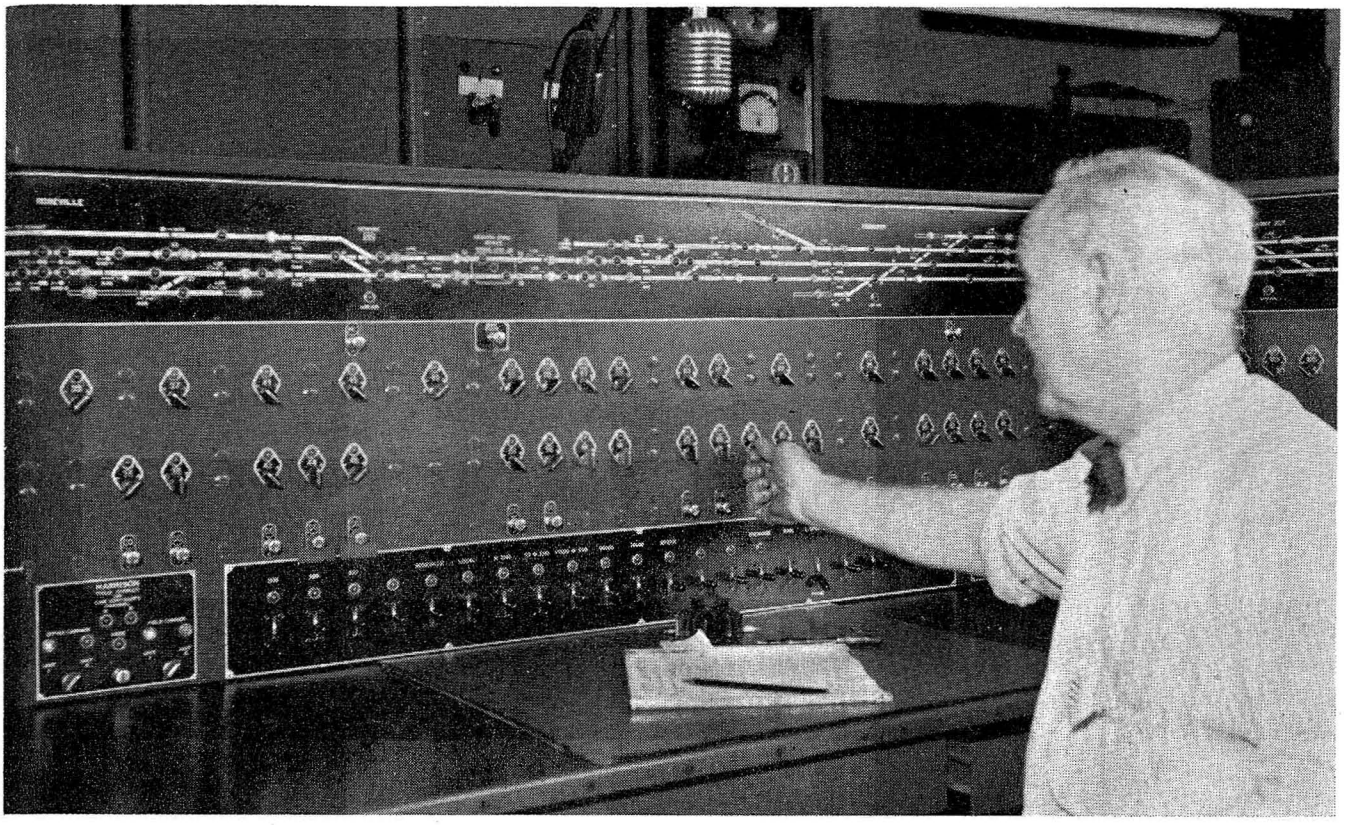


The leverman has control of interlockings at Newark, Harrison and Kearny Junction with this machine by direct wire and a multiplex code control system

