37 66	11.47	3 6	12.000
70	11⅛	32.89	32,333	37,802	31.38	10.32	3 3	12,000

It will be observed that there is a striking difference between the bending moment and the weight, as compared with Mr. Thomson's results. The weight of his joint for a 100-lb. rail is given at 85.4 lbs., and the bending moment at 46,600 lbs., therefore the bending moment per pound of joint is 545 lbs. My figures for a similar joint are over 1,000 lbs. per foot of joint. A similar comparison for all the four splices given shows like differences. The formula to determine the same load is the same, $M = S\frac{I}{C}$.

No more has to be done on this joint (after the section is rolled) than is required in the common fish-plate; that is, cutting to length and punching. I am glad to see this matter taken up by engineers —to whom it properly belongs—and that at least one person has been working along the same lines as myself. The stress per unit area cuts no figure, so long as they are alike in both rail and joint.

R. HINCHLIFFE.

Mr. Thomson comments as follows on the above:

Altoona, Pa., March 1, 1900.

To the Editor of the Railroad Gazette:

I can hardly feel justified in taking sharp issue with Mr. Hinchcliffe; for, while we are working along the same lines and are looking at two structures designed to meet the same end, the conditions under which the two structures have been placed are evidently different. When he gets a higher safe load for his 100-lb. rail, and a higher safe load for his 100-lb. splice, that means nothing more than that he took a distance between his supports less than the 18 in. which I gave. In fact, the length of his splice is only 14¼ in., and his distance between supports would of necessity be somewhat less than that. I have not been made familiar wtih the style of bars to which he is referring, but, in the light of recent practice, they seem very short. How short a grip we can take on the ends of two rails to make a successful and safe splicing has perhaps not been accurately determined. In 1890, or earlier, Mr. Bannister, Chief Engineer of the London, Brighton & South Coast Railway, placed on his 84-lb. bull-head rail a pair of splices that were of 100 per cent. strength, the length of which was only 18 in. His strong form of rail and wide spacing of ties enabled him to do this, and I believe that splice is standard on that road to-day. We, however, with our flat-base rail and our narrow spacing of ties, have different conditions to meet.

Mr. Hinchcliffe seems to have misunderstood what was said about stresses passing to the ties. I was comparing the splicing structure as published January 19 with my earlier pattern, which had the end portions of the depending flanges thrown up to horizontal position, to form wide lugs resting on the ties. I stated that this latter structure was in the nature of a bridge, and that the stresses delivered at the center could be transmitted through the splices to the ties, while in case of the other structure (the one shown Jan. 19) which took no bearing on the ties, the stresses could only pass to the ties as they passed through the rails themselves. This will, no doubt, make the matter clearer, and at the same time indicate that the two forms are radically different in principle.

When Mr. Hinchcliffe refers to our reaching different conclusions or results, I think he only means that we are furnishing figures that are based on different conditions, and that these figures are apt to be misleading until they are explained.

M. W. THOMSON.

Signaling As It Is and As It Might Be.

THE PRESENT.

BY A. H. RUDD.

(Continued from page 98.)

On a number of trunk lines the foreman stage is passed, and Signal Engineers in fact, if not in title, are in charge. Two systems are in vogue. Either each division has its own organization, or there is one general head for the entire road. Let us consider the first condition in two phases: under a close and under a liberal Superintendent.

In the first instance everything is sacrificed to saving in expense. This perhaps does not appear particularly in installation, although new work must be put in at the lowest figure, or all future work is vetoed. But in maintenance every nerve is strained to keep the figures down. Maintainers must be called upon to assist in construction work, neglecting their proper duties; and consequently inspections are kept at a minimum; and if the number of failures is not too pronounced, the condition is considered satisfactory. Not the Engineer, but the Superintendent is in fact the head of the department. A controlled manual system recently came under the observation of the writer where locks were tied up or failed to drop in place, towermen had keys to release their instruments, and track relays were habitually plugged because the Superintendent insisted that "we must get our trains over the road," while at the same time he failed to provide the requisite inspection force, and then pointed with pride to the record his signal expert was making in economy of maintenance. He really thinks his department is about perfect.

"Eternal vigilance is the price of safety," but this poor "signal sharp" never commands the price; and some day, when one of those trains "gets over the road"—and all over it, at that—the cause of the occurrence will be a seven days' wonder. Thoroughly competent inspectors cannot be obtained at the wages paid on the road in question. They are either men of steady habits and little knowledge, who cannot cover their sections in the allotted time and do their work thoroughly; or else skilled men who cannot be depended upon, perhaps on account of their bad habits, and who neglect their duties from lack of interest. The conditions here noted obtain also under a general organization in some instances, and for the same causes.

Under a liberal official, however, this plan of organization, while not always providing a bed of roses, is for the Signal Engineer an almost ideal one, in some respects. His force is usually a small one, he is perfectly acquainted with its personnel, and with all the details of the work in his limited territory; and he can give his personal attention to inspection and installation to a very large degree. With men enough to do the work without waste, but in the best possible manner, with the knowledge that his maintainers are attentive to their duties and can be trusted, he has confidence amounting almost to certainty that all will be well. Consequently his worries are few but—the salary is small. If he just fits the place, well and good. If, however, he is fitted for a much larger field, he becomes surfeited with the wealth of detail and the delicacies of the work, has unpleasant symptoms and at last falls into a rut, and usually a narrow one.

Even under the most favorable conditions there is one great defect in this system, viz.: lack of standards. Take as a fair illustration a road having five or six divisions. Each division head has his own ideas. There are four or five types of interlocking machines prominently on the market, and it is a fair supposition that each division will have not less than two of them. More probably each division has to carry three styles of machine parts in stock, and the same condition exists regarding nearly all material; while each man has a different method of installation. It is a good thing for the signal companies who first furnish the material, but a mighty poor one for the road barred from the market. Each division has its storehouse or houses. Several might be combined at a central point if the lines converge or intersect, and the cost of storekeeping and stock accounts decreased. By a general organization of the proper sort, the salaries of its higher official could be paid, with a handsome surplus remaining, by making these changes alone.

In the general organization, as it usually exists to-day, the head of the department reports either to the Chief Engineer or the General Manager or Superintendent. He establishes standards, orders material (passing upon the division requisitions as well as upon all new work, for which latter he prepares plans), and when the work is installed, it is turned over to the divisions for maintenance and manipulation. Here his work ends. If the plants are improperly maintained he cannot be held responsible, as the maintenance force reports to the Division Superintendent, who is not and, as previously shown, cannot be expected to be an expert. Is there not a flaw here? The same course is pursued in other departments, but the best sentiment is opposed to it, and the tendency is all against divided responsibility, with its resultant evils.

Resorting again to analogy—after locomotives are acquired by the motive power department, are they run by men selected solely by the Division Superintendents? Are they repaired in shops under his charge? Who is responsible for the inspection of rolling stock, of air brakes, and other elaborate machinery? Is responsibility divided between the Division Superintendent and the building and engineering departments?

How can a Signal Engineer know whether his standards require modification and how keep abreast of the times, no matter how good his judgment may be, if, after installing them, he never receives reports of their performances? In some cases he is favored with this data, but unless he knows the conditions at the time of report he cannot get a clear idea of their merits or defects or properly study failures. He must keep in touch with the maintenance force, and know that the work is properly cared for. What advance would there have been in locomotive construction if no data concerning the performance of new devices were accessible to the designer?

Present practice is so varied that a brief summary of the different methods of organization will be of interest. The list may not be absolutely correct as to titles, but these are immaterial in the comparisons desired to be made.

Chicago & North Western.
Signal Engineer reporting to Chief Engineer. All mechanical and electrical forces report to Signal Engineer.

C., C., C. & St. L.
Signal Engineer reporting to Chief Engineer, making all plans and periodical inspections, and deciding all signal questions. Division Foremen in charge of division work.

C., N. O. & T. P.
Superintendent of Telegraph. Two general foremen of signals (one for each district), under whom are all the mechanical and electrical forces.

Erie Railroad.
Signal Engineer reporting to Assistant Chief Engineer; establishes standards and has general charge of all signal work. The actual maintenance and construction forces report to the different Division Engineers.

Illinois Central; Michigan Central; Chicago & N. W.
Signal Engineer, reporting to Chief Engineer. Supervisor of Electric Signals in charge of all electrical forces; Supervisor of Mechanical Signals in charge of all mechanical forces, except that on Illinois Central some lampmen report to Road Department.

Long Island.
Signal Engineer. Under him, (a) Signal Foreman, in charge of all mechanical forces and lampmen, and (b) Electrician, in charge of all electrical forces.

Lake Shore & Michigan Southern.
Signal Engineer, reporting to Principal Assistant Engineer; establishes standards and makes plans. All maintenance and construction forces report to two Master Carpenters, who in turn report to the Principal Assistant Engineer. Levermen report to Division Superintendents.

Lehigh Valley.
Signal Engineer, reporting to Engineer Maintenance of Way. Under him (a) Supervisor of Electric Signals, in charge of all electrical forces, and (b) Supervisor of Mechanical Signals, in charge of all mechanical forces. The Signal Engineer has absolute charge.

New York Central & H. R.
Assistant Superintendents of Signals, reporting to Division Superintendents. Electrical and Mechanical Repairmen, and Foremen, Levermen and Lampmen reporting to the same.

New York, N. H. & H., Eastern District.
Supervisor of Interlocking, in charge of Division Foremen and all mechanical forces. Electrician, in charge of Division Foremen and all electrical forces. Both heads report to the General Superintendent.

New York, N. H. & H., Western District.
Two Signal Engineers, reporting to their Division Superintendents. Under them are all signal forces. Lampmen on one division report to Signal Engineer; on the other, to Section Foremen, Levermen, Station Agents, etc., according to location of signals. A third division has a Foreman of Interlocking and an Electrician, both reporting to the Division Superintendent.

Philadelphia & Reading.
General Signal Foreman. Chief Signal Inspectors. Division Signal Foremen, to whom report all maintenance and construction forces and Lampmen.

Pennsylvania.
Signal Engineer, reporting to Engineer of Maintenance Way. He establishes standards, makes plans and orders material. Supervisors of Signals report to Division Assistant Engineers and have full charge of construction and maintenance forces, carrying out plans of Signal Engineer.

Comparative Table of Wages.

Wages of Signal Forces prevailing under present practice:

	Per month.	Per day.
Signal engineers	$80 to $150	$2.66 to $5.00
Electrical supervisors	70 " 90	2.33 " 3.00
Interlocking supervisors	55 " 75	1 83 " 2 50
Division foreman, interlocking	55 " 75	1.83 " 2.50
Gang foremen, interlocking	50 " 75	1 66 " 2.50
Gang fitters, interlocking	50 " 68	1.66 " 2 27
Gang helpers, interlocking	30 " 40	1.00 " 1.33
Electrical repairmen	40 " 75	1.33 " 2.50
Electrical batterymen	40 " 55	1.33 " 1.83
Lampmen	30 " 40	1 00 " 1.33
Tower operators	25 " 65	.83 " 2.17

Average wages as shown by Interstate Commerce Commission report:

	Per day.
Locomotive engineers	$4 47
Conductors	3.67
Other trainmen	2.65
Station agents	2.42
Section foremen	2 22
Machinists	2.91
Station help	2.18
Carpenters	2.77
Other shopmen	2.34
Trackmen	1.39
Telegraph operators, despatchers	2.76
Switch, flag and watchmen	2 57

The above comparisons are made as nearly as possible between classes of labor requiring similar capacities (except in the first item) and carrying somewhere nearly like responsibilities. They speak for themselves.

