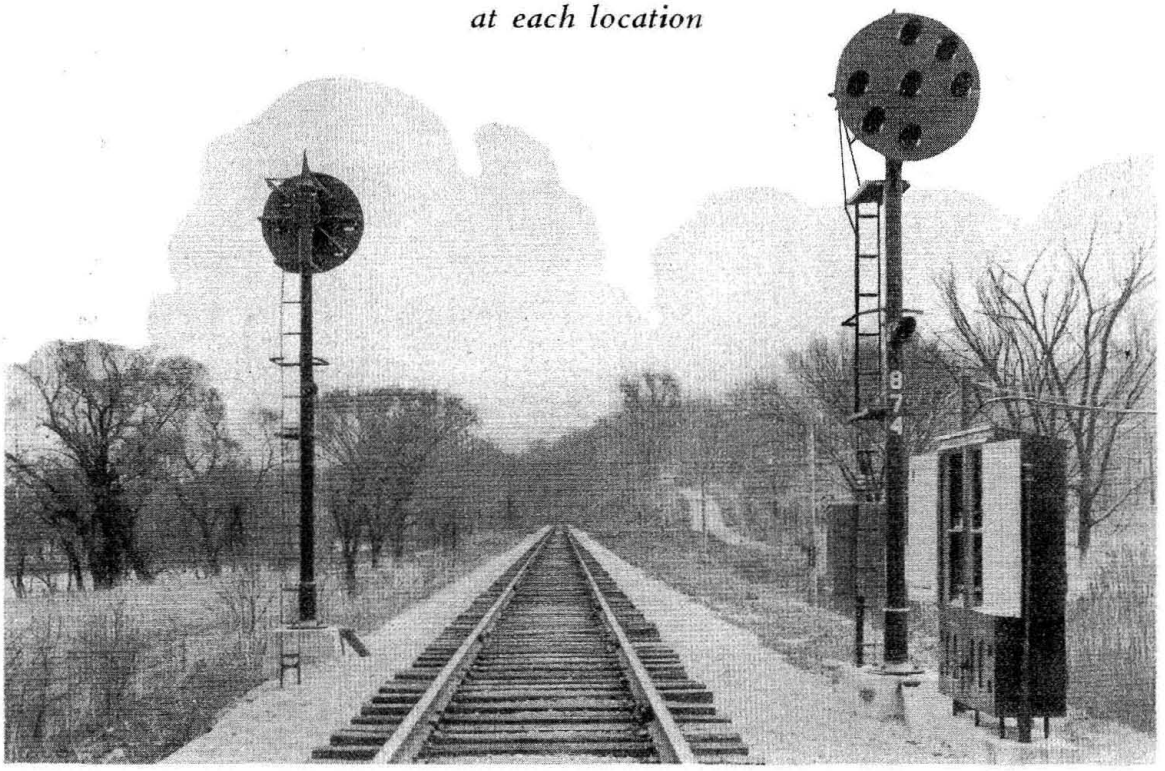
Railway Signaling

Vol. 22 June, 1929 Number 6

# Pennsylvania Installs A. P. B. Signaling on 86 Miles

*First installation of this type of signaling on this road—Telephone at each location*



*A typical intermediate double location*

THE Pennsylvania has recently placed in service automatic block signals of the position-light type on 86 miles of single track, from Xenia, Ohio, to Foster, 36.6 miles, from Xenia to Dayton, 15.4 miles, and from Wolf Creek, Ohio, to New Paris, 34.0 miles. This installation includes the first single-track automatic block signaling used on the Pennsylvania, as heretofore the single-track signaling on this road has been of the manual or controlled-manual type.

On the 36.6 miles of single track from Xenia southwest to Foster, which is near Cincinnati, there are eight passenger and about nine freight trains each way daily. On the east and west line from Columbus, Ohio, through Xenia to New Paris, on which the other two installations of single-track signaling are located, there are nine passenger and about three freight trains each way daily. Previous to the completion of the new automatic block signals, train movements had been handled by manual block, time table, and train orders.

The new signals are, in general, controlled by the absolute permissive block system of circuits as used extensively on other roads for years. However, several unique features are included to afford flexibility of operation.

As shown on the track and signal plan, the head-block signals are located at each end of the siding layout. The absolute signal governing movement into a single-track block is designated by the absence of both the number plate and marker light. A double-signal location is placed one mile from each head-block location, and the intervening distance to the distant signal for the next head-block is divided into blocks approximately two miles long.

