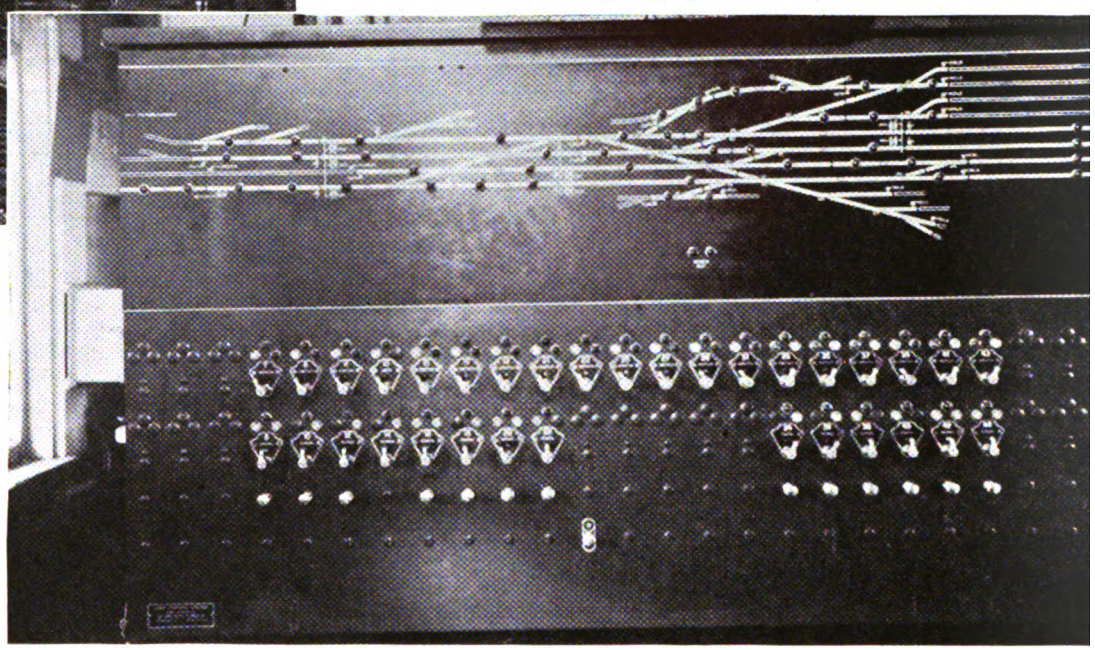


Special features are the use of plug-in relays, good construction of underground and aerial cables and special circuits to minimize the number of wires

Above— Southbound train on track 3 passing signal 40. Right—New section of the interlocking machine for the control of Brayton

The New Haven Installs All-Relay Interlocking at Providence, R.I.

At Brayton avenue, west of the station at Providence, R. I., the New York, New Haven & Hartford has installed a large all-relay electric interlocking, the control of which is in the same machine with a similar plant installed in 1943 east of the station, so that the one machine now controls an extensive track layout more than 1.8 mi. long.

Providence is the capitol of Rhode Island, and, including the city and surrounding suburbs, the metropolitan area has approximately 300,000 inhabitants. This city is on the through route of the New York, New Haven & Hartford between New York and Boston, Providence being 44 mi. west of Boston. All passenger trains stop at Providence. The schedules include 50 through passenger trains and 24 passenger trains which operate between Boston and Providence but not west of Providence. The passenger station is at ground level, south of the tracks, with a pedestrian underpass beneath the tracks leading to stairways up to platforms at track level. Eight main tracks extend through the station. Stub-end tracks, east and west of the main building, are for loading and unloading mail and express cars as well as for parking sleeping cars which terminate at Providence.