The responsibility for a proper organization and the selection of the right man at its head, rests entirely with the general officers. When this responsibility has been met, and the department established, the entire work should come under this official head, who should be held to a strict accountability for its correct installation and perfect maintenance. This leads to the consideration of the Signal Engineer and his forces to-day.

[TO BE CONTINUED.]

Slid-flat Car Wheels.

At the January meeting of the Northwest Railway Club, Mr. F. B. Farmer, of the Westinghouse Air Brake Company, discussed the causes of slid-flat car wheels. He first stated that it seems to be the general experience that the greatest number of wheels are skidded in winter, when the ground is not covered with snow; that the dust and the frost make a combination most favorable for skidding. As to other causes for slid wheels, he said in part:

Some time ago, while investigating the question of slid wheels, my attention was called to a machine that was being used at that time in the Soo shops. They grind cast wheels and mate and remount them. Noticing that a pair of wheels in the grinder had flat spots, and that the wheels were out of true, I asked the man to see if other cases were similar to this, showing that the large part of the wheel was just passing under the brake shoe, when the part having the flat spot would have been in contact with the rail. He followed it up for some time, and found that this is almost invariably true. On a road that had considerable trouble from cast wheels flattening, the matter was given some attention, and a device was got up for quickly testing this feature. They found a few cases where the wheels were bored out of center, traced them, and found a boring mill was responsible for the poor condition; so that I think the two instances cited are sample ilustrations of causes of wheels sliding.

It has been frequently remarked that when a wheel or a pair of wheels flattens, the next time they catch it will be in the same spot. I think this is more often due to such a cause as just mentioned rather than to the flat spot made in the first instance.

It may be of interest to hear of a test that was made on a western road some three years ago. Owing to the large number of flat wheels in a train of loaded cars, a test was made to determine about what pressure was necessary to slide wheels, and the distance necessary to produce a given length of flat spot. A loaded box car weighing 69,000 lbs. at the rails, was charged to 100 lbs. pressure, the brake was applied with full force standing, and the car was pulled for one-half mile. One pair of wheels turned almost the whole distance, two pairs slid intermittently, causing what is termed a "chain" flat, a succession of small flat spots, not serious enough to justify removal. One pair slid the entire distance, and had a 2¼-in. flat spot. Another test was made by applying the brake heavily, and pulling the car 100 ft. on what might be termed an ordinary rail, without sand. Then they examined the spot in contact with the rail and found scarcely any abrasion. The test was repeated on an undamaged spot, using sand the whole distance, and they found, upon examination, a 1-in. flat spot. So this shows how seriously sand may effect the flattening, and it indicates as well the small probability of wheels starting to revolve when sand is used after once locking. Of course, the great weight on the rail, with the car loaded, aided materially in causing this long flat spot, resulting from 100 ft. of sliding.

On the ore-carrying roads much trouble has been experienced from wheels sliding, due to several causes, the most important being that the empties are hauled one way, and the direction is generally an ascending grade. The grade and the empty cars enable the stop to be made with a very light application of the brake. In order to insure a release of applied brakes, the train-pipe pressure throughout the whole length of the train should be raised quickly and considerably. Where the reduction is small, the difference between the main reservoir pressure and the train line at the time of the release is correspondingly less than where the application is heavier. For that reason, holding the brake valve in the full-release position for a short length of time would give a sluggish flow toward the rear end and a lesser raise in pressure. If, to correct that, as far as possible, the brake valve is left in full release for a longer period, the brakes up at the head end are liable to be overcharged, and later on, through the temporary absence of any supply, the brakes may stick.

To overcome this the men have been instructed to insure, before attempting to release, a reduction of at least 10 to 15 lbs. On one road they even went so far as to say that before attempting to release, a full service application of 20 lbs. reduction should be made, and at the end of the season, whether from that or more attention being paid to other details, they had a better showing on the flat wheel question than previously. That same difficulty of brakes sticking from a light application has been met with often on passenger trains, particularly when the engineman has applied the brake a little to steady the train around curves. It does not mean that the application made for the purpose of stopping the train at a given point must be any different than otherwise, but before the release is attempted enough should be added to that to insure the desired result.

In discussing this question with some of the air brake men in this part of the country it was demonstrated that one of the principal difficulties attendant on the investigation of slid-flat wheels arose from the insufficient and unreliable information they had to start it with. The Northern Pacific had this matter up several years ago, and improved on the slid-flat wheel report used for several years by the Chicago, Milwaukee & St. Paul road. It first called for certain information from the inspector, telling him of the kind of test to make, and was a very valuable report, inasmuch as it also educated the men to guard against these troubles and thereby prevent wheel sliding. This was the report to be made out by the inspector. It was found, however, that you could not get from him a sufficiently accurate report as to the condition of the triple valve. The triple valve could not be repaired, when defective in the packing ring or slide valve, by the men, and had to be sent to the repair point where there was a competent man with the necessary tools. So, a form was got up to accompany the triple valve. At present the valve is invariably removed from the car in the case of flat wheels. Another one is put on, and, with the report which accompanies it, the removed valve is sent to one of the repair points, where they have plants for making an accurate test and men who are skilled in doing this work. The lower half of the report which accompanies the valve is left blank, to be filled in by the man making the test, and when it is finished, and the results are recorded, he forwards this report to the road foreman of the district. The man that removed the valve from the car makes out his report and forwards it to the road foreman, attaching the air brake defect card turned in by the conductor of the train bringing the car in. This same inspector immediately advises the roundhouse foreman of the train bringing in flat wheels. This foreman has a form calling for the condition of the pump governor, the pump, brake valve, and the brake parts on the engine that might have any bearing on the case. The roundhouse foreman also ascertains from the engineman who handled that train whether there was any burst hose, break-in-twos, or other cases calling for emergency application, that could have had any bearing on the subject. This information is forwarded to the road foreman, who originally spent a good deal of time hunting up this information, or endeavoring to hunt it up, but never getting it accurate or complete. Now, he has to devote no time to that: these reports all come in to him giving all the information that can possibly be gleaned on the subject, and from this he is able to determine, if it can be told, the cause of the flat wheels. The brake leverage of the car is also given on one of the reports. All of the different brake diagrams are printed on the back, and it is easy for the carman, without making any sketch, to show the location of the slid wheels with relation to the hand brake of the car.

In a number of cases it was found that the air brake was in perfect condition, and that the flat wheels were on the hand-brake end of the car. Those familiar with the Master Car Builders' type of brake rigging for freight cars will appreciate that, generally speaking, the hand-brake power is greater on the truck next to the hand brake than on the other; therefore, when these reports finally reach the General Air Brake Inspector, by tabulating them he is able to ascertain the number of cases where the air brake was in good shape and the flat wheels that were on the end of the car nearest the hand brake, which indicates that the cause of the sliding was very probably the hand brake. Then, I believe, a graphic report is made out, which enables one to see at a glance the number of slid-flat wheels, and the comparative record of that month and the corresponding month, or any month, of the same or the previous year.

I might add that the ore roads have very generally adopted what is termed the two-pressure system, which consists of carrying merely a lower train-pipe pressure with their empties and higher than the standard with the loads, which makes both safer, not only from the standpoint of wheel sliding but also from the danger to trainmen resulting from a burst hose or a break-in-two, when a man is trying to pass over the tops of the cars. The combination of those two, lower pressure and heavier applications, has resulted in a great betterment. They find, too—those who have watched the matter—that there are certain particular places where the brakes have stuck most, and that these places are where light reductions have been made. The Duluth, Missabe & Northern and the Duluth & Iron Range, the Lake Superior and Ishpeming and the Butte, Anaconda & Pacific are carrying 55 lbs. with their empties and 80 lbs. with their loads. Eighty pounds is used merely

Simple or compound (both)	Simple.	
Kind of fuel to be used (both)	Bituminous coal.	
Weight on drivers	96,000 lbs.	122,000 lbs.
" truck wheels	20,000 lbs.	....
" trailer wheels	24,000 lbs.	......
Weight, total	140,000 lbs.	122,000 lbs.
" tender loaded	96,000 lbs.	75,000 lbs.
Wheel base, total, of engine	26 ft. 3 in.	10 ft. 10 in.
" driving	11 ft. 4 in.	10 ft. 10 in.
" total (engine and tender)	51 ft. 4 in.	38 ft. 9¼ in.
Length over all, engine	37 ft. 11 in.	....
" " total, engine and tender	60 ft. 6½ in.	....
Height, center of boiler above rails	7 ft. 10 in.	7 ft. 10½ in.
" of stack above rails	15 ft.	14 ft. 6¼ in.
Heating surface, firebox	139 sq. ft.	106 sq. ft.
" " tubes	1,937 sq. ft.	1,732 sq. ft.
" " total	2,076 sq. ft.	1,838 sq. ft.
Grate area	42 sq. ft.	27 sq. ft.
Drivers, diameter	64 in.	52 in.
" material of centers (both)	Cast iron.	
Truck and trailer wheels, diameter	37 in.	....
Journals, driving axle, size	8½x9½ in.	9x10½ in.
" truck " "	5½x9 in.	....
Cylinders, diameter	19 in.	20 in.
Piston, stroke	24 in.	24 in.
" rod diameter (both)	3¼ in.	
Kind of piston rod packing (both)	Metallic.	
Main rod, length center to center	6 ft. 3¼ in.	6 ft. 1⅛ in.
Steam ports, area (both)	35 sq. in.	
" width (both)	1½ in.	
Exhaust ports, area (both)	69.5 sq. in.	
" width (both)	3 in.	
Bridge, width (both)	1¾ in.	
Valves, kind of (both)	10-in. piston.	
" greatest travel (both)	6 in.	
" outside lap	1 in.	¾ in.
" clearance	$\frac{1}{16}$ in.	0 in.
" lead in full gear	....	....
Boiler, type of	Belpaire.	Straight top. Radial stay.
" working steam pressure	190 lbs.	180 lbs.
" material in barrel (both)	Steel.	
" thickness of material in barrel	⅝ in.	$\frac{9}{16}$ in.
Boiler, diameter of barrel	56 in.	60 in.
Seams, kind of horizontal (both)	Butt.	
" " circumferential (both)	Lap.	
Thickness of tube sheets (both)	½ in.	
" crown sheets (both)	⅜ in.	
Crown sheet stayed with (both)	Radial stay.	
Dome, diameter (both)	28¼ in.	
Firebox, length	7 ft.	6 ft. 0 in.
" width	6 ft.	4 ft. 6¼ in.
" depth, front	62¼ in.	58½ in.
" " back	56 in.	58½ in.
" material (both)	Steel.	
" thickness of sheets (both)	⅜ in.	
" brick arch ? (both)	Yes.	
" water space, width (both)	Front, 4½ in.; sides, 4½ in.; back, 4½ in.	
Grate, kind of (both)	Shaking and rocking.	
Tubes, number	194	204
" material (both)	Wrought iron.	
" outside diameter (both)	2¼ in.	
" length over sheets	16 ft. 1 in.	14 ft. 6 in.
Smokebox, diameter	57½ in.	61½ in.
" length (both)	65 in.	
Exhaust nozzle (both)	Single.	
" " "	Permanent.	
Netting (both)	Wire.	
" size of mesh (both)	2½x2½ in.	
Stack (both)	Taper.	
" least diameter (both)	14 in.	
" greatest diameter (both)	19½ in.	
" height above smokebox	....	4 ft. 2 in.

Tender.

