of car. One cylinder operates each shaft *B*, thus making four per car. A separate pipe line with a standard Westinghouse 33-in. auxiliary reservoir attached, carries the compressed air which is supplied from the air brake train pipe or from the locomotive directly. There is a connection between these two lines at one end of the car, and a cock placed in this cross-over controls the admission of the air. This cock is opened by a single movement of the small lever, 38, placed on the end of the car, Fig. 2, and the air entering the cylinder line operates all the cylinders that may be open.

The cars may be dumped by hand, with a lever placed in the sockets, 6, which operate the detent shafts *B* by means of gears.

There is no danger of an accidental dump while running as the detent cannot slip from under the center valve strut unless by an application of the air or by the use of the hand levers. This is prevented by making all the levers removable and by placing the levers operating the cylinder cocks in a box that may be locked. It is impossible to close this box unless the levers are in the position which shuts the cocks.

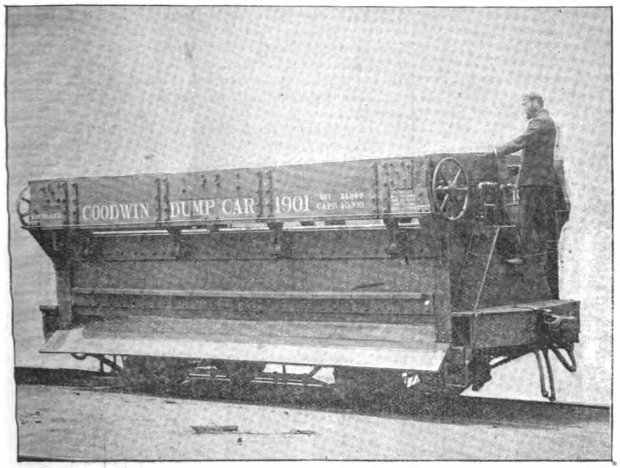
The side valves are replaced by a chain wound around a drum, 48, carried by a shaft which is operated from the end of the car by a rachet and gears. Three gears are enclosed by a malleable iron cover, 33. The center valves are replaced by the triangular casting, 21, which is pinned fast to shaft, *A*. This shaft is rocked by the long lever in socket, 42, shown in Fig. 2.

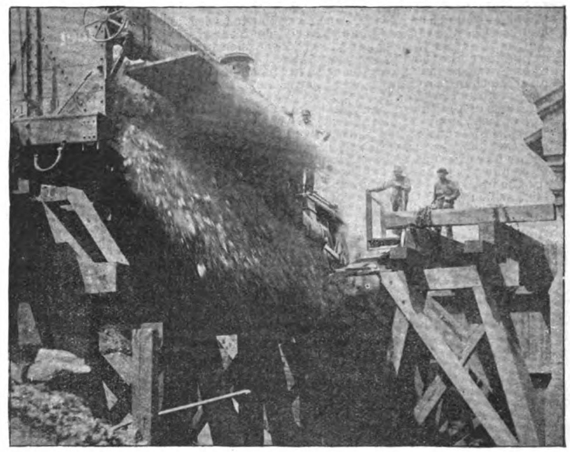
By means of the replacing chains, the side valves may be lowered gradually instead of dropped, and the load consequently discharged slowly. By this means the load can be distributed along the track while the car is in motion, if it is desirable.

All the valves and aprons are covered with steel plates ⅛ in. thick. The Williams couplers, Westinghouse automatic quick acting air-brakes, and M. C. B. Standard iron axles, journal boxes, brasses, 33 in. cast-iron wheels, etc., are used.

The weight of the car is estimated to be about 35,000 lbs.

It is the intention to build ore cars of special design for any road wanting them, and these will be similar in construction though of shorter length. These cars are put on the market by the Goodwin Car Company, The Rookery, Chicago.





The Goodwin Dump Car in Service.

Electric Locking Circuits for Interlocked Crossings.*

BY W. H. ELLIOTT.

In locking electrically the levers of an interlocking machine and taking the control out of the hands of the operator after the route has been set and the signals cleared for an approaching train, the use of the crossing is undoubtedly made much safer, as the operator is then unable to change any of the levers that would lead to a derailment. By locking the levers of the derails only, the operator is free to return any signal to danger at any time and by so doing endeavor to stop a train, should it be a desirable thing to do, but more than this he cannot do. By locking the levers electrically, it is also impossible for the operator to wilfully, or through carelessness, cause any damage to the interlocking by opening a derail or switch for a train or engine to run through trailing the point.