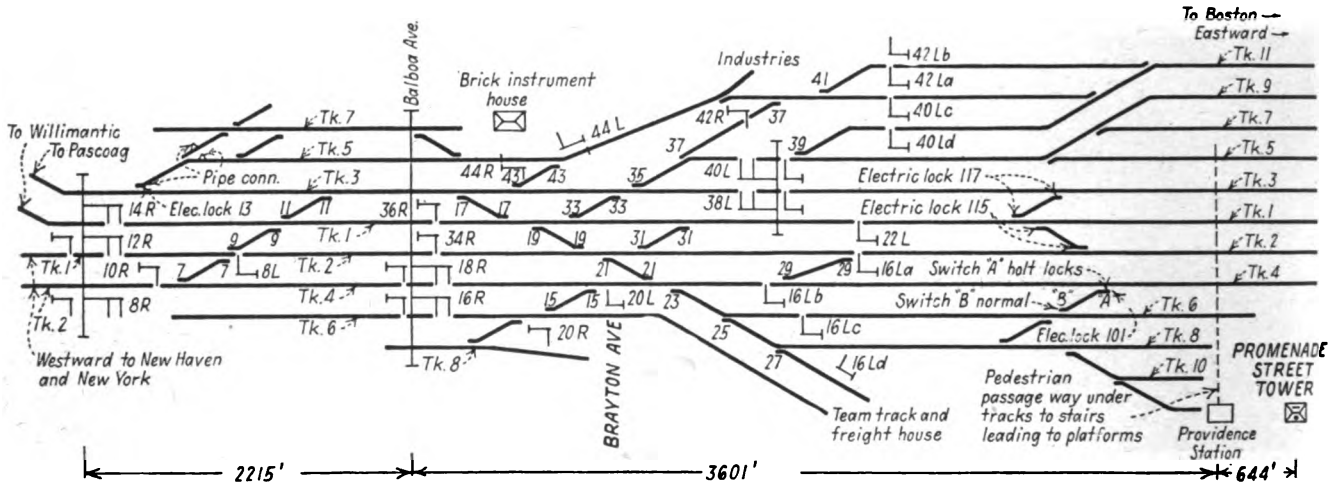
Some of the road freight trains pass through the station area on tracks 9 and 11 on the north side. Tracks No. 5 and No. 7 are used primarily by the trains which run back and forth between Providence and Boston. The through passenger trains generally use tracks No. 1, No. 2, No. 3 and No. 4 in the station. Two branch lines extend west and north from Providence, one to Pascoag, R. I., and the other to Willimantic, Conn. These lines branch off west of the interlocking at Brayton avenue.

Previous Interlocking

From the station area, 10 tracks extend west for about 3,700 ft. to Brayton avenue, where there is an extensive layout of crossovers and switches that were formally included

in a 100-lever mechanical interlocking. When installing new heavy rail through this layout in 1946, the track arrangements were simplified by replacing the double slips with conventional crossovers. Whereas the previous interlocking was confined to the area east of the overhead bridge at Balboa avenue, three additional crossovers, 7, 9 and 11, and seven signals were installed in the 2,215 ft. west of Balboa avenue.

The track changes and additions were so extensive that, rather than rebuild the old mechanical interlocking, it was discarded, and a new electric interlocking, including 110-volt electric switch machines and color-light signals, were installed. This new layout at Brayton avenue now includes 6 single switches, 12 crossovers, 24 dwarf signals and 7 two-unit high signals. Electric locks are in service on certain hand-throw switches, as indicated on the track plan. A hand-throw switch, just west of dwarf signal 42R, is bolt-locked normal when power-operated crossover 37 is reversed.