Type (both)	Swivel truck.	
Tank capacity for water	5,000 gals.	3,900 gals.
Coal capacity	8 tons.	6 tons.
Kind of material in tank (both)	Steel.	
Thickness of tank sheets (both)	$\frac{3}{16}$ and ¼ in.	
Type of under-frame	Wood with steel center sills.	Composite.
Type of truck (both)	Diamond frame.	
Truck with swinging motion or rigid bolster (both)	Rigid.	
Type of truck spring (both)	Elliptic.	
Diameter of truck wheels	36 in.	33 in.
Diam. and length of axle journals	5x9 in.	4¼x8 in.
Distance between centers of "	5 ft. 6 in.	6 ft. 3 in.
Type of truck bolster	....	Steel.
Type of truck transom	....	Channel.
Length of tank	19 ft.	....
Width of tank	9 ft. 6 in.	....
Height of tank, not including collar	4 ft. 10½ in.	....
Type of back drawhead (both)	M. C. B. coupler.	
With or without water scoop (both)	Without.	

Special Equipment.

Sight-feed lubricators (both)	Michigan.	
Bell ringer	Plattsmouth.	Crandall.
Couplers	Leeds pilot at front.	Chicago.
Muffler	....	Consolidated S. V. Co.
Sanding devices	"She."	Leach.
Driver brake equipment (both)	Westinghouse.	
Tender " " "	Westinghouse.	
" " beam (both)	Monarch.	
Driver " shoe "	Ross-Mehan.	
Piston rod packings (both)	C. C. Jerome.	
Valve "	Dunbar.	C. C. Jerome.

Signaling As It Is and As It Might Be.

THE SIGNAL ENGINEER AND HIS FORCES TO-DAY.

BY A. H. RUDD.

(*Continued from page* 148.)

To the uninitiated the position of this man is a "snap." Usually he does not have to work with his hands; he sits in the office, writes a few letters, and frequently makes pictures, which do not take much time, and which almost anyone could do; sometimes he even has a draughtsman to help him, and possibly a clerk. He rides over the road, and occasionally may be seen examining the different plants, and somehow he manages to keep busy. How easily he earns his salary! This varies from $1,000 to $2,000 a year. Perhaps the usual rate for such services is in the neighborhood of $1,800. At the lowest rate he receives nearly as much as a first-class locomotive engineer, and even more than many conductors. His maximum rate, however, is less than that of the two men combined, who are responsible for the safety of any single train or engine running over the road. But by his carelessness in installation or maintenance, by lax methods of conducting his department, in choosing his assistants, or in keeping them up to their work, he has every such train at his mercy; and its crew, depending entirely on signals, as they frequently now do, may be led into death traps through his instrumentality, no matter how careful they may be.

The locomotive runner has great responsibility for a limited time each day, but the strain is then relieved for a longer period; the Signal Engineer's work is never done. The strain is constant, and being subject to call at all hours, his time is rarely his own. This is particularly true under the division arrangement. Is this fact recognized by his superior officers? The men who have these departments in charge to-day are for the most part young, signaling being a comparatively new branch of railroading. They are intelligent and active, and as a class are enthusiastic; and most of them are ambitious.

The writer knows of such a one, who remodelled a system under his charge, effecting a yearly saving in battery maintenance alone of more than his salary, who each year reduced the cost of maintenance of his signals, while at the same time the percentage of failures was also lessened, this covering a period of over four years. At last he was compelled to use his maintenance forces so much for construction work that the failures increased appreciably, and surprise was expressed at the poor showing. He was naturally pleased at the appreciation of his efforts.

Signal engineers may be divided into two classes: Specialists, and all-round railroad men. What are the chances of advancement for such men? According to the present outlook there is little ahead. This is an age of specialists, and if a man desires to reach the head of his profession, even in signaling, he must practically give his life to it. The problems are innumerable. New conditions are constantly developing. Every energetic man is working to better the service, and any new idea of one is usually given to all, through the instrumentality of the growing Signaling Club, and if a new idea is good it is put into use all over the country. It is a constant study to keep abreast of the times. Many signal engineers have not time at their disposal to devote to such development, though all can see that this advancement ought to be recognized as a part of a signal engineer's duties.

There are three courses open to these men. The signal companies pay far better salaries than the railroads, and there is room for a limited number of the best in their employ. Others may become heads of new departments on other roads, and if very fortunate, attain the heights, and get $2,000 a year. Is this worth the while of a brainy, active man, when the possibilities in other fields are considered? Lastly, if they do not like their treatment or their prospects, they are at perfect liberty at any time to quit the business (and large numbers of them have done so). The first opportunity noted is of necessity very limited; the second is within reach of the majority. But not one signal engineer in ten would continue in the work if he had not a faint and lingering hope of something better than this eventually. Most of them are living in hope, and "hope deferred maketh the heart sick."

In the engineering department there always looms up the possibility of becoming chief; in the motive power, the Superintendent's office may some day be attained; and the same is true of most other branches. Any of these positions are worth years of work to obtain, but the summit of the signal department grade is in a valley compared with these altitudes. There is room at the top, but that top is pretty near the bottom of other departments.

There are signal engineers who fit their places well, and are contented to go on with no hope of advancement, for they fear added responsibility; but they are not the men that progressive managements are looking for. Suppose, on the other hand, a man can find time from his routine work to study transportation problems (and many come before him, in a limited way, in the handling of trains at junctions, terminals, etc., where if his eyes are open he can learn much); to examine roadway methods and work where his opportunities (at interlockings) are also first-class; and look into motive power practice until he knows as much about it as the average division superintendent. Are opportunities afforded him at present for any advancement on these lines? There have been one or two cases of such promotion, but as a general rule, when an assistant or division superintendent is required, do the officers ever think of turning to the signal department? Civil engineers, roadmasters, despatchers, conductors, or freight agents are usually chosen, and yet there is very good material in our department on several roads; men who can and do handle their own forces successfully (and competent signal workmen in good times are a pretty independent lot), men who appreciate the need of good track and ample protection, and know how to give it; men whose study has fitted them to meet successfully any conditions that may arise, and of sufficiently good address to make a favorable impression upon their patrons and the general public; men with broad views and a good education. Should they not be considered when higher positions are vacant?

If the science of signaling is to be advanced in the future, as it has been in the past, and in order also that protection may be of the best, and absolutely sure, it must be remembered that the experimental stage is in a large measure finished, and that absolute knowledge of past failures must be possessed by those in authority. Consequently some inducement ought to be offered to keep there those now in the service, who have experience, and to induce the coming generation to take up the study.

This can be done in two ways: either by giving the signal department the importance it deserves, making its head a well paid official, placed more nearly on an equality with the men he consults with, and then employing only the best men, who have proved by past record their thorough competency; with young men of ability under them to be fitted for like positions; or by letting it be definitely understood that the highest position in it is the stepping stone to a better office in a wider field. By these methods an objective worth attaining will be created, and signal engineers will put forth efforts to achieve it and to prove ability to hold it.

If such a condition should be brought about (and some roads are apparently moving in this direction) we should soon see better work done in fitting men for this field. We have in our technical schools courses in mechanical, civil, and electrical engineering, and men graduated by them, after a few years (in the majority of cases) attain positions of importance, and many times of high salaries. Under the suggested conditions, signal engineering would also be recognized. Courses of study, and lectures with practical illustrations, would be instituted, and the technical training and theory thus obtained would, in connection with a few years' practical work, be of great value in developing a superior class of men.

All of us to-day are handicapped in a measure, as they would not be, in that we have had to take our theory in homeopathic doses, as we could absorb it in connection with our work. Many a weary hour has been spent in projected improvements and development, when a little theory of the right sort, used almost unconsciously, would have lightened the labor and saved time. Some have had the advantages of electrical training, some of mechanical, but very few of the combination of the two, which is necessary in the well rounded development required for successful work.

The Signal Force.

It will be noted from a preceding table that the rate of pay of these men is below the average for like kinds of work. A skilled interlocking repairman must have a thorough knowledge of all parts of the machine and connections in order to make repairs quickly and well. His is a position of considerable responsibility, as careless maintenance may easily mean loss of life, and he requires probably more intelligence than a shop mechanic who, as a rule, is confined to one or two machines or classes of work. Fitters must know considerable blacksmithing and carpenter work, beside having the general knowledge of a repairman; they should receive more pay than a carpenter. Foremen and supervisors should be paid proportionately. The positions should be classified so as to make a regular line of promotion, great care being taken in the selection of lampmen in the first place.

Every man employed should be capable of filling a higher position than the one he is chosen for. The wages of lampmen should be a little better than those of track laborers, and bright, active young men should be secured. There will be no difficulty in this if the applicants understand that they actually stand in line of promotion. This is the secret of success in many great departments which employ good men who accept smaller wages, perhaps, than the average but who are contented because they know there is something ahead. If, however, there is good ground for a feeling that higher positions will be filled by skilled men from other roads, work becomes mechanical, interest is lost, and the attempt is made to do as little as possible and keep the place. Until a good organization is built up with our own men, this condition is often unavoidable; but with due care such an organization can be established in a short time, and the good results will be surprising.

Green men can learn to properly care for lamps in a few hours. Almost any one can do the work. But the error should not be committed of employing on this basis. Let the lampman be chosen as indicated above, and instructed to assist the repairman, and he will soon acquire considerable knowledge of mechanical work. Then promote (not degrade) him to the position of helper in the construction gang. In two or three years he will become a good fitter, and soon a repairman, having had experience in all branches of maintenance and construction work. Such a workman knows that the positions of gang and division foreman and inspector are within his reach if he shows the requisite ability, and the results will be better than if higher wages were paid with no hope of future advancement.

In these different classes also the pay may be graded according to length of service and ability. For example, a lampmen may start at $1.50 a day and be increased to $1.60 after a certain time; as helper he would receive $1.75 to $2; as fitter, $2.25 up to $2.50; as repairman, $2.75 up to $3; all by small advances and by transfers to more complicated plants, as opportunities offer.

The wages, of course, vary in different localities, but a scale on the above general lines should be established and adhered to.

In the electrical branch, batterymen usually receive about $50 a month. With a line of promotion, $1.75 a day is a good starter, until they learn maintenance work by assisting the repairman; then promotion follows through the gang, to repairman, etc. We should neither make our departments training schools for the telegraph and telephone companies, nor depend on those companies to furnish us linemen; but should teach our men in the gang to climb and become fair linemen, and after they have mastered the fine points of maintenance, pay them a slight advance over the prevailing wages of "trouble hunters" in the aforesaid companies, as many men now leave us for such positions. Foremen and inspectors should receive enough more to establish a line of promotion.

With this plan conscientiously followed there will always be men ready at hand to fill any vacancies which may occur, except, perhaps, two or three at the very top, where technical education is required.

A course in a correspondence school, or, preferably, in some technical school, followed by a year or two in the interlocking gang, and a similar period with the electrical forces, will fit a man with a trained mind for intelligent work in the draughting room and office; and later for the position of assistant, and finally of signal engineer.

The object of the foregoing has not been to prove that everything is going wrong; for such is not the case. We are advancing, though slowly, and improving all the time. But I have aimed to demonstrate some of the weak points in present general practice, so that if the managements desire it, and will take the necessary steps, progress may be more rapid in the future, until perfect development is attained. With this end in view a few suggestions are offered regarding an ideal organization, which in the writer's opinion is closely approached on several roads; although the fact remains that the departments themselves are not yet placed in the important position which they should occupy; and the intelligence required to manage them is probably not proportionately appreciated and compensated.

