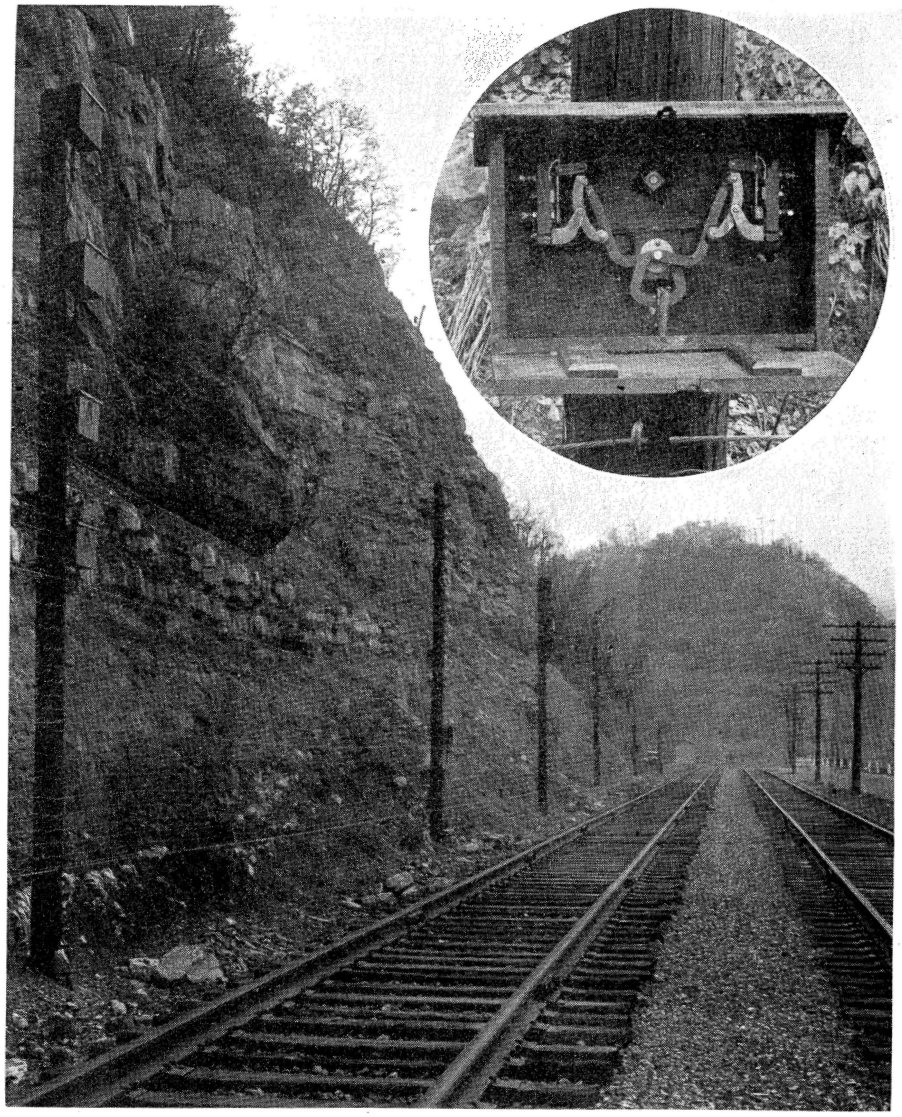


Insert shows interior of circuit controller box one of which is furnished at center of each fence panel as shown on pole at left of view

Pennsylvania builds new type of detector fence with signal circuit controllers affording complete protection while offering advantages in construction and maintenance as well

Slide Detector Signals

THE Pennsylvania, from a number of years' experience in the construction of special fences, linked electrically with the automatic signals to detect and warn of rock falls or earth slides which might interfere with train operation, has developed a design which is relatively simple and economical and which has proved highly effective under widely varying conditions. The new type fence is of such design that it can easily be lengthened or increased in height as conditions warrant and is adapted for installation directly alongside the tracks where it can readily be inspected, adjusted and repaired. A special type of controller has been developed to provide reliable service and to afford indication of operation.

In this latest design, ordinary farm fencing is placed vertically, panel above panel, on suitable poles to afford a yielding intercepter of rocks, ice or soil which might fall from cliffs or hillsides towards the tracks. Supported by messenger wire between poles, each of the vertical panels is fitted with circuit controllers at intervals, which open when any appreciable pressure is exerted against the fence. The opening of any of the circuit controllers automatically opens the control circuit of a line relay through which the signal circuits are controlled, in turn, causing the signals immediately each way from the section of the fence affected to assume their most restrictive aspect.

