

South Milford interlocking is controlled from Richmond 37 miles away

A COORDINATED program of improvements in track arrangements and signaling is now well under way on the Richmond, Fredericksburg & Potomac between Richmond, Va. and Potomac Yard, Alexandria. This program includes central control of interlockings, higher speed turnouts and crossovers at interlockings, coded track circuits, respacing of wayside signals to accommodate higher train speeds, the installation of electric locks on all main-line switches and train operation in both directions by signal indication.

The R.F.&P. connects with the Pennsylvania and the Baltimore & Ohio at Washington, D. C., and Potomac Yard, and with the Atlantic Coast Line and Seaboard Air Line at Richmond. During the winter months, approximately 40 passenger trains and 26 freight trains are operated daily over this line, a large amount of the freight traffic being perishable freight from the south. Within the last two years, the R.F.&P. has purchased 41 diesel-electric locomotive units, which is sufficient to handle normal traffic. Overflow passenger traffic will be operated by steam locomotives.

The first step of the improvement program was to lengthen passing tracks and yard tracks to accommodate 165-car trains, and to install No. 15 and No. 20 crossovers and turn-

outs at interlockings, so that train movements could be made at medium speed of 25 m.p.h. When entering or leaving passing-track or yard locations, there are two crossovers between the two main tracks, and either one or two switches entering sidings or multiple track. The track layouts, being similar at these locations, permitted the use of templates for a large majority of the signal circuits, thereby saving considerable time in circuit design.

Centralized Control for Interlockings

The next step in the overall program was to consolidate interlocking controls, the railroad being divided in this respect between terminal areas and line-of-road. A desk type control machine, now in

service at Richmond, controls three line-of-road interlockings, and it is anticipated as the program develops, that the control will be extended to include a total of 10 interlockings. The control machine at Richmond is located in the dispatcher's office on the second floor of the Broad Street Station building, and controls interlockings at South Milford, Milford and Quantico.

The layout at South Milford includes one switch, two crossovers and five home signals. A siding extends from South Milford to Milford, where the layout includes three crossovers and six home signals. The siding is signaled for operation in both directions, and serves as a passing track for both northbound and southbound trains. The main

Signal Modernization

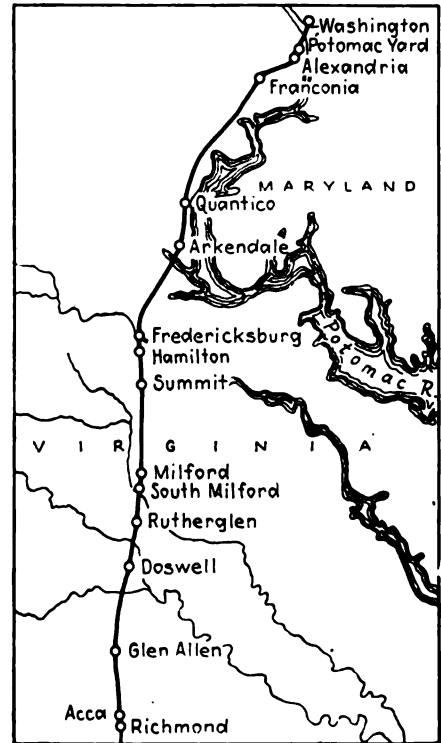
On 107 miles of double track, the control of interlockings is to be centralized—cab signals and train control are to be arranged for train movements in both directions on both tracks—thus forming a coordination program to increase track capacity and to keep all trains moving

tracks between these interlockings are also signaled for operation in both directions and may also serve for passing trains. At these remote control interlockings, the home signals are non-stick controlled, and will clear automatically after a train passes beyond the control limits, unless the controlling lever is restored to normal. Time locking is used on all home signals.

In the terminal area at Richmond, an electro-pneumatic interlocking, known as "JR", is located at Broad Street Station. The signal functions are controlled by a Model-14 interlocking machine installed in 1921 which is located in a separate building on the opposite side of the tracks from the station. The control of this interlocking is being moved into the station master's office to a miniature-lever desk-type machine. This change will permit much closer coordination between the station master and operator regarding trains moving in and out of the station, in the changing of locomotives and the cutting in and

out of passenger equipment. The Model-14 interlocking machine in the old tower will be removed. All relays in connection with the new machine will be located in the old tower, and a 151-pair, 22-gage telephone-type lead cable will extend from the machine to the old tower. New CP electro-pneumatic switch valves have been installed to replace existing Type-C switch valves, and additional circuits were added to provide for the removal of the mechanical locking. Additional signals and track circuits were installed to provide flexibility when handling 18 or 20-car passenger trains.

