The National Switch and Signal Co.

Electric Locking.

The Greatest Signal Plant.

Tunnel Protection.

No Train Orders
or Flagging Necessary.

1899

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Steubenville
Ohio

Inspector of State Line Tower Interlocking
At
Hammond Ind

Electric Locking.

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ELECTRIC LOCKS FOR DERAILS AND DRAW BRIDGES.

EXPERIENCE has shown the necessity of protecting against the changing of derails or switches immediately in front of a train which is moving at high speed. The arrangements of all properly designed signal plants provide that the signals cannot be cleared unless the switches are locked in their proper positions; but unless some provision is made to require the signal operator to keep the switch closed after a train has accepted a signal and until it has passed beyond his jurisdiction, there is always a possibility of throwing the signal back to danger and opening the derail. This danger has been emphasized many times by derailments at high speed, which could not have occurred had the switches been equipped with suitable electric locking.

When interlocking was first introduced into the United States there was some effort made in this direction, but it failed to receive universal commendation for two reasons: First, that the apparatus and installation of the work was very complex, requiring the attention of a skilled electrician to insure its working, and secondly, the cost was more than the railroads cared to incur, and the subject of electric locking was, for a time, dropped. The frequency of accidents, however, has forced the subject upon the consideration of signal engineers, and we have designed a device which is very simple and does not require the attention of an electrician, as it can be easily cared for by the leverman.

The track circuit between the home and distant signals, formerly used, has been abolished, and the only wiring now used is within the limits of the derails. Fig. 2 shows the application of electric locking to a simple grade crossing.

The electric lock is applied on the locking frame of the machine in such a manner that when the magnets of the lock are de-energized, a bolt is plunged through the tappet by gravity and in this position the tappet, which in all interlocking machines is actuated by the latch handle on the lever (preliminary locking), cannot be moved, and it is only after the magnets are re-energized that the tappet is released by the withdrawal of the bolt.

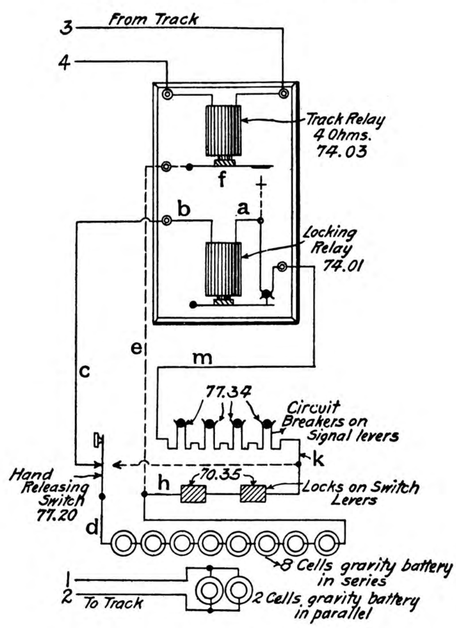
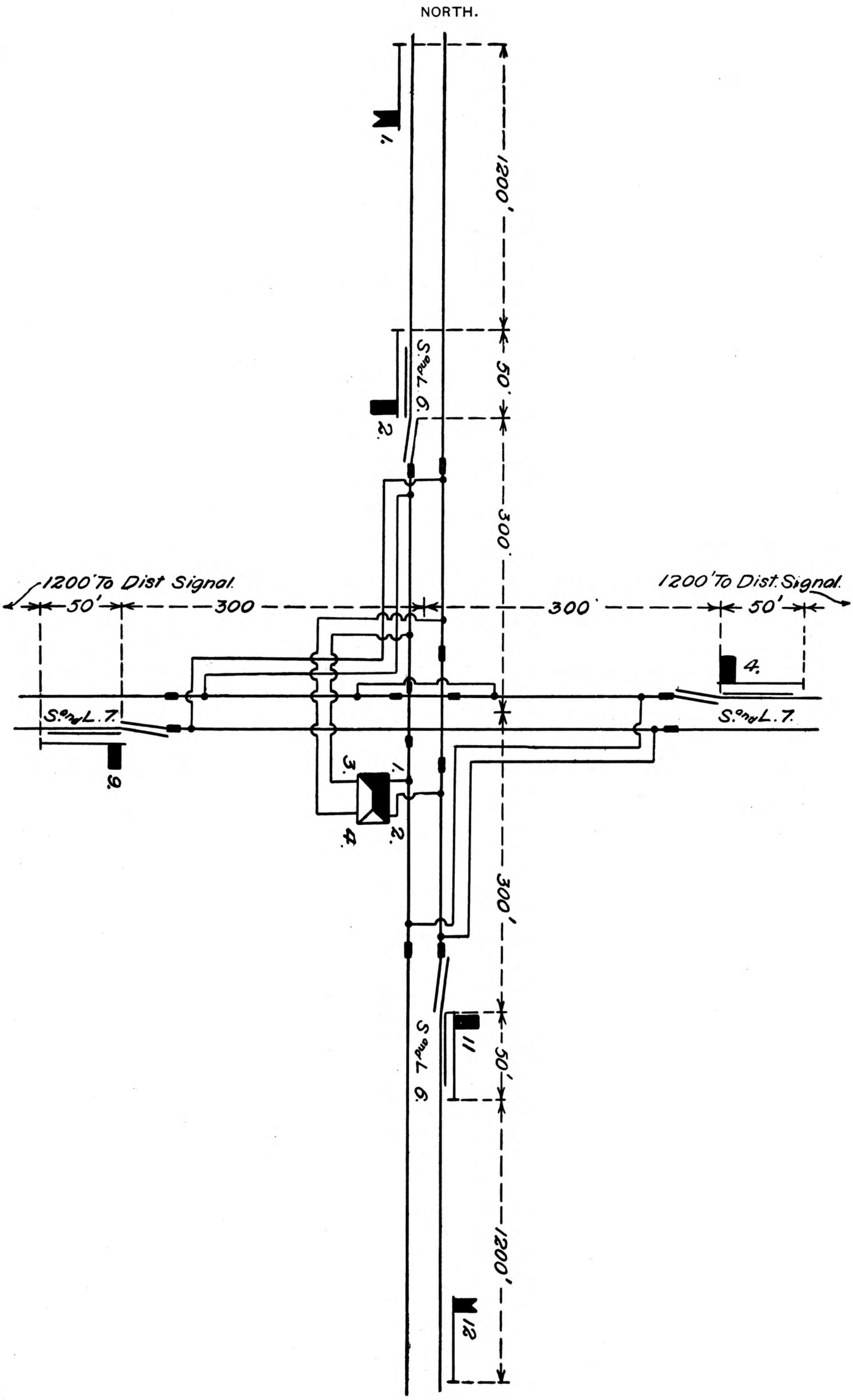


FIG. 1.