Most probably the first in the field in this country were the Union Switch & Signal Co., who strongly advocated the use of electric locking, a proposition being regularly made in their bids for putting in an electric locking device. Finding, however, that owing to the cost it was seldom or never wanted, they, while believing it was a good thing, have not pushed it to any great extent. The arrangement used by them to lock the lever consisted of an electro-magnet, enclosed in a box and attached to the front of the machine in such a manner, that when the armature was dropped by the opening of the circuit, it would fall into a notch cut in the outer edge of a disk attached to the flop of the lever it was desired to lock, locking it when the lever was reversed, the circuit through the magnet having been broken by the reversal of the lever. To effect a release, a track circuit placed beyond the limits of the interlocking was used, it being so arranged that not until a train had passed entirely off of the circuit and, therefore, out of the interlocking, could any change of the levers be made. For single track crossings, where a train running toward the crossing would release the locks before reaching the interlocking, mechanical interlocking relays were used, which by means of a track locking circuit prevented the completion of the releasing circuit, until the train had passed entirely over the crossing and off the lock circuit. This virtually accomplished all that was desired with any arrangement of circuits, so that the only claim made for the arrangement that I now describe is, that no mechanical interlocking relay is used and the number of circuits has been reduced as much as is possible while accomplishing the end desired.

By doing away with the interlocking relay the releasing is effected entirely by electrical means, and there is no chance of the points sticking and failing to release, nor is there any chance of the locks being released before they should be, by the operator jarring the relay box.

In the arrangement shown in Fig. 1 five different circuits are made use of, one, a track-locking circuit, *T T T*; second, a locking circuit, *L*, used to energize the electro-magnets of the locks and keep them unlocked, and the other three releasing circuits. These are marked *R*, and are used to restore the locking circuit after it has once been broken, thereby lifting the lock armatures and releasing the levers.

The locking circuit, *L*, which, to distinguish it, is shown in heavy lines, is made to pass through tha locking magnet *A*, through the contact points of the armature of the relay, *D*, through the circuit breakers, *B*, the contact points, *P*, of the relay armature, and the locks *K*. Also it may be turned through the releasing switch *S*. The battery, *M*, of about 12 cells, is used to energize the magnet, *A*, and the locks, *K*, whenever the circuit is complete.

The locks being released by the completion of the circuit and the armature of the relay *A* held up, any break in the circuit, as at *D* or *B*, will of course drop the locks and also the armature of the relay *A*, this armature breaking the lock circuit at the point *P*, so that it cannot be restored, even if it were again made good at the point where it had previously been broken. To restore the circuit, the relay *A* must be again energized, when its armature will be lifted and a contact made once more at the point *P*. To energize this magnet (*A*), a shunt circuit through the points of the releasing relay *R* is made use of, which bridges the gap made by the points *P*, and completes the locking circuit from the battery through wire 8 to the relay *R*, to *B* through wire 9, and then through *L* to the magnet *A*. The armature of *A* is thus lifted and the circuit completed once more through the points *P* and the locks.

But as the resistance of the locks is greatly in excess of that of the shunt circuit, not enough current will pass through the locks to energize them, so long as the shunt circuit is complete, and they are, therefore, lifted only after the shunt circuit has been broken. From this it will be seen that by passing the locking circuit through the contact points *P* of the relay *A* and around the locks, the control of the circuit is taken out of the hands of the operator, for while he may break the circuit and lock up the machine at will, he is powerless to unlock, and must wait for the train to pass out of the interlocking (beyond *R*) to release the levers.