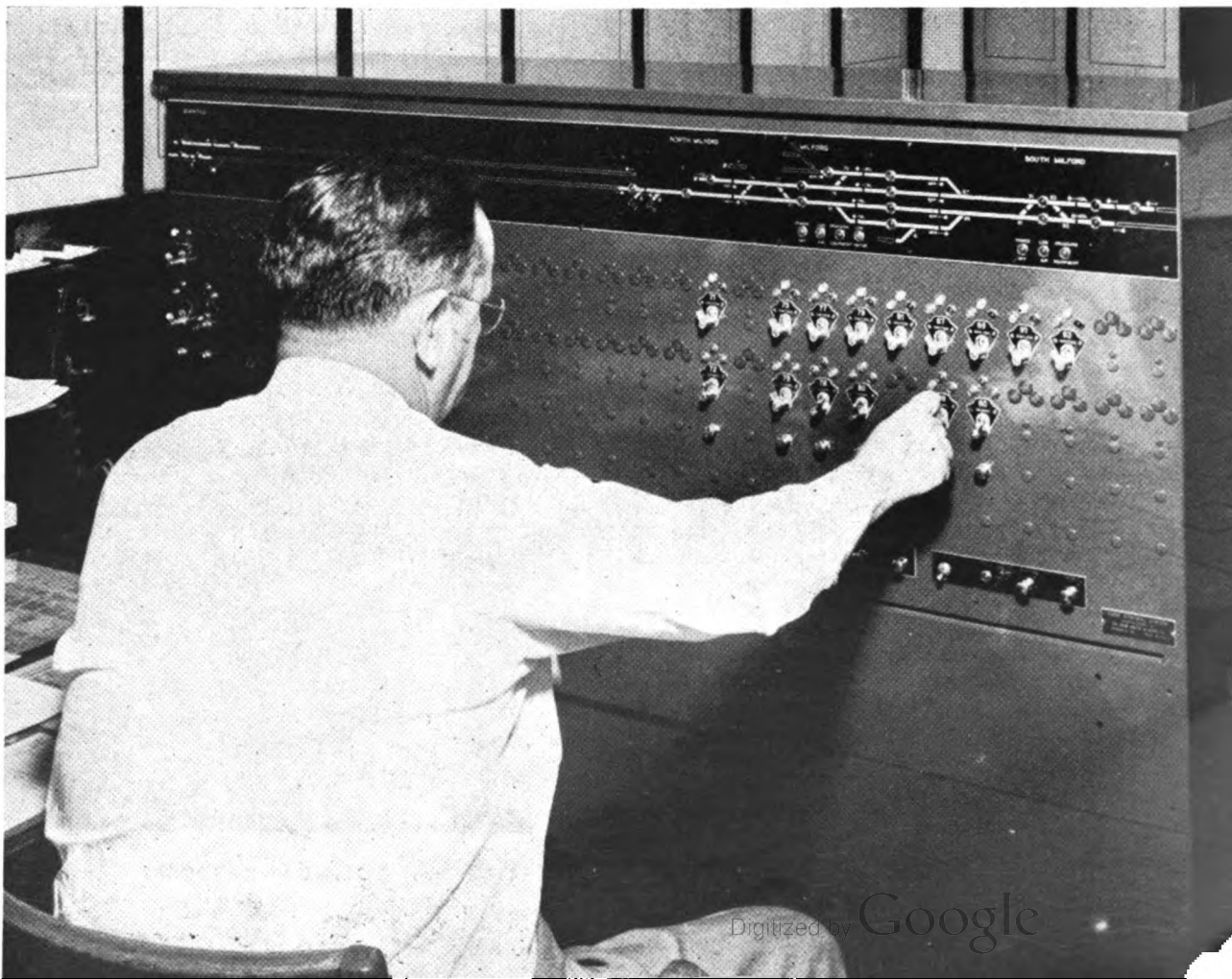
"AY" interlocking is located at the south end of Acca freight yard, Richmond. This location is also the entrance to the Acca engine terminal, and is the junction point for Atlantic Coast Line and Seaboard Air Line trains. The electro-pneumatic interlocking at this location was installed in 1919, and is controlled by a Model-14 interlocking machine. "NA" interlocking is located at the north end of the Acca freight yard,