But, after all, arguments and opinions do not always convince or carry weight; "the proof of the pudding is in the eating of it," and a statement, if it could be obtained, of the methods of installation, character of the work erected and maintained, reliability of the apparatus, and freedom from failures on such lines as the Lehigh Valley, Michigan Central, Illinois Central, Chicago & Northwestern and others where the signal engineers are in full, unhampered charge, compared with a like statement from some of the lines with equally good forces, where a different system prevails, would make very interesting reading and undoubtedly furnish facts enough to settle the organization question once and for all.

[TO BE CONTINUED.]

Distant Signal Wires Enclosed in Pipes.

As recently noted in the Railroad Gazette, there are a number of distant signals on the Lake Shore & Michigan Southern which are connected to the cabin by wires which are laid in iron pipes beneath the surface of the ground, the pipes, after the wire is inserted, being filled with oil. Mr. E. D. Wileman, Signal Engineer of the road, has given us an account of how these connections are put in, which in substance is as follows:

We have a dozen or more distant signals connected in this way. They are of various lengths, but only two or three have been in use any length of time. The one first put in is at Waterloo, Ind. The line runs through the station ground and through the valve well of a stand pipe. It has been in nearly two years and has given perfect satisfaction. It requires no adjustment except perhaps twice a year; and it works easier and better than any distant signal on the line not so connected.

We enter the pipe as soon as convenient after leaving the wire lock at the derail and continue the pipe as near the distant signal as practicable. The pipe is laid in a box of 1 in. boards, 6 in. wide. The box, without the top board, is laid in a shallow trench which is made as near as possible in a direct line to the signal. It is carried straight under crossovers or turnouts whenever necessary. If the general direction lies along a curved main line we follow that curve just a little farther out than the ends of the ties. The side strips of the box are put on so as to break joints with the bottom about 1 ft., and the top pieces are laid on so as to make a break with both the others of another foot.

The half-inch pipe is looked over and straightened, and a rod is run through to clean out ordinary dirt and roughness. The ends are reamed out and any sections with internal wrinkles or defects likely to injure the wire are culled out. Then this pipe is laid in the box. The wire, which is in one complete length, is kept drawn through each section as it is jointed up so that when the pipe is all in the box the wire is all in the pipe. Then the pipe is covered with hot roofing cement. Coal tar or pitch would be cheaper and probably equally good.

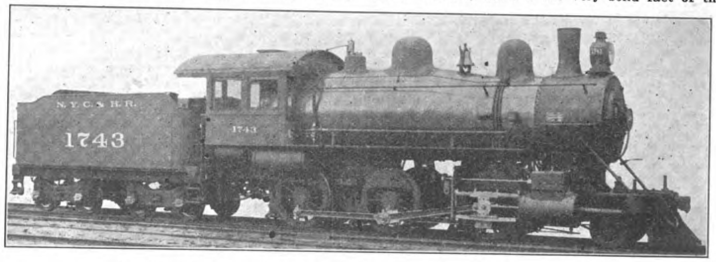
The cover is nailed on as soon as the roofing cement is on. In each line of pipe we insert near the middle a drip well made of a U-shaped 2 in. iron pipe which can be easily pumped empty. In some situations the boxing for the pipe is not absolutely necessary, but where there are cinders in the ground the pipe will soon be corroded if not protected.

A separate ½-in. pipe is used for each wire. At each end we first put on a washer of the right size and then screw a long cap over a packing of wicking and tallow to prevent waste of oil. This is especially necessary if the line is on such a grade that one end is much lower than the other. This packing does not need to be tight enough to interfere in the least with the free movement of the wire. Crude petroleum is used for filling, and the water needs to be pumped out of the well and oil filled in to the pipe about twice a year.

The cost of this arrangement is about $115 per thousand feet.

A Mogul Engine for the New York Central.

The engraving herewith, from a photograph, shows one of the new mogul freight engines building by the Schenectady Locomotive Works for the New York Central & Hudson River Railroad. The designs and specifications were furnished by the mechanical department of the New York Central and were worked out under the direct supervision of Mr. A. M. Waitt, Superintendent of Motive Power and Rolling Stock. A few of the leading weights and dimensions of this engine are compared in tabular form with weights and dimensions of the New York Central moguls described in our issues of June 30 and Sept. 29, 1899:



Mogul Freight Locomotive for the New York Central & Hudson River Railroad.

Mogul Freight Engines—N. Y. C. & H. R. RR.

	Class P, 1898.	Recent Mogul.
Weight in working order	152,000 lbs.	155,200 lbs.
" on drivers	131,600 lbs.	135,500 lbs.
Cylinder diameter and stroke	20 x 28 in.	20 x 28 in.
Diameter of driving wheels	57 in.	57 in.
Outside diam. of boiler (first ring)	67¼ in.	67$\frac{1}{16}$ in.
Working pressure per sq. in.	180 lbs.	190 lbs.
Heating surface, tubes	2,372 sq. ft.	2,321.6 sq. ft.
" " firebox	211 sq. ft.	185.6 sq. ft.
" " total	2,583 sq. ft.	2,507.2 sq. ft.

Other particulars of these new engines follow:

Fuel	Bituminous coal
Wheel base, driving	15 ft. 2 in.
Horizontal thickness of piston	4½ x 5 in.
Diam. of piston rod	3⅜ in.
Size of steam ports	18 in. x 1¼ in.
" " exhaust	18 in. x 2¾ in.
" " bridges	1⅛ in.
Valves	Richardson balanced
Greatest travel of slide valves	5½ in.
Outside lap " " "	⅞ in.
Inside " " " "	Clearance, $\frac{1}{12}$ in.
Lead of valves in full gear	$\frac{1}{32}$ negative lead full gear forward; $\frac{3}{32}$ negative lead full gear back
Material of driving wheel centers	Cast steel
Tire held by	Shrinkage
Driving box material	Gun metal
Diam. and length of driving journals	9 in. dia. x 12 in.
" " " " main crank pin journals	(Main side 6¾ x 5¼) 6 in. dia. x 6 in.
" " " side rod crank pin journals	Back, 5 x 3¾; front, 5 in. dia. x 3⅝ in.
Engine truck	Swing bolster
" " journals	6¼ in. dia. x 10 in.
Diam of engine truck wheels	30 in.
Kind " " " "	N. Y. Car Wheel Works Plate
Boiler, style	Extended wagon top
Firebox, length	108$\frac{1}{16}$ in.
" width	40⅜ in.
" depth	F., 82$\frac{21}{32}$ in.; B., 70$\frac{21}{32}$ in.
" crown staying	Radial stays 1⅛ in. diam.
Tubes, number	366
" diam.	2 in.
" length over tube sheets	12 ft. 2½ in.
Fire brick, supported on	Studs
Grate surface	30.3 sq. ft.
Exhaust pipes	Single
" nozzles	5 in., 5¼ in. and 5½ in. diam.
Smoke stack, inside diam.	16 in. at choke; 18½ in. at top
Tender, weight, empty	44,700 lbs.
Water capacity	5,000 U. S. gallons
Coal "	10 tons

The New Line to London.

By W. B. Paley.

The result of the first complete half year's working of London's newest railway, the Great Central, is very discouraging and there can be no doubt the company is in a position of some difficulty. Several unforeseen and unpreventable causes partly explain the misfortune, but the worst feature is that the London extension is not yet carrying anything like the traffic that was looked for. Of the total increased traffic receipts, compared with the last half of 1898, of £175,000, nothing whatever is left as increased profit to pay interest on the vast cost of the London line. On the contrary, working expenses are up by the heavy sum of £248,500, leaving the company actually more than £73,000 to the bad, after working, roughly, 100 miles of new line. This, however, by no means fills the cup of bitterness. So much as £50,600 has had to be provided out of revenue for interest upon what are called Lloyd's bonds, a security bearing 4 per cent. interest and issued instead of cash in payment for works and materials put into the line to London. The sum of £22,000 bearing 4¼ per cent. interest has been paid for hire of engines and rolling stock; about the most unsatisfactory form of expense a railway can have. These two securities, by law, take precedence over even the debenture stock and form, as it were, a first charge upon the undertaking. Nothing is added to the reserve fund, which had £7,000 credited to it a year ago; on the contrary £10,000 is now taken from reserve. With an increase of about £9,000 on certain joint line receipts, these extra charges added to the ordinary working expenses come to some £60,000 more, leaving the real deficiency of earnings, in round numbers, £133,000. Consequently, except 1 per cent. upon the 5 per cent. preference stock of 1879, no capital issued after that date receives a penny of interest.

But there are some hopeful features. Steamship receipts are nearly £11,000 greater, at a small increased cost; joint lines nearly as much, though two-thirds of it has gone in higher working cost; and a rise of about £10,000 in compensation for injuries is due to an accident which happened some time before the company went to London, and is not likely to recur. Besides, there is the very solid fact of the general traffic increase of £175,000, which is a great deal for a line of about 453 miles, although the company partly owns some 200 more and with certain running powers works its engines over 952½ miles of railway in all. About 66 miles of line are still under construction, representing a good deal of dormant capital, though part of it will not be wholly owned by the Great Central.

After all, it is too much to expect that the new line should pay its way from the first. Wonderful as is the volume of trade between London and the districts it serves, the facilities of the older lines for dealing with it are immense. The management is energetic. The Manchester service has been gradually quickened up as the banks get well consolidated, the fastest time now being 4 hours 35 minutes over the 206 miles, with three stops. After building no single-driver engines for many years, the Great Central is now turning out some at its Gorton Works, to run between Nottingham and London on the Manchester service. They are to have inside cylinders 19½ x 26, leading bogie, very large and high boilers, and 7 ft. 9 in. drivers. The longest and fastest run is now (February) London to Leicester, 103 miles, in exactly two hours.

The company's relations with the Metropolitan Railway, over whose line it runs for over 40 miles, seem to be a little better, and a good many trains now call at Harrow and Aylesbury, on that line, when required. The alliance with the Great Western, which will enable the Great Central to free itself of the unfriendly little line, is an accomplished fact. In addition, the Great Central have begun a line from Neasden, where their London engine sheds are, to Northolt, on the Acton & Wycombe section now constructing by the Great Western. This route will somewhat increase the distance from London to the large towns by the Great Central route, which is already longer than any of its competitors, but will give better gradients and a free hand in arranging the train services. A connection has also been made at Neasden which will be of great value for coal traffic. It was mainly for the sake of carrying their own coal traffic themselves that the Great Central came to town. Some very good positions for parcels and goods receiving houses have been secured in various parts of London, mostly as near as possible to those of the Great Northern.

The London establishment is now practically complete. The great hotel is in full work and doing well. The London coal yard is full of business, but the connection with the Regent's Canal seems to be doing little. Powers are sought to make several short branches to collieries, etc., and a link to shorten by azimuth work, devised by G. C. Comstock, Professor of Astronomy in the University of Wisconsin.

A description of the slide-rule, with illustrative examples of its use.

Various improvements in the field methods of surveying with the transit and stadia, prepared by L. S. Smith, Assistant Professor of Topographical and Geodetic Engineering in the University of Wisconsin.

The chapter on Mining Surveying has been entirely rewritten by Prof. Robert S. Stockton, E. M., of the Colorado State School of Mines, Golden, Colo., and by Mr. Edward P. Arthur, Jr., E. M., U. S. Deputy Mineral Surveyor, Cripple Creek, Colo.

A new Appendix B, being the latest Manual of Instructions for the Survey of Mineral Lands, brought up to 1899.

A new Appendix I, a reprint of the latest Rules for Restoring Lost Corners as issued by the General Land Office at Washington.

