above, the average speed of freight trains for the nine months in 1917 in miles an hour would be

$$50.47 \div 4.31 = 11.7.$$

Average train hours per freight car a day would be	
25.3 ÷ 11.7 =............................	2.16
Under these assumptions:	
Freight train locomotives required to produce 17,004.2 freight train hours a day:	
17,004.2 ÷ 4.31 =.........................	3,945
Additional freight locomotives available for service due to saving 17,004.2 freight train hours would be	
3,945 × 86.2% =........................	3,400
Revenue ton-miles a day that could be produced by 3,400 freight locomotives would be	
30,951 × 3,400 =........................	105,233,400
Freight cars required to produce 510,126 train car hours a day would be	
510,126 ÷ 2.16 =........................	236,170
Additional freight cars available for service due to saving 17,004.2 freight train hours a day would be	
236,170 × 94.3 =........................	222,708
Revenue ton-miles a day that could be produced by 222,708 freight cars would be	
222,708 × 445 =.........................	99,105,060

Saving in Equipment and Cost of Automatic Block

Cost of equipment saved per 100-mile division:		
3.49 freight locomotives at $60,000....................		$209,400
278 freight cars at $2,500............................		695,000
Total		$904,400
Cost of automatic block:		
100 miles of line at $2,500...........................		$250,000
Cost of operating and maintaining automatic block a year:		
100 miles of line at $115............................		11,500
Saving in crew overtime due to saving one hour per 100 freight train miles:		
Total hours saved a day.......................	16	
Total hours saved a year.....................	5,840	
Average overtime 75% of total hours saved....	4,380	
At $3.05 per hour =................................		13,359

A saving of 17,004 freight train hours a day means also a saving of 17,004 crew hours, or on an 8 hour a day basis, a saving of 2,127 crew days, so that the additional men available for service due to installation of automatic block signals will be

$$2{,}127 \times 5 = 10{,}635.$$

Saving of 16 freight train hours a day on a 100-mile division means a saving of 16 crew hours, or on an 8 hour a day basis, 2 crew days, so that 10 additional men are available for service due to installation of automatic block signals on 100 miles of line on which there is an average of 16 freight trains a day.

CABLE INSTALLED FOR DESPATCHING

The New York, New Haven & Hartford has installed lead-covered cables for use on their despatching circuits. This installation extends from the Mott Haven yards in New York, a distance of 70 miles, into the New Haven end. The New Haven installation is an interesting one, owing to the electrical and construction difficulties encountered. It follows the right of way and parallels the high tension line which is used in transmitting 11,000 volts a. c. single phase circuits, which are transformed down to 1,100 volts for the trolley system.

Much of the line is constructed through rock formation, making the underground construction a very expensive proposition. At some points along the line it was necessary to put the cable on short, heavy, storm-resistant poles. At crossing and at points where the high tension leads are in close proximity, concrete in cased duck is used. Where conditions permit the cable is put under ground. The cable was furnished by the Western Electric Company and is of the paper insulated duplex type, containing one pair of No. 10 B. & S. G. conductors, six quads of No. 13 and 16 quads of No. 16 B. & S. gage. Special insulation provides ample protection between pairs and between core and sheath.