Lackawanna First to Install

New Multiplex High Speed Code

In Large Interlocking Consolidation

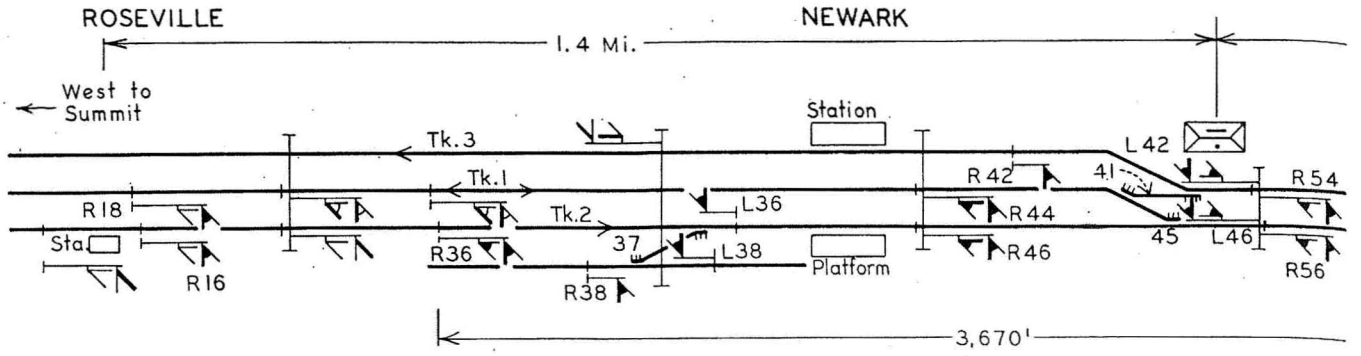
First installation of new multiplex code control system which can transmit 25 controls and 50 indications per second—Complete route set up with one code—Control machine includes route indication lamps, and other aids for rapid manipulation

AT NEWARK, N.J., the Delaware, Lackawanna & Western has installed a new tower and control machine for the control of previously existing interlockings at Kearny, Harrison and Newark which are located as shown in the plan herewith. Capacity is also available for control of the interlocking at Roseville Avenue. All of these interlockings are of the electro-pneumatic type, and each was previously controlled locally by a Union Model-14 interlocking machine.

Traffic Handled

Hoboken, N. J., across the Hudson river from New York City; is the eastern terminal of the Lackawanna. Newark is 8 miles west of Hoboken on the Lackawanna's main line via Summit N.J. This line is used primarily by passenger trains, the through freights being operated over a different route. On a normal week day, the traffic through Newark includes 233 passenger trains and 30 local freight trains to deliver and pick up cars at warehouses, coal yards and freight houses on this line. During the morning peak period of two hours between 6:19 a.m. and 8:24 a.m., about 55 suburban trains pass through Newark. An equally large number of trains are handled in a similar period in the evening.

From the east, three main tracks and a yard lead approach Kearny Junction, which includes three crossovers, two single switches, two derails and 10 home signals. Three main tracks and a siding extend west from Kearny Junction to Harrison. Near the west end of the Harrison



layout, the three tracks converge to two which extend across the Passaic river over a draw bridge with supervisory control from Newark tower. Thus the entire Harrison layout includes five crossovers, two single switches, two derails and 19 home signals. The Newark area starts with the westward home signals for the drawbridge, and includes four derails, one single switch, two crossovers and thirteen home signals.

The electro-pneumatic switch machines and the color-light home signals throughout this area are the same ones as were used previously. The new project of consolidating the controls of these three previous interlockings includes two features of special interest.

High Speed Codes

One of the features of this interlocking consolidation is the control of all switch, signal and associated functions at both remote interlocking sections (Harrison & Kearny Jct.) from Newark over a two-wire line circuit. The control of these functions is effected by a new high speed multiplex code system which employes high frequency carrier energy for the concurrent transmission of control and indication information at the rate of 25 controls and 50 indications per second. Each remote section of the interlocking has its own separate code system so that coding action to the two sections can be concurrent.