Confronted with many unstable rock cuts and rock cliffs along its lines in mountainous districts, the Pennsylvania has for years employed special watchmen and various types of indicating or intercepting fences to safeguard train operation. All of the fences used heretofore, however, have been only a single panel high, usually 4 ft., or a succession of such fences up the sloping face of the cut or hillside. These fences have proved effective where they could be installed at strategic points, but in many cases involving bluffs or cliffs, or even precipitous slopes, they were extremely difficult to install and only partially effective. Furthermore, being scattered back up the slopes, frequently covered in part with vegetation, these fences could not always be inspected readily from the track to ascertain any conditions which might have caused signal operation. Under the most favorable conditions, these devices were usually difficult of access for adjustment, maintenance and for clearing.

Fences Readily Inspected

In the type now installed, the fences are generally constructed directly alongside the tracks, and can be built to any height desired. Of proper height, and carried close enough to the ground, they insure positive interception of rocks from the higher as well as lower levels. At the same time, being erected directly adjacent to the tracks, they make possible rapid thorough inspection, adjustment or repair. As a matter of fact, the cause of any fence operation of the signals can be determined while traveling past the fence at reasonable speed on a track motor car. Even if the size

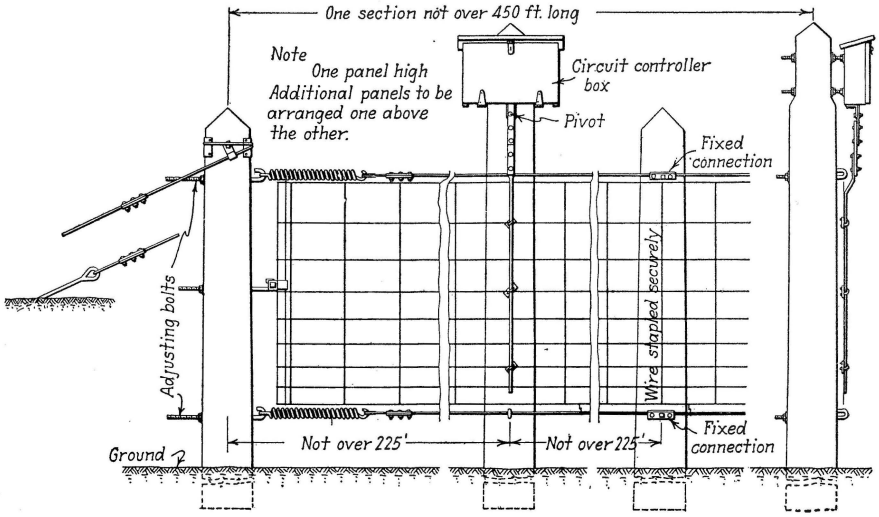
of a rock fall does not indicate clearly whether it is the cause of a restrictive signal indication, all of the circuit controllers are at such close range that a glance discloses whether any of them have been operated. Already the Pennsylvania has made more than 16 installations of the new type of protection fence. These range from 1 to 7 panels in height and in lengths up to 3,000 ft.

Construction of Fence

The new type of fence employs suitable poles, farm fencing, messenger wire and circuit controllers. In addition, however, it employs various pole fastenings and guys, wire spreader bars, and coil tension springs to keep the wire taut. The poles in most of the installations are treated timber, standard telephone and signal line poles being used for the higher fences. At certain locations, the fences have been erected on the poles of existing telephone and signal lines, and in at least one location where a long high fence was required, an existing transmission pole line was shifted to the opposite side of the tracks in order that it might serve also to carry the protection fence. At several locations, worn rails have been used as poles to support the fence, these being set in suitable footings.

Regardless of the length or height of the fences, they are all constructed in operating sections of 450 ft. or less, each section having one fixed end and one movable end, and either one or three intermediate supporting posts to which the fence wire is stapled loosely. The circuit controller or controllers are located on the center post of a section, and are so connected with the fence wire that as little as 1½-in. movement of the wire in a longitudinal direction causes them to operate. In fences more than one panel high, each upper panel is a duplicate of the lowest panel, except that a common messenger wire is used between adjacent panels to support the fencing in the lower panel and to hold the wire in the higher panel in a vertical plane.

The fence wire employed is usually of the woven "hog-tight" type, 4 ft. high, with smaller openings vertically at the bottom, while the messenger wire is ordinary steel strand galvanized pole-line messenger wire 5/16 in. or ⅜ in. in diameter. The fencing is held loosely on the messenger wires, top and bottom, by double rings of No. 8 gage galvanized wire, in alternate mesh openings, those along the top being staggered with those at the bottom.



