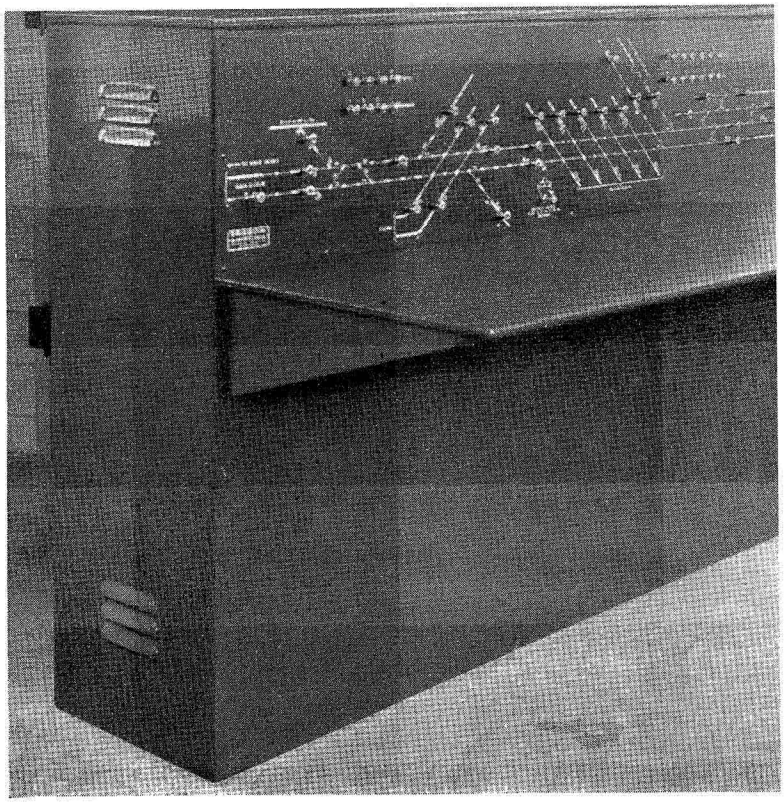
Switches and signals in a route are lined up by operating two push buttons, signal indications are shown in face of buttons, switch indications and track-occupancy indications are shown in track diagram.



The control machine is set at an angle so that the operator has a clear view of the tracks. Below—The Capitol Limited passing through the Western Avenue plant.

B. & O. C. T. Installs Route Interlocking

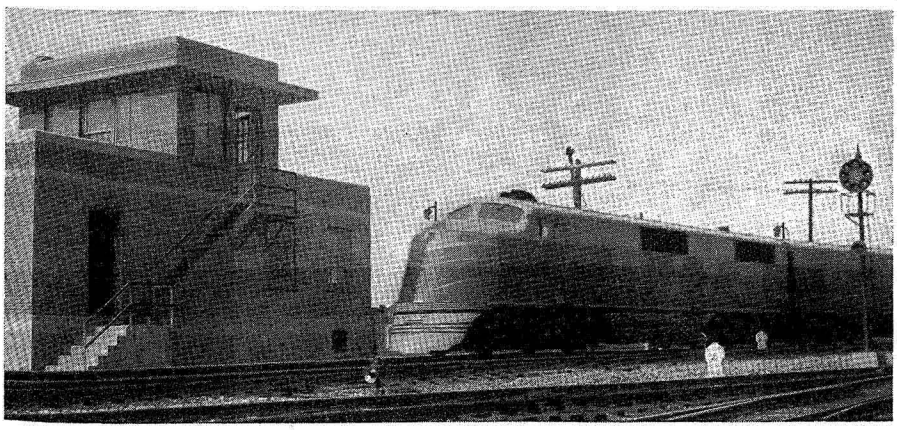
At a location near Western avenue and Fourteenth street in Chicago, the Baltimore & Ohio Chicago Terminal has installed an extensive new interlocking, a special feature of which is the application of a new type of route control rather than the conventional lever control. The control machine consists of a panel including an illuminated track diagram. On each of the lines representing the respective tracks, a push button is located at each point where a route through the plant may start. The operation of such a button initiates the setting up of a route, and subsequent operation of the same type of button at the location corresponding to the departure end of the route, completes the manipulation; following which the switches move to the proper position, and subsequently the signal clears.