Each code to Kearny Jct. consists of 32 steps with a capacity of 32 controls and 60 indications, of which 21 controls and 54 indications are now being used. The Kearny Jct. system employs 19.1 kc and 21 kc for the transmission of controls, and 11.0 kc and 12.0 kc for the concurrent transmission of indications. The Harrison system employs 23.0 kc and 25.4 kc for the transmission of controls and 13.3 kc and 14.6 kc for the concurrent transmission of indications.

Each code to a remote section of the interlocking contains complete information for every function in its associated remote section; so that complete routes can be set up with one code.

This system, by the use of KP and KN relays for stepping and by the use of different frequencies to obtain simultaneous or concurrent transmission of control and indication information, attains a speed of transmission that is, for all practical purposes in this project, as satisfactory as instantaneous control by direct wire.

The equipment for this system consists of an office coding unit, a field coding unit, a number of chain units at both office and field (the number depending upon the size of the installation), a transmitter and a receiver unit for each frequency used, and power units for supplying power to the transmitter and receiver units. These units are all plug coupled for ready replacement.

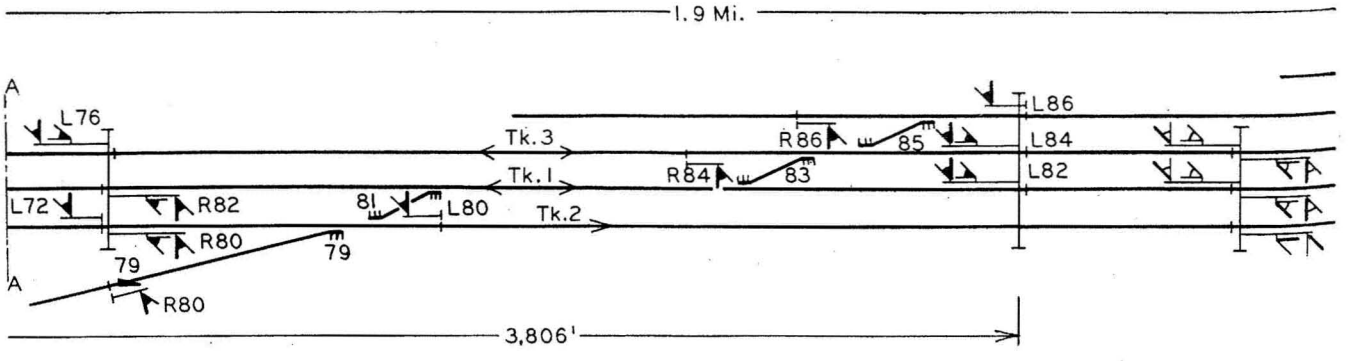
The office coding unit, transmitter and receiver units, and power supply units are mounted on a rack approximately 26 in. wide. This rack also contains a full complement of transmitter, receiver, and power supply units as standby equipment, and change-over relays, operated by a lever on the control machine, whereby the operator can transfer manually to the standby carrier equipment in case of a failure of the normal carrier equipment.

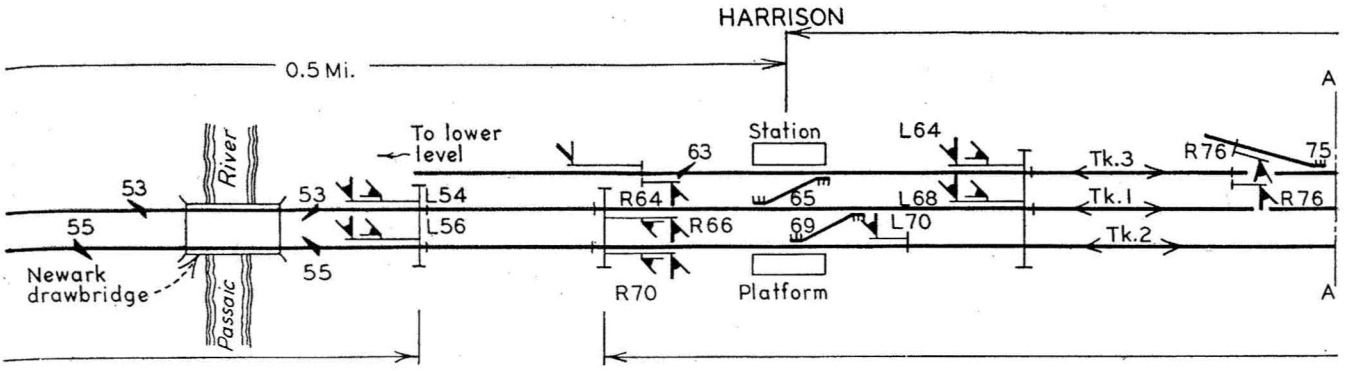
The office chain units, each consisting of 8 relays, are also rack mounted along with their associated indication relays. The various system units at the remote section of the interlocking are also rack mounted in a manner similar to the office equipment.