The length of the first block was fixed at one mile for two reasons. In the first place, where a train is on a siding waiting for a train in the same direction

to pass, the train on the siding can start to pull out, when the preceding train clears the mile block. The leading train in the meantime can easily clear the next two-mile block while the following train gets under way and covers the first mile block. In the second consideration, where trains are approaching a siding, the use of a one-mile block brings a train closer to the siding before encountering a caution block, thereby reducing the distance and time consumed while running at reduced speed.

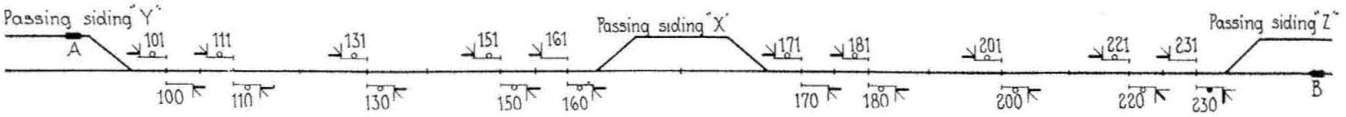
On many single-track automatic signal installations, two signals are held at the caution indication in the approach of a head-block signal, so as to insure that under no circumstances will an engineman encounter a stop indication without first having seen a caution indication at the signal in approach thereto. In the Pennsylvania's new installation, a unique circuit arrangement is used to insure a caution signal in each case, and yet at the same time to reduce to a minimum the length of the caution block and thereby lessen the delays in the vicinity of the passing tracks. The operation of this system of signaling, when two trains are making a meet, is shown in detail in the accompanying diagram, with an explanation under each sketch. Enginemen soon become familiar with local conditions, so that this caution feature is of decided assistance in controlling the speed of the superior train so as to eliminate train stops in many cases.

A telephone is mounted in a box at each signal location, and, in case a train is stopped at any signal indicating "stop," the conductor is required to call the dispatcher for information and get permission to pass the signal.

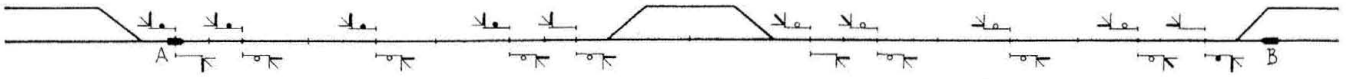
### Position-Light Type Signals

The automatic signals are the position-light type, with a 9.0-watt, 12-volt lamp in each unit. In order to provide a simple circuit for the operation of the system, and at the same time to eliminate the use of line repeaters, the track was fed separately in each direction at the cut-section located half way between signal locations. This placed the track relays at signal locations, and also provided means for approach lighting the signals.

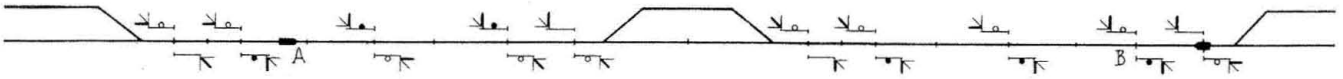
A 440-volt, single-phase, 60-cycle power distribution line is carried on two No. 6 hard-drawn solid-copper insulated wires with weatherproof covering. Double-petticoat glass insulators, with a top groove, are used for these line wires, which are carried on a new signal crossarm, which was added to the existing pole line used for communication circuits. A




Train *A* is about to come out of passing siding *Y* and has orders to meet Train *B* at switch *2*, passing siding *X*. All signals are normally clear. Headblock signals have no marker light. These numbers are for circuit reference only

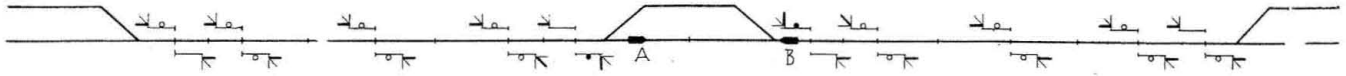



Train *A* has come out of passing siding *Y*. As soon as part of the train passed headblock signal *100*, the signals assumed positions as shown. All opposing intervening signals went to stop and proceed, headblock *161* to stop and stay, and signals *171* and *181* to approach. Train *B* has not reached headblock *231*