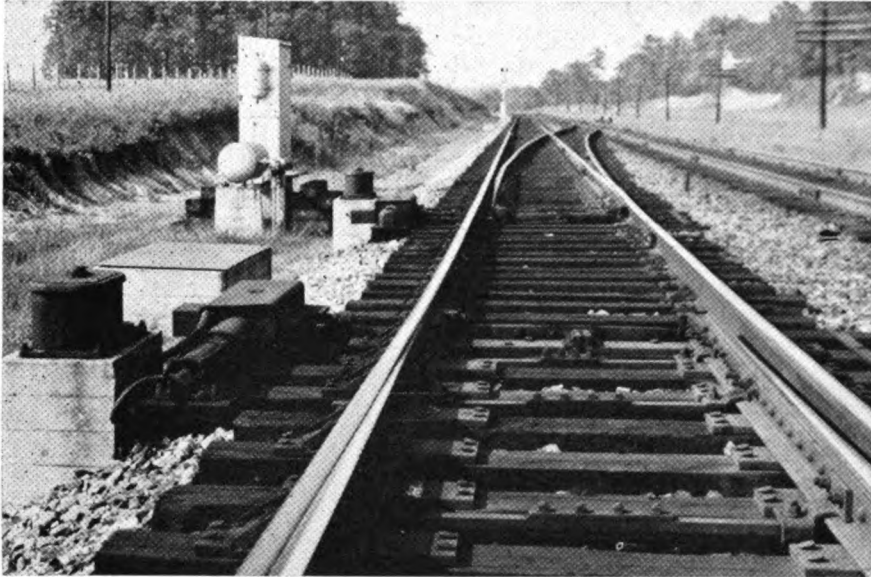


and is an electro-mechanical interlocking installed in 1913. "GN" interlocking, near Mile Post 5, is located at the north end of four tracks. This is an electro pneumatic plant installed in 1945. The interlocking was originally controlled by a Model-14 machine. This machine has

Program on the R. F. & P.

This machine in dispatcher's office is for the remote control of the interlockings





The switches at outlying interlockings are operated by electro-pneumatic machines

been removed, and the interlocking is now controlled from "AY" tower by code.

The old electro-mechanical interlocking at "NA" is being abandoned to provide room for the extension of yard tracks, and a new electro pneumatic interlocking is being installed approximately one-half mile north of the present interlocking site, this new interlocking to be remotely controlled by code from "AY" tower. The present "AY" interlocking is being modernized and arranged for relay operation, replacing Style-C switch valves with Style-CP switch valves, semaphore signals with color-light type, and the Model-14 interlocking machine with a miniature-lever desk-type machine. This new machine will contain the control for functions at "AY", new "NA" and "GN" interlockings.

In the terminal areas at Alexandria, there are seven interlockings controlled from two towers. "AF" interlocking is located at the south entrance to Potomac Yard, and at the junction with the Southern railway. Freight trains, including those of the Southern railway and C.&O. railway, enter and leave Potomac Yard at this location. "AF" interlocking is an electro-pneumatic plant which was installed in 1921, and is controlled by a Model-14 interlocking machine. One 2-½ foot desk type machine is located on each end of the Model-14 machine. The machine on the south end controls Seminary interlocking, which consists of one switch leading to the

Southern railway, used by south-bound Southern and C.&O. passenger trains, in addition to R.F.&P. trains. This same machine also controls, by code, South Franconia interlocking, which is a junction point on the R.F.&P. from two-track to three-track operation. The machine on the north end of the Model-14 machine controls, by unit wire, North Alexandria interlocking. This interlocking consists of the control of four crossovers connecting the two passenger tracks with the two freight tracks at the south end of Potomac Yard.