The electric lock poles are cone-shaped, which reduces the necessary battery to a minimum and assures accurate working of the lock. There can be no sticking of the armature on the poles of the magnet, since they do not come in contact. The four home signal levers have circuit breakers on their vertical rods. The circuit from the tracks runs through the track relay 74.03, Fig. 1. Having installed the circuits, insulated sections, electric locks, track and locking relays, batteries and circuit breakers, as shown, Fig. 1, the operation will be as follows:

In order to pass a train over the crossing the operator must first close the derails on one track by throwing either lever 6 or 7, Fig. 2, and the throwing of either lever locks the other in the opposite position. The interlocking provides that the derails on both tracks cannot be closed at the same time. Having thrown (reversed) lever 6 and closed the derails, the operator desires to pass a train from north to south and reverses home signal lever No. 2. The



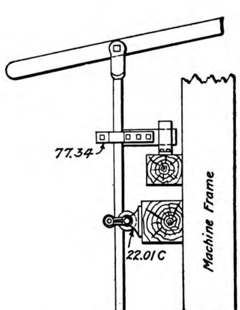
NORTH.
1200'
50'
300'
S. and L. 6.
1200' To Dist Signal.
50'
300
300
1200' To Dist. Signal.
50'
S. and L. 7.
S. and L. 7.
300'
S. and L. 6.
50'
1200'
SOUTH.

FIG. 2.

act of reversing this lever opens the circuit, de-energizing the lock magnet by means of circuit breaker 77.34, Fig. 1 and Fig. 3, and causes its plunger to drop into the tappet, holding it as before described.

But putting this home signal lever "home" again would not release the electric lock, as, the circuit once broken, the armature of 74.01 has fallen and broken the circuit, so that until this relay has been re-energized the armature cannot be lifted nor the circuit restored.

As soon as the first pair of wheels reaches the track circuit inside the derails the armature of the track circuit relay, 74.03, falls, completing the locking circuit through *a*, *b*, *c*, *d*, *e* and *f*, and energizes the locking relay; but the locks are not moved, as most of the current passes around them, owing to their greater resistance. When the train has passed out of the track circuit and therefore out of the derail limits, the track relay is re-energized, lifting its armature and forcing the entire current to pass through the locks by way of *a*, *b*, *c*, *d*, *h*, *k*, *m*, re-energizing them and withdrawing the plunger from the tappet, provided the home signal has been restored to its normal position. If it is not restored the circuit cannot be completed. It is necessary for the operator to return the home signal to danger before the train has passed out of the limits of the derail or else the operation of the locking relay will be ineffective and the operator will find that he cannot place the derail lever (6, Fig. 2) normal so as to pass a train on the other track.

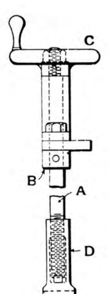


Lever in the Normal Position.

FIG. 3.

This might also occur in case a train which was approaching the home signal (2) under a clear signal should be stopped before reaching the derail and remain there, while a train on the other track desired to cross. In order to avoid the tying up of the signals in such a case, a release switch, 77.20, Fig. 1, is provided. This switch is enclosed in a box having a glass face which the operator has to destroy before he can operate the releasing switch, and since he is required to report all such breakages it forms a check against the unnecessary use of the releasing switch.

The hand releasing switch 77.20, Fig. 1, is a simple switch, and after the glass has been broken the operator may, if careless or malicious, use the switch more than once without reporting same and giving an explanation of the necessity of using it. We have not met with this objection in actual practice, but the objection is raised by some who are willing and desirous of extending and enlarging the scheme so as to require the operator to perform an act which would require more time, thought and deliberation than is required in the breaking of the glass in face of hand release switch box 77.20, Fig. 1, and also lock all home signals in danger position before derail lever can be unlocked. This is accomplished by our Mechanical Hand Release.



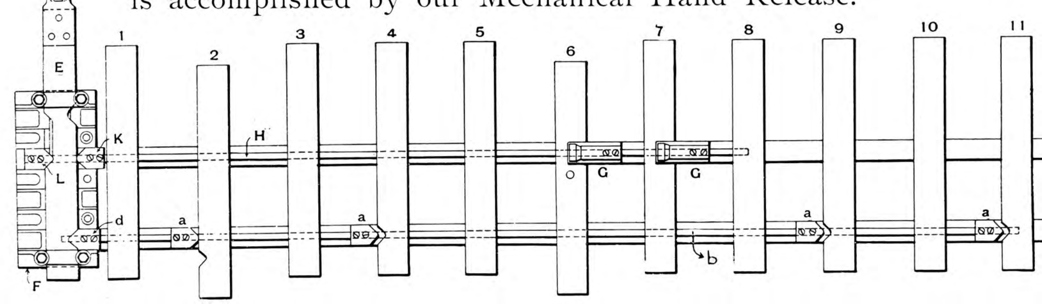


FIG. 4.

Figure 4 is a front view of our Mechanical Hand Release as applied to the locking frame of The National Machine for a simple grade crossing. Derail lever 6 has been reversed and electrically locked by reversing home signal lever 2, or by the failure of the releasing circuit. The Mechanical Hand Release mechanism is applied to the end of the machine, and so arranged as to compel the operator to lock all signals at danger before he can release the derail lever or open the derail. The mechanism consists of a vertical rod carried through the guide "B" and revolved by the hand wheel "C." The bottom end of this rod is threaded to move the lug "D" $2\frac{1}{2}''$ by 25 turns of the hand wheel

"C." This lug is riveted to a regular tappet "E" which travels vertically through a short section of the regular locking plate "F." This tappet is notched to receive and actuate the dogs on locking bars.

It will be noticed that the tappets 2, 4, 9 and 11 are notched to receive the dogs "a" which are carried on the locking bar "b."

There are two electric locks used which are applied to the tappets 6 and 7 representing the derails, and at the right of the plunger of these locks are releasing dogs "G" fastened to the locking bar "H," which is moved by the dogs "K" and "L" through the vertical downward motion of the tappet "E." The dogs "G" have a thin wedge-shaped nose, which, when moved to the left, pushes the armature lever of the electric lock inward, which action withdraws the bolt holding tappet 6.