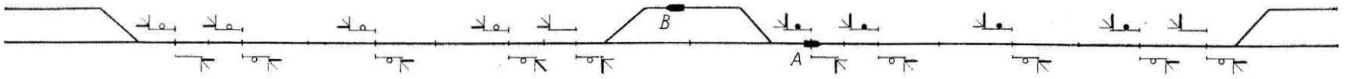



Train *A* has passed signal *110*, opposing signals *101* and *111* cleared up just as soon as train *A* passed them. Headblock signal *100* has gone to approach to allow for a following movement. Opposing signals to be passed remain in their most restrictive indication. Train *B* in passing headblock *231* caused all opposing signals, up to and including headblock *170*, to assume their most restrictive indication and signals *160* and *150*, the approach position


When Train *A* reached the cut-section half way between signals *150* and *160* (tripping point) it caused signal *171* to go from approach to stop and proceed. Train *B* is approaching signal *181*. Should Train *B* reach the tripping point, halfway between signals *181* and *171*, before Train *A* passes signal *160*, it will not drop this signal to stop and proceed in the face of Train *A*, because the first train reaching the tripping point will hold its signal at approach, so long as the block governing the signal is unoccupied




Train *A* is proceeding down the main expecting to find Train *B*, which is about to enter the passing siding




Train *B* has entered the passing siding and Train *A* has passed headblock *170;* thereby causing all opposing signals to assume their most restrictive indication as indicated

10-ft., 10-pin Douglas fir crossarm with wooden pins is used. The power wires are placed on pins No. 3 and 4, counting from the left and facing west, this position being chosen with the idea that, if the pole line is blown over by a storm, the end of the crossarm would strike the ground first, thus keeping the power wires off of the ground.

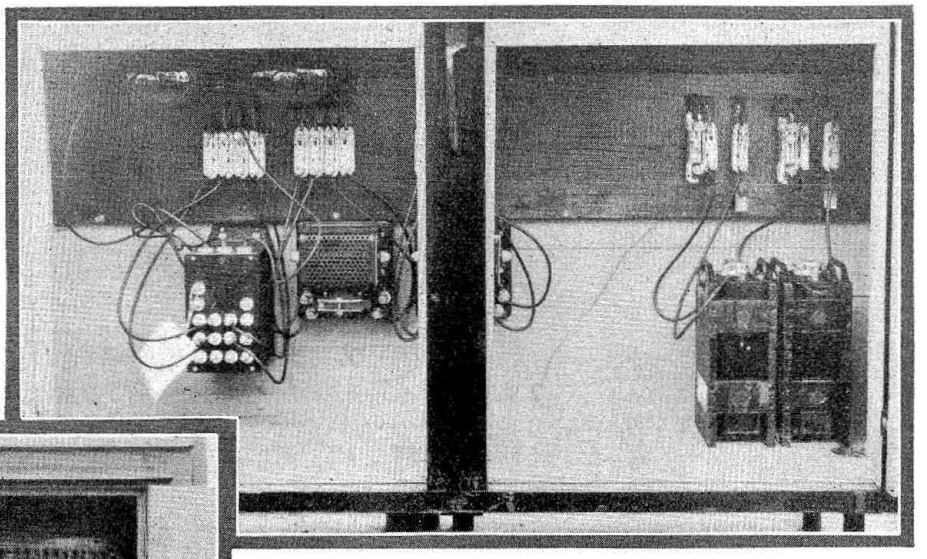
The 440-volt line is fed about 7.5 miles in each direction from a feed location. At each power feed, transformers are used for insulating the power company's circuit from the signal power line. With 440 volts at the source there is a drop of about 10 volts in 7.5 miles, and if the "feed" is cut through in case of emergency, there is a drop to about 410 volts at the end of a 15-mile section.