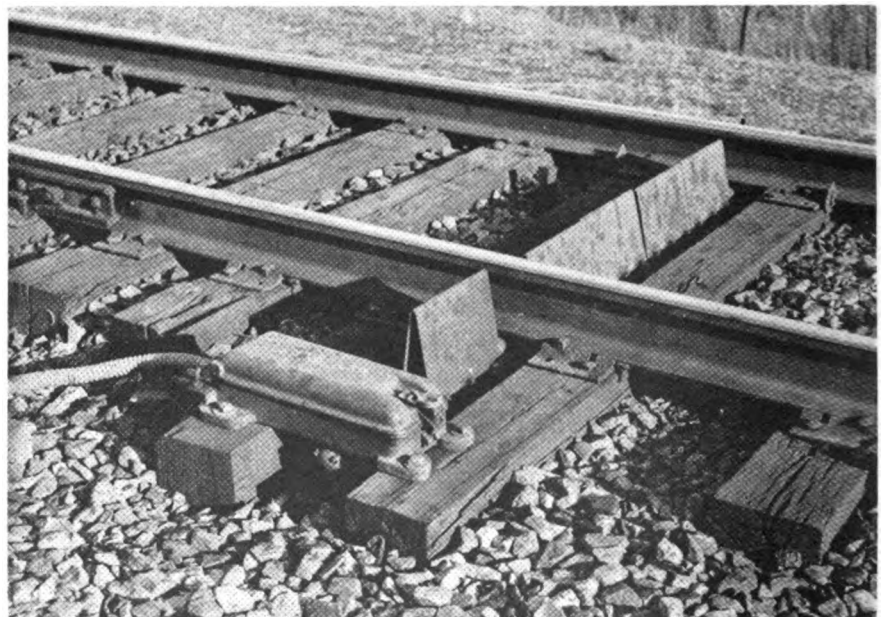
"RO" interlocking is located at the north end of Potomac Yard, and is the junction point between the R.F.&P. and Pennsylvania railroads. This is an electro-pneumatic interlocking and was rebuilt in 1935. In addition to controlling the signal

functions at "RO", two departure-track switches for freight trains leaving Potomac Yard are power operated and remote controlled from "RO" tower. Installation is now under way to power operate two receiving-track switches for trains entering Potomac Yard, the control of these switches to be from miniature levers located on the track model in "RO" tower.

Remote Control Circuits

Unit-wire, conventional code and carrier are all being employed to remote control interlockings. A line circuit, consisting of two No. 9 bare copper wires, extends from Richmond to Quantico, and line-of-road remote controlled interlockings are being controlled over this pair of wires by utilizing carrier. The R.F.&P. program for consolidating the control of a series of remote interlockings at one point required more control and indication channels than are readily available in the standard narrow-band carrier in the 10-to-30-kc. range. To obtain the channels required, the R.F.&P. adopted the broad-band, narrow-band coded carrier control system, which was recently developed and introduced by the Union Switch & Signal Company.

In the broad-band, narrow-band system, controls and indications are carried by broad-band carriers be-



Self-restoring type of dragging - equipment detector at Penola

tween terminals at the control point and one or more field locations. The necessary channels for the controls and indications of the various interlockings are obtained by using a group of narrow-band carrier frequencies to modulate each broad-band carrier. Thus, separate broad-band carrier frequencies transmit each group of narrow-band carrier frequencies in a separate "compartment". Since the frequencies assigned to each group of narrow-band carriers can be repeated in each "compartment", the controls and indications of an extensive series

"control" broad-band carrier are assigned, one each, to handle the controls at Milford, South Milford, North Milford and Quantico. Likewise, the narrow-band carriers modulating the "indication" broad-band carrier are assigned, one each, to handle the indications at those four points. Additional broad-band and narrow-band carriers can be added as the signaling program progresses.

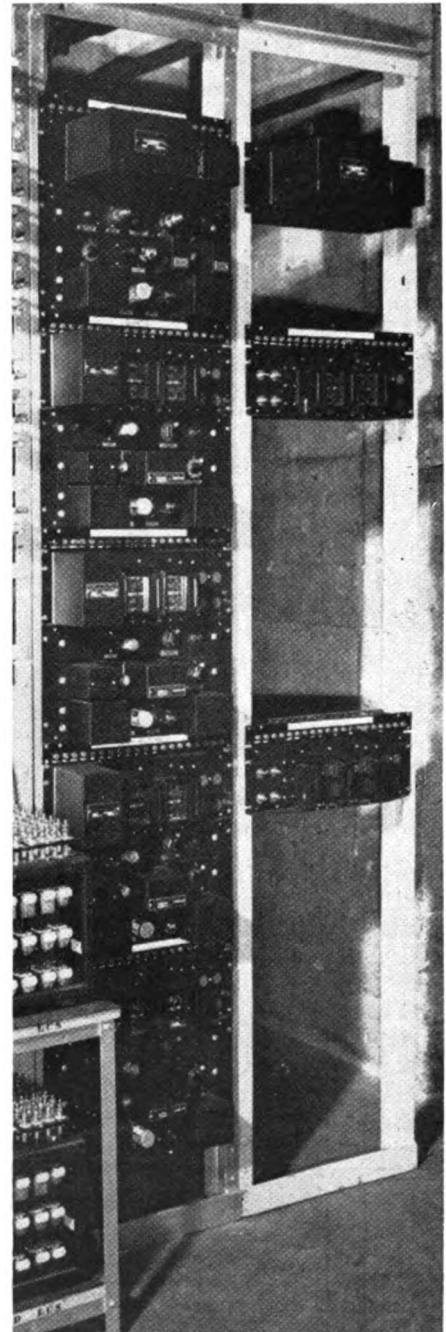
As mentioned before, the system is handled on a circuit of two No. 9 bare copper line wires over most of the territory, although the circuit is carried in a cable from Richmond north for 7,154 ft., and in various other sections totaling about 15,000 ft. Primarily because of high attenuation in the cable, a repeater was installed at Doswell, which is 25 miles north of Richmond. In this