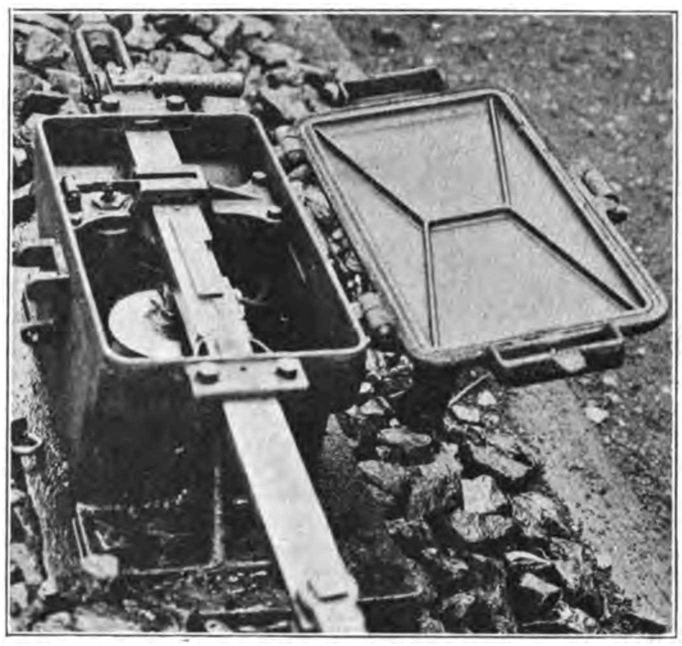
All train despatching is to be over this cable by telephone, in conjunction with a complete equipment of Western Electric alternating current selectors. All other wire traffic will also go through this cable, the large conductors of which will be used for through service between New York and Boston. By arrangement with the American Telephone and Telegraph Company the cable will be loaded to provide proper transmission facilities for permitting long distance connections with other points.

SAFEGUARDING MOVEMENTS IN SIGNAL TERRITORY

By Charles L. Sandrus

Signal Foreman, Pennsylvania Railroad, Altoona, Pa.

Various devices are used for electrically locking outlying switches, but the protection afforded has not always been satisfactory. This subject was referred to in the September, 1918, issue of the *Railway Signal Engineer* (page 269) and is one open for discussion. Much could be said about the various types of locks and other devices used in trying to protect the outlying switch, but since most of the methods now in use are familiar to the majority of signalmen, this article is limited to a description of an improved device. It has been the writer's privilege to work with a number of

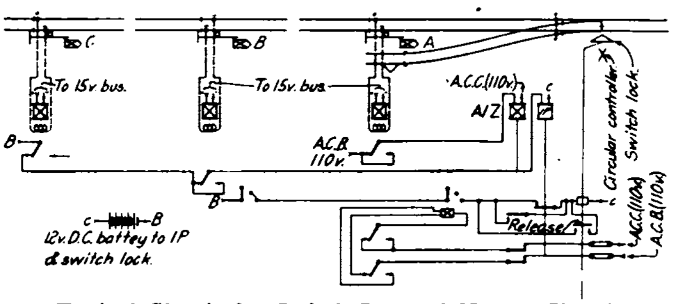


An Improved Device for Protecting Switches

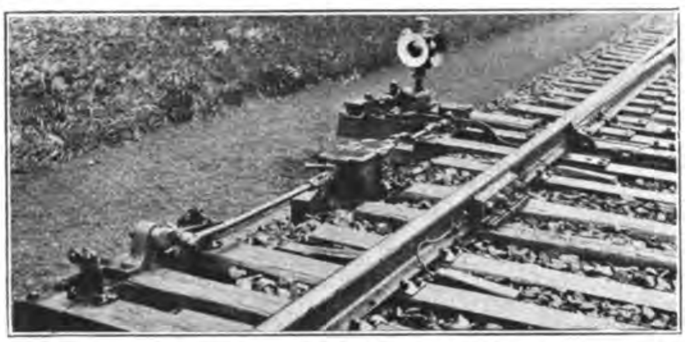
instruments used for the purpose and a device that gives excellent results and affords complete protection is now being used by the Pennsylvania railroad.

This instrument consists of an iron case with two slides running parallel through it, a time release, and an electro-magnet. Two levers are located at one end of the case and are connected to the two slides. One is a standard ground lever, operating the bottom slide, while the other is a small hand lever attached to the top slide. On the other side of the case and working in conjunction with the top slide, is a combination plunger circuit controller. The electro-magnet has a latch attachment which rests on the top slide, the slide carrying a locking dog.