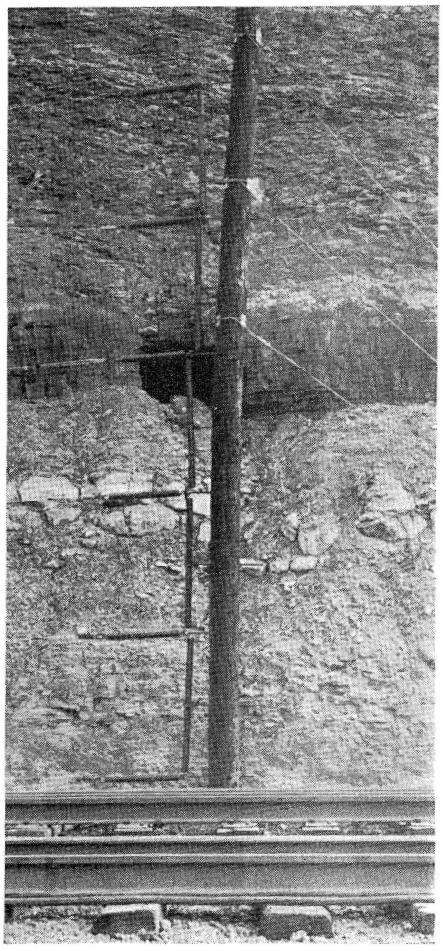
Details of fence construction

Application of these ring ties is accomplished by first coiling a continuous strand of wire around a 1½-in. bar to form a coil about 8-in. in length, and then nicking the wire with a chisel so that it can be broken readily into two-ring coils. While still a part of the long coil, each two-ring segment is twisted into position about the messenger and fence wire, and it is broken off only after it is in place. This method, which permits applying the individual wire ties in a fraction of a minute, was developed as the result of the difficulty and time lost in the initial installations in attempting to twist the double rings separately at the various tying points.

At the fixed end of each fence section, whether by itself or a part of a longer continuous fence, the messenger wires, top and bottom, are attached rigidly to hook bolts, the long threaded ends of which are made to extend through and for 8 to 10 in. beyond the opposite side of the pole. At the opposite, or movable end of each section, the construction is the same, except that a stout coil spring, about 18 in. long, is introduced between the wire and the hook bolt. By adjustment of the nuts on the hook bolts at the two ends of a section, the wire-carrying messengers can be drawn taut, and at the same time possess a degree of lateral flexibility.

To increase the sensitiveness of certain of the fences, springs have been provided at both ends of the messenger wires in each section, but this has not been found necessary generally, the one-end arrangement providing all of the flexibility necessary under ordinary conditions.

The wire fencing in each section is fixed rigidly at both ends, either directly to the pole by staples, or through a spreader bar or pipe to which the wire is secured, which, in turn, is attached to the pole by means of a clip and a through, tension-adjusting bolt. In the earlier installations of the new type of fence, the ends of the fencing in each section were given a spring connection to the posts, more or less similar to the spring messenger connections, but this arrangement was given up when it was found that there was ample flexibility in the fencing itself, through the slight sag that is inevitable in the

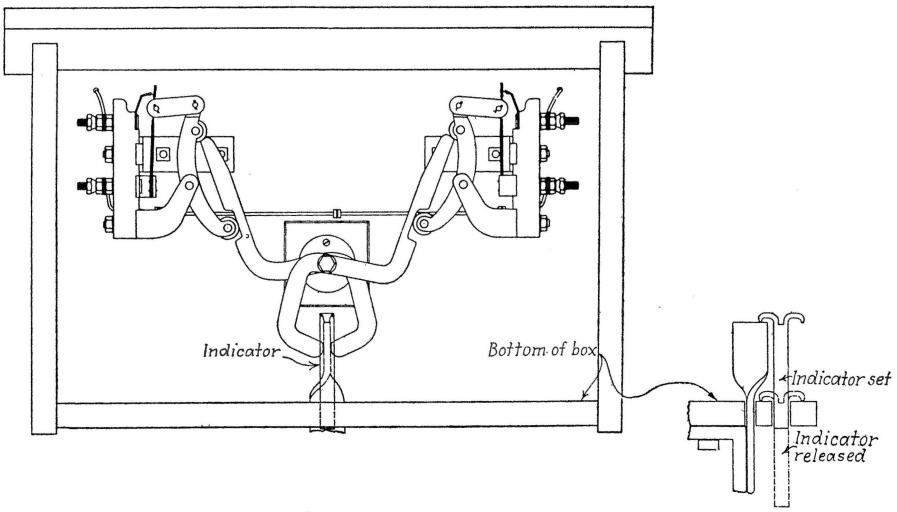


Construction at end of fence

long spans employed, to permit sufficient longitudinal movement of the wire at the center of the section to operate the circuit breakers.