divided as follows: the top panel is the relay-filter panel; the second is the receiver panel; the third, transmitter; and fourth, the power supply. As used on the R.F.&P., the panels are mounted on commercial racks, although they can also be mounted on individual racks. The receiver, transmitter and power supply panels can also be mounted in cases, using a different relay-filter



Narrow band and broad band control equipment in Milford relay room

Broad band and narrow band control equipment in Richmond office room



of interlockings can be confined to a relatively narrow range of frequencies handled by a few broad-band carriers.

At the present stage of progress, two broad-band carriers are in service between Richmond and Milford, one handling controls and the other indications. Each of these broad-band carriers is modulated by four narrow-band carriers. The narrow-band carriers modulating the

connection, it is interesting to note that with the broad-band, narrow-band system, each modulated broad-band carrier can be handled by a single repeater.

At Richmond, there are four single-station coding units, which pulse-modulate low-frequency transmitters of 0.84 kc., 1.24 kc. and 1.99 kc. These frequencies, in turn, modulate a broad-band repeater. At Milford, which is 41 miles from Richmond, the 55-kc. signal is demodulated, leaving the low frequencies. There are four receivers, each responsive to one of the frequencies listed above. The receivers each control a d.c. line and, in turn, a single-station coding unit, one coding unit at each interlocking. One unit is spare and can be used to replace any of the other three. The indication codes are handled by the same group of low frequencies, these modulating a 75-kc. broad-band carrier which is also amplified at Doswell.

A further feature of the installation is the use of new panel-mounted carrier equipment. This equipment is made up of four panels,

assembly to permit mounting it on the top of existing cases with only slight modification.

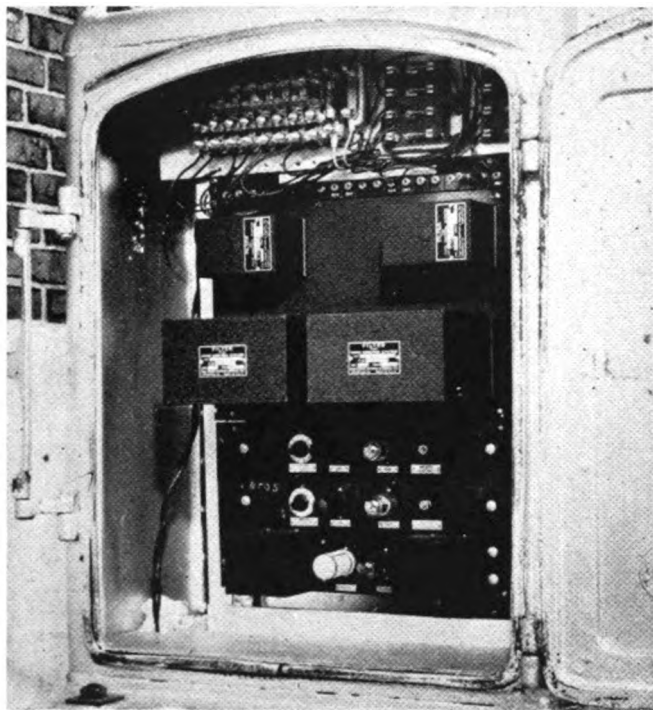
Since the panels are interchangeable, this arrangement permits maximum flexibility with respect to installation and maintenance. Any one, or a combination of the three mountings can be used; and if it is de-

sired to change out one element, for example the transmitter, it is not necessary to change out the entire carrier unit.