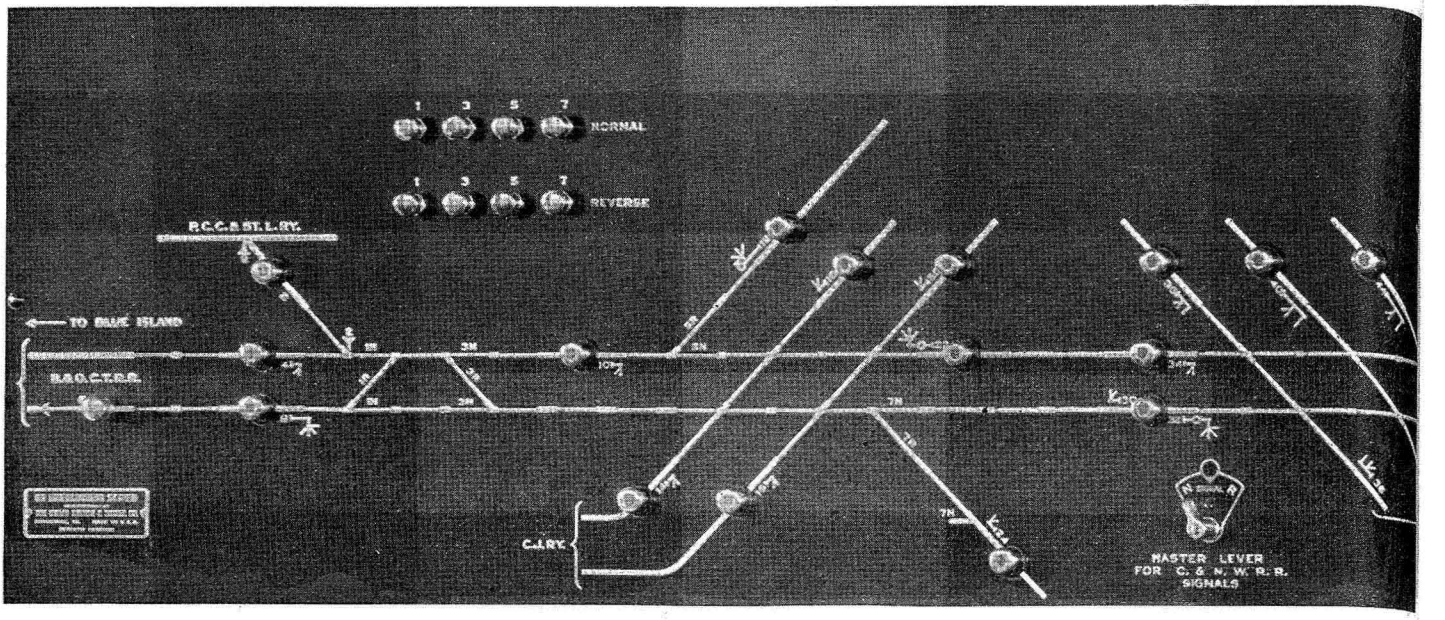
Track Layout and Traffic

The track layout at the location of this new interlocking includes a junction between a four-track line and a two-track line of the B. & O. C. T., a crossing of a double-track line of the Chicago Junction railway with a double-track line of the B. & O. C. T., and also crossings of five switch tracks of the Chicago & North Western with the double-track line of the B. & O. C. T. The home-signal limits include 6 crossovers, 4 single switches and 33 signals.

The B. & O. C. T. tracks through this interlocking are a part of a main lead extending into the Grand Central Terminal, which is located 3.6 miles to the east of Western avenue. This passenger terminal is used not only by the Baltimore & Ohio trains, but also by Chicago Great Western, Pere Marquette and Soo Line trains. One or more freight stations of each of these roads are located between Western avenue and the terminal. All of the passenger trains operated in and out of the terminal, as well as switching moves to serve the freight houses and industries in this territory, are operated through this interlocking and over the main line of the B. & O. C. T. in the territory between Western avenue and the terminal. Trains of the Baltimore & Ohio and the Pere Marquette use the double-track line diverging to the south at the Western avenue plant. Trains of the Chicago Great Western and the Soo Line use the tracks extending westward through the plant.

