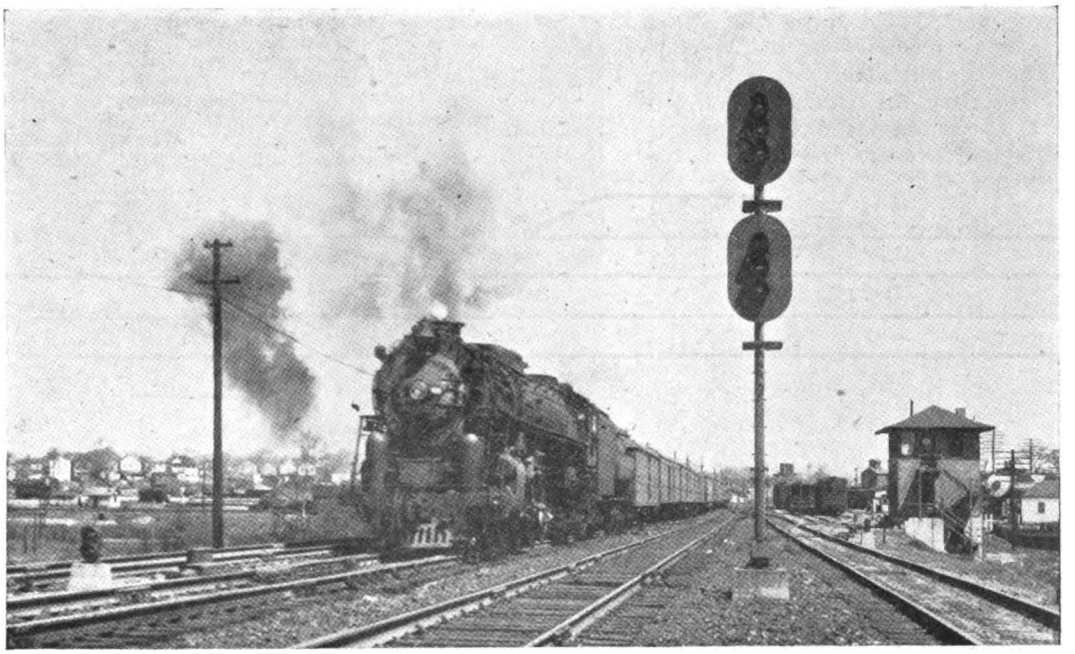


A view looking north in the new interlocking at Fredericksburg, northward signal 24L and the tower at right

All-Relay Interlockings On the R.F.&P.

Switching moves facilitated, operating flexibility provided and safety improved by plants at Fredericksburg, Va., and Alexandria, Va.

THE Richmond, Fredericksburg & Potomac has installed two all-relay control interlockings, one at Fredericksburg, Va., and the other at Alexandria, Va. The track layouts, methods of control and circuits in the two plants are quite different and, therefore, will be explained in detail separately.

Fredericksburg Plant

Previous to the recent construction, no interlocking was in service at Fredericksburg, the various switches and crossovers being operated by hand-throw stands, and movements crossing over between the main tracks were protected by flagging. The track layout of the new interlocking, known as "FB," is shown in Fig. 1. Team tracks and industrial spurs are located on both sides of the main tracks. Switch engines and local freight-trains make numerous switching moves crossing over the main tracks to spurs on the other side. Approximately 50 passenger-trains and 50 freight-trains are operated through Fredericksburg daily. In addition, the local freight-trains and switch engines make numerous moves through the interlocking.

From Fredericksburg south for a distance of approximately 3½ mi. there are northward and southward freight running tracks in addition to the two main tracks. These running tracks connect to the main tracks in "FB" interlocking through crossovers 33 and 23. A mechanical interlocking known as "WH" is located where these running tracks connect to the main tracks on the south end. Construction work is now in progress to abandon this mechanical plant by the installation of power switch machines and signals controlled from "FB" by means of code. Freight-trains using the running tracks may take water, and at the same time clear the main tracks for passage of faster trains. These tracks are also used to run through passenger-trains around local passenger-trains.

The Interlocking Control Machine

The interlocking control machine panel is 5 ft. long with spare space at both ends to allow for additional levers for the control of other layouts. At present, the panel has 6 switch levers to control 1 switch and 5 crossovers, and 6 signal levers to control 11 signals. Each switch lever has three indication lamps, the one at the left is lighted green when the switch is normal, and the one at the right is lighted amber when the switch is reversed. A white lamp above the center of the lever is lighted when electric locking is not in effect to prevent operation of the switch. If the white lamp

above a lever is dark, the towerman knows that he should not throw the lever, and cannot throw the switch. If he accidentally or inadvertently throws a switch lever, while its white lamp is dark, the switch will not operate. In such an instance, he must return the lever to the position corresponding with that of the switch, in order to regain control of the switch.