If, for any reason, it is necessary for the operator to release the derail lever from the electric lock the manipulation would be as follows: The initial movement of the hand wheel "C" moves the locking rod "b" through the dog "d," carrying with it the four dogs "a-a-a-a," locking the tappets of signals 2, 4, 9 and 11. Before this can be done, however, the home signal 2 must be put normal, raising the tappet so that notch on all home signal tappets are in line. The continuation of this movement of the tappet "E" brings the dog "K" opposite the second notch in tappet "E" and the final movement brings the beveled edge of notch on left side against the dog "L," forcing it to the left and carrying with it the releasing dogs "G G," which drive out the plunger of the electric lock as before described. This final movement of the tappet also brings a blank edge against the dog "d" which prevents the reverse movement of the dogs "a-a-a-a" and consequently locks the four home signal levers 2, 4, 9 and 11 at danger. Derail lever 6 may then be placed normal, and if it is desired to signal train on opposing route lever 7 can then be reversed, closing derails numbered 7. The tappet "E" is then reversed by revolving the hand wheel. The signals are by this action unlocked and at the same time derail lever is locked closed by the automatic action of the electric lock plunger, for since the magnets of the lock have not been re-energized, either by the passing of a pair of wheels over the releasing circuit since the reversing of the home signal lever No. 2, or since the failure of the releasing circuit through other causes, the plunger of lock is acted upon by gravity and will lock tappet when derail is closed. After this automatic locking of derail lever 7 either home signal 4 or 9 can be cleared.

It will be seen that by this arrangement of the mechanical hand release the derail lever can be released from the plunger of the electric lock whether it was locked by the reversing of the home signal lever through circuit breaker 77.34, Fig. 1, or the failure of the releasing circuit.

With these two systems of installing, our patrons may make the choice according to the elaborateness of the plant desired. Experience has demonstrated that while this releasing switch should be provided for extreme cases, it is very seldom used.

The application of electric locking is, of course, not confined to simple grade crossings, but is found very desirable in the most complex interlocking plants, and especially where a drawbridge is to be protected. The most important plants which have been protected by this company are:

The drawbridge at Peoria, Ill., for the Peoria & Pekin Union; Seventeenth Street, Philadelphia, for the Philadelphia & Reading; five points on the C., M. & St. P.; Hilbert Junction, for the Wisconsin Central; Merrimac, for the C. & N. W.; and Hartford, for the N. Y., N. H. & H.

It will be noticed that no crossing (detector) bars are shown in the plan; special note should be made of the security of substituting the rail circuit, which furnishes the same measure of safety as if the crossing bars were extended from derail to derail; the track between derails must be entirely clear before the opposing route can be set up. It will be seen that by using the rail circuit we have furnished a protection not possible with crossing bars or any mechanical means; and in considering the cost of applying electric locking we must deduct therefrom the cost of the four crossing bars necessary at a single track crossing.

We have shown detector bars at the derails, but they too may be dispensed with, as the rail circuit, through the action of the home signal lever and the electric lock, prevents the operator from changing a derail when a train is passing.

The reason for showing detector bars at the derails is to cover the remote possibilty of the operator being able to split a train when the electric lock fails to control the derail lever. This is very remote, as the electric lock acts by breaking circuit, and since gravity is always present we work continually on the safe side. We do not hesitate to recommend leaving off all bars in a plain crossing, thus making the switch lever's work much easier.

Since the fixed charges for the operation of an interlocking plant are the greatest expenses attendant upon signaling, and since these charges are not increased by equipping the plant in the most complete manner so as to secure the maximum protection, economy would suggest that in the installation of any interlocking plant the most approved devices should be used. This is demonstrated by experience and conceded by railroad managers. We believe that electric locking, while a small part of the total expense of installation, is a most necessary part. The costly accidents that have occurred which would have been prevented by the application of electric locking fully demonstrate its economy.

The Largest Manual Interlocking Plant in the United States.

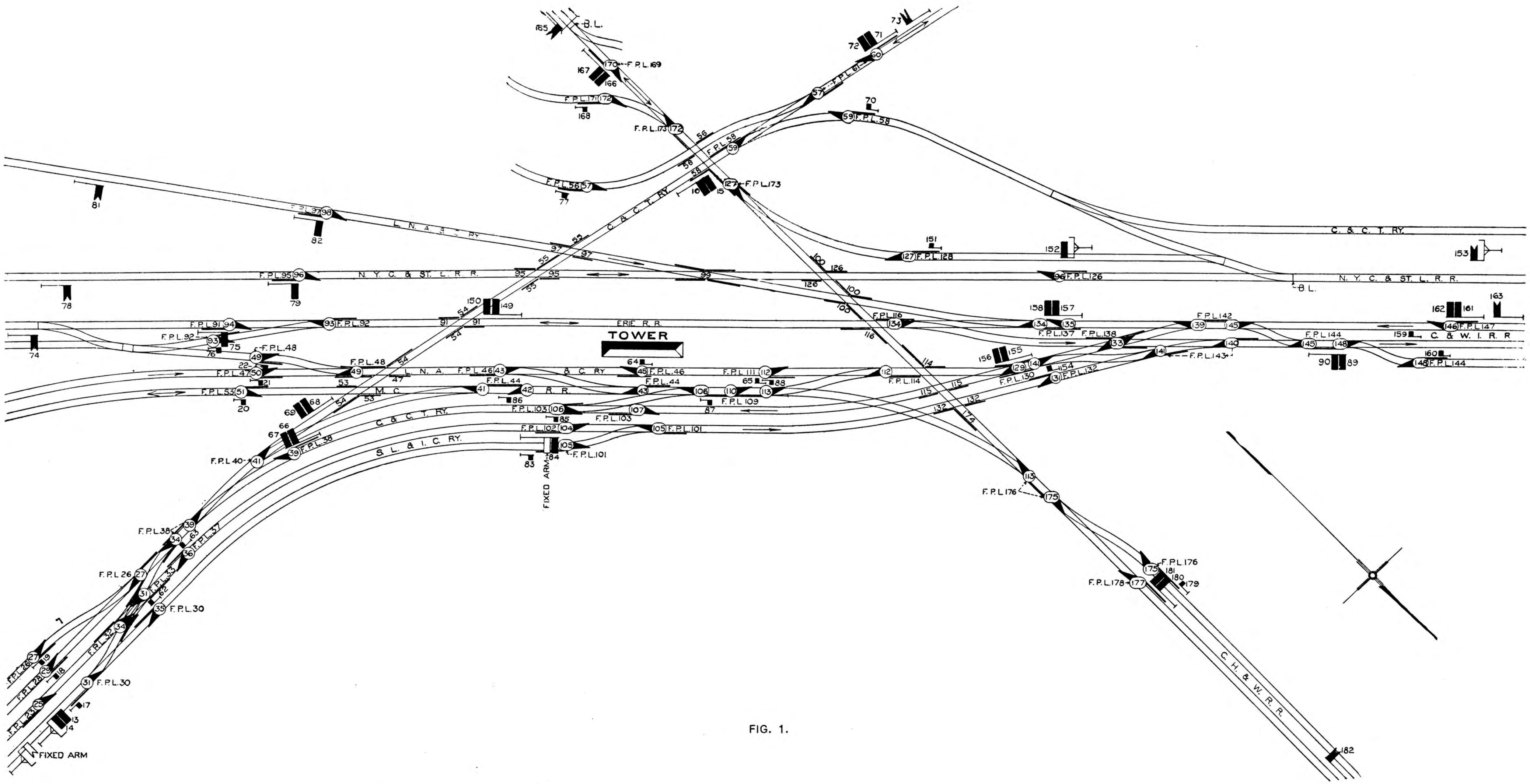

TOWER
ERIE R.R.
N. Y. C. & ST. L. R. R.
C. & C. T. RY.
L. N. A. & C. RY.
M. C. R. R.
S. L. & I. C. RY.
C. & W. I. R. R.
C. H. & W. R. R.
FIXED ARM

FIG. 1.