A spreader bar is always provided at one end of each individual fence section to provide a means of ready take-up to compensate for any stretching of the fencing, and also that the fencing can be taken down readily to permit routine ditching or clearing away of slide material with cranes or ditchers.

At the intermediate poles in each section, where both the messenger wires and the strands of the fencing wire are stapled loosely to the poles, permitting unrestricted longitudinal movement of the wire with the bulging of it at any point, it is necessary to withdraw the staples to take the fencing down for major ditching or clearing operations.



Details of construction of circuit controller

Circuit Controllers

Two types of circuit controllers have been used in the slide fence installation. One of these is a simple plug-type cut-out which, when pulled apart, opens the circuit. The other is a lever-type device effecting the same results, with longitudinal movement of the fence wire. The plug-type controllers were used in the earliest of the new fence installations. However, in the more recent installations they have given way in large measure to the lever-type controllers. This was brought about by fear that through long exposure to the weather, the plug device might corrode sufficiently to cause the prongs to bind in the receptacle, increasing the pull necessary to open the signal circuits, if not precluding the operation altogether under certain conditions.

In single-panel fences, the plug-type controllers are located on each side of the center post of the fence section, mid-way of the height of the fence wire. The receptacle of each controller is fixed rigidly to the post, while the plug is wired securely to the fencing. To insure transmission to the plug of a pull on any part of the fencing wire across its face, the plug connection to the fencing is made by means of wire ties extending at 45-deg. angles to the highest and lowest strands of the fencing, and wired securely to each of the intermediate horizontal strands crossed. Through this arrangement, a bulge of any part of the fencing transmits a direct pull on the centrally-located plug, even though it may not effect a pull on the fencing wire as a whole.

In installations of the fencing two or more panels in height, it has been found that a single plug-type controller, placed between panels, can be made to respond to the action of both panels by running the plug ties diagonally to all of the horizontal strands in both panels. This arrangement has been followed wherever panels can be grouped in pairs, any odd panel being treated individually as a single panel.

The circuit controller now employed generally in the newer installations is essentially a simple group of pivot bars and electrical contacts such as used in a switch circuit controller, but actuated by two specially designed trip levers, so arranged that movement of the lower extremities of either of the two levers of as little as ¼ in. will break the electrical circuit. This type of controller, one of which is provided for each panel of fencing in each fence section, is housed in a wooden box with a bottom-hinged face cover, so that it can be exposed readily for inspection and for resetting the mechanism in case of operation.

The boxed-in instrument is located on the center pole in each fence section, directly above the panel of fencing it serves, and is connected to the fence wire by means of a short flat pivoted bar, bolted to a steel rod which is clipped securely in a vertical position to various horizontal strands of the fencing. Through this arrangement, any longitudinal movement of the fence wire transmits a movement to one or the other of the operating levers of the circuit controller, a movement of approximately 1½ in. of the wire being sufficient to open the signal circuit.

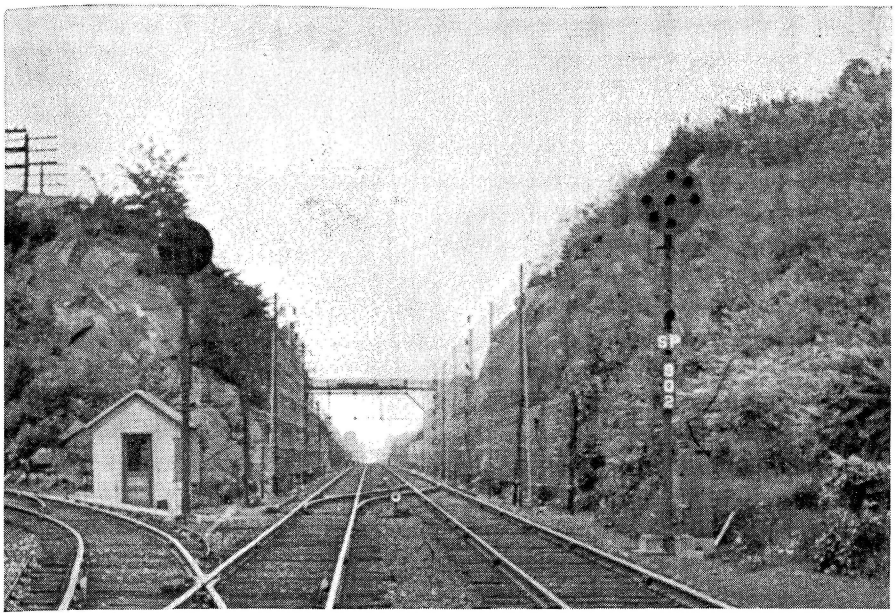
A feature of the lever-type controllers is that an effective operation of the device, that is, an operation sufficient to open the signal circuit, causes an indicating rod, the bottom part of which is painted white, to drop to a position where it projects through the bottom of the box housing, thus any of the controllers which have been operated can be detected at a glance from the track level.