Thus pre-conditioning of switch controls is prevented. The purpose is to prevent operation of a switch under a train if the towerman throws a lever while a train is on the switch, and at the same time the train fails to hold the shunt on the track circuit. Pre-conditioning of a switch control is prevented by the lock-stick relay, LSR, which is energized by a circuit through contacts in the lever and the switch-repeater relay, so that the lever and switch must correspond, in order for the relay to be picked up. The LSR relay is released when the HSR route check network relay picks up.

A red lamp above the center position of each signal lever is lighted when the signals controlled by that lever are displaying the Stop aspect. When a lever is thrown to the "L" position, and the corresponding signal clears, a green lamp is lighted above the "L" position of the lever. Similarly, when an "R" signal is cleared by moving the lever to the right, a green lamp above the "R" position is lighted.

Direct-Wire Circuits

The circuits in this interlocking are of the direct-wire type. The d.c. control circuits in the interlocking are fed by a set of 12 cells of 112-a.h. Edison B4H storage battery which is on floating charge. A route-check network in the tower proves that a track line up has been made ready for a signal to be cleared, and that no conflicting route is established. If the route-check network is not complete, and the towerman throws a signal lever, the route-check network relay will not pick up. If the route-check network is complete and the towerman throws a signal lever, the route-check network relay will pick up and will make the switch locking effective even if the signal does not clear. Another purpose for the route-check network in the tower is to prevent the operation of any other lever from "knocking off" a signal that has been cleared.

A diagram of some of the circuits is shown in Fig. 2. The lock stick relay LSR is released to lock the switch when the HSR, route-check network relay, picks up, and before the signal clears. The HSR up will drop the approach stick relay ASR, which in turn drops the LSR. The HSR is in the signal control network, and must be up in order for the signal control relay "H" to be energized.

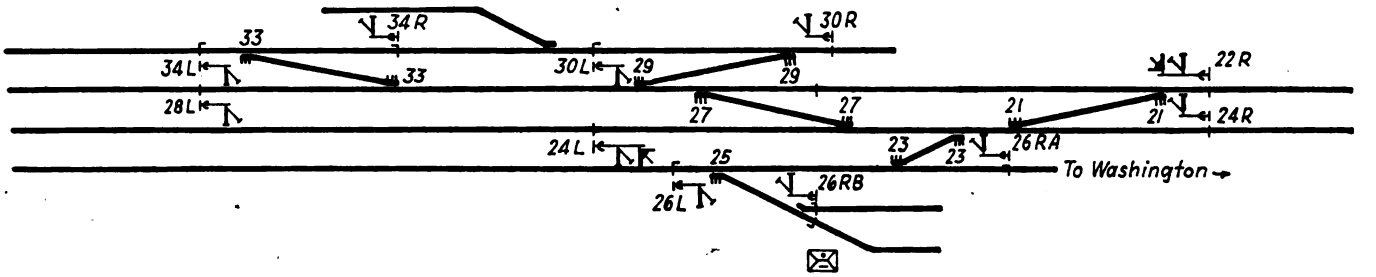


Fig. 1—Track and signal diagram of the new interlocking at Fredericksburg

Relays and Housings

The entire double-track main line of the R.F. & P. is equipped with automatic block signaling including continuous train control and cab signaling, a.c. relays being used on the track circuits because of the loop type of train control. These track relays are the Model-15, vane type.

The switch control relays which are the Model-14 DP polar type, rated at 1,000 ohms, are located in the tower, with control circuits extending to the control magnets for the corresponding electro-pneumatic switch machines. Neutral DN11 d.c. relays are used as switch repeaters. Approach locking is in service on the two normal-direction, high-speed routes, and time locking is in service on the remaining routes. The time periods are measured by DT-10 time-element relays, which are controlled automatically.

The signals on this interlocking are the style R-2 color-light type, the same as is standard on the entire railroad. The signal lamps are the double-filament type rated at 18 + 3.5 watts, 10 volts. The top units of the high signals, 22RA and 24LA, display three aspects: red, yellow or green. The lower units of signal 22R and 24L, as well as the dwarf signals, display red or yellow. Say, for example, that a northbound freight-train is departing from the running track under authority of a yellow aspect on dwarf signal 26L. As soon as the locomotive gets out on the main track, and if there is no train in the first two blocks ahead, a green cab signal will be displayed. This authorizes the engineman to accelerate to normal maximum speed as soon as the rear of his train is through the crossover. Because of lack of room at this location, 23 crossover is a No. 10 instead of No. 15 or 20, as used at other similar locations on the R.F. & P.

