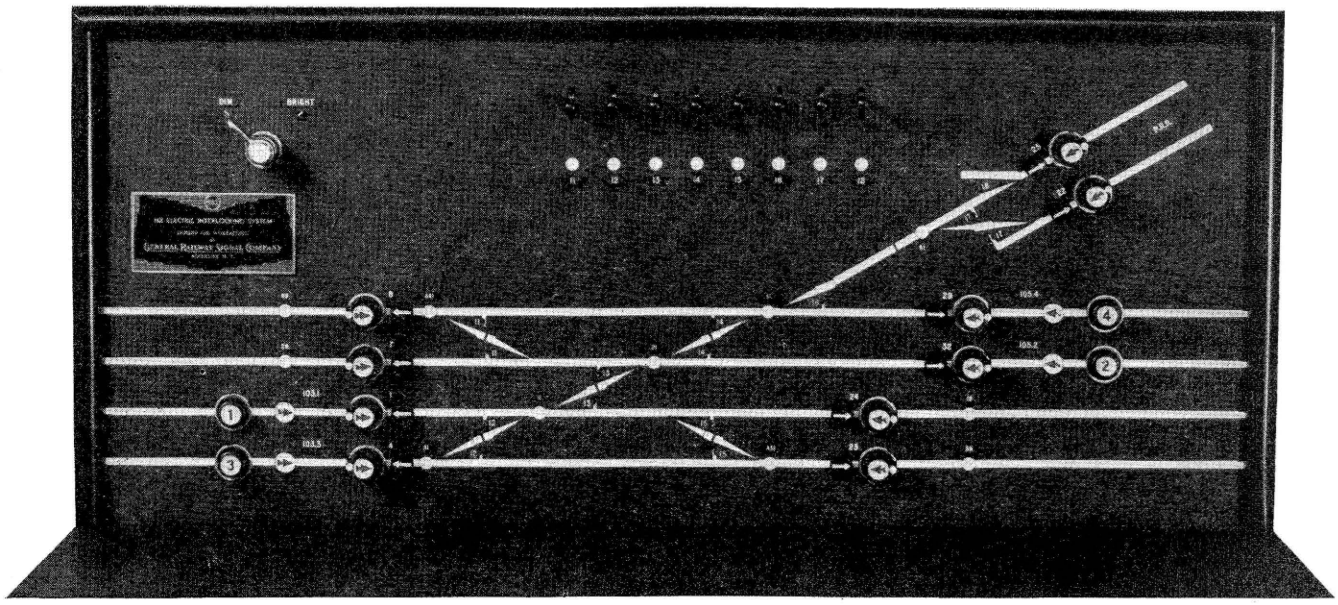


New route type control machine

New York Central Installs First Button-Control Route Interlocking

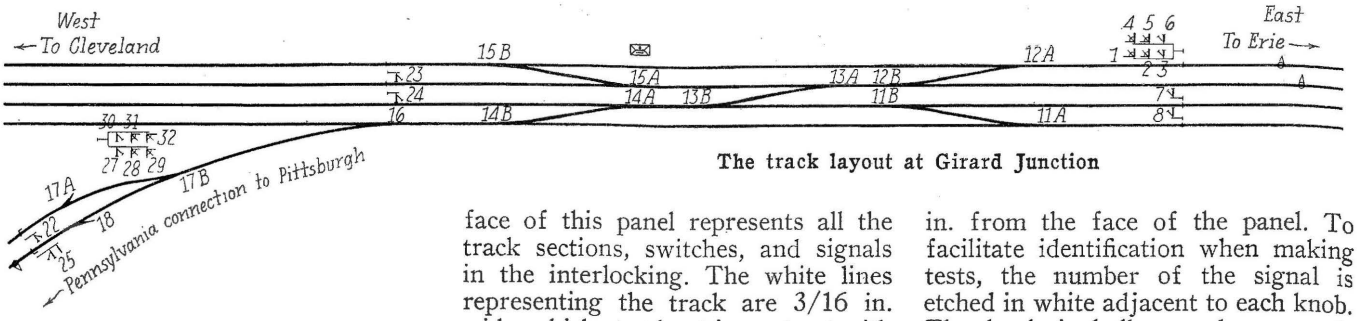
New control machine provides simplicity and facility of operation needed at plants where routes must be changed quickly and where a complicated route network exists

ON September 23, at Girard Junction near Erie, Pa., the New York Central placed in service the first installation of a new type of interlocking control, in which the switches in a route and the signal for directing a train movement over that route are all controlled merely by the operation of a knob and a button on a track model which is a part of the control panel.