We need add nothing to this statement other than to say that the new articles on the stadia cover the use of an interval factor, a simple way to determine the wire interval of a transit, and the prevention of systematic errors. The purpose of the interval factor is to make it practicable to read one and the same rod with telescopes having different wire intervals. Having a rod graduated to the standard units the reading taken from it is multiplied by a factor pecular to the telescope used. This method has not been adopted because of the extra computation, but by the use of a reduction table the labor is made very small. It is found that with a little practice and the help of a reduction table the field notes of an entire day may be reduced in 15 minutes or less.

The Consolidated Iron & Steel Companies.—The American Iron & Steel Association has compiled a list of the consolidations of iron and steel companies which have taken place in the United States since Jan. 1, 1898. The list is issued as a supplement to the Directory published annually by the Association and is corrected to February, 1900. It is an octavo volume of 56 pages and is to be obtained from Mr. James M. Swank, General Manager of the American Iron & Steel Association, at No. 261 South 4th St., Philadelphia, Pa. The price of the supplement is $2. The last addition to the Directory of Iron and Steel Works appeared in 1898, and this supplement brings matters up to date. It contains an authorized description of the organization of each of the consolidations mentioned, giving capitalizations, officers and character of plant. Mines, coke ovens, railroads and ships owned by the consolidated companies are also given.

TRADE CATALOGUES.

Car Couplers, Buffers, Vestibules, etc.—The Gould Coupler Co., 25 West 33d St., New York City, with offices in Chicago & St. Louis, and works at Depew, N. Y., issues its catalogue for 1900. This contains good illustrations, with descriptions, of the various devices made by the Gould Company, and these are so well known that we do not need to enumerate them. It may be well to remind the reader, however, that besides couplers, buffers and vestibules the company makes steel platforms and draft rigging, malleable iron draft beams, steel axles, brake-slack adjusters and special malleable castings. The steam forge which was burned in 1895 was rebuilt with improved facilities and the company is prepared to furnish forgings in considerable variety. It is also prepared at its various works to supply malleable and steel castings. A novelty which we discover in this catalogue is an improved attachment to the lock of the freight coupler, designed to quicken the action of the lock and to prevent "any possibility of its being displaced by shocks." With this attachment the lock, it is said, cannot vibrate out of place. This consists of an eye bolt connection to the back of the lock which has a spring, abutting against a lug in the shank of the coupler. The action of this spring is forward and downward and the spring is long and works under limited compression. If it shoud break, the lock is still operative. An excellent feature of the catalogue is that the drawings are given with such clearness and completeness that one can get considerable satisfaction in studying the details.

Inspection Cars.—The Light Inspection Car Co., formerly the Railway Cycle Mfg. Co., of Hagerstown, Ind., issues a small pamphlet showing various designs of inspection cars of the Hartley & Teeter patents. These cars are essentially of bicycle construction; that is, with tube frames, bicycle saddles, pedals and handle bars, wire suspended wheels and ball bearings. They are provided also with rubber tires and an efficient brake. One can imagine that great speed can be made with these cars and that one can get over the track with them with the minimum of effort. These cars are made to carry one or two persons.

The Link-Belt Machinery Co., Chicago, has issued a 6 x 9 in. pamphlet illustrating different kinds of elevators and conveyors for handling general merchandise. These include inclined carriers for handling freight from floor to floor in the same building, horizontal endless carriers and various styles of continuous freight elevators for small packages and barrels; somewhat similar elevators are used for handling ashes in power stations. Much of this apparatus is especially adapted for use in large freight houses and at docks.

The Boston Belting Co., Boston, Mass., has issued a little 16-page pamphlet entitled "Do You Know?" and in answer to the question the company explains it was established in 1828; that it makes all kinds of mechanical rubber goods, including belting, diaphragms, gaskets, hose, mats, matting, packings and numerous other articles; and that it makes these articles in many different forms.

Ventilating Fans.—The American Blower Co., of Detroit, Mich., sends catalogue No. 111, showing and describing a variety of disk ventilating fansfl Vertical and horizontal fans are shown, to be run by steam and by electricity, either belted or direct-connected. Prices, dimensions, weights and capacity are also given.

Signaling as It Is and As It Might Be.

AN IDEAL ORGANIZATION.

BY A. H. RUDD.

(*Continued from page 197.*)

The writer is perfectly aware that his ideas may by some be deemed extravagant from a financial standpoint, but are they not on the lines of true economy?

Although gross earnings are now largely increased, rates have not advanced and supplies have. High prices affect employes as well, and in order to enable them to live as comfortably as heretofore, their wages must be adjusted to this rise; otherwise they become discontented and seek other fields of labor where they can get more. How, then, can economy be effected? In manufacturing it is accomplished by labor-saving machines. In railroading it can be done —to mention one way—by increasing the capacity of present main lines, through shortening the intervals between trains. In large yards, the number of switchmen may be reduced by concentrating the control of switches under one or two men. A good many dollars are paid each day for foot races back and forth. Proper signaling will accomplish this end, though it is difficult to demonstrate in cold figures what this saving would be.

Block signaling is a species of insurance, and the only true way to estimate its value is to summarize the accidents occurring for a number of years, note carefully the cost of those which proper signals surely would or possibly might have prevented, and, then consider how many installations might have been paid for by the sums lost. Consider the cost of delays involved. Also the cost of detentions, which, even without accidents, might have been avoided in the ordinary course of traffic through more rapid handling of trains. Then remember that "an ounce of prevention is worth a pound of cure," multiply the amount of wreck damages by sixteen, and contemplate the result!

The following organization is suggested for a large road. For smaller roads some of the assistants may be dispensed with. It will be noticed that the Lehigh Valley organization has been quite closely followed, that being one which measures up to the requirements, better than most, and which with slight modifications will give the best results.

ORGANIZATION.

The Signal Engineer will report to, and receive his instructions from, the head of the engineering [or transportation] department, and will have charge of the installation and maintenance of all mechanical, automatic, electric and interlocking signals.

He will prepare plans, specifications and estimates for all new plants, and superintend their erection and installation.

He will prepare plans and instructions relative to the proper mechanical construction, manipulation and maintenance of all classes of signals, which, after approval by his superior, shall become standard. (Instructions regarding manipulation must also be approved by the General Superintendent, if the Signal Engineer reports to the Chief Engineer.) It shall be his duty to enforce adherence to such standards and instructions.

He will superintend the maintenance and any alterations of existing plants and fixtures.

He will make frequent inspections of all signaling plants and apparatus, and see that they are properly operated, and maintained in a satisfactory condition.

He will make periodical reports relative to the operation of the signaling systems under his charge.

He will investigate all reports of detentions to trains caused by failures of signals, and of damage done to signal plants or apparatus, reporting his findings and recommendations in the matter to his chief, to the Division Superintendent, and to any other official who should take cognizance of same.

He will prepare statements showing the cost of maintenance or installation of the various plants or branches of the service.

Division Superintendents will furnish the Signal Engineer any information and assistance he may require to enable him to discharge all the duties assigned to him.

All employes must obey the instructions of the Signal Engineer in all matters relating to the proper construction, maintenance, and mechanical manipulation of the signal plants or fixtures in their charge.

The Signal Engineer will advise the division operators as to the disposition to be made of all messages relating to signal interruptions.

No removals or alterations, other than routine repairs incidental to the proper maintenance of signals, will be undertaken without orders from the Signal Engineer; excepting in emergency cases, in which event the Signal Engineer shall be notified as soon thereafter as possible, and satisfactory reasons given.

All requisitions for signal supplies will be prepared by the Signal Engineer, so as to insure perfect uniformity and accuracy of definitions.

The Signal Engineer will give special attention to training the various repairmen, to secure a reduction of expenses and higher efficiency of the force, by combining the work connected with the various classes of signals, as far as feasible.

The Signal Engineer will be assisted by an Electrician, a Supervisor of Interlocking, a Foreman of Signal Construction and a clerk (and draughtsman, if necessary). These will report to the Signal Engineer and be assigned their respective duties by him.

The Signal Engineer will report on a special payroll, to his superior, the time of all his men engaged on work on the different divisions, such time to be charged to these various divisions and the bills forwarded to the respective Division Superintendents.

For the head of such an organization a man should be chosen who can be implicitly trusted. He must be skilled in mechanical work, so that in designing standards, he may embody the best known practice, or improve upon it. He must be able to work out his own locking sheets, and make plans so perfect in detail that the Foreman of Construction will not have to spend half his time overcoming unexpected obstacles, which make the original plans impracticable, and the balance of it figuring out how the work is intended to be installed. He must understand all the problems to be solved, and be an electrician of ability, with thorough knowledge of the principles and methods of working the different systems, so that in designing his circuits no chances may be left for the display of clear signals erroneously. He must have knowledge of all the economic features of the profession, and possess a large share of executive ability.

Such men are to be found to-day, and are only waiting for the opportunity to demonstrate their ability when their handicap is removed. They should be given the opportunity to prove their competence, and when they have done it, be paid salaries commensurate with their positions and with those of other officials with like responsibilities.

They should have sufficient office help to enable them to get about and see what other signalmen are doing, and be allowed the necessary money for this purpose, that they may continually broaden and keep out of a rut. Then the Signal Engineer should be given, not absolute freedom from restraint by any means, but sufficient help, at large enough wages, to ensure the best results, and authority much beyond that with which any such officer is at this time entrusted.

Each autumn Division Superintendents should render reports of the points they deem it necessary to have signaled the ensuing year, the General Manager selecting from them the work most desired. Detailed plans and estimates on a liberal scale should then be prepared by the Signal Department after consultation with the engineering force as to possible track changes to simplify the signaling. A decision should then be reached as to the funds available for the purpose, and the points to be protected finally chosen. A secondary list could be made, of less important places to be attended to, if saving enough is effected over the estimates of the first list to allow it without exceeding the appropriation. In this matter of plans absolute authority should be given the Signal Engineer.

A little signaling, like a little knowledge, is a dangerous thing. If the work is worth doing at all it is worth doing well.

An installation should be complete throughout. All possible routes should be signaled and separate levers provided for at least the high speed route signals and preferably for all. All switch and lock levers should be underloaded rather than overloaded. Two or three light levers can be handled more quickly than one heavy one, and the maintenance cost is decreased 40 or 50 per cent. by such arrangement. It also lessens in great degree one of the danger points in mechanical interlocking; that of the switch remaining in one position with its lever in the other, through a broken connection, thus releasing the locking for a wrong route.

Careful inspection has sometimes prevented such trouble, but the possibility of it, though remote, exists. An additional and perfect preventive is the installation of circuit breakers in connection with and operated by the facing-point switch itself in each high-speed route and placed in circuit with electric locks on the levers of signals governing over the same. Electric locks should also be provided in all cases where detector bars will not absolutely protect, and especially to hold routes after distant signals have been cleared. These points, often neglected, provide loopholes in the system and an axiom of signaling science is that "if there is a possible chance for any mistake, it will certainly be accepted sooner or later."

Expenditures on these lines will not be as impressive to the traveling public as fine stations and grounds, beautiful flower beds and other ornamentation and luxurious cars, but the lack of them will more forcibly impress this same public when avoidable accidents occur through their omission.

In the automatic block signal field, trolley and other foreign currents frequently pass over the rails, and knowledge of means to counteract them is often essential to prevent the most serious results.

Materials and workmanship in installation should be of the best. The almost universal employment of wood for foundations necessitates expensive renewals on an average every five or six years. During renewals switches and other functions must often be disconnected and worked by hand. The use of concrete or cement piers obviates this necessity, and the additional first cost is more than saved in a short time.

The Signal Engineer, who understands these matters, should have final decision as to plans, materials and methods of construction.

[TO BE CONTINUED.]

Present Status of "Light Railroads" in England.