Route Indications on Control Machine

A second interesting phase of this new Lackawanna project are the new features of the control machine. The center panel of the control machine is 60 in. long, with a wing section 30 in. long at each end, thus totaling 120 in. of panel length; all 54 in. high. The illuminated track diagram, at the top of the panel, has a white line ¼ in. wide to represent each track. On these lines small red lamps which are normally dark, are lighted when corresponding track sections are occupied.

At each place on the diagram, corresponding with a home signal, there is a symbol of a signal which has two normally-dark repeater indication lamps; a red one to repeat the Stop aspect and a green one to repeat a Proceed aspect. Under certain conditions these lamps are flashing, as will be explained later. At each location on the diagram corresponding to a place where a train can depart from





home signal limits, there is a white lamp with a black arrow pointing in the direction of departure. This arrow is illuminated during certain phases of manipulation.

The levers are the so-called paddle type, which are pivoted at the center on a horizontal shaft, extending into the machine. The switch levers, which are painted black, are in the upper row. To move such a lever, it is first pushed, then turned 90 degrees, then finally released. Above each lever there is a single red indication lamp, which is normally extinguished. This lamp is flashed when the corresponding switch is in a position out of correspondence with its lever. This lamp is lighted steady when the control of the switch has been removed, electrically, from the lever.

clear a corresponding R signal. However such operation of a lever actually requires four separate motions: (1) push, (2) turn, (3) release and, (after a check of the route) (4) a final push. A red lamp over each signal lever, normally-dark, is lighted during certain phases of manipulation, as will be discussed later.

Traffic locking is maintained between towers east and west on certain tracks. These levers are green. Electric lock levers are blue, and train-order levers are yellow.

Typical Manipulation

With all levers normal and no trains present, all the indication lamps on the panel are dark. The manipulations to set up a route for a train to enter at home signal RC80

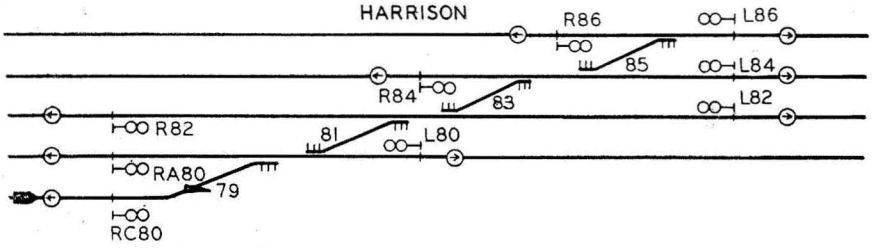


Diagram of a portion of the Harrison interlocking pertaining to the discussion of routing a train (at signal RC 80) through the interlocking