For many years, both in this country and abroad, some signal engineers have favored interlocking machines on which levers controlled one or more *interlocking units,* while others have favored machines where levers have controlled *routes.* In some European countries the route-lever system is widely used, but in the United States the control of interlocking units by levers predominates, chiefly because of greater simplicity, ease in correcting trouble, and further because in many track layouts more levers would be used for route control than for interlocking unit control. The new "NX" (route control) system is an entirely new conception. It is based on the theory that all routes have an entrance and exit. It combines the desirable features of the two systems, in that a route can be set up more rapidly and with fewer manipulations than in any interlocking system heretofore designed.

The knob is located on the line representing the track at a point corresponding with the signal where the train will enter the plant; hence it is called an entrance knob. The button is located where the train is to leave the plant; hence it is called an exit button. Thus, the operator never has to think of a route in terms of individual switch and signal levers, but rather as having an entrance and an exit. The control for a complete route is set up very quickly, and, furthermore, the switches to be moved in lining up a route are set into operation practically simultaneously, but their time of starting is distributed so as to reduce the initial starting current surge of the switch machine motors. The result is that a route, involving as many as four crossovers, two single switches, and a derail, can be completed and the signal cleared in approximately nine seconds after the operator pushes the exit button. The advantages of such rapid operation in a busy terminal plant, requiring numerous changes in routes, are readily apparent.

The new plant at Girard Junction is located on the New York-Chicago main line at a point 17 miles west of Erie, Pa. Throughout the Erie division, the New York Central has four main running tracks. At Girard Junction there is a junction between the New York Central and a single-track main line of the Pennsylvania, which extends south to Pittsburgh, Pa., via New Castle, Pa., the Pennsylvania using the New York Central tracks between Girard Junction and Erie. The average daily traffic through this plant includes about 50 passenger trains and 50 freight trains on the New York Central, and 2 passenger trains and 20 freight trains



The track layout at Girard Junction

on the Pennsylvania. Extra passenger trains and freight trains are operated as required, so that the total train movements through Girard Junction average from 125 to 150 daily.

Changes Made at This Time

The track layout at Girard Junction includes five crossovers between main tracks of the New York Central, two single switches and two derails on the Pennsylvania and a total of 10 signals. This plant was formerly controlled by a conventional lever-type electric interlocking machine with a 32-lever frame, including 30 working levers. This machine was one of the early pistol-grip type, and, as it had been in service since August 17, 1906, at this busy plant, the parts were worn to the extent that replacement of the entire machine was necessary. All of the 14 switch machines in service are the Union M-2 type with Type-F controllers. These machines operate on 110 volts, d-c., the power being distributed over the plant on bus wires from a 56-cell, 120-a.h., lead-type storage battery. The signals on the New York Central are the General Railway Signal Company's color-light Type G, and on the Pennsylvania, Union Style B semaphores. The only change made in the 1937 improvement was to replace the old electric interlocking machine with the new control machine. The switch machines, signals, power battery, and all wiring distribution outside the tower were continued in service without any change.

General Features of Control Machine

The control system and button-type machine installed at Girard Junction were designed and manufactured by the General Railway Signal Company, this company adopting the name NX as descriptive of its system of route control, the name being derived from the two words "entrance" and "exit."