What are the best means of encouraging the building of light railroads? constitutes Subject 38 for discussion at the International Railway Congress, to be held next September; and reports on the subject have been made by Mr. Joseph Tatlow, Manager of the Midland Great Western Railway of Ireland, and by Mr. W. M. Acworth. Mr. Tatlow reports for Great Britain and Ireland; and the report, with appendix, fills over 80 pages of the Bulletin for January. Mr. Tatlow discusses the law in detail, gives a history of State-aided railroads built in Ireland since 1889 and then goes on to tell what has been done under the Light Railway law of 1896. Only one railroad has been finished and put in operation under this law, but the applications which have been made and the action of the Board of Trade and the Light Railway Commissioners on these are reported at great length. Inquiries were made of 44 railroad managers in England and replies are given showing their views on the subject of building inexpensive railroads to accommodate rural districts. Mr. Tatlow refrains from stating his conclusions as to the probable benefits of the Light Railway act, as it will be necessary to wait for further experience before it will be possible to form an opinion. The Act appears thus far to have worked with smoothness and efficiency.

Mr. Acworth was asked to treat the subject with reference to countries other than England, but he says that he has no special knowledge which would enable him to do this successfully, and he makes a short report criticising the working of the English Act. He has no great hopes of beneficial results from this law, for the reason that the relaxation of the restrictions which are imposed by the Government on the construction of standard railroads has not been carried far enough. The standard of construction and of safety is still too high. Many of the companies already started are likely to find it impossible to earn a profit on their capital. The Government grants not more than 20 per cent. of the capital necessary, even in poor districts, while railroads already running in Ireland have been built at the sole expense of the Government. State aid is difficult to manage at best, as it will be impossible to adjust the rival claims of old unsubsidized railroads and new State-aided lines.

TECHNICAL.

Manufacturing and Business.

George A. Barden, formerly Superintendent of the works of the Standard Pneumatic Tool Co., Chicago, has been appointed Eastern Agent of the same company, with headquarters at 619 Washington Life Building, 141 Broadway, New York.

McCord & Co., Chicago, makers of railroad supplies, have moved their Chicago offices to Suite 1475, Old Colony Bldg.

The American Locomotive Sander Co., of Philadelphia, informs us that on the first of the month it had on its books orders for 901 track sanders for future delivery. This indicates a rapid growth in the application of sanders to locomotives.

F. M. Pease, of Chicago, has bought all the narrow-gage rolling stock of the Baltimore & Lehigh RR., which road is now being made standard gage. Mr. Pease has also delivered 50 box cars to Swift & Co. and 100 cars of the same type to the Pittsburgh, Shawmut & Northern RR.

The Illinois Central is building a second Jordan earth and ballast spreader. The Grand Trunk has bought from H. H. McDuffy, sole agent, 521 Monadnock Block, Chicago, a license to build two of these machines for use in the grade reduction and double track work to be done this season on the Chicago & Grand Trunk division.

The New York offices of the Chicago Pneumatic Tool Co. have been moved from 122 to 95 Liberty St.

Iron and Steel.

Jones & Laughlins, Ltd., operating the American Iron & Steel Works at Pittsburgh, Pa., and Laughlin & Co., owning and operating the Eliza furnaces in the same city, which are practically the same interest but which have been operated separately, have been merged into one company hereafter to be known as the Jones & Laughlins, Ltd., capitalized at $20,000,000. The officers of the new company are: B. F. Jones, President; C. M. Laughlin, Vice-President; Willis L. King, Secretary, and B. F. Jones, Jr., Treasurer. The holdings of Laughlin & Co. in the Lake Angeline Iron Co., the Monongahela Connecting RR. and in ore, coal and coke properties have also been acquired.

Bids will be wanted about May 1 by James H. Purdy, Thornton, N. M., President of the Cochiti & Northwestern Ry. Co., on 52-lb. rails.

Horace Crosby, Second Vice-President of the National Tube Co., died of pneumonia at his home in Allegheny, Pa., April 5. He was born in Belfast, Me., December, 1847.

The Detroit Bridge & Iron Works has a contract with the Grand Trunk Ry. for bridges requiring 4,000 tons of material, and also a contract for 2,000 tons of bridge steel for the Missouri Pacific.

Owen Sound, Ont., offers subsidies, etc., for an iron and steel plant to cost $600,000. A company is being organized with a capital of a million dollars.

The Blue Bell Iron & Steel Co. of Philadelphia, Pa., has been incorporated in Delaware, with a capital of $300,000, by Herman Becker, Edwin A. Yarnell and Joseph W. Thompson, all of Philadelphia.

The Risdon Iron & Locomotive Works, San Francisco, Cal., are reported to have secured control of the Pacific Rolling Mill of that city. It is stated that the Risdon Co. will spend about $3,000,000 for a ship-building plant and a large dry dock.

The Pittsburgh Steel Construction Co. has been organized by Geo. M. Bole, John L. Mullen and others, and headquarters have been opened in the Westinghouse Bldg., Pittsburgh. The company proposes to build steel bridges, buildings, etc.

Col. David Campbell, Superintendent of the Empire Iron & Steel Company's furnaces at Philadelphia, Pa., died in that city April 3. He was born in Middletown, Pa., Dec. 30, 1832.

Andrew D. Cramp, at one time Superintendent of the Cramp ship yards at Philadelphia, died in Boston, Mass., March 29, at the age of 43. He was a son of William H. Cramp and was born at Philadelphia.

Three bills before the Ontario Legislature authorize municipalities to grant bonuses to companies establishing iron and steel works. One bill is to enable the city of Collingwood, Ont., to pay $115,000 to the company which proposes to establish a steel plant at that place. Another is to enable the town of Fort William to grant $50,000 to the Mattawin Iron Co. which will build an iron furnace in that town. The third is for a $25,000 grant for a copper smelter in the same town.

The Lukens Iron & Steel Co. is having a universal plate mill built at Coatesville, Pa., to roll plates from 9 in. up to 48 in. wide and 100 ft. long.

The Maryland Steel Company, Sparrow's Point, Md., has an order for 1,510 tons of rails for the Metropolitan Railway of London, England.

The Nashua (N. H.) Iron & Steel Co. has been sold to the Eastern Forge Co. of Boston, Mass. E. F. Chandler, the present manager, will continue to act as agent.

The Gillette-Herzog Mfg. Co. of Minneapolis, Minn., has the contract to rebuild the Convention Hall at Kansas City, Mo., which was destroyed by fire last week. The Carnegie Co. will supply the greater part of the material.

New York State Canals.

The bill appropriating $200,000 for surveys of the canals of the State of New York was unexpectedly passed last week at Albany.

The Nicaragua Canal.

So far as we can now judge the Nicaragua Canal bill will not be passed at this session, although of course we cannot be certain until Congress has adjourned. No doubt its passage this session would be premature and unfortunate, considering the very important report that the Commission is certain to make within the next 10 months.

Steel Underframe Cars.

The Pressed Steel Car Company has taken an order from the Philadelphia & Reading Railroad for 540 box cars with steel underframes. These cars are of 80,000 lbs. capacity. The company has also an order for 1,000 gondola cars with steel underframes from the same road. The company will add somewhat to its new establishment at McKees' Rocks for the purpose of building cars of this type.

Cost of Treating Ties at Edgemont.

In describing the tie treating plant of the Burlington & Missouri River RR. in our last issue, page 213, it was said that the cost of treating by the chloride of zinc or "Burnett" process (which is used at Edgemont, S. D.) is from 12 to 15 cents for each tie. We learn from the Chief Engineer of the road that these figures are a little too high, the cost being from nine to ten cents, and never exceeds the latter figure.

Grand Trunk Railway Bridges.

In the annual report of the Grand Trunk the Chief Engineer says the replacement of the old bridges, which are too light for the present loads and rolling stock, by others sufficiently strong to meet all probable future requirements, has been carried on more slowly than was expected by reason of the impossibility of obtaining the necessary steel for superstructure. All the bridges between Montreal and Island Pond, a distance of 147.83 miles, have been finished, and trains of maximum weight are now running over them. Between Island Pond and Portland, 149.42 miles, the renewal of the bridges is being pushed forward as rapidly as the short supply of material will permit. The Victoria Jubilee bridge has been finished, including roadways, footpaths and approaches, and was opened to the public Dec. 1 last.

Carnegie Pattern Shop Burned.

The pattern shop of the Carnegie Steel Co. at Homestead, Pa., was burned during the night of April 7. Numerous patterns and armor-plate drawings that were to be submitted to the Navy Department were destroyed. The loss was $75,000.

Chicago Drainage Canal.

Water was turned into the Van Buren St. by-pass, Chicago, on the morning of April 6. Its completion is the last important work remaining on the drainage canal, and the filling of the tunnel will diminish the velocity of the current in the Chicago River. The by-pass at Adams St. was opened Nov. 2 and noted in our issue of Nov. 19, 1899. The combined length of the two by-passes from Adams to Van Buren Sts. is about 1,150 ft. They are crescent-shaped tunnels under the west bank of the South Branch of the Chicago River, and were made necessary by the narrowness of the river and its inability to carry the required amount of water. They will carry 100,000 cu. ft. of water a minute at their fullest capacity. The tunnels run under three buildings, three railroad tracks and the teaming yards of the Fort Wayne railroad and the work has been done without causing any interruption to traffic. They are 50 ft. wide and 16 ft. deep, with concrete walls on both sides, on which rest steel girders weighing 15 tons each, placed 10 ft. apart. Between the walls concrete arches 4 ft. thick at the girders and 15 in. thick at the crown are built to add to the strength of the surface. Lydon & Drews had the contract for the substructure, in which 2,500,000 ft. of timber (board measure) and 76,000 lineal ft. of piles, and 8,000 cu. yds. of concrete for the walls was used. The superstructure was built by Griffith & McDermott, and 4,000 cu. yds. of concrete and 1,500 tons of steel have been used by them. The work has been carried on day and night and Sundays under the direction of Mr. G. M. Wisner, who has been the engineer in charge, and it has cost about $550,000.

Subway to East Boston.

The Boston Transit Commission has asked for sealed bids for building Section A of the East Boston tunnel in Maverick Sq. and Lewis St. The section consists of about 139 ft. of open incline, and 680 ft. of two-track subway. Bids will be received at the office of the Commission, 20 Beacon St., Boston, Mass., until 12 o'clock noon, Friday, April 20. A bond to the amount of 20 per cent. of the contract will be required. H. A. Carson is Chief Engineer.

Block Signals Needed in France.

The Minister of Public Works in France has designated the following lines which it is declared should be equipped with the block system as soon as practicable. He specifies the portions which should be first equipped as follows, Table No. 1 giving the most important, and Table No. 2 those next to be looked after:

TABLE NO. 1.

Line.	Km.
State Railroad, Chartres to Bordeaux (sections not yet equipped)	434
Paris to Royan	47
Total	481
Eastern	6
Southern	305
Orleans, main lines 302 km., branch lines 237 km.	539
Western, main lines 127 km., branch lines 170 km.	297
Total	1,628

TABLE NO. 2.

Line.	Km.
State lines, Nantes to Bordeaux	373
Paris-Lyons Mediterranean, main lines and branches	895
Orleans, Brive to Montanban	163
Western, main lines and branches	174
Total	1,605

Aggregate, 3,233 kilometers or 2,009 miles.

THE SCRAP HEAP.

Traffic Notes.

It is reported that the Wabash road, after paying employes by check for a long time, will resume the use of the pay car.

The Buffalo, Rochester & Pittsburgh has voluntarily advanced the pay of locomotive firemen. It is said that the advance amounts to 10 per cent.