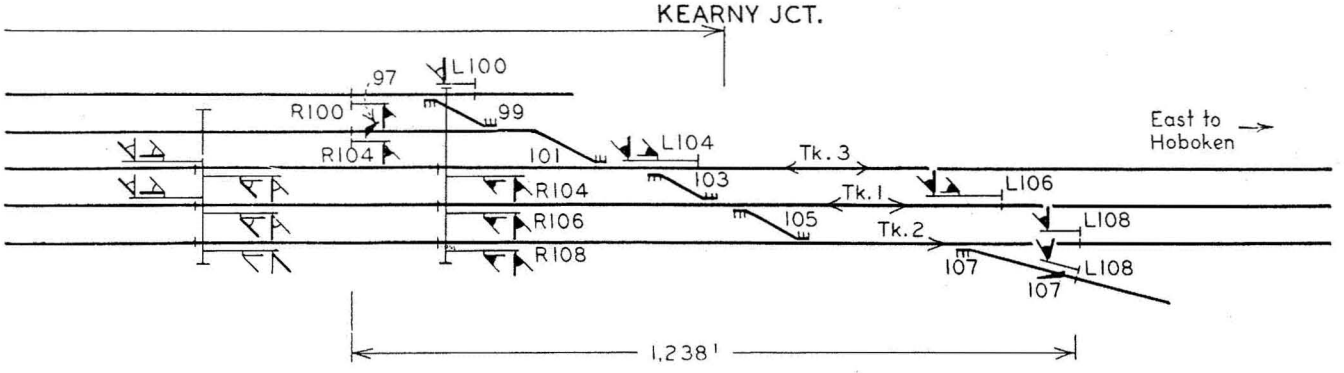
The signal levers, which are red, are in the second row. Each of these levers normally stands on center, with the paddle edge vertical. It is turned 45 deg. to the left to clear an L signal, or 45 deg. to the right to and to depart at L86, are as follows:

The leverman pushes, turns, and releases, the switch levers 79, 81, 83 and 85. As each of the these levers is reversed, the red lamp over it starts to flash, denoting disagreement between the lever and the switch it controls. (The code to control these switches does not go out until later.)

Next the leverman pushes, turns and releases signal lever 80 from the normal to the R position. As the lever is positioned to R, the lamp over it starts flashing, denoting disagreement between the lever and the signal it controls and a code is transmitted to Harrison to control the switches in accordance with the positions of their respective levers. The clear signal control is not included in this code. When the switches operate in response to this control code, an indication code is returned to the Newark control machine, and the indication lamp above each of the switch levers stops flashing. Furthermore, to indicate to the leverman that the switches and crossovers are now lined up properly (for a train to go from signal RC80 eastward to the exit at signal L86) two indications appear: (1) the red lamp in the symbol for signal RC80 (where the train will enter) is flashing and (2) the lamp is flashing in the exit arrow pointing east, located adjacent to the symbol for signal L86 where the train will leave home signal limits.

Thus the leverman has a quick optical check that the route has been established, and is ready for him to clear the signal, which he then does by taking the final action in operating the signal lever, i.e., he pushes it.

On the other hand, if the flashing light arrow and red signal lamp did not appear at the beginning and ending of the route he intended, the