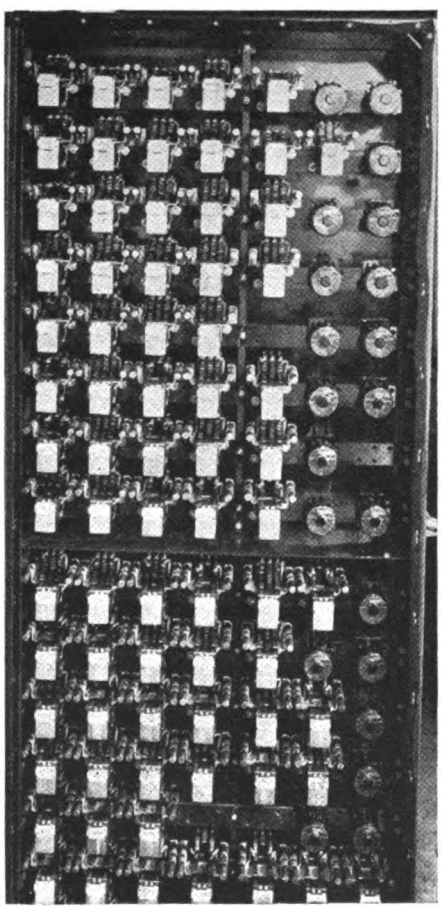
Track and signal plan of the entire layout of the new interlocking west from the station through Brayton avenue layout

Power Switches

The new switch machines are the M-2 type, rated at 110 volts d.c. The Type-F controllers are in separate cast-iron cases, mounted on cast-iron foundations near the switch machines. A cast-iron junction box on a concrete foundation is located half way between each switch machine and its Type F controller. The incoming underground cable is terminated on terminals in this box. From these terminals, wires extend to contact posts in either the switch machine or the controller. Thus this practice, of locating the junction box between the machine and the controller, simplifies the wiring, as compared with running the cable to either the machine or the controller.

The switch layouts are equipped with heavy gage plates, 1 in. thick and 7 in. wide. Adjustable rail braces are used on three ties at each switch. On two ties the plates extend under the switch machine which fit between two toe plates on the tie plates. This construction maintains the relative position of the machine with respect to the rails. The new work includes the installation of Ramapo Ajax free swivel No. 1 switch rods which minimize the "rolling" of the switch points.

The signals on this new interlocking are the searchlight type with H-5 plug-in mechanisms which can be changed out quickly without removing wire connections. The signals which govern train movements on the high-speed tracks are all high signals on overhead signal bridges. Each of these signals has two searchlight heads and both heads are capable of displaying red, yellow or green where required. On the ground, beneath each signal on a bridge, there is a single-unit dwarf signal of the same number which normally displays purple, and can be controlled to display yellow as the call-on aspect or for a slow-speed diverging move. Dwarf signals are used also to govern train movements on sidings and secondary tracks, other than the high-speed tracks.



Relays in rear of machine

Brick Instrument House

In order to provide a fireproof housing for the relays, batteries and charging equipments required at Brayton avenue, a two-story brick building 19 ft. by 27 ft. was constructed just north of the main tracks near Balboa avenue. The relays, terminal boards and much of the wiring are on the upper floor. The batteries and charging equipment are in a room in the east end of the ground floor, and the remainder of this floor is a room for maintainers' headquarters.