All machinery used for this plant is made for direct current working at 110 volts. The cost of maintenance of the entire plant since its installation has been an average of only $42 a month, which is less than the salary of the lamp tender, replaced by the electric switch light.

The entire plant was installed complete by the Arthur Frantzen Company, electrical contractors, 225 Dearborn Street, Chicago, Ill.

Railroad Legislation in Iowa.

The recent session of the Iowa Legislature passed three acts affecting railroads. The first one regulates the assessment of sleeping and dining cars. The annual statements of the railroads must "show the average daily sleeping car and dining car service operated on each division." The second enlarges the power to condemn. Section 1998 of the code of Iowa is amended so that any company operating a completed railroad shall have power to condemn lands for necessary additional depot grounds "or yards, for additional or new right of way for constructing double track, reducing or straightening curves, changing grades, shortening or re-locating portions of the line, for excavations, embankments, or places for depositing waste earth."

The third act regulates the sale and redemption of tickets. Every railroad must provide for the redemption at the place of purchase and at the general Passenger Agent's office of the whole or any integral part of any unused passenger ticket that such carrier may have sold; and shall redeem the same at a rate which shall equal the differnce between the price paid for the whole ticket and the cost of a ticket between the points for which said ticket has been actually used. No carrier shall limit the time in which redemption shall be made to less than ten days from date of sale at the place of purchase and six months from date of sale at the General Passenger Agent's office. Where the rate is regulated by statute tickets sold at the maximum legal rate must not bear any condition of limitation as to the time of use, or as to transferability, without first providing for the redemption of said ticket, as directed by the preceding section hereof, and also having notice of such provision and privilege of redemption conspicuously posted at each place where tickets are sold. To refuse or neglect to redeem a ticket within ten days is punishable by a fine of $100. Nothing in this act is to prohibit the sale of mileage tickets bearing reasonable conditions.

All of these laws go into effect July 4, 1900.

The Cape Cod Canal.

The project of a waterway across the neck of Cape Cod has for several years been agitated in the Massachusetts Legislature. Several stock companies have been formed and dissolved in connection with the scheme, but it was not until January, 1899, during the last legislative session, that a charter was granted to the Boston, Cape Cod & New York Canal Company. Nothing has been done during the year beyond a preliminary survey and some plans for a route.

During the present session of the Legislature, the bill granting the charter was called up for amendment by general agreement. On Wednesday, April 18, the amended bill was passed for engrossing by the Senate. This action is claimed by the promoters of the enterprise to be tantamount to a final acceptance, as the House has already voted favorably on the main act. The bill will go before the latter body probably early in the week, and will then pass to the enactment reading.

Amendments introduced by Senators Post and Atwell on April 11, and incorporated in the charter, grant practically all that has been asked by the petitioners with regard to the issue of stock and bonds and provisions for the cancellation of indebtedness. The maximum bond issue is fixed at $12,000,000, contingent upon the estimate of the Harbor and Land and Railroad Commissioners of the cost of construction. Stocks and bonds are to be under the control of the State Treasurer, who is to disburse only such sums as are directed by the dual Board, to the account of work actually done. Another amendment, probably introduced as a joke, provides that a deduction is to be made from the amount of the securities if any part of the cost of construction is paid by the United States Government.

The President of the company is General Charles C. Dodge, of New York City. The promoters will give no other names, but it is stated that Mr. Rignal Woodward of Boston is interested. The company has opened offices in Boston, and shares them with the Cape Construction Company, of which Mr. Woodward is President, and which is eventually to build the canal.

The proposed route is across the narrowest part of the neck, from Barnstable Bay to Buzzard's Bay, the western part following the course of Monument River. The length from tidewater to tidewater is about eight miles, but the amount of dredging necessary to reach deep water on the Buzzard's Bay side will increase this to 13 miles. An immense breakwater will have to be built off Barnstable, to shelter the entrance from the prevailing northeast storms in winter. The canal will cross the Old Colony Division of the N. Y., N. H. & H. RR. at three points, and the bill granting the charter provides that the expense of providing and maintaining drawbridges at these points shall be assessed upon the canal company by the dual Board.

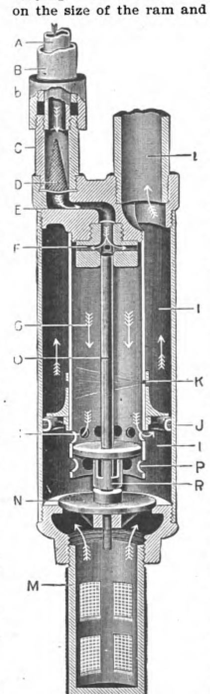
The depth at mean low water will be 30 ft., the width at the bottom 100 ft., and the width at the top 200 ft. The plans and surveys for the proposed route, bridges, breakwater, etc., have been made by Messrs. A. L. Rives and E. L. Cortheil, who are named as the company's engineers.

The advocates of the bill claim that the canal will benefit Boston and New England generally, and they advance the following facts and arguments: That Cape Cod is one of the most dangerous coasts known; that 30,000 vessels, of which 6,000 are steam craft, are compelled to round the Cape each year; that freight interests, especially those in perishable Southern fruits, will be greatly benefited by the estimated saving of one day's sailing time; that shipping rates on coal will be lessened, cheapening it over the whole of Eastern New England, and that a night trip from Boston to New York, without change, will be a great attraction in connection with passenger boats.

Boston, April 24.

The Erwin Steam Ram.

The Penberthy Injector Company of Detroit is putting on the market the Erwin steam ram for raising water to heights as great as 60 ft., the capacities varying from 4,000 to 8,000 gallons an hour, depending on the size of the ram and the lift; the steam pressure used is about 75 lbs. These are especially intended for use at locomotive water stations and where so used the pumping plant consists of the ram, which is placed beneath the surface of the water, and the boiler.



The construction of this ram will be seen from the accompanying engraving showing a sectional view. At the time of starting, the ram is filled with water which has flowed in by gravity. When steam is turned on it passes through the steam pipe A, nipple C. conical screen D, the main steam port E and radial steam ports F, into the cylinder G. The water is then forced downward through the openings H into the surrounding discharge chamber I, where it passes through the annular check valve J and out of the discharge pipe L. When the steam reaches the lower end of the cylinder G, it is exhausted through the large openings H faster than it is admitted through the steam ports F, is condensed in the surrounding discharge chamber I, and the partial vacuum is made more complete by a spray of water which enters from the discharge chamber I through the small opening K. When a partial vacuum is formed, the pressure of the atmosphere on the water outside of the ram forces water upward through the bottom strainer M. The main check valve N is then raised and the valve rod O, which is rigidly attached to it, shuts off the steam at the upper end of the cylinder. A volume of water under atmospheric pressure is at the same time forced upward through the discharge chamber and out into the discharge pipe. A portion of this water, however, passes through the openings P, forces up the float R, which moves freely on the valve rod O, and refills the chamber. The water under atmospheric pressure having then lost in momentum, the steam acting downward on the valve rod, closes the main check valve, and through pressure exerted on the float, again forces water out of the cylinder and through the discharge chambers and discharge pipe. A covering pipe B surrounds the steam pipe for the distance it is submerged beneath water, to prevent condensation.

The chief advantages claimed for this method of raising water are that no oil or packing is required, the ram needs little attention, the friction losses are small and steam is used economically. Two sizes are made, the "Standard" being adapted for working against a 60-ft. head, and the "Low Lift" rams against heads of 40 ft., in which case larger quantities of water are handled. The rams are brass and the strainers are malleable iron with brass screens.

Signaling As It Is and As It Might Be.

AN IDEAL ORGANIZATION.

BY A. H. RUDD.

(Concluded from page 241.)

Now as to maintenance. It does not pay to install work and then let it deteriorate. It should be always kept up to its initial efficiency. This can be done only by constant watchfulness, and sufficient force should be allowed, particularly with automatic signals, so that inspection can be made daily. The saving in delays to trains will pay for this additional care.

At large terminal stations this fact is fully recognized and proper maintenance given, especially where electro-pneumatic machines are employed. Observe the constant inspection at points such as the Pittsburgh, Philadelphia and Jersey City stations of the Pennsylvania, the Philadelphia terminal of the Reading, the Boston terminal of the Boston & Maine, and at the last and greatest of all, the South Station of the Boston & Albany and New York, New Haven & Hartford in the latter city. At this magnificent station all departments worked together so harmoniously during installation that the best results were attained, and the liberal policy of the Terminal authorities in dealing with the contractors has made possible the highest development of the work.

The same policy should prevail at outlying points, where delays, though not so annoying, still disarrange the service.

Signals are not infallible, and the possibility of one showing clear when it should indicate danger must be guarded against by every possible means. Weekly inspections, a common practice to-day, are not a sufficient safeguard, particularly for automatic signals at outlying points. A good deal may happen to them in a week. Tracks, engines and cars are inspected daily, and oftener, and air brakes whenever the composition of a train is changed in any way. The mechanism which gives notice that their application is required should be equally well maintained.

On long stretches of track in outlying districts, velocipedes or track bicycles will pay for themselves in six months, keeping expenses down and at the same time making this necessary inspection practicable.

Maintenance men should never be called on for construction work, but should be assigned a full daily task and be held to it constantly. With this end in view the following plan is recommended. As noted above, the Signal Engineer should have on his staff an electrician, a supervisor of interlocking and a foreman of construction.

Under the jurisdiction of the Electrician would come all electrical apparatus connected with automatic and "tower" systems, also crossing bells, telephones (where a separate department does not exist), annunciators, call bells, electric clocks, fire alarms, etc. Under the Supervisor of Interlocking, all mechanical work pertaining to the maintenance of fixed signals, and under the Foreman of Construction all new construction work.

Such assistants can be readily found, as numbers of men are competent in each of the branches, although those who combine two of them are few. They should be paid enough to command the best talent.

All Division Signal Inspectors, Repairmen, Batterymen and helpers will be appointed by and report to the Signal Engineer. No new work or extensive alteration is to be started without an order to the Signal Engineer from his superior. The Signal Engineer will then give the necessary instructions, and notify the Superintendent of the division in which the work is to be done.

In case the Division Signal Inspectors or Repairmen require assistance from the division roadway forces, they will notify the Signal Engineer, who will call on the Division Superintendent for such assistance as is required; excepting that in cases of emergency, they may arrange direct with the Division Superintendent, or with such officer as he may designate, the reasons for such action to be reported subsequently to the Signal Engineer.

Division Signal Inspectors or Repairmen must make all necessary and ordinary repairs promptly, but must not make any change in the signals, or renewals or extensive alterations, without proper orders from the Signal Engineer; excepting that in cases of emergency they may arrange direct with the Division Superintendent, or with such officer as he may designate; the reasons for such action to be reported subsequently to the Signal Engineer.

Division Signal Inspectors and Repairmen must keep the Signal Engineer, the Division Superintendent, and the telegraph operator at their headquarters advised at all times of their whereabouts.

Each division will have one or more Signal Repairmen of Mechanical Signals, who will be responsible for the proper maintenance and working of all interlocking and mechanical signals, and any other signal apparatus placed in their charge in the division. Repairmen must make constant examinations and see that all apparatus is properly maintained and operated, and that all lamps and fixtures are kept in good condition. They will make daily reports to the Signal Engineer and the Division Superintendent. They will observe all instructions they may receive from the

Signal Engineer or from the Supervisor of Interlocking.

There will be one Signal Inspector of Automatic Signals assigned to each division where automatic signals are installed to an extent requiring such Special Inspector. The Signal Inspectors of Automatic Signals will be assisted on each division by Signal Repairmen of Automatic Signals, Batterymen and helpers, as may be determined by the Signal Engineer.