The new control machine is made up in the form of a cabinet, the control panel being 13 in. high and 29 in. long. The track model on the face of this panel represents all the track sections, switches, and signals in the interlocking. The white lines representing the track are 3/16 in. wide, which stand out in contrast with the dull black face of the panel. The switches and crossovers are represented by small, movable sections of the track called route indicators, which outline the route immediately after the operator pushes an exit button. A small lamp with a red lens mounted behind the track lines is located adjacent to each movable route indicator, and each such lamp is lighted when its corresponding switch in the field is locked and not free to be moved. Thus these lamps are known as "lock lights." Small track-occupancy lamps, mounted in each section representing each track circuit, are normally extinguished, but are illuminated when a train occupies the corresponding track section. When making a crossover movement over a track section including two lamps, such as on track 3 and 4, a train causes the track-occupancy lamp nearest the crossover to be lighted, the other lamp being extinguished. The purpose of this special control is to outline more distinctly the route being used.

In the line representing the track, at the location corresponding to each interlocking signal, there is an entrance knob. Each of these knobs is ¾ in. in diameter and stands out 1 in. from the face of the panel. To facilitate identification when making tests, the number of the signal is etched in white adjacent to each knob. The knob is hollow and surrounds a separate support for a round disk of translucent glass with a black arrow, which fits in the face of the knob. The arrow points in the direction in which the corresponding signal controls, and maintains this position regardless of whether the knob is turned. The lamp behind the arrow is illuminated when the route is complete and the signal clears. A small round white marker on the outer rim of the knob indicates its position, this marker normally being in line with the track and at the base of the arrow in the face of the knob. When lining up the route, the knob is turned to bring the white marker to the top when clearing a high-speed signal for a through-route or a medium-speed signal for a diverging route. The knob is turned to bring the white marker to the bottom when clearing a low-speed or call-on signal.