INTERLOCKING PLANT AT STATE LINE, INDIANA AND ILLINOIS, AT HAMMOND, INDIANA.

WE believe no more complete and perfect interlocking plant has ever been built than that recently installed at Hammond, Ind. The new line of the Chicago, Hammond & Western Railroad extending from Hammond to Chicago, is intervolved with the tracks of the Chicago & Western Indiana; Chicago & State Line; New York, Chicago & St. Louis; Chicago & Erie; Chicago, Indianapolis & Louisville; Chicago & Calumet Terminal; Michigan Central, and State Line & Indiana City Railroads. By an examination of the location of tracks and switches illustrated in Fig. 1 the difficulties attendant upon the moving of all traffic at this point with safety and dispatch will be readily appreciated. Although only a portion of the plant is located in Illinois, it was decided to conform to the requirements of the Interlocking Act of that State, and since the specifications for signal work on the various railroads interested are not in harmony, and as the representative of each road was naturally desirous of securing all possible benefits to the property entrusted to his charge, it was found to be extremely difficult to offer a plan which would meet with the approval of all. It was also desired to arrange the plant to operate all switches and signals on existing tracks, and at the same time have the frame of the interlocking machine and the tower sufficiently large to accommodate prospective additions, and these prospective additions were not set forth and could not be decided upon in advance.

In order to arrange the levers in the machine so as to minimize the labor of the operator, it was divided into three groups, which has made it practicable to operate the plant with two men on a shift of eight hours, who, with the addition of one repairman in charge of the maintenance of the plant and one man to attend to the cleaning and lighting of lamps, constitute the whole force employed. These two levermen handled on an average of two hundred trains, issued fifty train orders and fifty telegraph messages per day shortly after the plant was put in service.

Interlocking Machine.

The interlocking machine, illustrated in Fig. 2, is The National Switch & Signal Co.'s '96 model. The back of the machine with view of one-half of the interlocking is shown in the illustration, the other half being on the front. The machine frame is made for 224 levers and is 94 feet in length. There are at present 157 active levers performing the following functions:

43 levers for 70 facing point locks and 20 crossing bars.
45 levers for 68 switches and 1 movable point frog.
6 levers for 19 crossing bars.
63 levers for 63 signals.

It will be seen that although this is the *largest* manual interlocking machine ever constructed in this country, it occupies no more vertical or horizontal space than the simplest machine, which is a very great advantage, as it can be placed in a much smaller tower and give more room for the operator than any other style. In the construction of the locking for this plant 2,500 feet of locking bar and 900 locking dogs were used. At intervals of 11 feet in the length of the machine, spaces were left to carry the floor joists through the machine and to enable the operator to pass through to the front of the tower and thus avoid going around the ends when levers are normal.

Figure 3 illustrates an interior view of the tower on the operator's floor. It will be seen that the minimum of space is occupied by the machine and only the levers project above the floor. The accessibility of the locking for cleaning or alterations is illustrated in Figs. 2 and 4, all the locking being readily gotten at. The design of the locking plates and the location of the guides on the

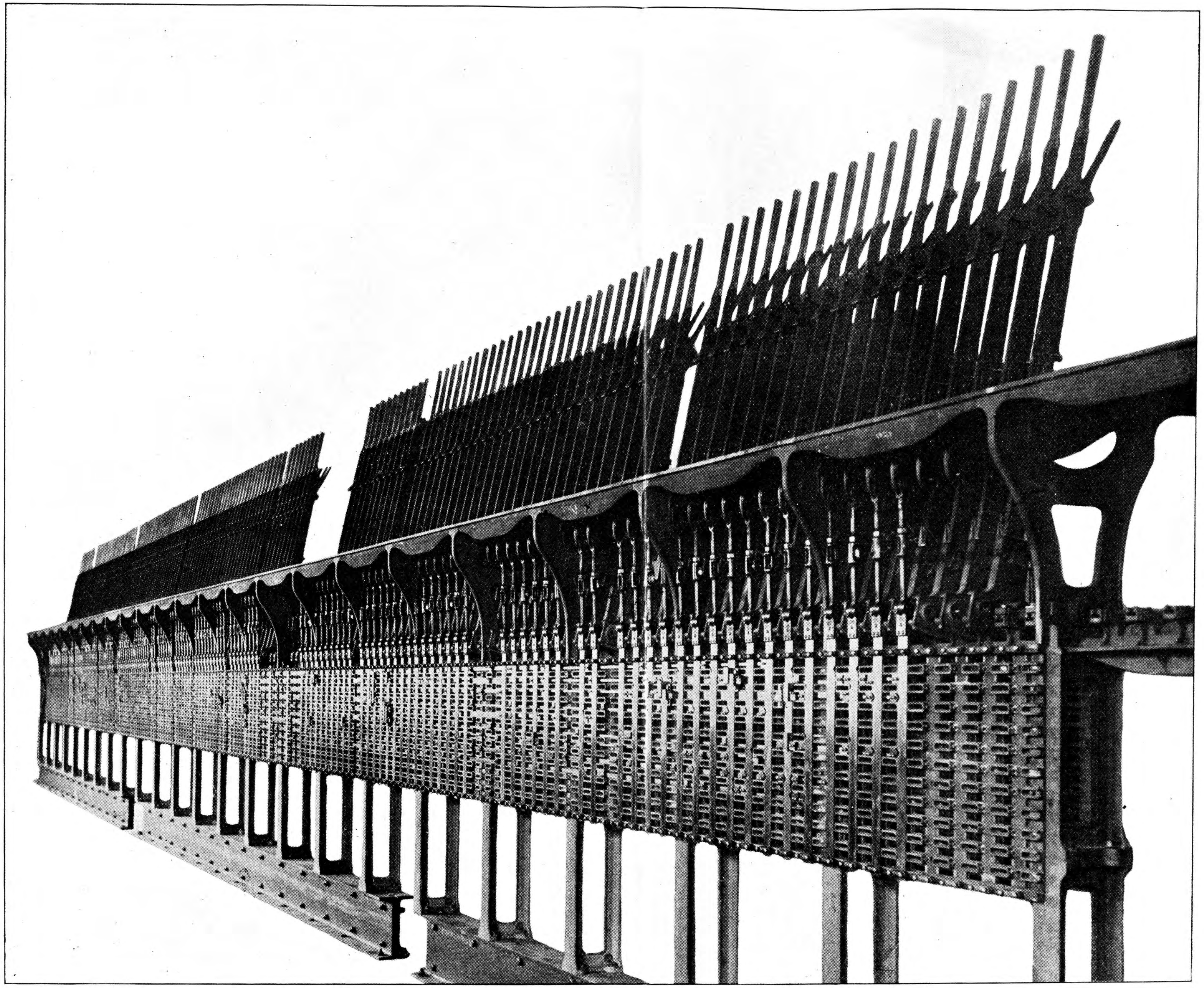


FIG. 2.