Power Supply

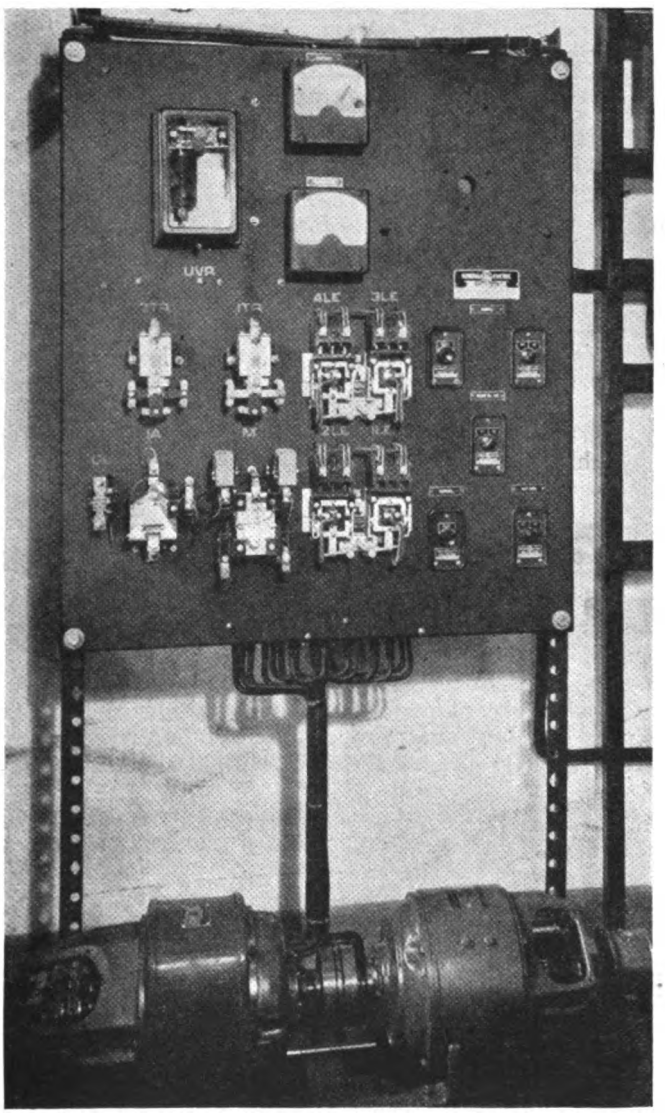
In the new layout at Brayton the track circuits are the d.c. neutral type, fed from full-wave rectifiers which are energized through transformers from a 110-volt power distribution circuit.

The M-2 electric switch machines at Brayton are the 110-volt d.c. type and are fed by a set of 60 cells of 248-a.h., 15-plate Ironclad type Exide storage batteries, in the brick house at Brayton avenue. For feeding control relays and circuits, there are three

sets of six cells each of 72-a.h. storage batteries.

The signal lamps and the rectifier-fed track circuits are normally energized from commercial a.c. power. There are three sources of commercial power which are so connected as to automatically energize the station in a predetermined order. If this a.c. fails, automatic switches on a panel are operated to feed 110-volt d.c. from the main storage battery to operate a special d.c.-a.c. motor-generator set. The motor is rated at 2 hp. to take 15.6 amp. at 115 volts. The generator is rated at 1.2 kv.a., 240 volts a.c. The machine operates at 1,800 r.p.m. and has a regulator that holds the speed practically constant under normal load. This machine will start and take over the load so quickly that there is no time for a track relay to release or the filament of a lamp to grow dark.

When this machine goes into operation due to an a.c. power failure, an indication is shown on the interlocking machine and the leverman calls the maintainer. When the commercial a.c. power is again available, he switches the feed back again and shuts down the motor generator. The motor generator and automatic switching equipment, as shown on the panel in one of the pictures herewith, were furnished by the General Electric Company.



Motor-generator set and automatic switching panel

Cable Construction

Between the tower at Promenade and the brick instrument house at Brayton, approximately 3,800 ft., there are four cables averaging 45 conductors each. As shown in one of the pictures, these cables are run in rings on stranded galvanized-iron messengers attached to short cross-arms on wood poles which are set along the north side of the main tracks between the west end of the station and Brayton Avenue. The wires in these cables are No. 14 for control and indication circuits and No. 10 for the common returns.

At Brayton avenue the messengers are tied to a wood pole set a few feet from the two-story brick instrument house, and the cables extend through a special opening which was provided for this purpose when constructing the building. When the cables were in place, the extra space was filled with cement and compound.

Underground cable entrance

The underground cables enter the building through a special duct in the floor and, with outside protective coverings in place, extend up through the floor to the second story of the building. Thus the potheads of the outer covering are all out in the open at the rear of the terminal board where they are not subject to moisture and can be seen and inspected readily, as is illustrated in one of the pictures.