Each switch is operated by an A-5 electro-pneumatic switch machine using a Style CP valve assembly. The air pressure for operating these machines is distributed by a main run of 2-in. pipe, with individual ¾-in. pipes extending to each machine. The 2-in. pipe is buried about 2 ft. underground, in the same trench with the underground cables. The air pressure is supplied by two compressors each rated at 20 cu. ft. per min., at 220 r.p.m. Each compressor is directly connected to a 3-hp., 220-volt a.c. General Electric motor. The compressors

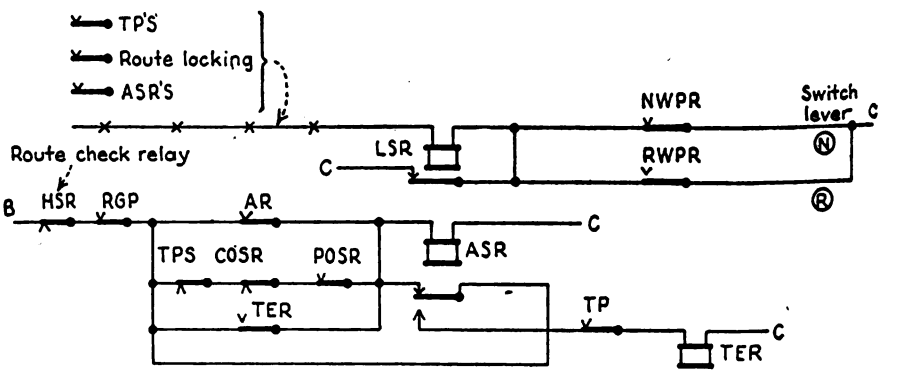
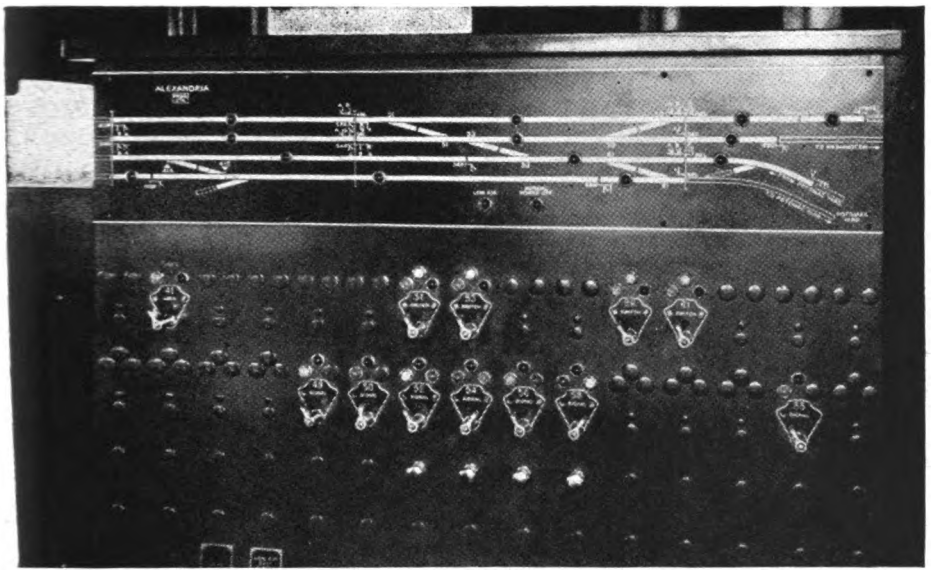


Fig. 2—Pre-conditioning of switch is prevented by the lock stick relay LSR



Interlocking machine for remote control of layout at North Alexandria

are controlled automatically by General Electric Company pressure-controlled contactors. One compressor cuts in at 43-lb. pressure and out at 55 lb. If the pressure drops below 40 lb., the second compressor cuts in automatically.

Wires and Cables

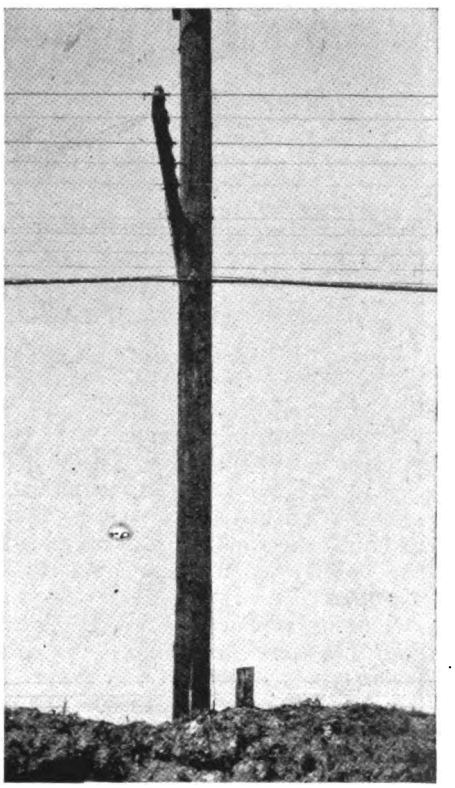
The underground cables enter the tower through a concrete chase, and terminate in a sheet-metal case on the ground floor of the building. This case has a board of ½-in. transite with holes for individual wires to extend from the back to terminals on the front of this board. From the second post of each terminal, a wire extends back through another hole and then through a chase to the relay cabinet or to the interlocking machine. These chases are fire-proof, being made of concrete with sheet-metal covers. The relays are in sheet-metal cabinets with sheet-metal doors which have glass panes. No terminals are used on the boards in these cases, the wires being run from the relay posts up through individual holes in the boards, and from there out through the chase.