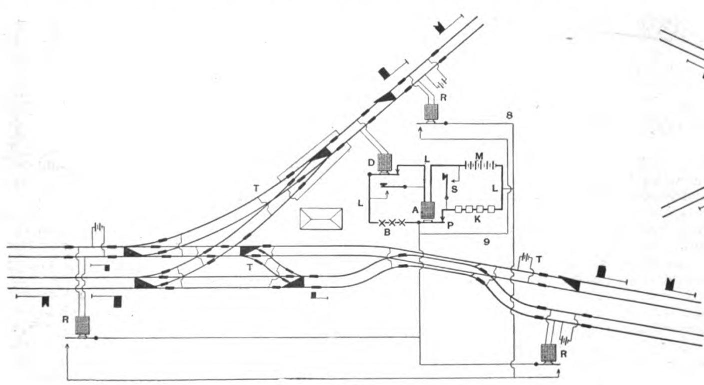


Fig. 1.

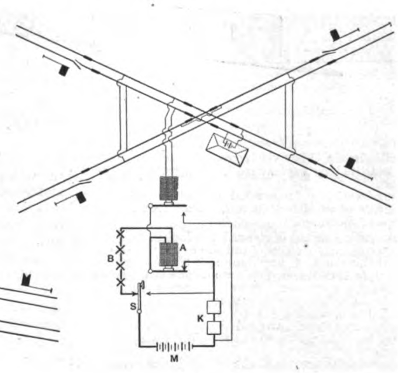


Fig. 2.

Automatic Electric Locks for Switch Levers; Diagrams of Connections.

The releasing circuits, of which there are three, one for each track on which trains usually pass out of the interlocking, extend only through 60 ft. of the track. The relay *R* is energized and the armature held up so long as there is no pair of wheels on this short piece of track to form a short circuit. When the relay is deenergized by the short circuiting the armature falls and makes a back contact, completing the shunt circuit through the locking magnet *A*, around the locks and restoring the locking circuit in the manner spoken of. The locks are not released until the locking circuit through the points of relay *R* has been broken, so that as long as there is a train on the releasing circuit the machine is locked up. A train must not only have reached there-

* A paper read before the Railway Signaling Club, Chicago, Nov. 12, 1895.

leasing circuit but must pass beyond it before the levers will be released.

The track locking circuit, energizing the relay *D*, the armature of which when down is made to break the locking circuit and prevent the locks from being released, is used to prevent a train passing over a releasing section on one track from releasing the locks before a train which may be on one of the other tracks has passed out of the interlocking. In this way an operator is prevented from making a mistake and changing the switches in front of any engine that may be working within the limits of the interlocking and which, for the moment, he may have overlooked.

The circuit breakers *B*, one of which is provided for the lever of each home signal, are used to break the circuit and lock up the machine whenever a home signal is cleared, thus insuring that while the signal may be returned to danger at any time, no change can be made in the switches of the route that had been set. As the locking circuit is the one that is broken when the home signal is cleared, the circuit will, of course, not be restored and the locks will not be released, when a train passes out of the interlocking, if the signal has not been returned to danger before the last car has passed off the releasing circuit. This makes an operator attend strictly to his duties, as otherwise he may be caught with the machine locked up when there is a train wanting to use one of the other tracks of the crossing.

In case of a failure of the circuits to release, a releasing switch *S* may be closed and the levers unlocked. This switch is enclosed in a locked box having a piece of glass set in the cover, which the operator has to break before he can get at the switch to close it, and every glass broken has to be accounted for and a good reason given for the breakage. A second switch, enclosed in another box, which is of the same construction as the first, is provided which, when closed, will do away with the track locking circuit, without throwing the locking entirely out of service. As it is a somewhat difficult matter to maintain a track circuit where there are many pipe and wire lines crossing under the rails, nine out of ten cases of failure being caused by some trouble with the track circuit, the use of the apparatus with this switch closed will be found to give almost the same protection as with the track locking circuit in use, while admitting of the use of circuits that will seldom or never fail. If at any time changes in the rails or repairs to the interlocking are being made, this switch can be closed by the repairman and the locking feature for the greater part be maintained.

The order in which the several operations take place when a train is admitted to and passes over the interlocking is as follows:

When the home signal is cleared the locking circuit is broken by the circuit breaker *B* and the locks and the armature, *P*, of the relay, *A*, are dropped; the armature of the relay, *D*, is also dropped as soon as the train reaches the track-locking circuit. When the train reaches the releasing circuit, *R*, the armature of the releasing magnet, *R*, drops, making a back contact; this completes the locking circuit around the point, *P*, as soon as the circuit is restored at the other points where it has been broken.