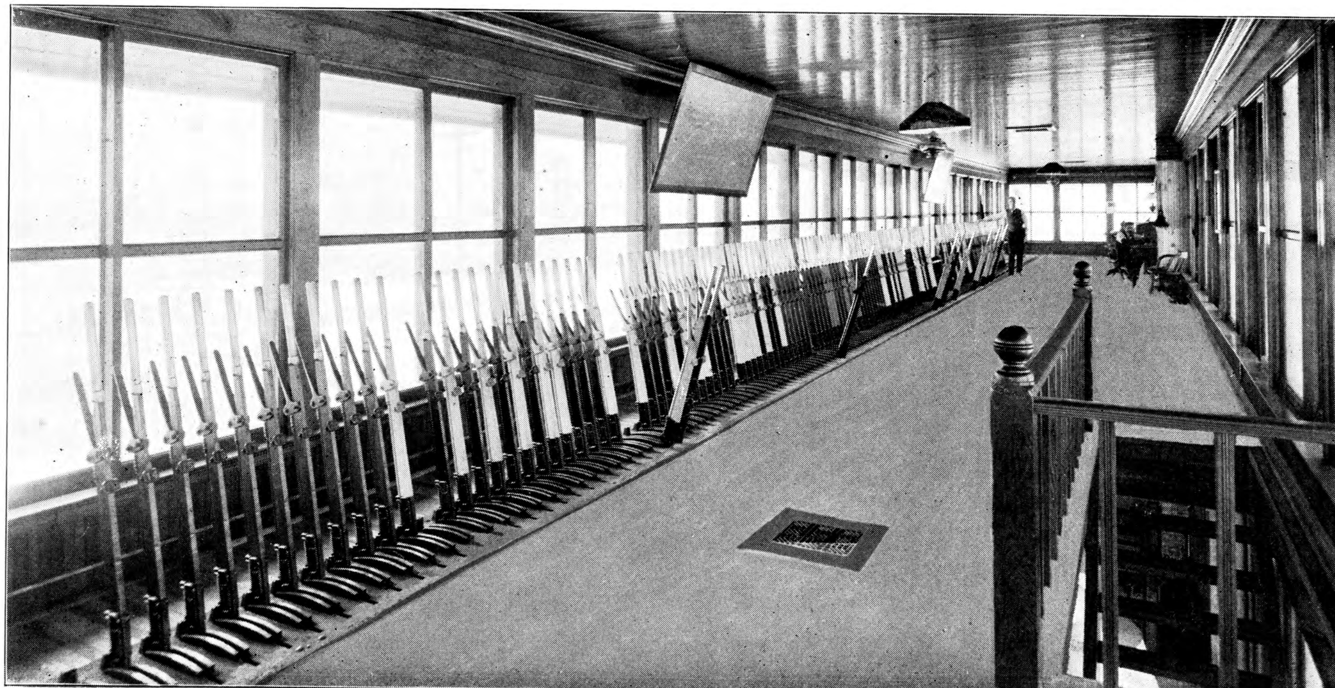


FIG. 3.

locking bars provides for the minimum amount of friction, the locking bars being fastened to the guides and dogs in such manner as to provide a clear space between the bars, thus avoiding the rubbing friction of one bar upon another. The tappets are connected with the link motion actuated by the latch handle by means of an adjustable connection, and are prevented from falling below a fixed line by a shoulder on back of tappet, which rests upon the upper edge of locking plate, which is accurately milled to a uniform plane throughout the length of the machine. The machine is supported by a 20″ steel girder carried on five steel pillars mounted on concrete piers. See Fig. 4.

Signal Cabin.

Although the American Railway Association have decided to name the house which contains an interlocking machine a signal cabin, the size and character of this building would seem to entitle it to more dignity than is implied in the term "signal cabin." The building which is illustrated in Fig. 5 is 100′ 8″ in length by 16′ ½″ in width, and the second or operating floor is 15′ above the top of rail. The building above the water table is of pressed brick laid in cement. Careful attention has been given to the designing of the cabin so that the operator may have a clear vision of all the tracks within the limits of the interlocking and beyond to a considerable distance, and the three large triple windows below the floor light up all the working parts of the machine below the operating floor, so that a superficial examination of all the mechanism may be easily and quickly made. There are two stairways, one at either end, in order to enable a conductor who is required to get train orders at this point to enter tower at the nearest end, secure his orders, continue through the cabin and exit at the opposite end. The construction of the cabin is on the slow-combustion plan. All joists which are not carried through from wall to wall, are hung at the machine end on iron straps.

The interior finish of the operator's room is in the natural wood and carefully executed, as illustrated in Fig. 3. The roof is of No. 1 Bangor slate, supplied under the specifications of the United States Government. Heat is provided by two large hot air furnaces on the ground floor (see Fig. 4) with pipes leading to registers above, and although the machine is of the extreme length mentioned, requiring unusually long and continuous lengths of