For switches and signals within the interlocking limits, the circuits are in underground cable, and the remainder of the longer runs are in aerial cable. Of special interest is the fact that this aerial cable is the new self-supporting type, the cable and messenger being manufactured and installed as a unit. The insulated conductors are enclosed in an asbestos braided covering in the conventional manner, and this cable is attached to the messenger by a spiral wrapping made of a 5/16-in. copper strap. The messenger is made of Copperweld wire. The size of the messenger can be varied depending on the weight and size of a cable. This self-supporting aerial cable was made by the Kerite Company. An advantage of this new cable is the facility with which it can be installed, as compared to installing a messenger with cable rings.

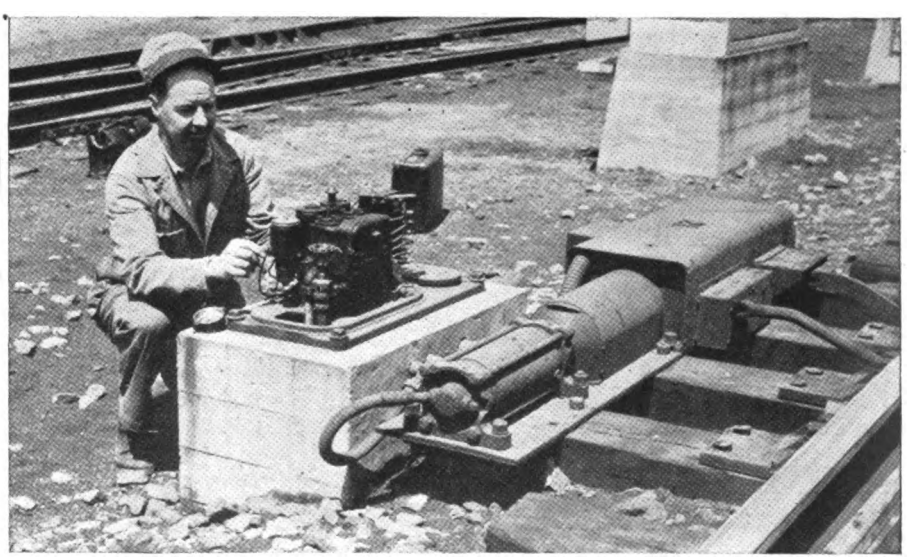
The Alexandria Plant

The track and signal layout of the new remotely-controlled interlocking at North Alexandria is shown in Fig. 3. In this territory the four tracks of the Richmond, Fredericksburg & Potomac are used also by trains of the Southern and the Chesapeake & Ohio. Tracks No. 1 and No. 2 which are used by passenger trains, extend north across the Potomac river and to the Union Station in Washington, D. C. The two tracks, No. 3 and No. 4, are used for freight-trains which enter and depart from the Potomac Yard. Approximately 85 passenger-trains and 100 freight-trains are operated through this territory daily. In addition, numerous switching movements and light-engine moves are made.

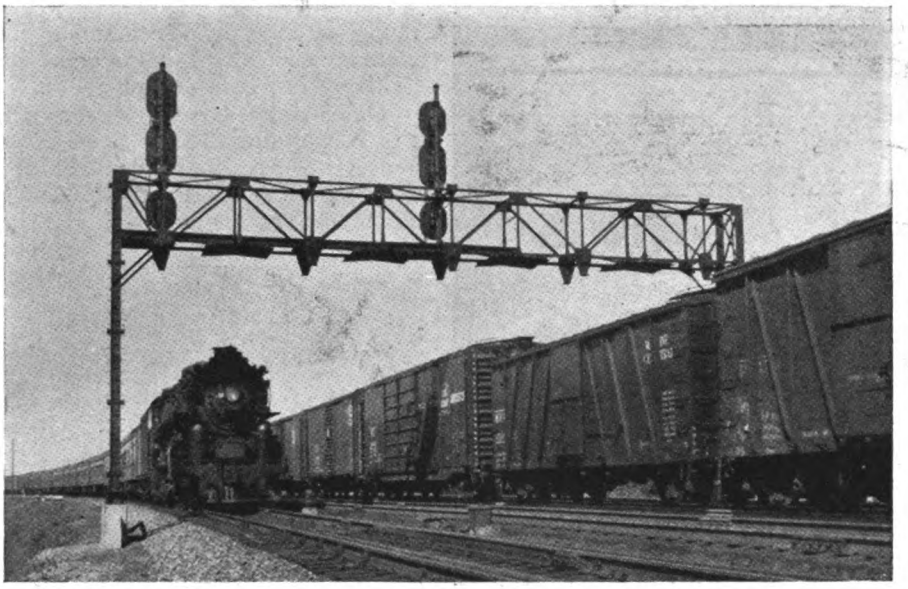
The four crossovers, as shown in Fig. 3, were installed at North Alexandria to increase the flexibility for train movements between this layout and "AF" tower which is 1.5 mi. south. The crossovers 51, 53 and 61 are arranged so that a northbound freight-train on track No. 1, No. 2 or No. 3 can be routed into Potomac Yard on track No. 4. Likewise a freight-train leaving the yard on track No. 3 can be diverted to track No. 2 or No. 1. By means of crossover No.