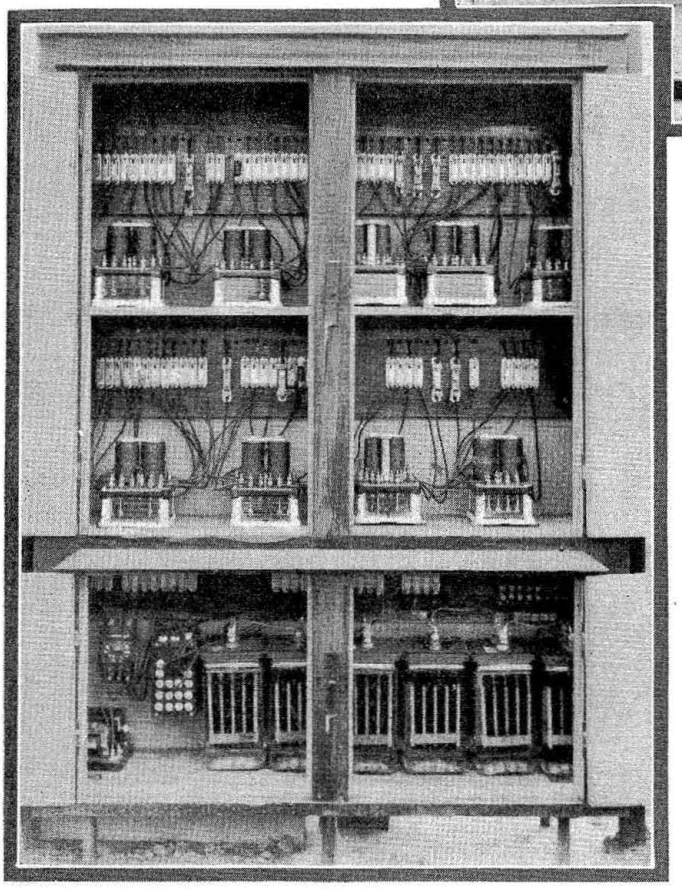
The line control circuits are on No. 10 hard-drawn solid-copper wire with weatherproof covering, and are carried on double-petticoat glass insulators.

The 440-volt power line is protected by 750-volt arresters, located on the pole at the signal location where the power line is tapped as well as on the first pole in each direction. The line control circuits are carried from the line pole to the case in a 12-conductor manufactured cable. On entering the case, the 440-volt circuit is taken through insulated plug cut-outs and then to the 440-volt line transformer for feeding the rectifier and lights.

Right—Lower section of instrument case at track-cut location showing charging equipment and track battery

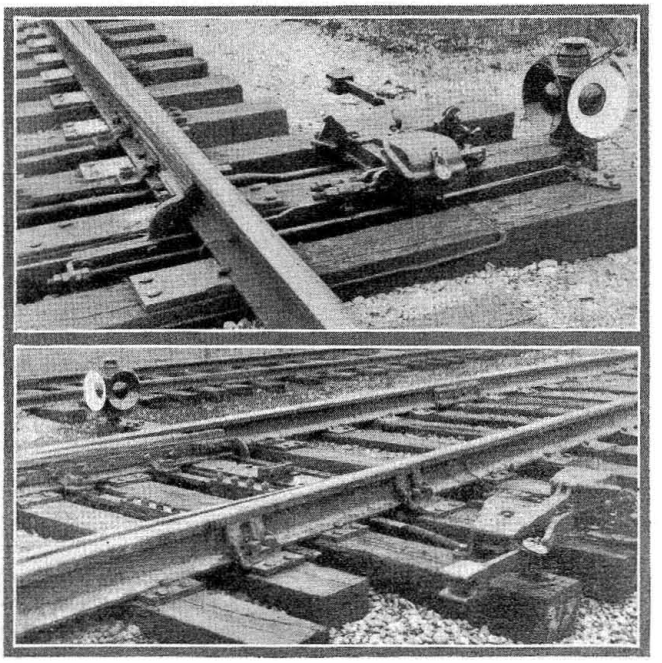
Lower—Interior view of instrument case at signal location. Lower section used for battery and charging equipment





### Instrument Cases of Wood

The instrument cases are made of well seasoned wood, with double doors in front and a removable false back held in place by screws. Six ¾-in. by 30-in. anchor bolts extend upward from the concrete foundation. A 6-in. section of 1-in. pipe is placed over each bolt, and a strap of ¾-in. by 2½-in. iron fits over each pair of bolts. The case fits over these bolts onto the straps and the nuts are tightened inside the case to hold it down. This construction keeps the wooden case off of the foundation, thus preventing rotting at this point. At each end of the case a second-hand 2½-in. pipe extends out of the founda-



Two views of manually-operated switch and lock movement installed on main-line switches