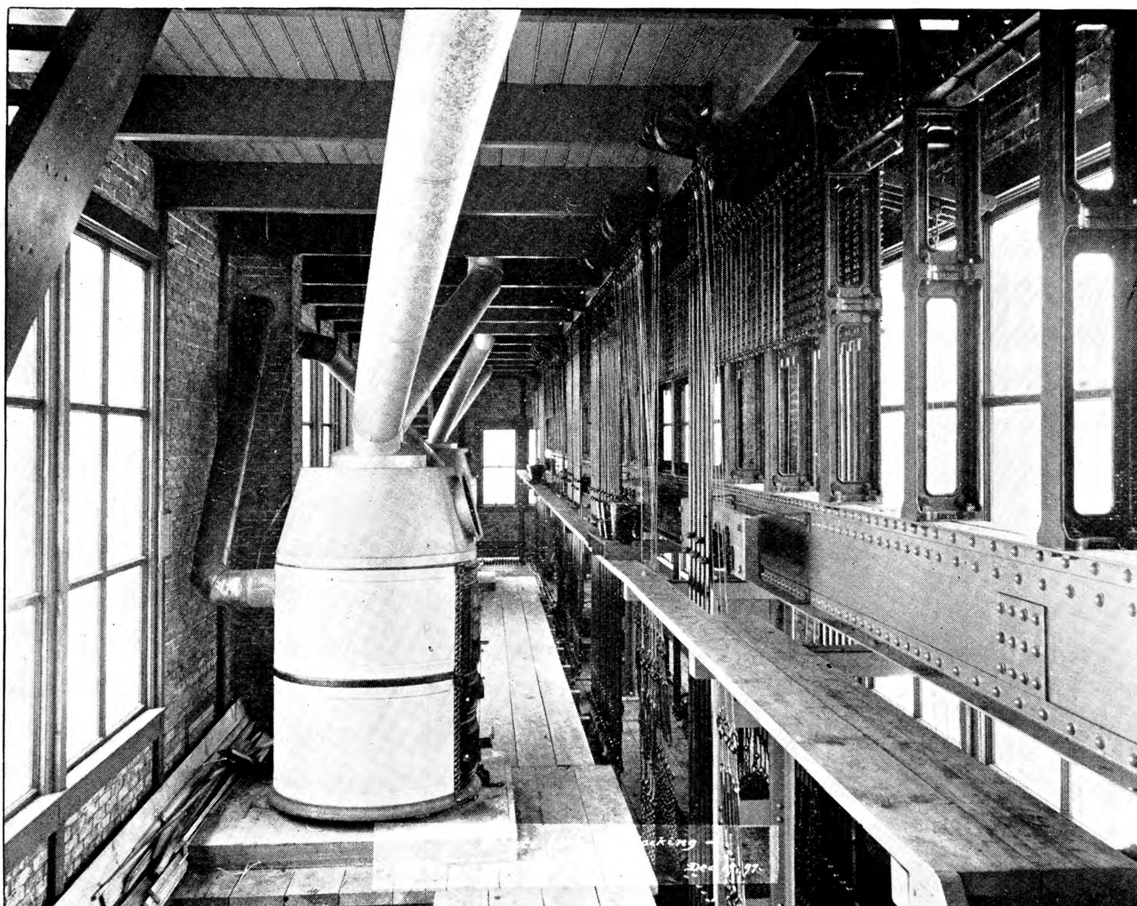


FIG. 4.

locking bar, no difficulty has been experienced from change of temperature. The foundation of tower is carried below frost line and is made of concrete formed with hydraulic cement.

GROUND WORK.

One of the most important requirements of a perfect interlocking plant is the locating and fixing of the lead out and connections to the switches and signals in such a manner as to secure accurate alignment, avoiding all unnecessary angles and changes in surface level, and in order to accomplish this to the best advantage, an exact plan was made of all the tracks, switches and signals as located on the ground to a scale of 10′ to the inch. The cabin was accurately located on this plan and the location of every line of connection, crank, rocking shaft, etc., was carefully laid out and indicated on this plan. No selectors were used, each signal blade having its independent line of connections. All pipe lines are of 1″ iron pipe carried on double, anti-friction pipe carriers placed 7′ centre to centre, and the value

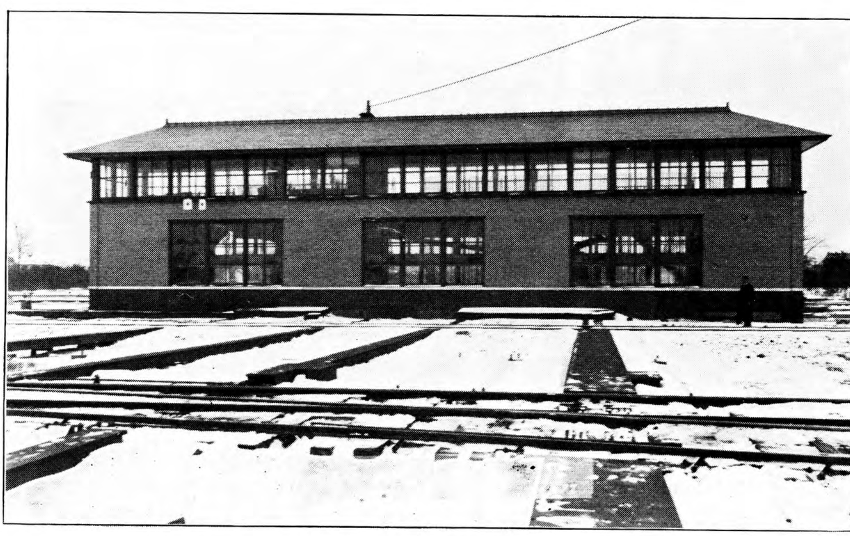


FIG. 5.

of the *double*, *anti-friction* pipe carrier is emphasized in this work, for although switches are operated in this plant at an extreme distance of 1,242 feet, and although owing to the net work of tracks it was not possible to secure straight alignment, there has been no difficulty experienced by the operator in throwing any of the switches, notwithstanding that since the opening of the plant there has been snow almost continuously covering the tracks. It may be interesting to know that there are 62,000 feet of 1″ pipe weighing 47 tons used in this work. The most extreme signal operated from this cabin is 2,492 feet, and no automatic compensators have been used. There are 109,000 feet, or about 21 miles of signal wire consumed in the plant.

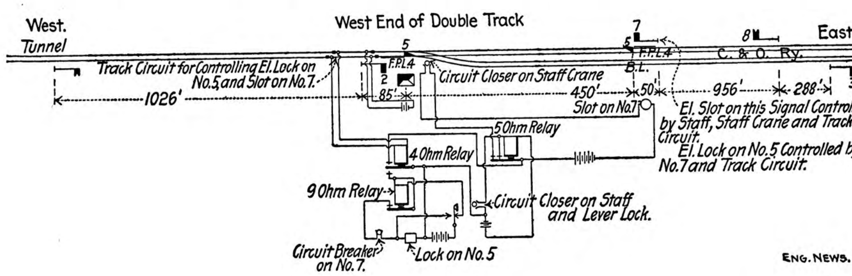
Where it was necessary to carry a number of connections under the tracks at a given point a substantial support for the track was provided by means of a special design of steel ties. The foundations for pipe carriers are of oak as illustrated in the *Railway and Engineering Review* of January 8th; all crank, compensator and wheel foundations are further secured by being imbedded in concrete. We believe this installation represents the highest type of signal work which has been accomplished, and we take pleasure in inviting inspection of the work in all its details. This entire work was designed and executed by The National Switch & Signal Company, whose works are at Easton, Pa., with offices at 43 Cedar Street, New York, and 1237 The Monadnock, Chicago.

The Protection of Railroad Traffic Through Tunnels.