The wires of all the incoming underground and aerial cables are terminated on terminals on a board made of asbestos board. Each wire extends through an individual hole in the board and the bare wire end is fitted into a Thomas & Betts squeeze-on connector which has a lug that fits on the terminal post and is held by the standard nuts. The terminal posts

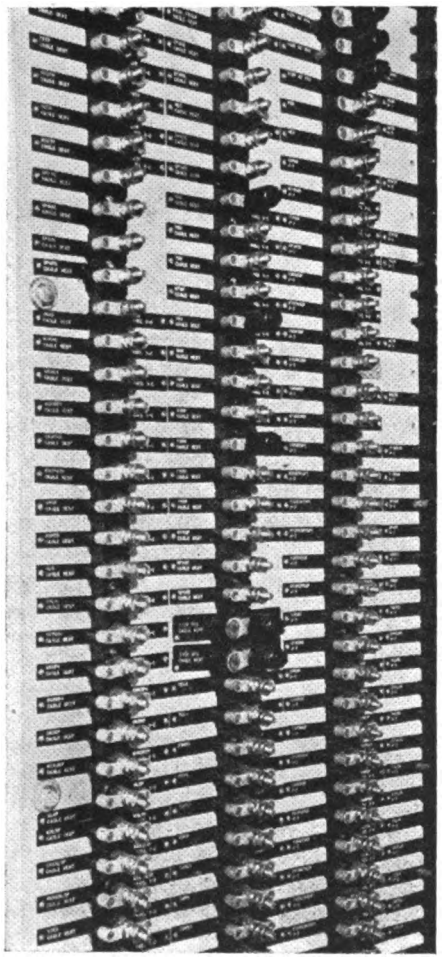
which carry 110-volt energy are equipped with insulating nuts. On this board the terminals are spaced 1 in. vertically, and the rows are spaced 6 in. horizontally, thus allowing space for tags. This same type of terminal board construction using panel boards and squeeze-on connectors is used in the instrument cases at various locations on the plant, as shown in one of the pictures.

All-Relay and Remote Control

This new interlocking is of the all-relay type, the interlocking protection being accomplished locally by relays and circuits in a new building mentioned above. This entire interlocking is controlled remotely from panels added to the previous machine in the tower at Promenade street which is just east of the station and 6,460 ft. from the first eastward home signal in the Brayton avenue layout. The controls and indications between Promenade street and Brayton avenue are by direct-wire circuits, in aerial or underground cables. Some of the interesting features of the project are the special features employed in these circuits as means for checking operations and reducing the number of wires required in these cables.

The all-relay locking, by interconnections of circuits, is all located in the building at Brayton avenue, but indications of the occupancy of track sections, the position of switches, and aspects displayed by signals, must be provided on the control machine at Promenade street.

The indications, track-occupancy, position of switches and the aspects displayed by signals are handled by the small sized Type-L relays, and this same type of relay is used as required for lever-repeaters and other relays in the route check networks in the machine. It should be understood that these Type-L relays are used only on so-called non-vital information service such as controlling indications on the control panel. For circuits involving actual controls or locking, the conventional types of relays of the plug-in types are used. The WK relays are the magnetic-stick polar type and they are mounted in a horizontal row in the machine directly behind the control panel, as shown in one of the pictures. The Type-L relays on non-vital circuits are mounted in racks that are enclosed in sheet-metal cabinets located in the rear of the interlocking machine. These cabinets are hinged at one side to swing out, as illustrated in one of the pictures. The front covers on these cabinets fit on felt strips and are held in the closed position by screw clamps thus making the cabinets practically dust proof. These new L-type relays are the plug-in type so that they can be changed out quickly and without the chance of making a mistake in wire connections.



Squeeze-on wire connectors on terminal board

Two Birds With One Stone

In view of the fact that the controls between Promenade and Brayton are the direct-wire type and the distance is approximately 3,800 ft., special efforts were required to devise means for using wires for two purposes with the objective of reducing the number of wires required in the cables. One phase of this was to use one wire to bring in two indications.