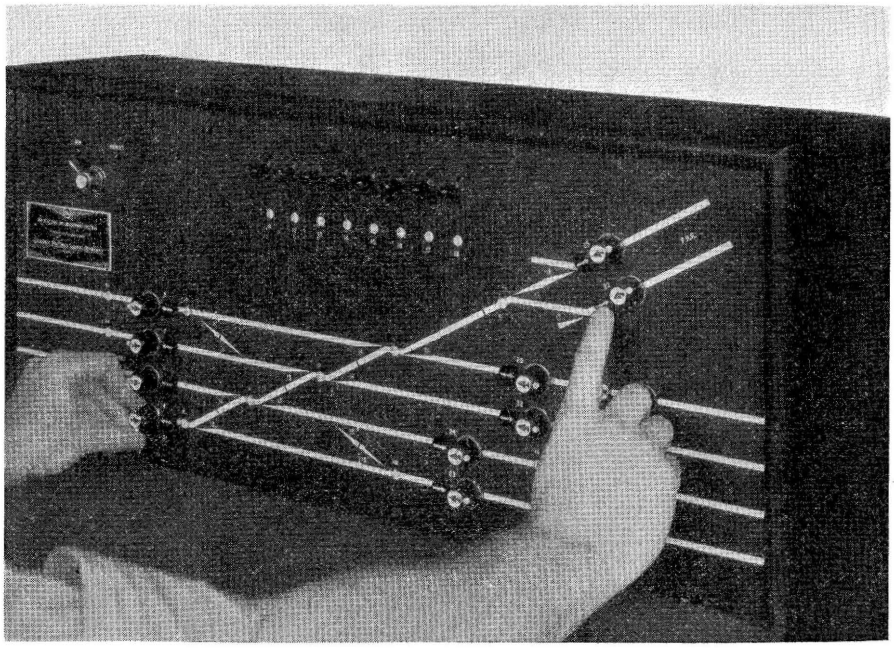


Illustration of the methods of machine operation

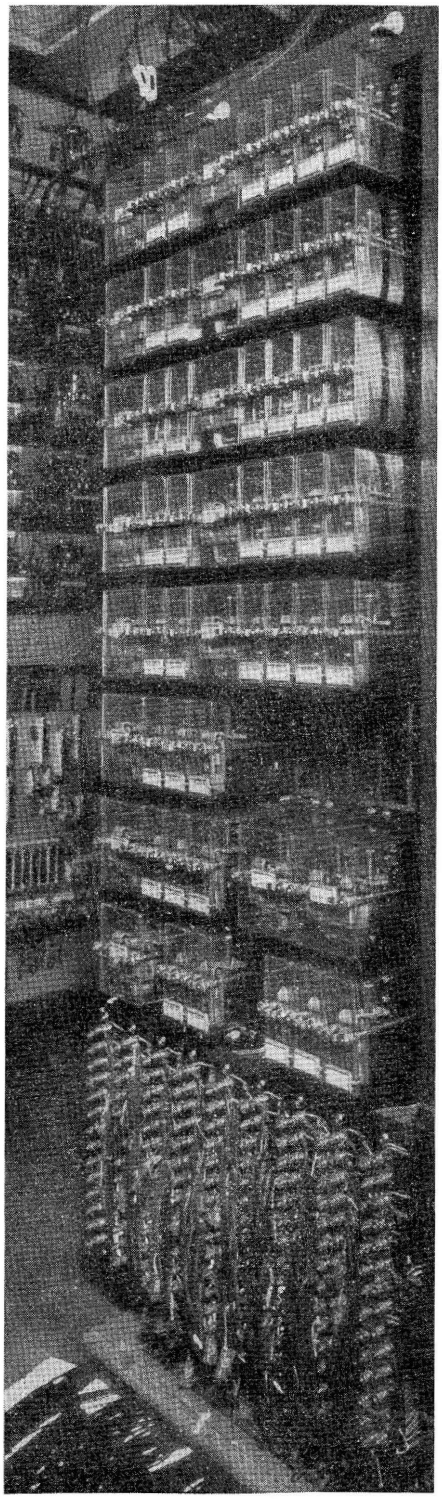
An exit button is mounted in the line representing each track at the place where the train leaves the controlled area. Each exit button is 9/16 in. in diameter and normally stands out from the panel 5/16 in. A white arrow on the face of each button points in the direction a train would be going when leaving the end of a

route controlled by the respective button. When lining up a route, the exit button is pushed in and it then returns to its normal position by spring action.

An annunciator system, including bells and indicator lights, informs the operator of the approach of trains. For New York Central main-line trains in the normal direction of operation, the annunciator sections extend about three miles in the approach to the plant, so as to include the track section beyond the second automatic signal. Thus, if the route is not lined up, an engineman gets the first caution signal at least two miles from the home signal. When a train in the normal direction enters an annunciator section, as for example, eastbound on passenger track No. 2, a bell rings, and a lamp lights in the annunciator push-button 2, which is the first push-button from the right of the control machine on track line 2. In order to stop the ringing of the bell and to acknowledge thereby the approach of the train, the operator either pushes this illuminated annunciator push-button or clears the home signal for track 2, thus cutting out the bell. It should also be noted that to the left of annunciator push-button 2 and between it and the entrance knob for the route, there is a circular white lens with a black arrow pointing to the left. This represents the approach signal. The lamp behind this lens is lighted when the approach signal for the route is clear.

Operation of Machine

When the operator is ready to line up a route through the interlocking for an approaching train, he turns the entrance knob corresponding to the point where the train is to enter the interlocking area. This is known as "route initiation." Next, he pushes the exit button corresponding to the point where the train will leave the interlocking area. This is known as "route completion." This operation completed, the system automatically lines up the route. First the route indicators, on the control panel, line up showing the route that was called for; then the switches in the field operate into the positions required by the route. Next the signal clears in the field, and, on the control panel, the small red lock lights appear at the points of their associated route indicators, indicating those switches which are locked up. A light illuminates the arrow in the entrance knob showing that the signal has cleared and that the route is ready. If the route is lined up for a through-move on one of the New York Central main tracks, the indicator for the approach signal is lighted when its corresponding approach signal clears. The combination of a train on an approach circuit of such a route, as indicated by a light in the annunciator button, and a light in the approach signal indicator informs the operator that the train has accepted the route which is now locked up. In case of emergency, the home signal could be set to stop by turning the entrance knob to its normal position, but no switch could be moved until a clock-work time release is operated, thus introducing time for the train to be brought to a stop, as in any interocking today.