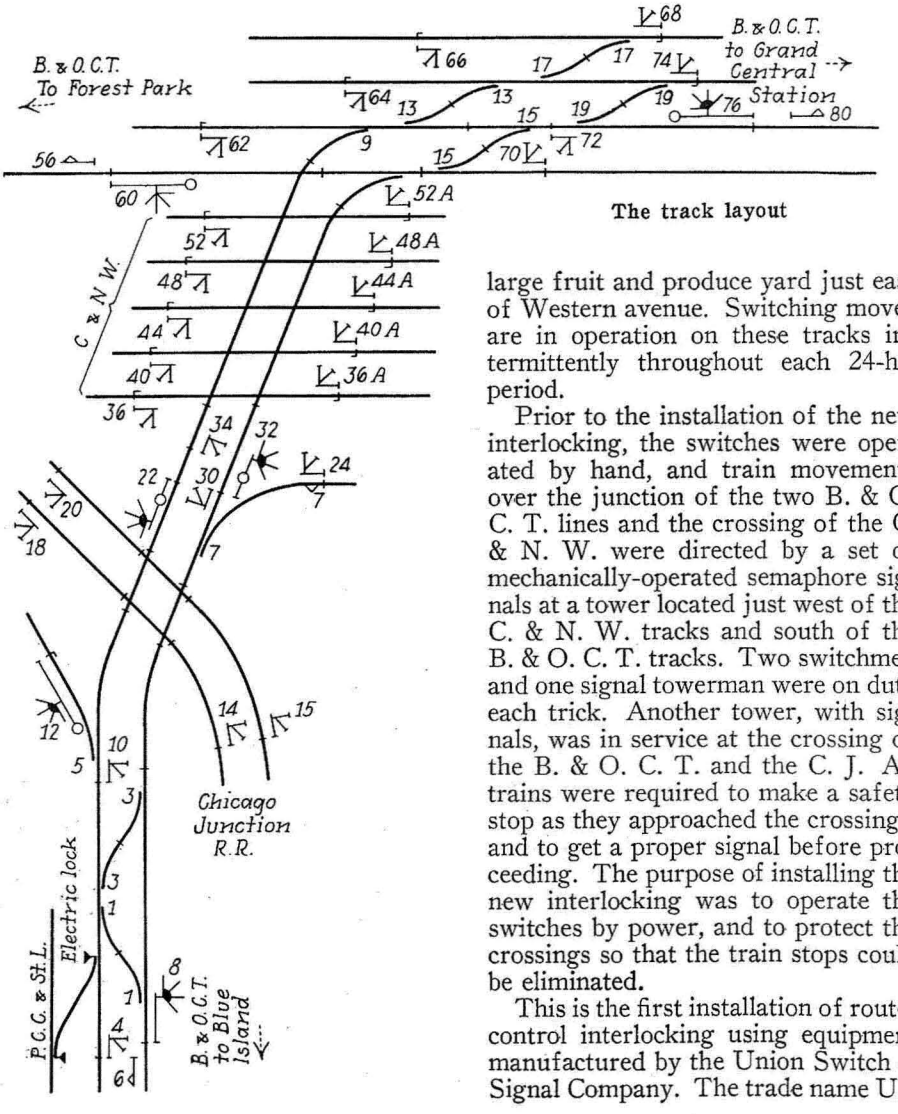
In periods of normal traffic, as many as 1,200 total moves are made over the plant daily. A total of 26





The route-control buttons are located in the face of the

scheduled passenger trains are now operated daily through the new interlocking, and the roads mentioned above also operate about 166 through freight, transfer and switch runs through the plant daily. The Chicago Junction operates about 60 freight trains daily through the plant. The five tracks of the C. & N. W., which crosses the double-track main line of the B. & O. C. T. in the plant, are yard lead tracks extending into a large fruit and produce yard just east of Western avenue. Switching moves are in operation on these tracks intermittently throughout each 24-hr. period.