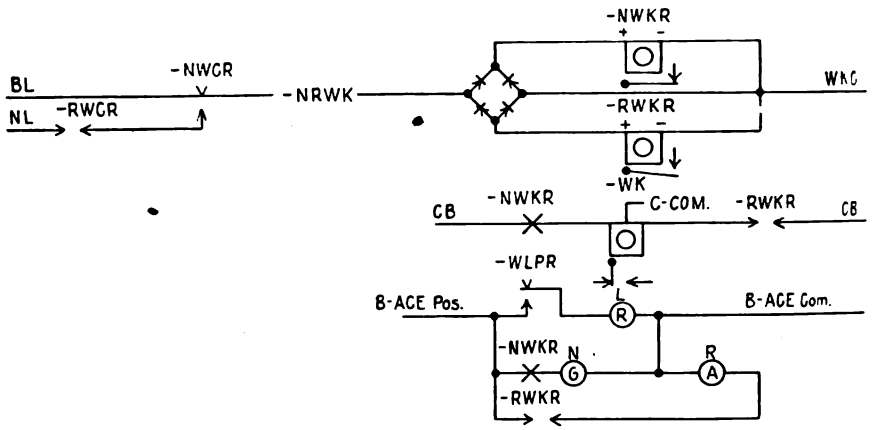


Fig. 2—Showing how both switch indication relays are controlled over one wire and a common

One Wire and Common

In connection with a common line wire in the cable, one cable wire serves to control the two relays which repeat the normal and the reverse positions of a switch. As shown in the diagram Fig. 2, the two switch indication relays, — NWKR and — RWKR, at Promenade are connected through a rectifier to the cable line wire to Brayton. When the switch is normal, positive battery BL feeds over the line and through the rectifier to hold relay—NWKR picked up. This causes

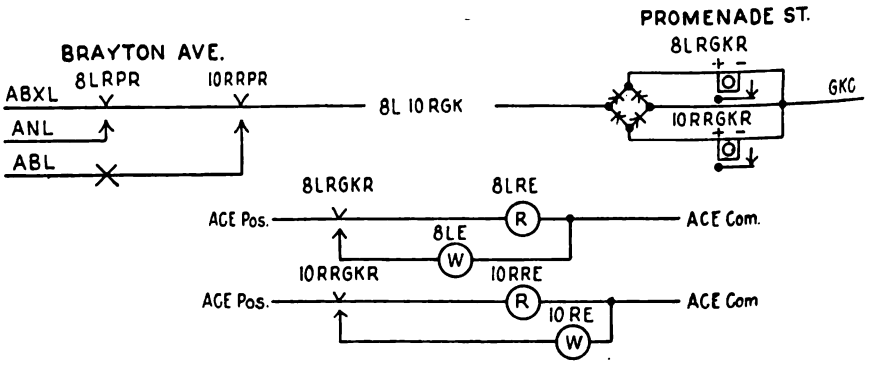


Fig. 3—Showing how two signal indication repeater relays are controlled over one wire and a common

View showing the construction of the over-head cables

Fig. 4—Lever repeater relay

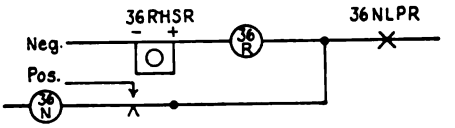


Fig. 5—Part of the route-check network

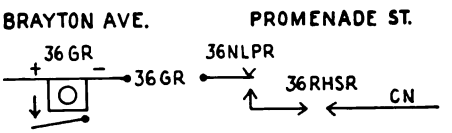


Fig. 6—Control of relay 36GR

see that the track line up at Brayton is such that the signal can be cleared over the route as intended.