The Type B relays are mounted on one panel 29 in. wide and 84 in. high

As the train accepts the signal and travels over the route, the track-occupancy lamps on the panel in the route are illuminated to indicate the movement of the train. The light in the entrance knob is extinguished as the home signal goes to stop. As the train passes through the plant and the route is released, the small red lock lights disappear.

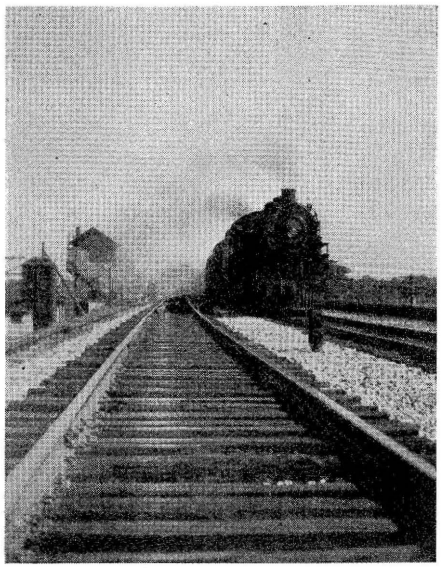
If the operator wishes to hold the route, he leaves the entrance knob in the same position, and the home signal automatically clears for a following train. If he wishes to set up a new route, he turns the entrance knob back to normal and lines up the new route in the usual way. The facility of holding the same route for a succession of trains has its value at Girard Junction where there are numerous through-movements on the New York Central main line. It is understood, however, that the system can be made to provide automatic route restoration by the train, in which case the operator *pushes* the entrance knob instead of turning it when lining up the route. Moreover, the option of manual or automatic route restoration can be obtained with the one type of entrance knob and either or both may be used as operating conditions require.

Simplicity and Speed of Operation

Since the setting up of a route requires that the operator know only the entrance and exit of a route, the operation of the plant is indeed simple, no manipulation charts or diagrams being required. An important point is that an operator newly assigned to this plant can readily learn how to handle the control machine without an extended period of instruction.

With the new control machine, the Girard Junction plant can be operated much faster in changing routes than was formerly possible. With a conventional type of electric interlocking, such as was used previously at Girard Junction, when operating a switch, the lever was moved into the indication position and then the operator had to wait until the switch machine operated and locked up, at which time the indication lock on the lever was released to permit final movement of the lever. The total time for the operation of each lever was from four to six seconds. In lining up a route involving several switches, the operator usually placed all the levers over to the indication point and then went back to each lever to complete its operation; therefore, the total time was some-

what less than six seconds multiplied by the number of levers operated. Each crossover, single switch, and derail was controlled by a separate switch lever. For example, when routing a train from track 3 on the