The time release is located directly under the slides and is wound and unwound by two adjustable plates fastened to the bottom slide. Each time the ground lever is thrown to unlock the switch the release starts to run down, and when the lever is reversed the release is wound up. To operate the switch the ground lever is thrown, which causes the bottom slide in the device to make a complete stroke, and at the same time, through a mechanical dog arrangement, the top slide is withdrawn far enough to cause the contacts in the circuit controller to open, causing signal "A" (see circuit plan) to assume the stop position. This operation, with the block unoccupied, will permit the miniature lever to be withdrawn its full throw, releasing the plunger from the lock rod and unlocking the switch. With a train approaching, the switch cannot be unlocked unless sufficient time is given for the clockwork release to operate. This release may be adjusted for operation in from one to four minutes to protect a train at any desired distance from the switch, thus providing time for the train to have passed over the switch before it can be thrown. The approach circuit to this device takes battery at signal "C" through the three-position track relay with the signal in the 90 deg. position, through the three-position track relay at "B" at 90 deg. and 45 deg. to the "P" relay. Battery is also taken over the circuit controller of signal "B" in the 0 to 45 deg. position, to signal "A" at stop and through a contact on the "P" relay to pick up the switch unlock. The "P" relay is cut around through the time release, and both the release and the "P" relay are cut around a back contact on relay "A1Z," which leaves the switch free to operate in the event of shifting. In some cases an indicator is used to show locked or unlocked in connection with the device; where this is desired it can be provided for very easily through the relay contacts.



Typical Circuit for Switch Located Near a Signal


The Device Installed at a Switch Location

It will be observed from the circuit sketch that after a train has passed signal "C," the switch is locked, and remains so until the train has arrived at signal "A," because of the "P" relay being open, thus affording the same protection as is now obtained at an interlocking plant. In this particular case the control circuits for signal "A" are shown cut through the A1Z relay, but this is altogether dependent on the location of the switch. In installing the device, it can be placed directly on the ties, but to get the best results from any instrument of this kind it is necessary to avoid as much vibration as possible, therefore, it is recommended that it be placed on a separate concrete foundation. The lock is so designed that it can be used in automatic, manual block, controlled manual block territory, or for the control of distant switch signals. Back locking is obtained in all cases. The time element, of course, would be unnecessary except where approach locking is desired. An important feature in connection with this device is the fact that the switch is locked by a standard mechanical plunger, which makes a very substantial lock.

STRONGER RAILROAD POLE LINES

One of the most important matters acted upon by the Association of Railway Telegraph Superintendents at the annual meeting in Chicago on December 5 was the adoption of rules for the specifications for railroad pole lines. These rules provide that such lines shall be designed under the proper assumptions of load of wind and ice for the territory in which they are located. A factor of safety of two is provided, except for poles located within a striking distance of the main track in which case the factor of safety shall be three.

Up to the present time, telegraph and telephone pole lines have been built in accordance with individual experience or more or less "rules of thumb method." These methods have not given the results now required. The method of design as recommended by the association will apply recognized engineering principles to pole line construction. While the initial expense may be somewhat increased, a saving will be effected by less maintenance, the avoidance of delay and interference with railroad traffic by the failure of telegraph and telephone service used for the operation of the railroads.

The committee having the matter in hand believes that a factor of safety of two for new poles will generally be sufficient for new pole lines to insure continuity of service and a factor of safety of three should be used for new poles when located within striking distance of the tracks, where a failure would interfere with the running of trains as well as severing communication.

It is intended that the specifications shall also include a provision covering the safe maintenance of pole lines. Wooden poles shall be maintained to never fall below 60 per cent of the original strength when new or for pole lines having a factor of safety of two when new the maintenance shall never fall below 1.2. Those located within striking distance of main tracks having a factor of safety of three shall be maintained to never fall below 1.8.

Railroad traffic has been seriously interfered with in some parts of the country every year by pole line failures during sleet storms, because the poles were not originally built to withstand the load of sleet and wind which prevails in the territory in which they are located. Under the new method of applying engineering principles, as recommended by the association, the construction and maintenance would be such as should avoid the unnecessary interference with traffic which has so frequently occurred in the past. The managements of the railroads realize that the pole lines which carry the wires for train dispatching, automatic block signals and for general railroad communication service are vitally necessary to handle large volumes of traffic and they are demanding better facilities consistent with the advances being made in the track, bridge and other similar construction work.