New self-supporting cable



H. B. Anderson, maintainer, inspecting controls at a switch



Southbound train at Signal 52L at North Alexandria

59, a southbound passenger train can be diverted to track No. 2 to run to "AF." Likewise a northbound passenger train can be run from "AF" to North Alexandria on track No. 1, and be diverted to track 2 via crossover 51.

The interlocking at North Alexandria is controlled remotely from a panel type machine in the tower of the "AF" interlocking, the new panel machine being placed at the north end of the Model-14 interlocking machine for the "AF" plant. The new panel machine for North Alexandria has 12 levers. Four switch levers control four crossovers. One lever, in the same row with the switch levers, controls the electric locks on a hand-throw crossover between tracks 3 and 4, as shown on the plan. Four levers control the eight home signals; two levers control the traffic-direction signals 48L and 50L; and one lever controls the special hold-out signal 66L. The indication lamps on this panel are similar to those on the machine at Fredericksburg as was explained earlier in this article.

An investigation by R.F. & P. engineers showed that the 1.5-mi. distance between "AF" tower and the interlocking at North Alexandria is too long to use direct-wire control circuits economically for the remote interlocking. Further study proved that, for this distance, a circuit scheme using one wire per function would be more economical than a code system using only two line wires, such as applied on numerous C.T.C. installations. In the one wire per function scheme, as applied on this North Alexandria project, two common wires between "AF" and North Alexandria serve in connection with all the circuits; one common for control circuits and one common for indication circuits. One wire between "AF" and North Alexandria, in connection with common, serves two purposes in various combinations. Two rectifiers at the tower, and a similar set at the field location, are used to furnish split d.c. power for feeding polar line circuits. No storage batteries are used.

In this remotely-controlled interlocking a route network is used in the "AF" tower the same as at the Fredericksburg plant. The "L" type relays are used for indications, route-check and lever repeaters. All these relays are mounted in the sheet-metal case of the panel type interlocking machine.

Control of Switch and the Return of a Signal Indication

The upper portion of Fig. 4 shows how one line wire, 51WR & 52GK, is used for the control of crossover No. 51 and also for the return of the indication of signal 52. Assuming that crossover No. 51 has been operated to the normal position by a circuit over the line wire 51WR & 52GK. Then the indication that the switches are over and locked in the normal position goes back to "AF" on line wire 52G & 51WK. In the tower, the relay 51WRNR, which indicates the normal position of crossover 51, is a neutral "L" type relay that is energized by line voltage of either polarity. On the other hand, switch indicator relay 51WKPR, to repeat the reverse position, is a type KP polar relay that picks reverse with NL polarity from the field location.

With crossover 51 over and locked in the normal position, signal lever 52 is thrown to the right. This energizes relay 52HSPR. Back contact 1 of this relay, in the circuit in the upper portion of the diagram, opens the circuit for relay 51WR so that it is released. Referring to the lower portion of the diagram, with back contact 1 of relay 51WR closed, and with 52HSPR up, the circuit from CN