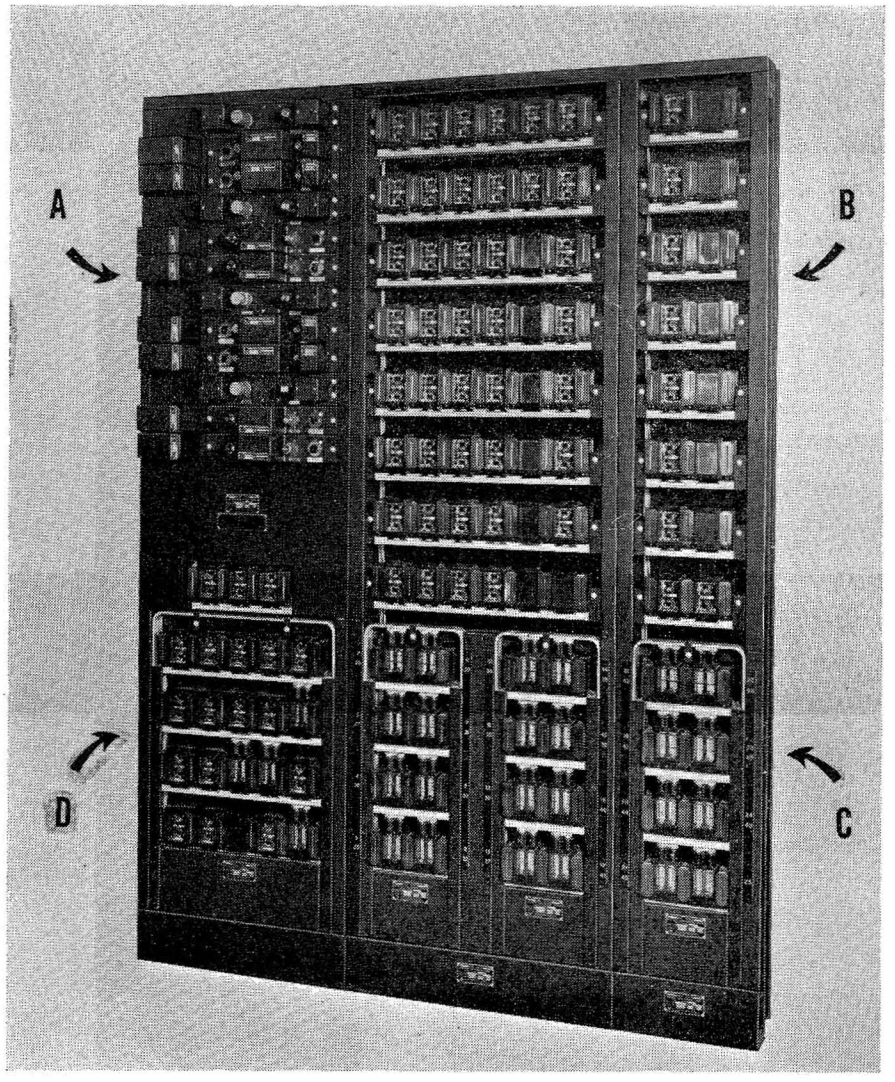
leverman would instantly know that the switches were not lined for the route he wanted, and, therefore, he would not take final action to clear the signal. The circuits for this operation are such that all the switches involved, move at once, and are referred to as "packaged, or one-cycle routing." All switch controls are thus set up in one code cycle.

Assume now that the indication lamps did show that the switches were lined for the route intended, and that the leverman had given the signal lever its final push. This action electrically removes (in the control machine) the control of all switches from the levers involved in the route before signal control character is transmitted which is noted by a steady red light over each of these switch levers. The flashing lamp over the signal lever will continue to flash, but the flashing white exit arrow lamp and the flashing red lamp in the signal symbol will be lighted steady. As soon as the signal clears, and an indication to that effect has been returned to the Newark control machine, the flashing light over the signal lever, and the red light in the signal symbol are extinguished, and a steady green light is lighted in the signal symbol. The steady red light over each of the switch levers continues to be lighted, as an indication that electric locking is effective in the machine. These steady red lights over the switch levers can be extinguished only by a code from the field to the effect that their lock relays are energized. Operation of such a lever when the lever light is burning will not be effective in operating the switch.

When the train passes RC80, an indication code is initiated which lights a track-occupancy indication lamp for the first track circuit; extinguishes the steady green light in the signal symbol; lights the steady red signal lamp in the symbol; flashes the lamp over the signal lever; and continues the steady white light in the exit arrow. The single red light over each of the switch levers continues to be lighted steady.