Operation of Route Check Circuits

In the route check network, in the machine, when lever 36 is thrown to the right, the stick relay 36RHSR is energized if the remainder of the circuit is completed by contacts in switch levers and in relays which repeat the switches to check that a pos-

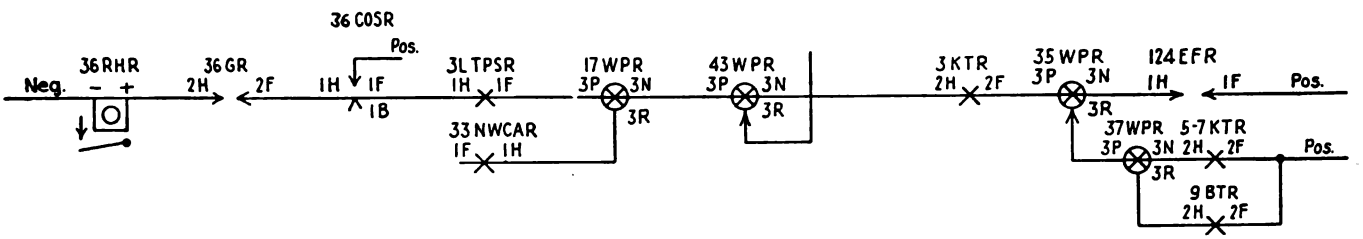


Fig. 7—Circuit for the control of relay 36RHR

the lamp on the control panel to be lighted to indicate that the corresponding switch is normal. On the other hand, if the same switch at Brayton is reversed, negative battery NL is fed to the line wire and goes through the rectifier to pick up relay—RWKR, rather than—NWKR at Promenade.

Signal Indication

Similarly one line wire in the cable, in connection with a common line wire, is used to repeat the display of a Stop aspect on both signals 8L and 10R, the respective indication relays at Promenade control machine being 8LRGKR and 10RRGKR. In this instance, both these signals may display Stop aspects at the same time, and, therefore, the circuit is as shown in Fig. 3. The energy is fed to the line circuit through contacts of relays that repeat Stop aspects of the two signals. If 10R only is clear, then impulses of positive battery ABL are fed over the line wire 8L-10RGK from Brayton to Pomenade to hold up relay 8LRGKR. If signal 8L is cleared but 10R is not, the impulses of negative battery ANL are fed over the line to hold up relay 10RRGKR. If both signals are at Stop, then successive impulses of positive and negative battery, ABXL, are fed over the line wire to energize both relays 8LRGKR and 10RRGKR.

Route Check Network

In view of the fact that all the switches, signals and track circuits in the Brayton avenue layout are repeated by repeater relays in the machine at Promenade, it was quite practicable to connect up a route check network circuit in the machine. In brief, the advantage of this route check network is that when a signal lever is thrown, a check is made to see that the track line up at Brayton is such that the signal can be cleared over the route as intended. A small portion of the route check network is shown in Fig. 5. Having picked up relay 36RHSR, it sticks up through its own front contact and its lever contact. This feature prevents a signal, having been cleared, from being "knocked down" by operation of any lever other than its own lever. Then lever repeating relay 36NLPR, shown in Fig. 4, which is slow releasing, opens its front contact and opens the circuit for the opposing signal controls, shown in Fig. 5.

With lever-repeater relay 36NLPR down and relay 36RHSR up, a circuit, as shown in Fig. 6, is complete to feed energy from the control machine out over a line wire 36GR to energize relay 36GR at Brayton avenue. As shown in Fig. 7, a front contact in relay 36GR completes the circuit to energize relay 36RHR, the other con-

tacts in this circuit being through relays which check the position of switches, signals and track circuits, to see that the route is complete and unoccupied.