The conventional one-station, 32-step, Form-510 time-code control system is installed at Milford, North Milford, South Milford and Quantico. At Richmond Station, the code and carrier equipment, as well as relays and other apparatus are located in the basement, and at Milford this equipment is located in a sub-tower. The repeater equipment at Doswell is located in a signal

basis and, in order to reverse traffic the block must be unoccupied and polar circuits reversed. This action will knock down all track relays and start code from the exit end of the block, to pick up each track relay in turn throughout the block. If this code is not received at the entering end, the signal cannot be displayed. By the use of stick relays after direction of traffic has been established following moves may be made as in double-track operation. The failure of one track circuit after traffic has been established will

are located approximately 1 1/2 miles before reaching the approach signal to the interlocking. When dragging equipment actuates the detector, a Restricting cab signal is displayed in the locomotive, and the approach signal displays a flashing-red aspect, indicating that the dragging equipment detector has been actuated and the train must be inspected. Indication that the dragging-equipment detector is operated is also sent to the dispatcher's office in Richmond, or if approaching either terminal area, to the controlling tower. After the train has stopped and inspection has been made, a push button located on the signal displaying the flashing-red aspect is operated to reset the dragging equipment circuit, which per-



The broad band repeater equipment is in this case near Penola

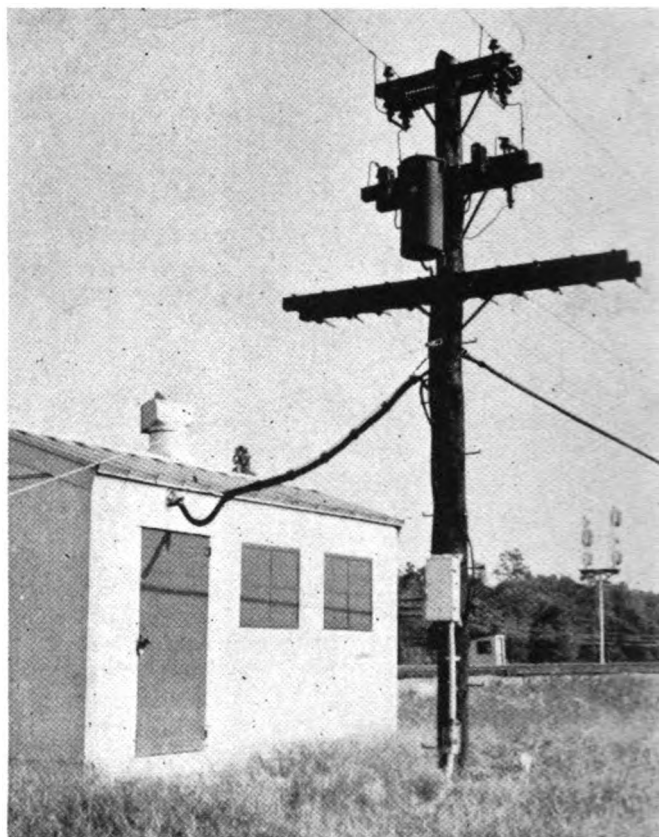
case. At other locations, the necessary signal apparatus is located in sheet steel houses.

Track and Traffic Circuits

The present 60-cycle a.c. track circuits, using a Model-15 two-position track relay, are being changed to 60-cycle a.c. coded track circuits, except at interlockings, where they are being replaced by neutral d.c. track circuits with a.c. code superimposed on the track for operation of locomotive train control and cab signals.

Traffic circuits are being installed to permit the operation of trains in either direction on either track. The traffic circuit consists of one line circuit for each track with a common return. One series polar and one series neutral relay is required at each signal location. This circuit is normally energized, indicating no train in the block and the entering signal not displayed. The traffic circuit is designed on a non-vital

A line pole and a sheet metal house at remote controlled interlocking



not tie up the block as in conventional A.P.B. signaling.

The present two-speed train control and three-indication cab signals, operating on the loop inductive system, were installed in 1928. The loop equipment is being replaced by code equipment, the three-indication cab signals by four-indication cab signals, and the two-speed feature of the speed control is being retained.

Dragging Equipment Detectors

Self-restoring dragging equipment detectors are being installed approaching certain interlockings, and

mits the normal indication to be displayed by the approach signal.

Automatic signals are being spaced to provide approximately two-mile blocks. At some locations, where local conditions do not permit this distance, adequate braking distance is provided for by use of the Approach-Medium signal aspect. This signaling program has been planned and is being installed by the railroad's forces under the direction of V. P. Shepardson, engineer signals and communications. The major items of signaling equipment are being furnished by the Union Switch & Signal Company.