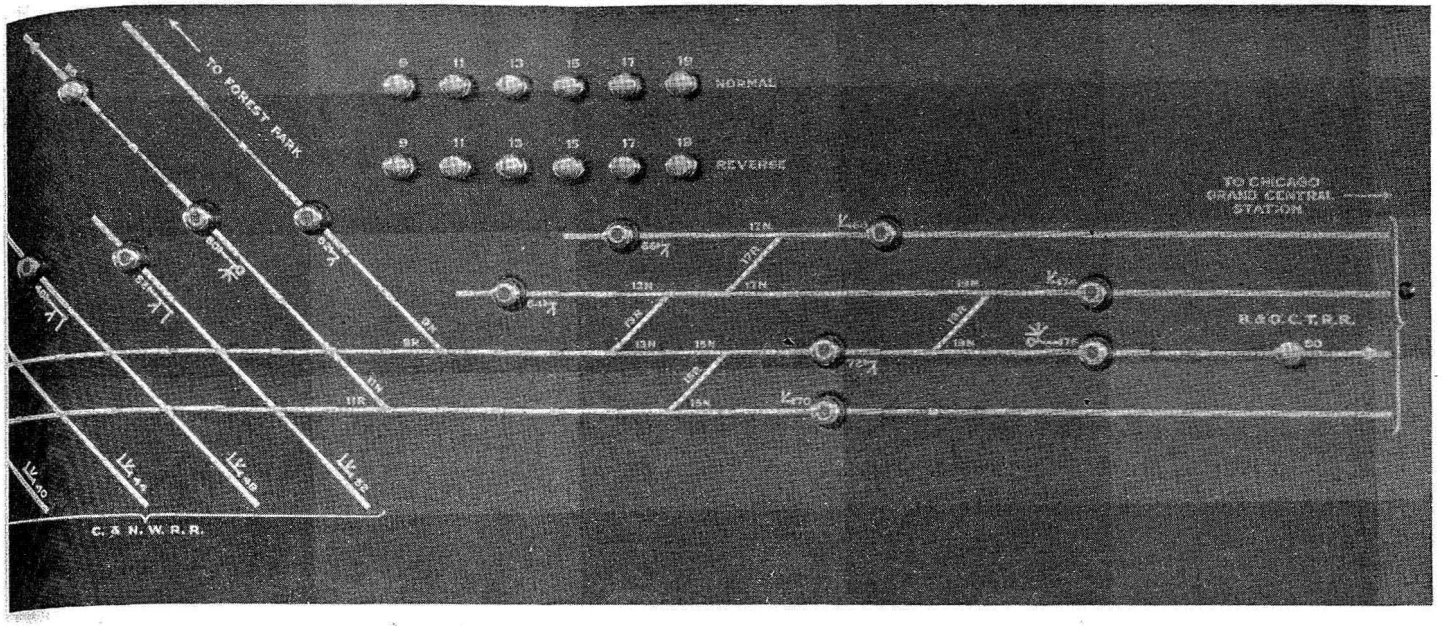
The track layout

Prior to the installation of the new interlocking, the switches were operated by hand, and train movements over the junction of the two B. & O. C. T. lines and the crossing of the C. & N. W. were directed by a set of mechanically-operated semaphore signals at a tower located just west of the C. & N. W. tracks and south of the B. & O. C. T. tracks. Two switchmen and one signal towerman were on duty each trick. Another tower, with signals, was in service at the crossing of the B. & O. C. T. and the C. J. All trains were required to make a safety stop as they approached the crossings, and to get a proper signal before proceeding. The purpose of installing the new interlocking was to operate the switches by power, and to protect the crossings so that the train stops could be eliminated.

This is the first installation of route-control interlocking using equipment manufactured by the Union Switch & Signal Company. The trade name UR has been adopted as descriptive of the term Union Route interlocking. The face of the control panel is made of sheet metal and is 14 in. high and 5 ft. 8 in. long. The machine case is 45¼ in. high and 17 in. from front to rear. A desk, supported by brackets, is attached to the front of the machine just below the panel, this desk being 30 in. from the floor, 21⅜ in. wide and 5 ft. 8 in. long. The machine is located in the new tower on the upper floor, which consists of a single room with windows on all sides so that the leverman has a clear view of the tracks in all directions. The machine is set at an angle so that the leverman can see in all directions, excepting east, without turning his chair. As the case of the machine is only 45 in. high, he can see over the top without leaving his normal position.

Route-Control Buttons

The route-control buttons are located in the face of the machine panel in the lines representing the tracks, each button being mounted in the location corresponding with that of a signal which may govern a train movement to enter the plant or a section of the plant. Only one button is used at each of the locations corresponding to a signal. Such a button can be used either to initiate or to complete the control of the line-up for a route. The first button operated marks the start of the route, and thus determines the signal which will be cleared. The second button establishes the end of the route or, in other words, the track on which the train will depart from the plant. When a route is to be set up in the opposite direction over the same line-up of tracks and switches, the same two push buttons are operated in reverse sequence. The operation of



machine panel in the lines representing the tracks

the two buttons completes the control for a line-up of a route regardless of the number of switches involved, and, furthermore, as soon as the switches are positioned and locked, the signal or signals for the route clear, an important point being that not only the signal at the beginning of the route clears, but also signals within the plant on that route also clear. For example, in lining up a route from signal 8 to departure button 70, the operation of these two buttons lines up the route and causes not only signal 8, but also signal 32, to clear. On the other hand, if the route was to be established only from signal 8 to signal 32, then these two respective buttons would be operated, in which case signal 32 would not be cleared. Thus, routes may be established from signal to signal or through an intermediate signal to the end of the plant.