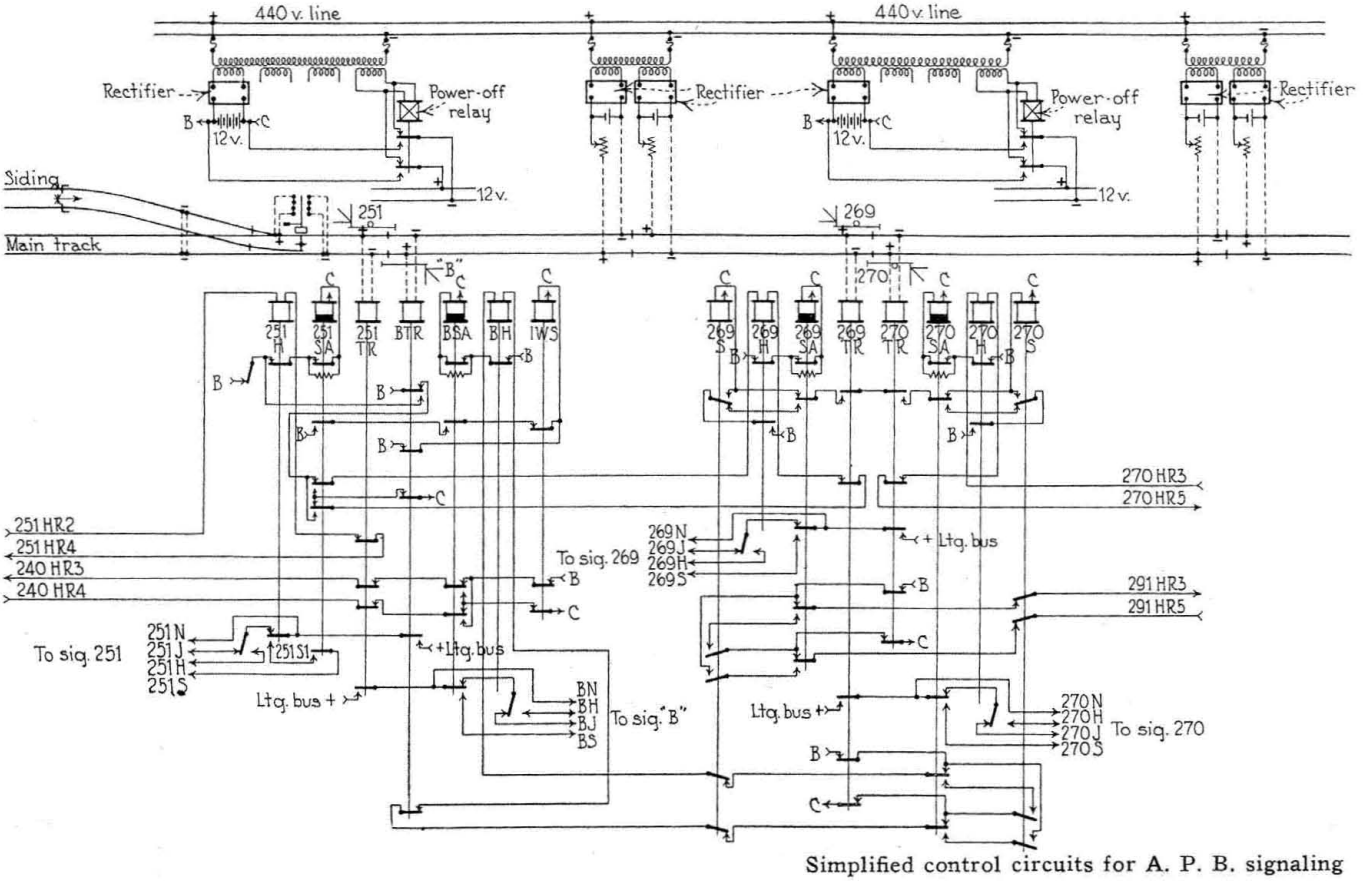
tion to a point several inches above the case; these pipes serve as braces for the case and also as cable posts.

In the concrete foundations a 90-deg. fiber conduit elbow runs down from the top and out underground towards the track. The wires are brought into the space at the back of the case, each wire passing through a hole above the arrester or terminal mounted on the front of the panel. Lightning arresters are used on all low-tension line circuits. The ground rods are ¾-in. by 8-ft. One rod is used at each of the three line poles, one at the relay case and one at the telephone box.

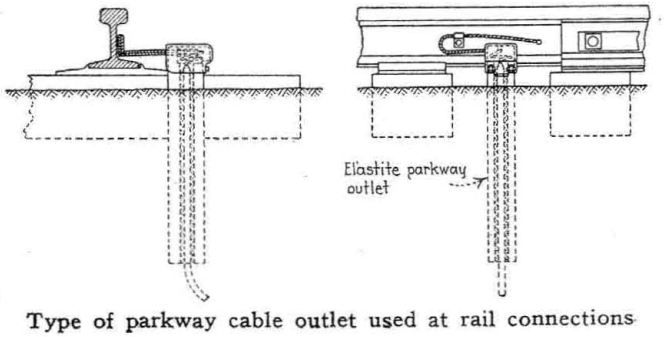
The relays for the westbound signals are mounted on the top shelf and those for the other direction of traffic on the second shelf. The rectifiers, transformers, power cut-out plugs and the battery are on the lower shelf. The transformers have secondaries for lighting and for rectifier charging.