If the operator has restored the home signal to danger, closing the circuit at *B*, then as soon as the train passes off the track-locking circuit the relay, *D*, is energized, allowing the relay, *M*, to be energized by the releasing relay when the train has passed on to the releasing section. This completes the circuit at the point *P*, but without lifting the locks. When the train passes off the releasing section, the relay, *R*, is energized, breaking the shunt circuit and forcing the whole of the current to pass through the locks, releasing them. The levers are then once more under the control of the operator.

Where it is desired to lock the levers of a plain crossing interlocking, a much simpler arrangement can be used than the one described, while practically the same results may be obtained. This arrangement is shown in Fig. 2.

As will be seen, only two circuits are used, the track-locking circuit being done away with and the one releasing circuit being made to act also as a locking circuit. All the other parts, the locking circuit, the locking relay, the circuit breakers, the locks, the hand releasing switch and the shunt circuit through the back contact of the releasing relay are the same as with the arrangement first explained. Using only one track circuit and that a releasing circuit, does not change the action of the locks in any way, as the locks are not lifted in either case until the train has passed off the circuit, and practically out of the interlocking.

For very complicated crossings where no switching is allowed without the train passing each time outside of the derails, this arrangement will undoubtedly answer all practical purposes, and, at the same time, be very easy to maintain and cost but little to install. For a plain crossing, the total cost need not be more than $150, although if the crossing was made at a right angle it would probably cost more, a different system of wiring having to be put in:

Skeen's Automatic Crossing Signal.

This signal, used on a number of street railroads, is designed for crossings, but is suitable for any danger point, and may be used to operate an automatic block system.

Referring to the accompanying cuts, Fig. 1 is a perspective of a signal for use at a four-way crossing, with the casing partly removed, exposing the interior and working parts; Fig. 2 is a detail of the locking device, showing the means by which the signal is held in position; Fig. 3 is a diagram showing connections for a crossing of two single track lines; Fig. 4 is a perspective of Skeen's trolley contact.

The signal, Fig. 1, is divided into two compartments—the upper one containing the working parts which operate the semaphore, and the lower one containing the signal lamps.

This signal is operated by a series of solenoid magnets, designated on the drawings as *A A'*. The cores of these magnets are connected by the connecting rod *F F'* to the crank *H*, which is fastened immovably upon the shaft *E*, which extends through a bearing out through the casing and to the outer end of which is fastened the disk. On the inner end of the shaft *E* is fastened the lamp contact bar *C'*. When the current is passed through either of the solenoids *A* or *A'*, it turns the disk *D*, which is normally horizontal, into a vertical position. This action also turns the contact bar *C'* against the contacts *C*, thus lighting the lamp in one of the compartments below.

The signal is held in the position into which it is turned by the locking device shown in Fig. 2. In Fig. 2 the current has passed through the coil *A* and turned the disk *D* from a horizontal into a vertical position. The connecting rod *F*, which has a slot *G'*, is passed through an aperture in the base and is held down by the shoulder *I'*. It will be seen that it is impossible for the wind or other outside influence to turn the disk back into a horizontal position, as the lower extremity of the connecting rod *F'* will tend to move in an arc struck from the center *E*, as shown by the dotted arrow, and be prevented by the shoulder *I'*. When, however, the current is passed through the solenoid *A'*, and the core *B'* is lifted, the slot *G'* allows the connecting rod *F'* to rise above the shoulder *I'* and be released, as shown by the full arrow.

When the disk is in a horizontal position the magnet core *B* will be down and the connecting rod *F* will extend through the aperture *I*, and the pin in the crank *H* will be at the upper end of the slot *G*, thus locking it in the same manner that it is locked in the other position; thus a positive lock is formed for both positions of the semaphore.

Referring to Fig. 3, it will be seen that the car moving toward the west has passed the contact pan *L*, and by so doing has caused the current to pass to the ground through the coil *A*, which operates the signal, stopping the southbound car. The contact bar *C'* is at the same time turned against the contact brushes *C*, which gives current to the lower lamps, thus showing red to the southbound car and green to the westbound car. The apparatus will remain locked in this position while the car is passing between the pans *L* and *M*. When the car passes the trolley contact *M* the disk will be turned to its horizontal position by the current passing through the coil *A'* (behind *A*) to the ground, and the lamp contact will be broken by removing *C'* from contact with the brushes *C*. After the westbound car has passed the pan *M* at the crossing the southbound car will have right of way and proceed, and, making contact with the pan *L'*, will cause the disk used for blocking the east and west track to assume a vertical position, and the lamp in the upper compartment to be lighted, showing a red light to westbound cars and a green light to southbound cars. This warning position will be maintained till the southbound car passes the pan *M'* at crossing, when the signal will be returned to normal and locked.