The buttons operate on the non-stick system of control, so that each button returns to normal position by spring action as soon as the operator removes his finger. The control set-up for a route is automatically cancelled by the passage of a train. Therefore, no further manipulation, comparable to lever restoration, is required of the operator. When it is desired to cancel a route manually, the push button which was operated first is *pulled* toward the operator. A call-on signal is displayed by re-establishing the route control in the same manner, when the route is occupied.

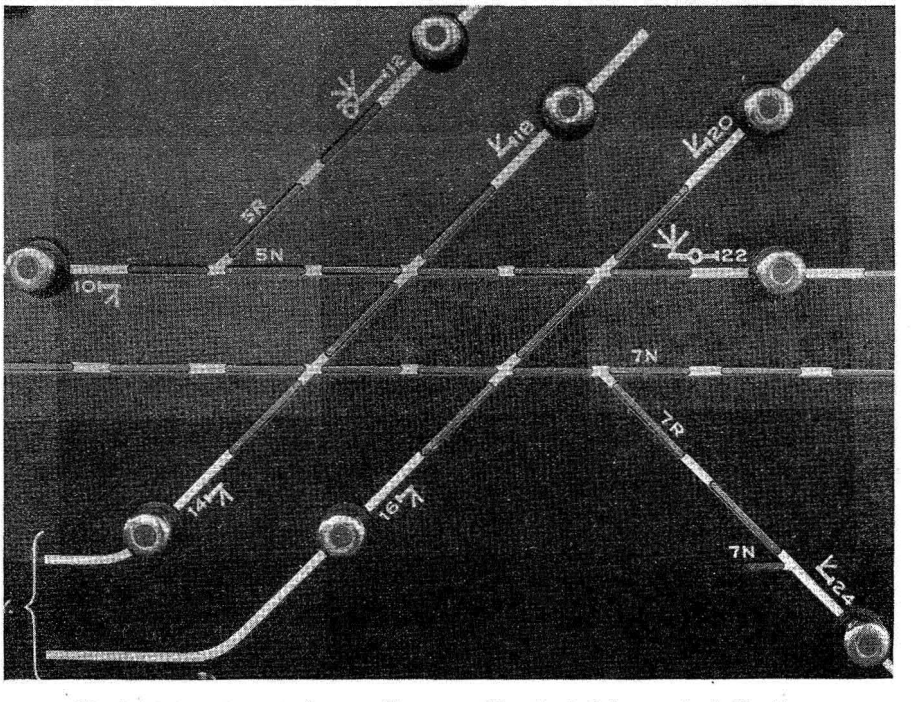
Signal Indication on Control Machine

Information concerning the aspects being displayed by a signal is indicated in each instance by lamps, which are mounted behind the corresponding push button, and which throw light through a lens located in the center of the button. Normally the lamps are extinguished. When the first button of a route set-up is operated, the indication lens in that button is illuminated to show red. This indicates that the route set-up is still incomplete and that the signal has not cleared. As soon as the route is completed and the signal clears, the indication in the button changes from a red to a green. This green indication burns steadily when a high-speed, medium-speed or slow-speed signal clears, but the indication lamp flashes green when a stop-and-proceed, call-on signal is cleared.

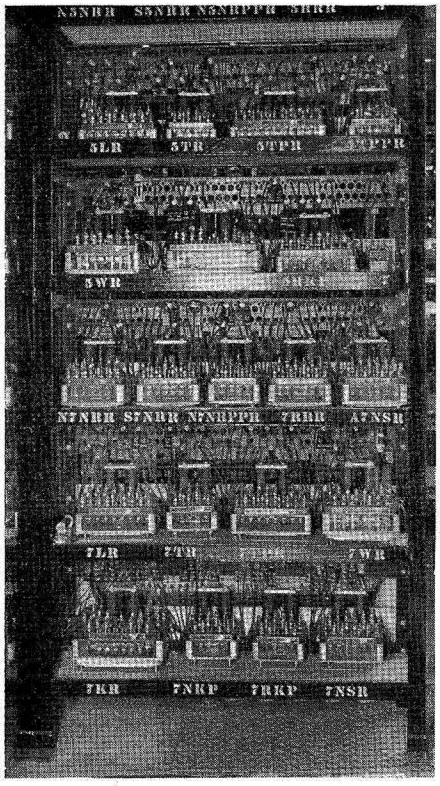
The indication lamp in the button at the leaving end of a route ordinarily remains extinguished, but if an attempt is made to set up a route which is not available, a red light will appear in that button as an indication of improper manipulation. In such a case, both buttons must be *pulled* in order that the controls may be restored to their normal condition.