[*Reprint from "Engineering News," Feb. 24, 1898.*]

BY CHARLES HANSEL, M. AM. SOC. C. E.

THE majority of tunnels built in the original construction of railways in the United States are for a single line of track, and on many roads the increase of business has made it necessary to double-track the line and enlarge the tunnels. If it were practical to arrange a system whereby the enlarging of the tunnels would not be necessary, and at the same time maintain the full capacity of the line, it is plain that a vast saving in money would result to the railways. An arrangement which accomplishes this object has been lately installed on the line of the Chesapeake & Ohio Ry., controlling the traffic



between the stations of Lowell and Hilldale, W. Va. Between the two stations is a tunnel 6,500 feet long, and a bridge 528 feet long, and the total distance between the stations is 4.2 miles. The tunnel is only large enough for a single track. In order to move traffic through this tunnel on a single track, with perfect safety and without train orders, an absolute block system has been established between Lowell and Hilldale, known as the Electric Train Staff System, with electric locking and electric slots as auxiliaries.

The location of all signals, derails, and circuits at Lowell are illustrated in the accompanying cut, and the apparatus at Hilldale exactly duplicates it. The home signals admitting trains to the tunnel are fitted with electric slots; the derail levers are fitted with electric and staff locks, and there is a train staff pillar in each tower and a staff crane in front of each tower. In the normal position of the machine and train staff, that is, all staffs being in the staff pillar, the home signals are kept at danger, and the reversing of the lever will not clear them, and it is necessary to complete the circuit and energize the magnets of the electric slot on the home signals in order that the operator may clear them. This cannot be done until a staff is removed from the staff pillar and placed in the crane in position to be taken by the engineman. The removal of a staff either from the Hilldale or Lowell staff pillar prevents the removal of a second staff from the same pillar until the first staff has been carried to the opposite station or replaced in the pillar from which it was removed, and a staff cannot be taken out of both pillars simultaneously, or as long as there is one staff removed from either. The placing of the staff in the crane is an order for the engineman to proceed, and the act of placing it in the crane makes a continuous circuit through the magnet of the electric slot on the home signal; and the operator can then clear his signal. When the engine reaches the tower where the crane is located and the engineman takes the staff as an order to proceed into and through the tunnel, the circuit being broken, through the slot on home signal, the signal immediately goes to danger, and, consequently, we are not dependent upon the act of the signalman to throw it to danger.

Another provision is also made to secure this result. Although in practice, experience has shown that the engineman seldom, if ever, misses his staff, it is possible for him to do so and proceed into the tunnel without it, and it is desirable to have the home signal go to danger immediately upon the entrance of the first pair of wheels within the limits of the block. In order to accomplish this a short piece of track circuit has been introduced in advance of the home signal near staff crane, so that the presence of a pair of wheels on this circuit de-energizes the electric slot and the home signal goes to danger the same as if the staff were removed. This track circuit is also used to control the locking circuit, and after the derail has been closed and the home signal given, the operator cannot again open the derail until the train has passed over this circuit, thus avoiding the possibility of opening a derail immediately in front of a train moving at high speed. This system of electric locking may be briefly described as follows:

An electric lock is placed on the locking frame in front of the tappet operating with the latch handle of the derail lever. This lock is so designed that when there is no current in the lock magnet the plunger falls by gravity through a hole in the tappet and it is impossible for the operator to raise or lower the tappet so long as the bolt remains in this position. As soon, however, as the magnets are energized, the movement of the armature pulls the bolt free from the tappet and the operator can then change the position of his signal. The normal position of this lock frees the lever, the derail being open. When it is desired to clear the home signal the first act of the operator is to reverse the derail lever, closing the derail and locking it on the ground through the facing point lock. He then reverses the home signal lever, clearing the home signal. The act of reversing this home signal de-energizes the electric lock magnets by opening the circuit through a knife switch on the tail lever of the home signal and the bolt plunges through the tappet, as before described, and although the operator may at any time replace the home signal to danger, this act does not renew the current, and the derail remains locked closed until the train has passed over and beyond it and over the track circuit, except when the current is renewed by the hand release, which is furnished for the purpose of enabling the operator to change his signals in case a train does not require the signals after they have been cleared or in case there is any failure in the track circuit. This hand release is (in this case) a simple switch enclosed in a box having a glass case, the key of this box being in the hands of the signal inspector, and not in the possession of the signal operator, and in case it is absolutely necessary to employ the services of this release switch the operator is compelled to destroy the glass, which action must be reported with explanation of cause.

The purpose of the derail is two-fold: That is, to prevent fouling at the end of double track, and also to prevent trains entering the tunnel unless the tunnel is absolutely clear. In order to insure that both derails cannot be closed at the same time, a staff lock on the derail lever is introduced. When a staff is removed from the pillar it is placed in the staff lock on the derail lever and the lever unlocked and reversed, closing the derail. The staff is then removed from the staff lock and placed in the crane. The derails and switches at opposite end of tunnel remain locked in the normal position, and cannot be unlocked until this train staff is carried through the tunnel to the opposite staff station. This absolutely prevents the engineman from overrunning his signal at either end and proceeding into the tunnel, and consequently all head end collisions are prevented.

The manipulation of traffic between Lowell and Hilldale may be described as follows: We will suppose a train to be approaching Lowell, west-bound. The operator, observing its approach, or being advised of the time of its arrival, either by telegraph code or time-table, asks the operator at Hilldale for an unlock to permit him to remove staff. If a train has been given a clear signal at Hilldale to go to Lowell, this unlock cannot be given Lowell, the derail, No. 5, will remain open and signal, No. 7, remain at danger, which will necessitate the stopping of the west-bound train at the home signal, or else if it should not stop it will be derailed and carried on the ties. If, however, there is no train between Hilldale and Lowell, and the operator at Hilldale has no staff out, he can give Lowell an unlock which permits him to remove a staff. Having withdrawn this staff from the pillar he places it in the staff lock on the derail lever and unlocks the derail lever, No. 5. This lever also being connected with the switch No. 5, by reversing it he sets the switch for a west-bound movement and closes the derail, and the opposing derail and switch at Hilldale remain locked in the normal position. He then removes the staff from the staff lock and places it in the crane outside of his cabin, which act energizes the magnets on the electric slot on home signal No. 7. He then reverses home signal lever No. 7 and the west-bound train proceeds under a clear signal. The entrance of a pair of wheels into the block section beyond the derail No. 5, or the removal of the staff from the crane opens the circuit, de-energizing the magnet of the electric slot on the home signal No. 7, which immediately goes to danger. The engineman now proceeds through the tunnel, having absolute protection in front by the fact that the home signal at Hilldale is at danger and the derail open and protection in the rear through the home signal No. 7 being at danger, and as soon as the rear end of his train has passed the short track circuit beyond the switch the operator can open his derail so that the train is then moving on a single track protected by an open derail in front and rear on the lines which might otherwise admit opposing traffic. Since the signalmen at Lowell and Hilldale cannot remove a second staff so long as the first one issued remains out of either pillar, they cannot give orders for an opposing train to enter the block or follow the first train into the section, and in consequence the engineman on the west-bound train, as described, absolutely controls the movement of traffic over the section between the home signals at Lowell and Hilldale until he has reached Hilldale and delivered this staff to the signal man at that point.