For a crossing of single tracks but two pairs of solenoid magnets and their corresponding disks and lights are required; for a double-track crossing four pairs of operating solenoid magnets and four corresponding signals; but the same number of lights are required as before. Fig. 1 shows such a signal adapted for double-track crossings, but the diagram of Fig. 3 is used for simplicity.

A trolley contact or pan especially adapted to operate with this signal is shown in Fig. 4. It consists of a bar upon which is suspended a set of branching springs overlapping one another and approaching, but not touching the trolley wire. The bar is insulated and electrically connected with its proper solenoid A or A'. The trolley passing along the trolley wire by its groove touches these springs and sends a certain and continuous current to the solenoid magnet without impeding the passage of the trolley.

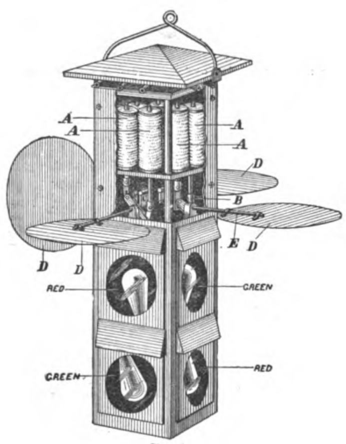


Fig. 1.

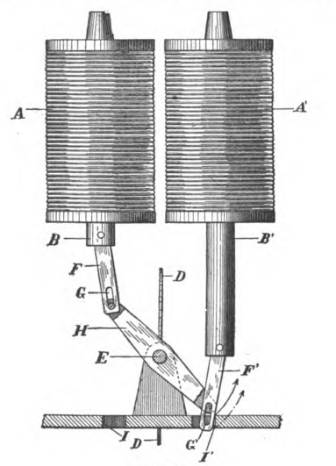


Fig. 2.


Fig. 4.

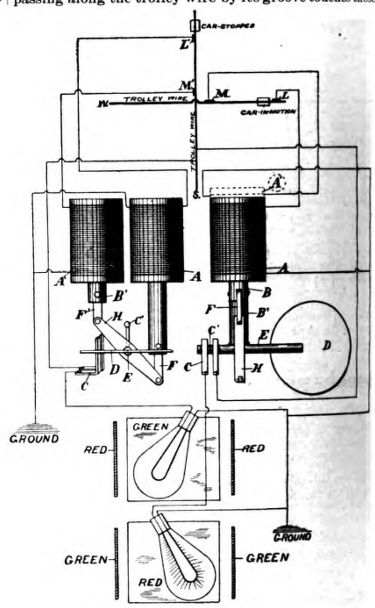


Fig. 3.

Skeen's Automatic Signal for Electric Railroad Crossings.

There is a cut-out feature combined with the apparatus which enforces the warning given by the visual signal. It consists of an insulated section interposed in each trolley wire and extending from the crossing to a suitable distance away from same, and corresponding with the distance between the trolley contacts previously described. Each insulated section is wired to a switch operated by the same shafts which cuts the current in and out of the corresponding section in the same manner as the lights are cut in and out, and simultaneously with them. Thus when a car going east reaches its insulated section it will cut out the current from the insulated section of the crossing line, at the same time that it presents a warning signal to that line. The signal may be used with or without the cut-out switch.

This signal is made by the Skeen Electric Switch & Signal Company of St. Louis.

Tests of A Ten-Horse-Power De Laval Steam Turbine.*

BY PROF. WILLIAM F. M. GOSS.

The de Laval steam turbine experimented upon constitutes a part of the permanent equipment of the Engineering Laboratory of Purdue University, and the present paper is based upon data secured chiefly through the assistance of Charles E. Bruff, B .M. E.

* A paper presented at the New York meeting (December 1895) of the American Society of Mechanical Engineers.