The line relays are 1,000-ohm, the track relays 4-ohm and the slow-acting relays, 500-ohm. The slow-acting relay has a special control, its pick-up being retarded by means of a 500-ohm resistance unit which is shunted by a front contact in the relay. The purpose of retarding the pick-up of the slow-acting relay is to prevent an instantaneous clear signal, when a light locomotive passes the signal ahead, which would happen, on account of the slow-acting relay controlling the clear control in the rear. All relays are placed on coiled springs to absorb shock.

The signals are lighted from the a-c. power, except in case of a power outage, when a power-off relay switches the circuit to the storage battery, which is used normally for line circuits only. One cell of storage battery is used on each track circuit. All batteries are charged by copper-oxide rectifiers, the charging rate being set at 25 per cent above the average discharge of the circuit.




**Simplified control circuits for A. P. B. signaling**




**Type of parkway cable outlet used at rail connections**

The underground wiring is in parkway cable, No. 9 single-conductor being used for rail connections and seven-conductor No. 14 parkway for underground runs from the instrument cases to the signals. The details of the parkway outlet at the rail are indicated in an accompanying drawing.

All rail joints are bonded with duplex cable bonds welded to plugs which are driven into ⅜-in. holes in the web of the rail. The bonds are on the outside of the rail and are held in place by one clip near the middle of each bond.