The Signal Inspector of Automatic Signals will have charge of the Signal Repairmen of Automatic Signals, Batterymen and helpers on his division, and will be responsible for the proper maintenance and working of all automatic signals and any other signal apparatus placed in his charge. He must make constant examinations and see that all apparatus is properly maintained and operated, that all lamps and fixtures are kept in good condition, that the electrical bonding is maintained or speedily replaced when broken by track changes or otherwise, and locate all trouble promptly. He must be prepared at all times to personally make all minor repairs without calling on the Signal Repairmen. He will make daily reports to the Division Superintendent and to the Signal Engineer. He will observe all instructions he may receive from the Signal Engineer or from the Electrician.

The Signal Repairmen of Automatic Signals, Batterymen and their helpers must obey all instructions of the Signal Inspector, and make all necessary and ordinary repairs promptly, reporting in all matters to the Signal Inspector, and keeping him at all times advised of their whereabouts.

With an organization as here sketched, with sufficient funds allowed for enough skilled labor at good wages to make daily inspections, delays to trains would be vary rare, breakdowns being anticipated and repairs made before failures occurred. And it is far cheaper to employ a few good men than a number of poor ones. This is especially true in construction work, where it would be considered a proof of imbecility to pay fitters $2.50 or $2.75 a day for digging foundation holes when sufficient talent could be obtained at $1.35 to $1.50 and the work better done. It is scarcely less idiotic to attempt to use laborers as fitters and have them spoil as much material as they use, making it necessary to do work once and sometimes twice over and then having it not quite right, and taking a foreman's time when he might be better employed.

Such a course, however, is often pursued by Signal Engineers to-day from sheer force of necessity, through inability to secure the necessary appropriation for a better class of men. They all know its wastefulness, but they are helpless. This method would not be dreamed of in the shops, or in any of the other well organized departments, and it is to be hoped that the day has dawned when it may be abolished in the Signal Department also.

CONCLUSIONS.

Signaling has passed out of the experimental stage. Appreciation of its value, and knowledge of its details and theory of practice, on the part of managing officials as a rule has not developed as rapidly as the science itself. Consequently the work has not reached its perfect development on many roads through inability of the Signal Engineers to overcome preconceived ideas and prejudices and to obtain necessary appropriations.

It should be generally realized that proper signaling prevents accidents as well as aids in the handling of trains, and that incomplete or bad work increases the dangers.

Complete installations should therefore be the rule, and they should be erected with a view to future requirements and having in contemplation a general scheme of full protection when the entire work is finished.

Proper maintenance should be allowed for, including daily inspections of automatic signals at least, as there is no economy in allowing expensive plants to deteriorate. To accomplish these objects the departments should be placed on a better footing, with a general organization so that all work would be maintained by Signalmen, who should be paid sufficient wages to insure the best talent available. The saving in expenses should not be attained through low wages and cheap materials or workmanship, but economies should be effected by perfect organization, through keeping the size of forces and amount of stock on hand at the lowest possible limit, and all men constantly employed.

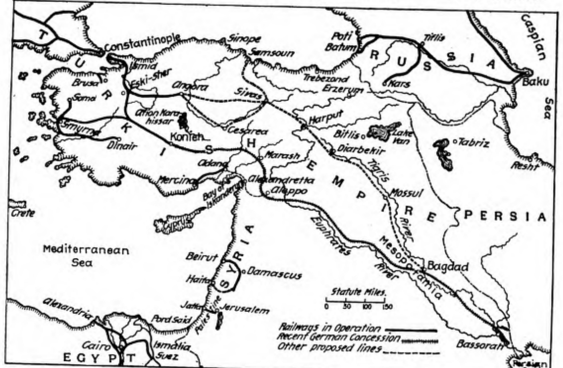
Signal Engineers should be given more responsibility and authority, with complete charge of their departments and all branches of the work, and allowed leisure time enough to keep themselves posted on all new methods and advances in designs, and not be compelled to do two men's work. They should be paid higher salaries than those now prevailing, in order to induce the best men to continue in the work and to make it an object for younger men to fit themselves in technical schools and by practical training for work of this character.

It is hoped that these suggestions will bring forth discussion from Signal Engineers, and that managing officials also will find some points of interest. At all events the present conditions have been noted and the possible development of the Signal Department outlined, as the matter appears to some, at least, of the Signal Engineers of American railroads.

Proposed Railroads in Asia Minor.

From apparently authentic reports it appears that the concession for the new railroad through Asia Minor to the Persian Gulf has been granted to the Anatolia Railroad, a German company which now operates a line from Constantinople southeastwardly to Konieh, about 300 miles. The extension is to run from the latter place southeastwardly through Marash and Bagdad to Bassorah. The line, as shown on the accompanying sketch, lies through Aleppo. This information, as well as the map, we take from a report by Consul M. A. Jewett, of Sivas, Turkey, published by the State Department in a recent issue of Consular Reports (No. 665).

It is said that the French company owning the railroad from Smyrna eastward to Afion Karahissar has been authorized to take 40 per cent. of the stock in the new extension, this having been the price of the withdrawal of this company's opposition; and local objectors had to be conciliated by a clause in the concession giving the Turkish Government the right to buy the railroad at any time. Consul Jewett thinks that the German company will take measures, in operating its new road, especially by making preferential rates, to constantly favor commerce with Germany as against other countries; and the Germans are said to control railroad traffic from Smyrna as well as from Constantinople. Germans own the line to Angora. Mr. Jewett suggests that if American capitalists wish to get the better of German interests they should secure a concession for a line from Samsoun to Bagdad. This line would open up a country which would furnish a much larger agricultural traffic than can be had on the line through Marash, as the latter traverses a barren and sparsely inhabited territory.



Railroads in Asia Minor.

A New Form of Car Trust.

Mr. Edward S. Avery of 67 Wall Street has devised a form of car trust which he thinks possesses advantages over the ordinary form of such trusts. The following is an extract from a letter in which the plan is outlined at length:

Car trust agreements require the payment of one-tenth or one-sixth of the unpaid cost of the cars annually and draw high interest. Most managers would prefer to obtain the capital for equipment by issuing first mortgage bonds, requiring no annual payment on account of the principal and drawing low interest. Repairs and renewals are supposed to maintain the integrity of the equipment as security. We propose an issue of car trust certificates or bonds in an amount equal to eighty or ninety per cent. of the cost of cars given as security, running for twenty or thirty years, requiring no annual payment on account of the principal, and drawing interest at the same rate as is obtainable on the railroad company's first mortgage bonds.

Are cars good security for a loan of thirty years? The integrity of such security could be maintained by monthly or semi-annual payments into a sinking fund, which would be expended at the end of say every third year in the purchase of new cars. This simply provides specifically for maintaining the equipment. A covenant to add new cars every third year might not require cash payments into a sinking fund. The following table shows how cars would depreciate in value but the integrity of the security be maintained. It begins with cars costing $100,000. They are supposed to depreciate at the rate of one-tenth yearly. New cars are purchased and added to the security at the end of every third year out of the sinking fund, which accumulates at the rate of 10 per cent. of the cost of the original cars each year during the first three years, 13⅓ per cent. per annum during the next three years and 16⅔ per cent. per annum thereafter. The salvage or scrap value of the original cars (20 per cent. of $100,000, or $20,000) could be applied in part payment of the sum required for the sinking fund in the twelfth year. Every third year thereafter about ten thousand dollars for salvage could be applied in the same way. Deduct also the interest on the sinking fund. Thus we have an average yearly net requirement of, roughly, $12,000 for the sinking fund, to which should be added $3,600 per year for interest at the rate of 4 per cent. on the $90,000 of certificates, making a total requirement of $15,600 per year. The purchase of new cars every third year keeps the equipment up to date, and results in an increase in the number of cars. There would be about twice the original number of cars in service after the ninth year. The value of the security is fully maintained during the first nine years, then it gradually increases until the eighteenth year, after which it remains at $110,000. At the end of thirty years the security, including the salvage value of old cars remaining on hand, would be worth $40,000 more than the debt of $90,000.

Value of the Wooden Cars at the Date of the Agreement, $100,000; Value at the End of the—

3d yr.	6th yr.	9th yr.	12th yr.	15th yr.	18th yr.
$70,000	$40,000	$10,000	......	......	......
30,000*	21,000	12,000	$3,000	..	....
	40,000*	28,000	16,000	$4,000	..
		50,000*	35,000	20,000	$5,000
			50,000*	35,000	20,000
				50,000*	35,000
					50,000*
$100,000	$101,000	$100,000	$104,000	$109,000	$110,000

21st yr.	24th yr.	27th yr.	30th yr.
$5,000	..	......	......
20,000	$5,000	......	......
35,000	20,000	$5,000	......
50,000*	35,000	20,000	$5,000
	50,000*	35,000	20,000
		50,000*	35,000
			50,000*
$110,000	$110,000	$110,000	$110,000

* New cars purchased out of sinking fund.

The size of the sinking fund in a specific case would depend upon the kind of cars, the work for which they were intended, etc.

Six ordinary car trusts of ten years each would be required to accomplish results which could be obtained by the use of one thirty-year car trust. If our certificates drew four per cent. interest as compared with five per cent. for the ten-year car trust certificates, we would effect a saving of about $1,500 per year in interest. The time and expense required in creating five ten-year car trusts would be avoided.

If steel cars, having a life of 20 years, were used, the annual payment into the sinking fund would be about one-half that shown in the table.

Eight-Coupled Tank Locomotive for Wales.

The Cooke Locomotive & Machine Company has recently completed two eight-coupled tank locomotives for the Port Talbot Railway of Wales; a road worked in connection with the docks at Port Talbot. The principal dimensions are as follows:

Gage	4 ft. 8½ in.
Fuel	Soft coal
Weight on drivers	137,000 lbs.
" " truck wheels	32,000 lbs.
" total	169,000 lbs.
Wheel base, total, of engine	22 ft. 1 in.
" " driving	15 ft. 6 in.
Length over all, engine	38 ft. 6 in.
Height, center of boiler above rails	7 ft. 11⅛ in.
Heating surface, firebox	128 sq. ft.
" " tubes	1,361 sq. ft.
" " total	1489 sq. ft.
Grate area	24 5 sq. ft.
Drivers, diameter	52 in.
" material of centers	Cast steel
Truck wheels, diameter	42 in.
Journals, driving axle, size	8 x 8$\frac{7}{16}$ in.
" truck " "	6¼ x 9⅞ in.
Main crank pin, size	5¾ x 5½ in.
Cylinders, diameter	19 in.
Piston, stroke	24 in.
Boiler, diameter of barrel	56 in.
Firebox, length	7 ft. 0 in.
" width	3 ft. 6 in.
" depth front	63½ in.
" " back	61½ in.
" material	Copper
" thickness of sheets	Sides ½ in., back ½ in., front ½ in. and 1 in.
Tubes, number	219
" material	Solid drawn brass
" outside diameter	2 in.
" length over sheets	11 ft. 11 in.
Smokebox, diameter	59 in.
" length	39 in.
Tank capacity for water	2,000 gal.
Coal capacity	2 tons

Special Equipment.

Wheel centers	American Steel Casting Co.
Tires	Latrobe Steel Co.
Steam gages	Ashcroft

According to a Belgian newspaper, if the Belgian State railroads accept a proposition made by the French Northern Railroad, a train will be put on between Paris and Brussels which will run through without stopping, except at the border, a distance of 192 miles, in less than three hours. At present the quickest time between the two cities is 4¾ hours.