Switch Control Circuit

A typical switch control circuit is shown in Fig. 8. At Brayton the operation of the switch is controlled through contacts of relay—WR and this relay is controlled by front contacts of the electric locking relay—LR. One wire—WRI extends to the tower at Promenade. The—WK relay is a magnetic-stick polar relay that repeats the position of the switch as last operated, as is shown in Fig. 2. Referring again to Fig. 8, the circuit through the contacts of the—WK relay and the switch lever repeater relay—WLPR are such that, in order to control the operation of the—WR relay, the lever before being thrown must be in the position corresponding to the then position of the switch as indicated by the—WK relay. As shown in the diagram, the switch is in the normal position and relay—WLPR is energized by being in series. When a signal is cleared or track occupied at Brayton to release lock relay—LR, then relay—WLPR is released. If the lever is thrown while the lock relay is down, the circuit is not complete to operate relay—WR even after—LR picks up because the circuit is open at the front contact in relay—WLPR. Thus the leverman is prevented from storing or pre-conditioning switch controls. By thus preventing pre-conditioning, the circuits prevent operation of the switch if shunt is lost for a moment which might be enough to let—LR pick up. With the circuit as shown, the tower-man must return the switch lever to the position corresponding to that of the switch in order to regain control.

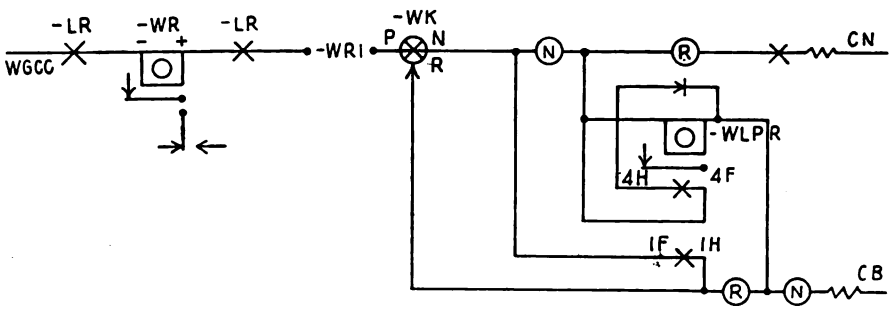
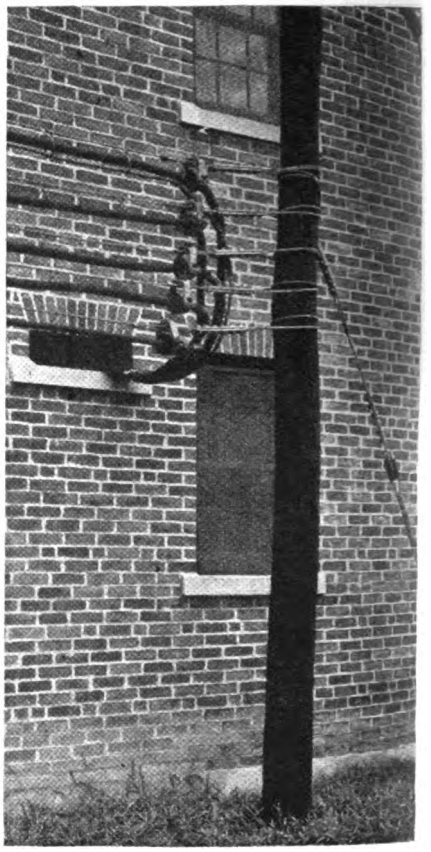


Fig. 8—Circuit for the -WR and -WLPR relays

Signal maintainer replacing a plug-in relay



Aerial cables entering the tower

Plug-in Relays

Throughout the entire project at Brayton, the relays are the plug-in, quick detachable type, which not only saves time when replacing a defective relay, but also prevents mistakes in the connection of wires to terminals. The receptacles for these plug-in relays are bolted to racks made of angle iron and the incoming wires are soldered to contact lugs in the rear of the receptable plates. One of the pictures herewith shows a signal maintainer demonstrating the ease with which a plug-in relay can be replaced.

Installed By Railroad Forces

This new interlocking was planned and installed by the New York, New Haven & Hartford signal forces, the major items of equipment, including control machine, signals, switch machines and relays, being furnished by the Union Switch & Signal Company.