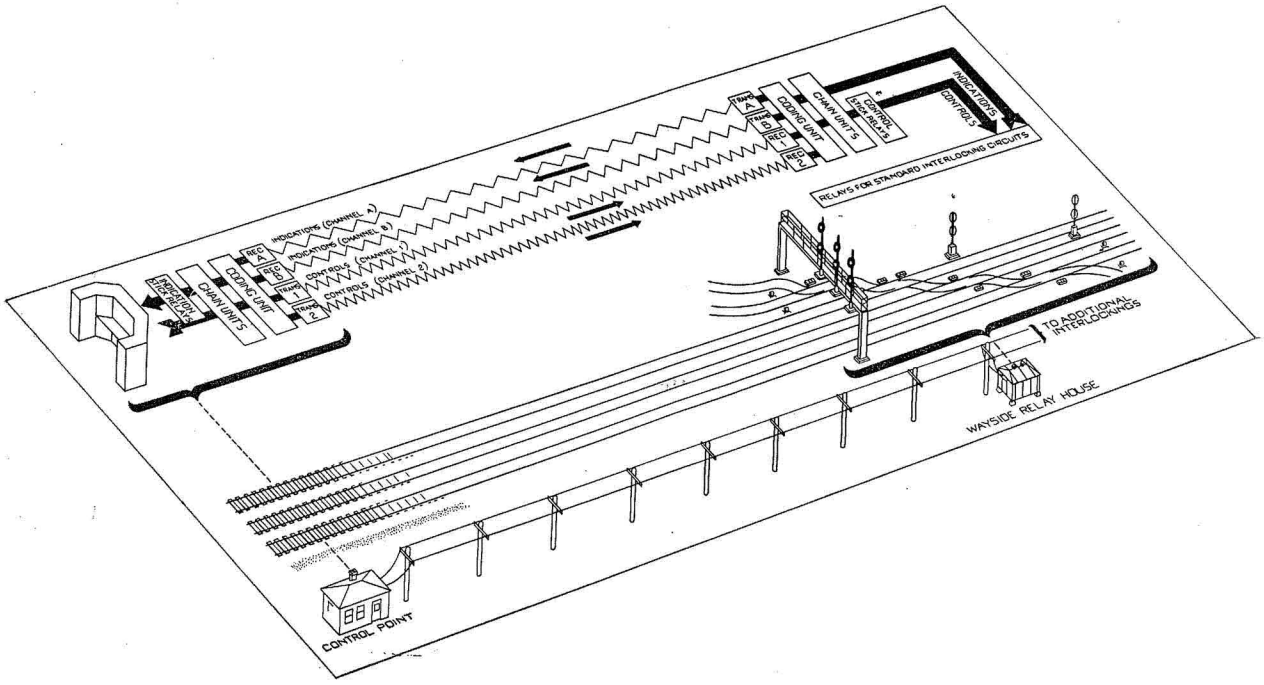
Assuming that the train has proceeded so that its rear is now occupying crossover 85, and at that time, the leverman places the signal lever 80 to the normal position; code is sent that releases switch locking in the field in the usual manner. But before switch locking on the machine is released, a check must be transmitted from the field. Then after signal indication is received, the flashing signal lever lamp is extinguished; the steady red signal symbol light and the steady white exit arrow light are extinguished; and the steady red lights over switch levers 79 and 81 are extinguished, as the train recedes from each track circuit involved. (This circuit action permits "prepositioning" of switch levers for a conflicting route if necessary before the primary route is vacated, and by the same token, obviates "switch storage.") This explanation brings out the fact that any switch or switches previously involved in a route, cannot be moved until the signal lever, governing that route, is placed in its normal position, but that the mental and manual work of the operator can be performed for the conflicting route while the train occupies the primary route. Finally, as soon as the rear of the train proceeds beyond signal L86 switch 85 will be unlocked and the conflicting route can be obtained by turning the controlling signal lever to its proper position.

In this area, the Lackawanna has numerous close following moves, and therefore, provisions have been made for call-on aspect controls and for fleeting of trains. To explain the use of the "call-on" control in connection with a close follow move on signal RA82, assume train "A" is still in the block. Let it further be assumed the operator has not placed lever 82 to the normal position. Steady red switch lever lights on levers 81 and 83 remain; the steady white exit light at signal L82 remains; steady red signal symbol light remains; and flash-



Field equipment for the multiplex code control system:

- **A. Carrier equipment consisting of transmitters, receivers and power supply units**
- **B. Final stick (KP) relays controlled by chain units**
- **C. Chain units for receiving control information and transmitting indication information concurrently**
- **D. Coding unit for controlling chain stepping action**



This shows the basic multiplex arrangement for one interlocking with a coding speed of 25 controls . . . 50 indications per second. Additional interlockings, and associated multiplex equipment, can be handled over the same pair of line wires

ing signal lever light remains.