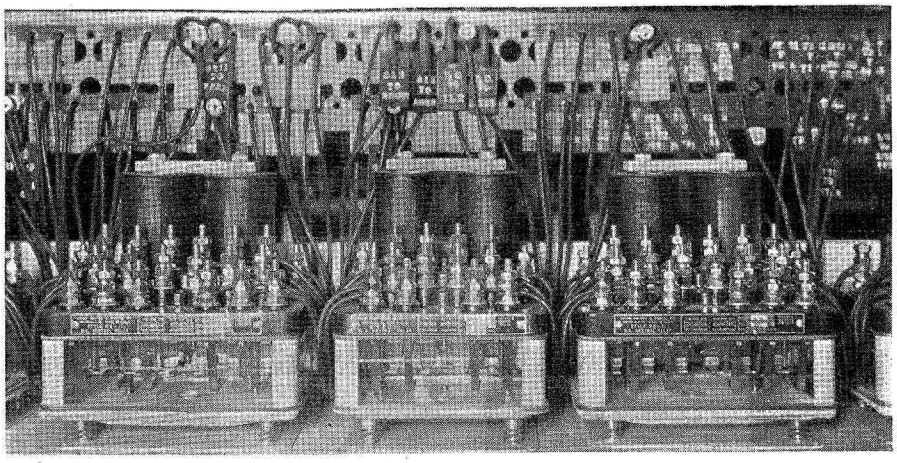
Control of Alternate Routes

In some instances, alternate routes are available within the plant for a train passing from an arrival point to a departure track. For example, between signal 34 and 74, the preferred route is via switch No. 9 reversed, No. 13 reversed, No. 17 normal and No. 19 normal. A secondary route, however, may be arranged via No. 9 reversed, No. 13 normal, No. 15 nor-



Moulded translucent glass sections are illuminated for route indications





The 14 relay racks in the tower are made of angle-iron and asbestos board with composition terminal boards

mal, signal No. 72 and switch No. 19 reversed. The control is so arranged that normally when push buttons 34 and 74 are pushed, the preferred route would line up. However, if track circuit 13 is occupied with switches 13 normal and 17 reverse, then the secondary route will automatically become established when buttons No. 34 and No. 74 are pushed. The secondary route can be established, when desirable, by pushing push button No. 34, then No. 72, and then again pushing No. 72 and finally No. 74.

Special Control of C. & N.W. Signals

After the passage of a train on the B. & O. C. T. tracks, it is advantageous that switching movements on any or all of the five C. & N. W. tracks be started at once. In order to facilitate manipulation, one miniature-type, two-position lever was provided for the control of all of the 10 signals on the C. & N. W. tracks. The controls of these signals are non-automatic. Only one track circuit is employed on these C. & N. W. tracks to provide locking to prevent establishing a conflicting route. After these signals have been cleared, they remain so independent of occupancy of any or all of the tracks on the C. & N. W. With this control arrangement, the C. & N. W. can continue to switch back and forth over the crossing with no further attention on the part of the towerman. When a through train is approaching on a B. & O. C. T. track, the towerman sets the C. & N. W. signals at stop as a warning for the C. & N. W. to clear the home-signal limits as soon as possible.

A situation might arise in which a switch engine, running light or with only a few cars, would approach on one of the C. & N. W. tracks at the same time another switch engine with a long cut of cars was approaching on another C. & N. W. track. Time might be available for the light engine to move across the plant, but if the drag were allowed to proceed it might interfere with through trains on the other road. In order to take care of such circumstances, a separate push button control is provided for each track on the C. & N. W. If the signals for only a certain track or tracks of the C. & N. W. are to be cleared, the separate push buttons for the corresponding tracks are used, as for example, push buttons 36, 40, 44, 48 and 52.

Traffic Locking

In some unusual circumstances, it may be desirable to run trains in the direction opposite to the assigned direction of traffic. For the protection of such movements, a traffic button is provided for each approaching track to the new Western avenue plant and must be depressed to get a signal to that point. Traffic push buttons 6, 56 and 80 are used for this purpose.