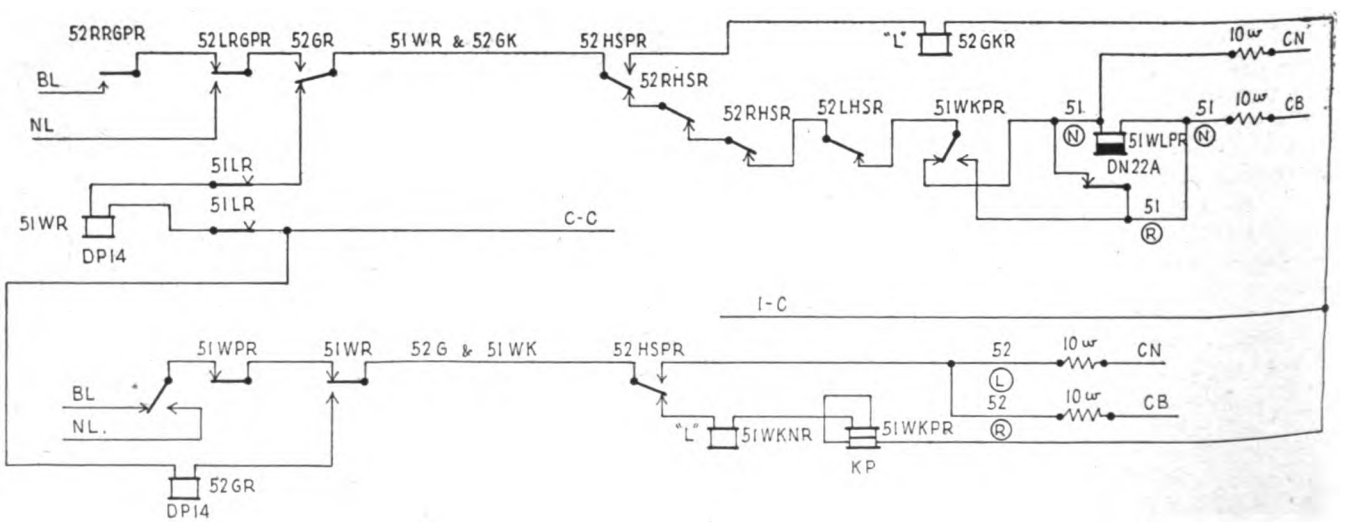


Fig. 4—Typical switch and signal control and indication circuits

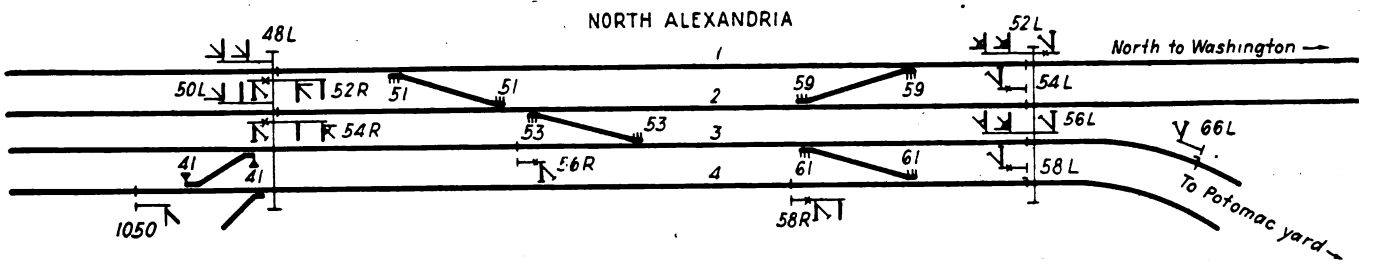


Fig. 3—Track and signal plan of interlocking at North Alexandria

through the 52L lever contact is closed, through front contact of 52HSPR and back contact of 51WR, to energize signal control relay 52GR, which causes signal 52R to clear.

Referring now to the upper section of the diagram with relay 52GR up, when signal 52L clears, the relay 52LRGPR is released, so that NL battery feeds through back contact of 52LRGPR, front of 52GR, over the line wire 51WR & 52GK to "AF," and then through front of 52HSPR to energize indicator relay 52GKR. This lights the lamp above the "L" position of signal lever 52.

Two Call-On Controls on One Wire

When necessary to move a second train into home signal limits which are already occupied by a train, certain signals can be controlled to display a call-on aspect, this being accomplished by positioning the corresponding lever and then pushing a button below that lever. The Fig. 5 shows how one line wire is used to send out a call-on control from either signal lever 52 or 54.

The lower right-hand portion of Fig. 5 shows how two track-occupancy indications are handled simultaneously over one line wire. If track circuit 51 is occupied, relay 51TP is released, and if track circuit 53 is occupied, relay 53TP is released.

Direct current energy is fed through a 120 coder. Positive energy impulses are fed 120 per min. from the front contacts to ABL, and negative energy impulses, 120 per min., are fed to BNL. Both positive and negative are fed to ABXL. When track relay repeater 51TP is released, the pulses feed over the line wire and through the rectifier to energize 51TKPR. If 53TP is released, the negative pulses feed over the line and through the rectifier to energize relay 53TKR. If both the track repeaters, 51TP and 53TP, are released, both the positive and negative impulses, i.e., first a positive and then a negative, are fed over the line wire to cause both the indicator relays, 51TKR and 53TKR, to be energized.

Special Signaling

The two passenger tracks, No. 1 and No. 2, are each signaled for train movements in both directions on the 1.5 mi. between North Alexandria and "AF" interlocking. Two levers in the Model-14 interlocking machine at "AF" are used to control the direction of traffic on these sections of track. The southward traffic signals at North Alexandria, 48L and 50L, are controlled by levers on the new panel machine. The passenger station at Alexandria which is about 800 ft. south of signal 48L, is used by trains of all three roads; the R.F. & P., the C. & O. and the Southern.

Progressive Indications

For normal-direction right-hand running, the signals, such as 48L, are non-stick, with progressive indications. For example, with traffic established southward on track No. 1, with lever 48L to the left, and with a southbound train making a station stop at Alexandria, the signal 48L at North Alexandria automatically displays the restrictive aspect, red-over-yellow, to authorize a following train to keep moving at restricted speed and to close-in on the train at the station. Then, if the train ahead gets under way, the second train can drift on down to the station without making an extra stop.