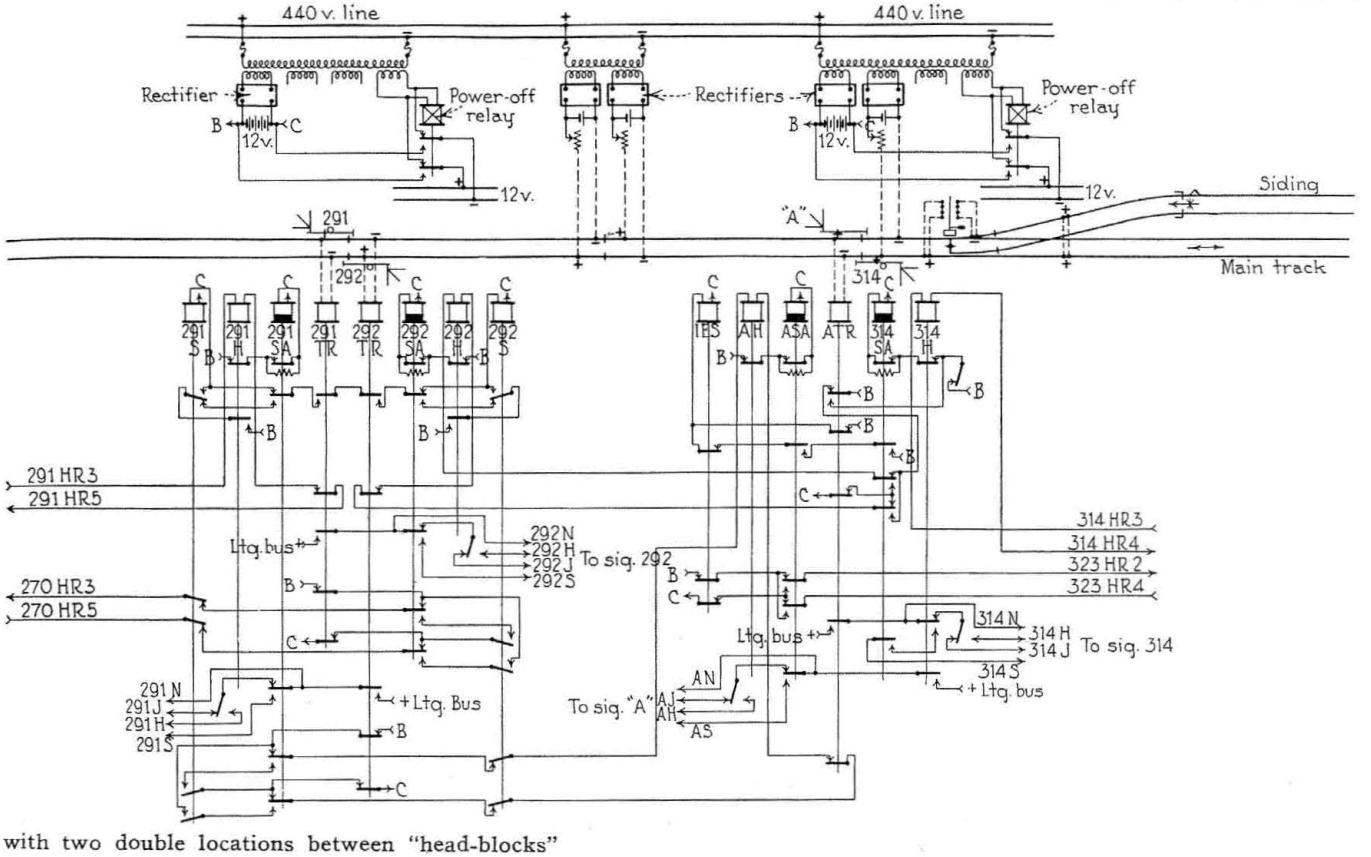
### Special Protection for Switches

At the time the signals were installed, each main-line switch was equipped with a manually-operated mechanical switch and lock movement, as shown in the illustration. A circuit controller, connected so as to shunt the track when the lock plunger is withdrawn, is incorporated as a part of this mechanism. For these shunt connections to the rail, bare stranded cables are run along the ties and held in place by staples, the ends being plugged into the rail. A

hand-thrown sliding type derail is placed at the fouling point on every main-line turnout, and a switch circuit controller is connected to and operated by the derail.

### Construction Organization

The work of installing the automatics was in charge of two general foremen, who reported to the supervisor of telegraph and signals. One of the general foremen had charge of the section between




with two double locations between "head-blocks"

Xenia and Fosters, and the other the section between Xenia and New Paris. All of the forces in the respective territories reported to the general foremen. It was the duty of the general foreman to distribute material to the gangs, supervise the construction work and keep the office informed of material needed and other matters necessary for the prompt completion of the project.

In order that trained signalmen could be used more advantageously at signal work, the concrete work of making case and signal foundations was handled by contract. A competent signalman was placed

---

**Operating Rules Issued by Division Superintendent to Govern Automatic Signals on Single Track**

Rules 551 to 564 inclusive, will not be effective except by special instructions.

*551.* (See standard signal aspects).

Rule 276 indication amplified as follows:

Indication—Stop—then proceed in accordance with Rule 509, 559 or 660.

Rule 277, last paragraph of indication amplified as follows:

For other trains—Stop—then proceed in accordance with Rule 509 or 559.

*555.* Block signals govern the use of the blocks but unless otherwise provided do not supersede the superiority of trains nor dispense with the use or the observance of other signals whenever and wherever they may be required.

*555a.* On portions of the railroad so specified in the timetable, when a train that has no work short of the next meeting or passing point, receives permission from the signalman or a home or block signal indication authorizing it to proceed, it may, unless otherwise directed, run ahead of superior trains in the same direction it is moving, clearing superior opposing trains as prescribed by the rules. A train that has work between two meeting or passing points must clear all superior trains in both directions as prescribed by the rules between those points. All the rules and special instructions that apply to opposing trains remain in effect.

*555b.* (Blank).

*555c.* A train having passed beyond the limits of a block must not back into that block without orders from the superintendent except that while shifting at an interlocking station movements may be made beyond the home signal by permission of signalmen and under protection as prescribed by Rule 99. Signalmen must not give permission for such movements when there is a train between the point where the move is to be made and the next block station where a signalman is located, which has been authorized to move in the direction of the former point.

When permission has been given for a movement beyond the home signal, signalmen at that point and at the next block station must know that it has been made before admitting another train to a block either at or between their stations to move in the direction of the point where such movement is being made.

*555d.* Signalmen will not permit a train to enter a block at a hand-operated switch without permission from the superintendent if there is a train between the block stations on either side of it where signalmen are located which has been authorized to move towards the switch where the train is to enter the block.

When a train has been given permission to enter a block at a hand-operated switch the signalmen at block stations on either side of that switch must know that it has entered the block before admitting any other trains to a block at or between their stations to move in the direction of that switch.

Signalman will arrange with conductor or engineman of a train desiring to enter a block at a hand-operated switch to give him information regarding passing trains on the main track, and will also arrange with them that after having received permission for their train to enter the block, to advise him when such movement has been made.