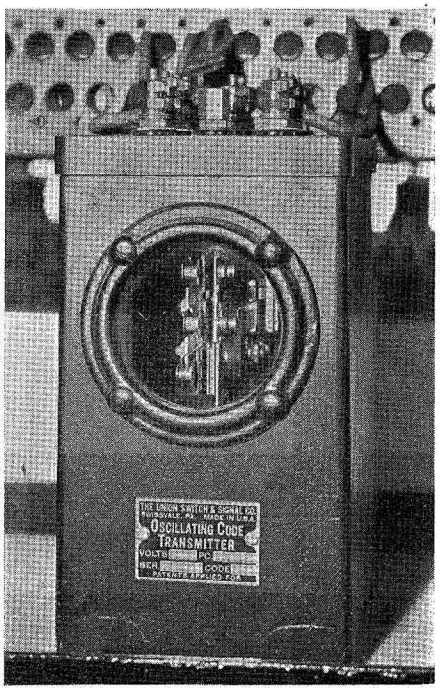
As a reminder to the operator that a reverse-direction train movement is set up against an entering signal of the plant, a translucent arrow, which can be illuminated white, is associated with each traffic button.

Route Indications

The entire track arrangement controlled from the UR interlocking panel is indicated by individual white lines representing the tracks. This track layout is on a steel front plate with a dull-black baked enamel background. The steel plate is cut out, and these cut-out places are filled by moulded translucent glass sections to represent the track circuits.

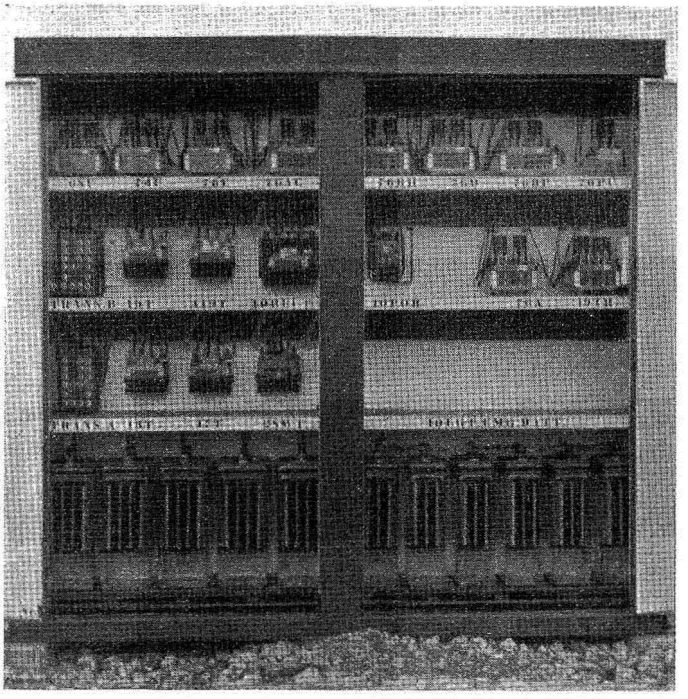
Two lights of different colors, one white and the other red, are located back of each section of track. This makes three indications available, one being the normal unoccupied condition, indicated by no illumination; a second being a white illumination, this indicating the complete route as set up through the limits of the interlocking, and a third being a red illumination of those sections as they are occupied by a train as it advances over the route. As the rear of a train clears the various sections of track, the indication on the track automatically becomes normal, without illumination.