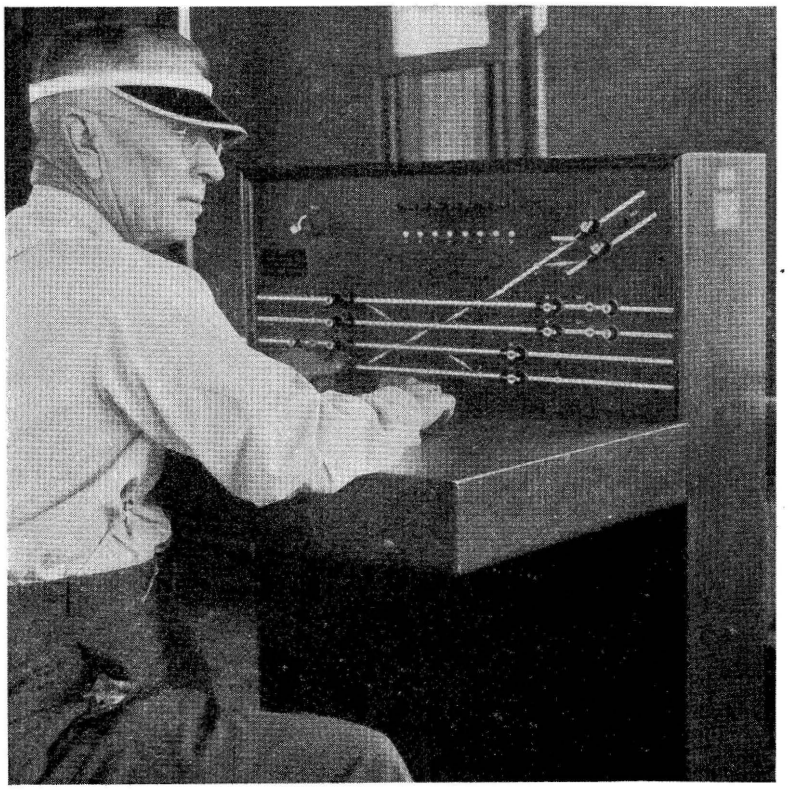
View looking east

New York Central to the passing track on the Pennsylvania, a total of 5 switch and derail levers and 1 signal lever were operated, requiring about 30 seconds of the operator's time to line up the route. In contrast, with the new NX system, the operator can line up this same route in about nine seconds from the time he turns the entrance knob and pushes the exit button until all the switches in the route operate into correspondence and the signal clears. This means a saving of about 21 seconds in time for completing the route and clearing the signal. Thus, in an instance when two trains on close time are approaching the plant, a delay or a stop to one train or the other is frequently obviated by the NX control machine.

Individual Operation of Switches

When maintaining and adjusting switch points and switch machines, it is desirable to have individual control rather than route control, which forms a part of the NX system. For this reason, a separate test key is provided for each switch, these keys being mounted in a row along the top of the control panel. When in the center position, these keys are disassociated with, and have no effect on, the normal operation of the plant. When a maintainer wants to test a switch, however, the operator must first cancel any route set up over the switch and then manipulate the corresponding test key *down* to place the switch normal, and *up* for reverse. A small lamp below each test key is lighted whenever the key is moved into a position out of correspondence with the position of the switch in the field. This lamp stays lighted until the switch is over and locked in the position corresponding to that of the key. These small lamps also light whenever a switch is out of correspondence with the position called for by the route lined up on the control panel. Therefore, if the operator sees that one of these lamps remains illuminated, he knows that the switch has failed to complete its stroke and lock up. In addition to being used for test purposes, the test keys can be used at any time that a switch fails to operate properly in the normal procedure. For example, if the switch points are obstructed by snow, the operator can throw any switch back and forth by manipulating the test key, thereby smashing the obstruction and permitting the switch to complete its movements and lock up. He can then revert to the use of the normal control which automatically cuts out the test key. An important point is that movement of the test keys is ineffective when any route is established by normal control; and that if a test key is operated, a route can be set up over its corresponding switch, but only in the position already called for by the test key.

Below—The control machine is very compact



Background of New Development

While route lever control of interlocking is not new, the entrance exit idea is a new concept. Route interlocking with a lever for each route has been used for at least 30 years in France, and a plant was installed in England in 1933. One of the latest plants in France uses multiple-position levers, so that each lever controls several routes. Such route lever interlocking has never been regarded with great favor in this country, although plants using levers to control the switches and signals of complete routes have been in service in the United States since 1921. Route lever interlocking is likely to require many more route levers than there are interlocking units. Girard Junction evidences this, and layouts of a more complicated nature do so to a greater degree.

Of the 10 signals at Girard Junction, 2 signals control 6 different routes each, 6 signals 4 routes each, and 2 signals 2 routes each. Thus the 10 signals control a total of 40 routes. If a route control machine using a separate lever for each route had been used, it would have required 40 levers, or, if each lever controlled the route for both directions, 20 levers would have been required. The control system and NX machine installed at Girard Junction uses 10 entrance knobs and 10 exit buttons which are incorporated as an integral part of the track model; thus being directly associated with the routes themselves. This installation at Girard Junction on the New York Central was the first installation of button-control route in-

terlocking in the United States, and an installation of the same NX type of equipment, manufactured by the General Railway Signal Company, Limited, of London, England, was placed in service on the Cheshire Lines at Brunswick, England, on February 28, 1937, this being the first installation of its kind in the world.