No diminution of speed is required in picking up the staff. In daily practice it is picked up at a speed of from 30 to 40 miles per hour without the means of any automatic mechanism, but simply by the hand of the engineman. If it is found impracticable to take the staff at a speed greater than this, and such speed is desired, the apparatus described very fully in the catalogue and pamphlets of the National Switch & Signal Company of Easton, Pa., provides for this requirement. No derails or signals are provided for a backup movement, and if such a movement is made it would be necessary to make this provision, which is simply an extension of the system hereinbefore described. A reverse movement, that is, from Hilldale to Lowell, would be made in the same manner as hereinbefore described for the movement from Lowell to Hilldale.

This block system was designed and furnished by the National Switch & Signal Company of Easton, Pa. The staff instruments had been in operation at that point for some time before the auxiliary electric locks, slots and derails were added, and since the installation of this work the plant has met with such approval by the officials of the Chesapeake & Ohio that they have decided to add electric locking, electric slots and derails at other points where they now are operating with the train staff only. We believe this is the most complete and valuable system of block signaling for the protection of single lines through a tunnel, which single line is required to carry all the traffic delivered to it from a double track on each side of the tunnel, and we are assured by the operating officials that they are able to handle traffic not only with absolute safety, but with as great facility as if they had gone to the great expense of enlarging this tunnel to accommodate a second track.

THE absolute Staff Block System for single track working SECURES GREATER SAFETY than is afforded by any other system. It provides for the maximum traffic, and DOES NOT REQUIRE BACK FLAGGING, which, under the rules of the American Railway Association, cannot be avoided under any other block signal system yet designed.

[*Reprint from "Railroad Gazette," April 8th, 1898.*]

AVOIDANCE OF BACK FLAGGING BY USING ELECTRIC TRAIN STAFF. NO TRAIN ORDERS REQUIRED.

DURING the past week a problem has been placed before us which may be of interest to the American Railway Association as affecting the rules promulgated by it relative to flagging. A certain railroad has a station situated at the foot of descending grades in both directions, the grade for east-bound trains being heavier than in the opposite direction. It is the practice for an east-bound train, after having stopped at the station, to back up and make a run for the opposing grade. We were asked if an automatic signal could not be put in at some distance west of the station, controlled by a push button at the station, which would permit the operator to throw it to danger behind the train by pressing the button and permitting east-bound trains to back westward without sending out a flagman. We held that under the rules of the American Railway Association this could not be done, and to confirm our opinion we addressed a letter to a well-known operating man and received the following reply:

In my opinion, it is not only bad practice and contrary to the standard code for a train to back up in the manner you describe, but it is also such to even stand on the main track without sending out flagmen. Rule 399, Standard Code, reads: "When a train stops or is delayed under circumstances in which it may be overtaken by a following train, the flagman must go back immediately with danger signals a sufficient distance to insure full protection, etc." Again, under head of Telegraph Block System, rules for enginemen and trainmen, rule 531 reads: "Block signals, unless otherwise provided, do not affect the rights of trains under the time-table or train rules." Rule 532: "Block signals do not dispense with the use or observance of other signals whenever or wherever they may be required." These same rules are repeated under the head of controlled manual block and automatic block systems. It is an unwritten law of railroads that a train which has passed over a certain portion of the road under its train rule and time card rights has no right whatever to move back in the opposite direction from which it was running. In order to cover this point so that in case a freight train breaks down where it might save a delay to other trains in clearing the main track, after able to move, the following clause was added in our book of rules: "When it is necessary to move a train backward between stations a flagman with danger signals must be sent out not less than thirty telegraph poles in the direction in which the train is to be backed from rear of the train. The speed of the train must not exceed four miles per hour and the conductor must be stationed at the rear end of the last car in position to enable him to see the first sign of danger so as to signal the engineman and stop the train if necessary."

Faith is a good thing in its place, but practical railroad men, such as those of the American Railway Association, who formulated the standard code, have not, up to this time, had sufficient faith in appliances to be operated automatically or through human agency to hold a train so that it is deemed safe to depend entirely upon such protection to take the place of the flagman.

The only scheme which we know of that should permit a train to move back in a block section without sending out flagmen is the electric train staff. With this the engineman having a train staff, which is virtually an order to move in either direction within the block controlled by that train staff, can go any distance desired east-bound and reverse the movement as often as he pleases with absolute safety, for the reason that no opposing orders can be given, and, consequently, no trains can get into the block from either end unless they go by the signal at danger and enter the block without an order; and, if it is considered that trains might enter a block without an order and against an absolute stop signal, the system may be further enlarged by introducing the physical protection of the derail operated in connection with the signal. This is not, however, considered necessary; consequently we say a train having with it the train staff is absolutely protected.

We submitted our opinion to another well-known operating official, and his reply as follows confirms it:

"I agree with you that when the electric train staff system is in use it is practicable to run trains that hold the staff in either direction on single track.

This is our practice on the Savannah bridge block when there is necessity for it, such as ballast trains, pile drivers or work trains of any description. It is also the English practice and is provided for in the rules relating to staff workings."

Unless our position is not sustained by the opinion of the Association and the results of actual practice it would seem that some modification might and should be made in the rules of the Association.

In considering the problem first mentioned, and supposing the train staff block was in operation, the east-bound train could hold its staff received from the station in the rear, and having performed its work at the station at the foot of the grade before mentioned, could back westward as far as desired, and deliver the staff at the bottom of the grade and receive the staff for the section ahead as it passed the station; consequently, no automatic signal would be required nor would flagman have to be sent out.

Since the train staff absolutely controls all switches in a given block, and permits trains to work in that block in either direction without train orders and without sending out flagman, it will be seen that it is the most complete method of controlling traffic on a single track line.

Where a single track line is used by several companies the employees of these companies are not required to be examined on the rules if the track over which their trains operate is controlled by the staff system, and, consequently, no explanations or special bulletins are issued; all that the engineman needs to know is that he cannot get a clear signal unless the train staff is ready for him and no misinterpretation of orders can occur, because none are issued.

The volume of traffic which can be moved over a single track controlled by the train staff is greatly in excess of the amount where no train staff is used, because considerable time is often required for the passage of trains, and it is not infrequently the case that trains lie at a passing track, junction or station for several hours when there is no physical necessity for it.