To clear a "call-on" signal for a close follow move, the operator now pushes the respective call-on button under the lever of the signal involved. As soon as the call-on is clear, the indication will extinguish the steady red signal symbol light; illuminate a steady green signal symbol light; extinguish the flashing signal lever light; and cause the steady white exit light to continue. Should train "A" pass out of block before train "B" accepts signal R82, the signal aspect in the field will progress automatically, and, therefore, needs no operation from the machine.

After train "B" passes signal R82, there will be no change in signal aspect. The call-on aspect does not automatically go to red upon the passage of the train. Hence, there will be no change in signal symbol lighting.

Controls for Fleeting

When several following trains are to pass through home signal limits on the same route, the leverman need only leave the signal lever in its L or R position, and the signal will clear again after each train has gone, the same as an automatic. This will space trains the length of the block beyond the home signal. If following trains must be operated on closer spacing, the "call-on" controls can be used, and established for fleeting. To restore the machine to normal, after "fleeting" action has served its purpose, the leverman need only return the signal lever to normal position.

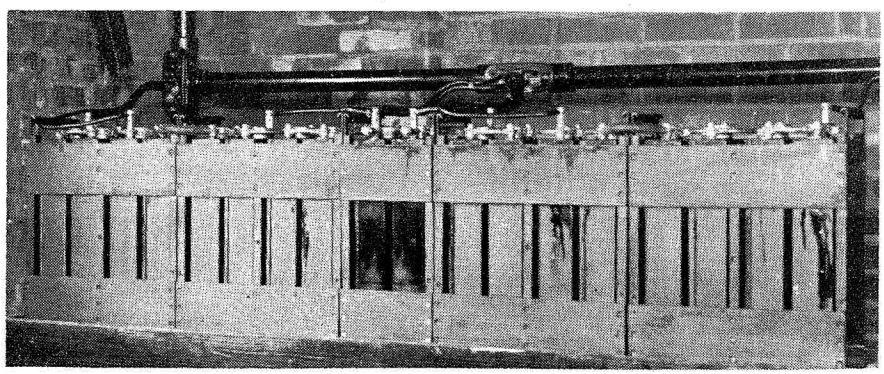
This territory is equipped for electric propulsion of trains using 3,000 volts d.c. Therefore the track circuits are the a.c. type. In each zone, i.e. Kearny Junction, Harrison and Newark, the track circuits are each repeated in the instrument house, using a Type PN50B plug in d.c. relay. The rack of these plug-in relays, located in the tower at Newark, is shown herewith.

Direct wire circuits, rather than code, are used for the control of switches and signals in the area near the new tower at Newark. Conventional plug-in type PN50B relays are used except for a.c. track relays and KR relays located in the tower. Plug tops are used on these. These relays are used for the local controls of switches and signals.

The wiring between relay racks, interlocking machine, and terminal boards for incoming cables is run in Transite chaseways. The control circuits inside the tower are No. 16 flexible wire with TC insulation and green fireproof outer covering, made by The Kerite Company. Tubular type white Duramark tags with black printed numbers are used for wire identification.

At each of the three zones, Kearny Junction, Harrison and Newark, the multiplex coding equipment is fed at 24 volts from a floating 120 a.h. Edison storage battery. The d.c. control circuits and relays in each zone, i.e., Kearney Junction, Harrison, and Newark, are fed by a set of 9 cells of 120 a.h. Edison storage battery.

This consolidation of interlockings was planned and constructed by Lackawanna forces under the direction of J. R. Heisler, signal engineer, the major items of equipment being furnished by the Union Switch & Signal Division of Westinghouse Air Brake Company.



Storage battery feeds multiplex code equipment and d.c. control circuits and relays