The control in this NX type route interlocking system is all accomplished by inter-connection of circuits, no mechanical locking between knobs and buttons and no electric lever locks being used. Complete protection is provided to insure that a route is properly established and that no conflicting route can be established. The circuits are arranged to provide approach, route, and detector locking according to modern practices. The circuits are all of the direct-wire type, no coded equipment being involved.

In order to dispel any impression on the part of the reader that the circuits are complicated or that an excessive number of relays are required, a brief explanation can be given of the basic principles of the control organization.

Basic Principles of Control

In brief, the number of selection relays depends on the number of switches and crossovers in a track layout. For routes in each direction, one "conditioning" relay is used for each of the switches or crossovers that may be trailing. For eastward routes there are seven conditioning relays and for westward routes there are five. Associated with each exit button there is a stick relay known as an exit relay, and as there are 10 exits, an equivalent number of exit relays are used.

When the operator turns an entrance knob, he initiates an impulse which energizes a conditioning relay corresponding with each trailing switch in any possible route starting from that entrance. Pushing the exit button energizes its exit relay, which, in turn, energizes the route-selecting relays associated with each switch or crossover as determined by the conditioning relays. The route-selection relays provide the necessary interlocking against conflicting routes and also position the switches to correspond with the route desired. As these switches operate into position, the signal clears for a high-, medium-, or low-speed move, depending on the position of the entrance knob. This, in brief, is a picture of the basic NX circuit organization.

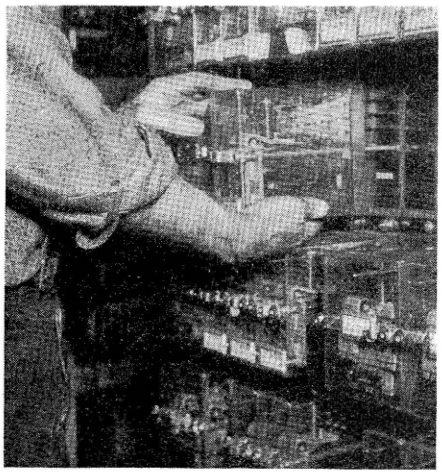
The additional relays required when installing the NX control system are of the small-sized, quick-detachable type known as the G-R-S Type B. These relays, including the 12 conditioning relays, the 10 exit relays, the 21 relays for route selection, and 8 relays for switch control, total 51 relays of the B type. Some of the new relays handle circuits formerly controlled through previously existing relays of the conventional type, so that a few of the old relays were dispensed with. Furthermore, consideration should be given to the fact that this Girard Junction installation was made without any wiring changes outside the tower. Therefore, it is quite possible that a considerable number of the switch control and checking relays could be eliminated in an all new installation.

Relay Mountings

The 51 Type B relays and 5 spares are all mounted on one panel 29 in. wide and 84-in. tall. The incoming wires are attached to terminals on a board at the bottom, and flexible wires from these terminals extend up behind the rack and are soldered to plugs which extend out beyond the face of the bakelite board. In each relay, the connections from the coils and contacts each extend to a pair of prong springs in the base of the relay. When installing a relay, the prongs in the rear of the base of the relay are pushed over the corresponding plug protruding from the face of the rack. Thus, a relay can be replaced quickly by pulling one off and pushing another in place; no terminal nuts or jumper wires need be handled or changed in any way.

A special feature of the Type B relay is that a compression spring is arranged to give about the same contact pressure on back contacts as is effective for front contacts. The gravity pull of the armature is in excess of the A.A.R. five-inch-torque requirement, so that without the aid of the compression spring the armature will release when energy is cut off the relay. Thus the use of the compression spring has no bearing on the safe operation of the relay.

The installation of the new interlocking control was carried out by the signal forces of the New York Central, under the jurisdiction of F. B. Wiegand, signal engineer, and under the supervision of H. D. Abernethy, assistant signal engineer, and L. L. Whitcomb, supervisor of signals. The major items of material for this interlocking, including the control machine and new relays, were furnished by the General Railway Signal Company.



Above—Type B relays are easily replaced. Below—Eastbound train passing signal 29