Signal Forces in Charge of Operation

Where a signal circuit pole line is used to support the slide detection fencing, the wires of the signal circuit are brought down the poles at the circuit controller locations and are connected through the individual circuit controllers. Where the fencing is on the same side of the right-of-way as the signal circuit pole line, but on separate poles, overhead signal line connections are made to the tops of the circuit controller poles and are then carried down through the individual units. Where, on the other hand, the signal pole line is on the opposite side of the tracks from the slide fence, connection to the fence is made through parkway cable carried beneath the tracks, and supplemental signal circuit wires are run from pole to pole along the top of the fence and through the circuit controllers.

In only a few instances has it been necessary to relocate existing roadside signals to provide full protection to trains through the slide fence areas. A special marker "SP" is attached to the signal mast to inform the engineman that a "stop" aspect of the signal may be caused by a slide. In certain instances, to avoid relocating signals, two-light, distant-switch-indicator signals, mounted on masts about 11 ft. high, have been provided to give the necessary advance warning of slide fence operations.

Because of their intimate relation with the signal system, inspection of the slide fences and their maintenance



Automatic signal with special "SP", slide protection marker

are largely in the hands of signal department forces. However, the track section forces are required to keep constant watch of the fences in their respective territories, and are subject to call for making any major repairs or for removing any debris which may foul the fences, ditches or tracks.

If a train is stopped at a signal through the operation of one or more of the fence circuit controllers, it is required, after investigation, to proceed under caution until it is beyond the restrictive territory of the signal. The engineman is then required to report the stop indication to the nearest towerman or dispatcher, who immediatedly notifies the signal department forces. Where any obstructions to the track are reported, the track forces are also called out.

Up to the present time the Pennsylvania has built 16 of the newer type of fence installations, ranging in length up to 3,000 ft. and in height from 4 ft. to about 30 ft. In one stretch of less than three miles between Edgecliff, Pa., and Valley Camp, on the Conemaugh division, there are six separate fence installations, varying from one to five panels in height, and from approximately 300 ft. to 2,250 ft. in length. These six installations, in themselves, involve a total of 6,330 linear ft. of fence and approximately 15,850 linear ft. of fence wire.

Figures are not available regarding the number of fence operations at all of the installations, but that the fences are effective as a safety measure is clearly seen in the record of one of the fences near Glen Union, Pa., on the Williamsport division. Here, within the 13-month period from December 1, 1933 to December 31, 1934, there were a total of 64 fence operations. On two occasions in April, six tons and two tons, respectively, of ice, rock and mud, fouled both main tracks, operated the fence and stopped trains. On six other occasions during the year when trains were stopped, the fence had caught and retained ice or rock weighing from 200 to 2,000 lbs., which would have fouled the tracks if it had not been stopped by the fence.

In addition to the above, there were 56 other cases of fence operation within the period, causing warning signal indications to be displayed, but not necessarily stopping trains. These were caused by small slides or rock falls which, in all probability, would not have fouled the tracks. Such indications have occurred at all of the different installations, causing delay to trains on occasions, but this has been deemed justifiable in view of the positive 24-hour protection given to train operation, and the savings made in patrolling the tracks.

In many cases the sensitiveness of the fences has been reduced by adjustment of the circuit controllers, so that only falls and slides of a magnitude which might possibly cause unsafe operating conditions are reflected in danger signal indications. This has reduced materially the number of unnecessary interferences with trains.

A mechanical plant involving switches for two crossovers on the Philadelphia Rapid Transit was replaced by an automatic control interlocking