The 1.5-mi. distance from North Alexandria to "AF" is too short to be cut into two automatic blocks, therefore, signal 48L at North Alexandria is the distant signal for the southward home signal at "AF." When the home signal at "AF" displays the medium-clear aspect, then signal 48L displays the approach-medium aspect, yellow-over-green. A relay, in series with the

(*Continued on page* 371)

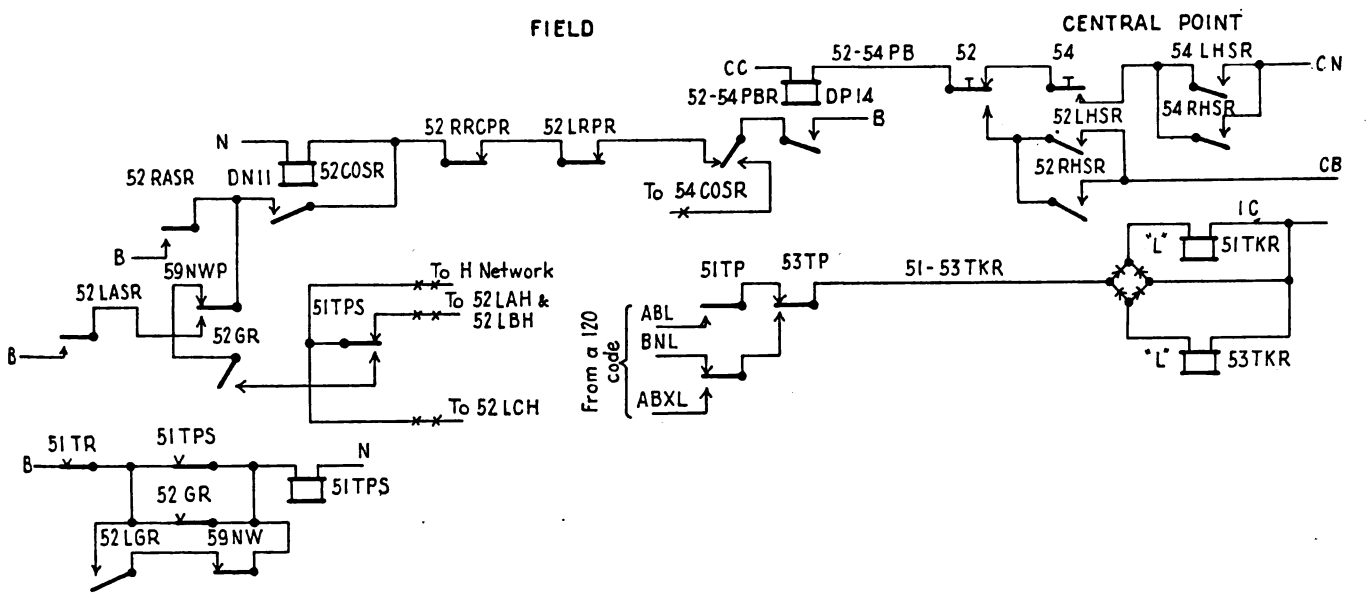


Fig. 5—Two call-on controls on one wire, and two indications on one wire

R.F.&P. Plants

(*Continued from page 353*)

filament of the yellow in the upper signal head, will be released if the filament fails. Circuits through contacts of this light-out relay are arranged so that, if the relay is released, the green will not be displayed but rather the restricted aspect, red-over-yellow, will be displayed. This conforms to good practice in that, if a lamp filament fails, a better aspect is not displayed. The advantage of the R.F. & P. practice is that, if a filament fails, the train gets some aspect to keep moving, rather than presenting a Stop aspect or the equivalent in the form of an all-dark signal.

Hold-Out Signal

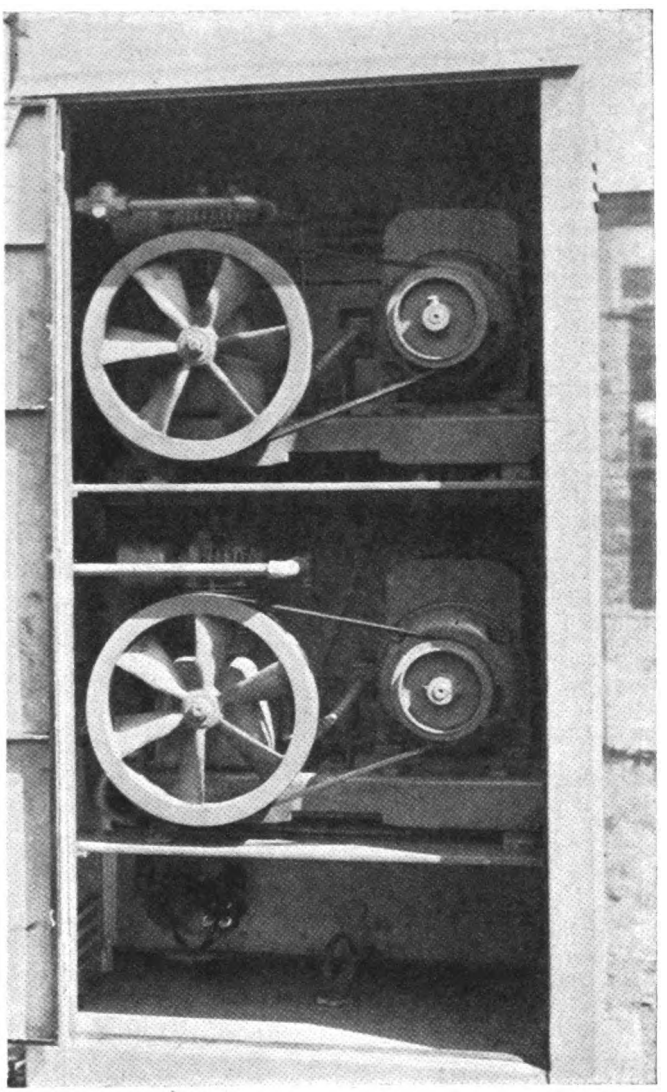
Dwarf 58L on track No. 4 cannot be cleared unless crossover 61 is reversed, as all signals are arranged so they cannot be cleared against traffic. Southward dwarf signal 66L on track No. 3 is a special hold-out signal which was installed as a means to hold southbound freight-trains back at that signal so that the track between 66L and home signal 56L would be available for light engines to make moves in and out of a track at a switch not shown in the drawing.