*555e.* When a train clears a block at a hand-operated switch, the conductor or engineman must report clear to the signalman.

A train must not enter a block at a hand-operated switch without permission from the signalman, and after receiving such permission it may proceed to the next block signal not exceeding 15 mph., expecting to find a train in the block, broken rail, obstruction or switch not properly set.

*556.* Lights must be used upon all block signals from sunset to sunrise and whenever the signal indications cannot be clearly seen without them.

*557.* Signalmen must not admit a train to an occupied track between home signal and the net signal in advance without first stopping the train.

ENGINEMEN AND TRAINMEN

*558.* (Blank).

*558a.* Engines or trains assisting a train ahead, and trains being assisted by another engine or train pulling, may pass stop-and-proceed signals in stop position without stopping.

*559.* When a train is stopped by a stop signal located at the entrance to a block it must stay until the signal displays an indication authorizing it to proceed, except that:

(A) If authorized to pass it at stop, the train may proceed not exceeding 15 mph. to the next block signal, expecting to find a train in the block, broken rail, obstruction or switch not properly set.

(B) If means of communication have failed, and should no cause for detaining the train be known, it may proceed, when preceded by a flagman, to the next point of communication or to the next block signal that displays either approach, approach-restricting or clear indication, expecting to find a train in the block, broken rail, obstruction or switch not properly set.

Except while being governed by Paragraph B, when a train is stopped by a stop-and-proceed signal it may proceed at once not exceeding 15 mph., expecting to find a train in the block, broken rail, obstruction or switch not properly set; if the train is preceded by a flagman because of having passed a signal at stop where means of communication had failed, the flagman must continue to precede the train to the next point of communication or to the next block signal that displays either "approach, approach-restricting or a clear" indication.

Note.—When a train is stopped by an automatic block stop signal, where means of communication have failed, the permission to proceed preceded by a flagman to the next point of communication or to the next signal displaying either approach, approach-restricting or clear indication, as prescribed by paragraph B of Rule 559, does not apply to interlocking and other stop signals.

*560.* When a train is stopped by a block signal which is evidently out of order the fact must be reported to the superintendent.

*561.* Both switches of a crossover must be open before a train starts to make a crossover movement, and the movement must be completed before either switch is restored to normal position.

*562.* Where switch indicators are used, the indications displayed do not relieve enginemen and trainmen from protecting their train as required by the rules.

*563.* Unless otherwise directed, when two or more trains or engines have been coupled and so move past any block station, they must be separated only at a block station and the signalman notified.

*564.* Excessive use of sand at any point is prohibited, and its use must be restricted to actual necessity in automatic block signal territory.

with each of the contractor's gangs, as an inspector to locate the foundations, inspect the contractor's work and to keep the general foreman informed of material needed. Another advantage of contracting the construction of the foundation was the fact that this work was rushed through to completion before freezing weather set in. The remainder of the signal work continued through the winter.

Working plans were made at the office at Xenia. On account of the cold weather, it was found that a great amount of time could be saved by wiring the cases in the tool cars and setting the cases completely wired on foundations, with the exception of hooking up the relays.

A signal gang, consisting of approximately 15 men, an assistant foreman and a foreman, was given a stretch of 7 to 10 miles, depending on conditions. This gang completed the bonding, erected the signals, wired the cases and did all the other work.

The bonding was done with power bonding machines, several machines being concentrated on a foreman's section, and when the work was done the drills were transferred to another gang.

### Circuit Checking

The testing was handled by a crew of six men. First the track circuits were all adjusted and polarities tested. A line check was made by opening the relay points on all line control circuits and observing the action of the signal in the rear in each instance. The same test was made for the caution indication. The hook-up of all relays, transformers, etc., was compared with the working plans. A local point check was made; for instance, the control of the stick relays, slow-acting relays and H-relays was checked locally. An actual performance test was made by observing signal performance during normal train movements. Telephones at each location facilitated these tests. By the use of track shunts, each track circuit was tested and checks made at the same time to see that the signals corresponded in each instance. The double-caution feature of signals at head-blocks was checked to see that a train hitting the tripping point would hold its signal against another train approaching in the opposite direction. The test man on this division spent about two weeks with each maintainer, giving him instructions on methods of testing, maintenance, and locating troubles.

One of the signal construction gangs on the Pennsylvania's recent single-track project in Ohio. At extreme right are three "aces" who were transferred from the Western region to assist on this recent work