Call-On Improves

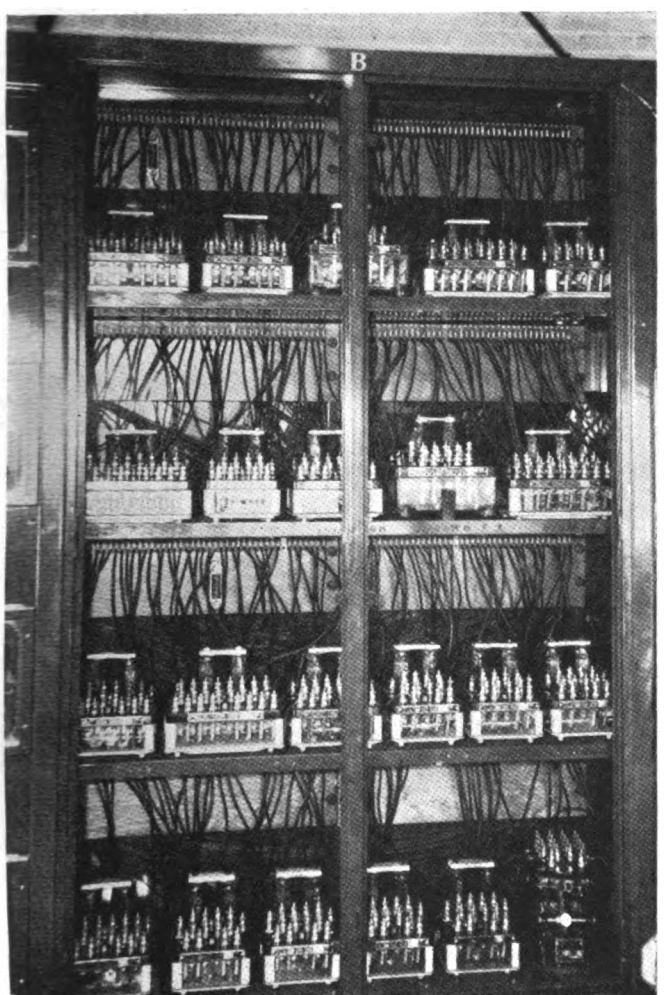
When the push-button is used to display the call-on aspect for normal through movements, and the track conditions change to permit a better aspect before the train arrives at the signal, the aspect will progress to the better indication and the call-on relay COSR will drop out. If the push-button is used for other than through normal movements, the COSR will remain up until the signal lever is placed normal by the operator.

At North Alexandria, each switch is operated by an A5 electro-pneumatic switch machine with type CP valves. The compressed air is furnished by a set of two compressors each rated at 9.2 cu. ft. per min. Each compressor is belt connected to a 2-hp., 230-volt, single-phase capacitor motor made by General Electric. The motors are controlled automatically by air pressure. One compressor cuts in at 43 lb. and cuts out at 55 lb. If the pressure goes below 40 lb., the second compressor cuts in and runs until the pressure is 53 lb. These two compressors are housed in a sheet-metal case located on the north side of the track about midway of the four crossovers. From the compressors the air pressure is distributed in a 2-in. pipe, with ¾-in. extensions to each switch. The pipes are buried about 2 ft. underground, in the same trench with underground cables.

These new interlockings at Fredericksburg and North Alexandria were installed by forces of the Richmond, Fredericksburg & Potomac, under the jurisdiction of V. P. Shepardson, assistant engineer signals and communications, the major items of equipment being furnished by the Union Switch & Signal Company.



Right—Air compressors for the operation of the eight switches at North Alexandria layouts



Left—The relays in the tower are in sheet-metal cabinets having glass panel doors