Information as to whether each switch is in proper position and locked

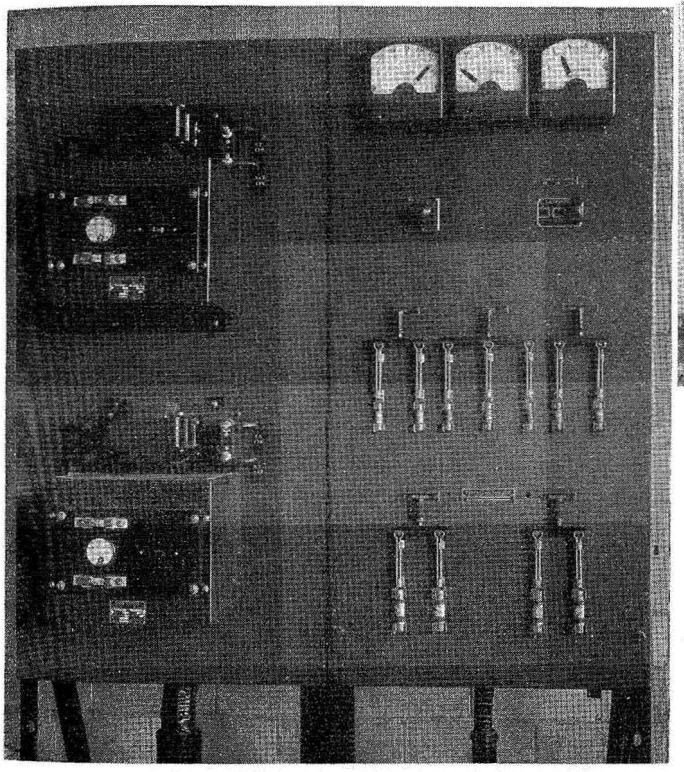


An oscillating code transmitter provides flashing button indications

is indicated by means of short sections of the track diagram which represent the switch leads. Referring to the illustration of the track diagram, the section of the track line 7N is used to indicate the normal position of switch 7 and likewise section 7R indicates the reverse position. If any switch is not in proper agreement with the route set-up, established by operation of the route-control buttons, the short section of the diagram embracing the switch will remain dark until the switch moves into agreement. Sectional route locking is in effect to lock all functions, such as switches, in advance of a train and in the sections occupied by a train. As the rear of a train clears each track section, the route locking is released in the respective section, so that other routes involving the section released can be lined up.



Instrument case No. 4—typical of outlying construction



The control of the power supply is concentrated on a two-panel switchboard

Individual Control of Switches for Test Purposes

When a switch is being tested or adjusted, the operation of the switch should be under the direct control of the towerman, entirely separate from the route-control system. Furthermore, when a layer of ice or a block of coal obstructs the operation of a switch point to prevent it from making its complete movement and from being locked up, separate individual control of each switch is necessary in order that the switch may be moved back and forth to crush the ice or coal. For the reasons outlined above, a set of individual switch control buttons is provided. The buttons for the control of the switches at the west end of the plant are located in a group in the upper left-hand section of the control panel, and those for the switches in the remainder of the plant are in a group in the upper right-hand section of the panel. These buttons are not located as a part of the track diagram, because they are not used in normal operation of the route-control system. Two buttons are provided for every switch, one to control the switch to the normal position and the other to the reverse.

When a switch is being operated by the individual control buttons, the completion of a normal or reverse switch operation is indicated by illuminating a short section of the track diagram in the normal or reverse switch lead, as previously explained under the heading, "Switch Indications."

The control established by the individual switch control buttons, and the corresponding indication, may be cancelled by *pulling* out the last button operated, or the individual control will be automatically cancelled by means of the route-control system when a signal is cleared for a route through the switch. In the latter case, the switch is moved to the desired position by the individual control, and then a route control is established by use of the route-control buttons. The individual control holds the switch in position until the route control becomes effective. When the signal is cleared, the sectional route locking becomes effective and releases the stick relays used for individual control.

The circuits are so arranged that any existing set up of route control must be cancelled before operating switches by means of the individual control. As a result, the operator cannot, inadvertently, by individual control, operate a switch in a route which has been established by route control.

Storage of switch control is prevented by the route-locking circuits, which prevent the establishment of any route control which involves a change in the position of a switch or crossover which is locked, and also render ineffective the operation of the individual switch control buttons while the switch or crossover is locked. A route set-up becomes electrically locked so that manipulation of the individual switch control buttons or an attempt to set up a conflicting route will have no effect upon the route in use.

Route Control Circuits for UR Interlocking

The diagram shown in Fig. 1 represents a control panel for a track layout involving crossover 1 and switch 3 and signals at points 2, 4, 6, 8 and

10, to govern train movements through the plant. Assume, for the purpose of explaining route control, that a three-position circuit controller is located in the track diagram at the point corresponding to each signal location. Each of these circuit controllers may be considered normal in its center position, and each of these controllers may be equipped with contacts to be closed when the controller is operated to the right and other contacts to be closed when the controller is operated to the left.

Referring to Fig. 2, controllers 2 and 8 may be operated to the right to set up a route from 2 to 8. A circuit is then closed from B through the right-hand contact of controller 2, a back contact of relay 1ANR, winding of relay 1RR, back contact of relay 1BNR, winding of relay 3NR, back contact of relay 3RR and right-hand contact of controller 8 to C. This circuit energizes relays 1RR and 3NR in series. The contacts of relays 1RR and 3NR may then function the same as corresponding contacts on switch levers in a standard relay interlocking system and operate crossover 1 and switch 3 to the positions required for a move from 2 to 8, providing the usual approach and route locking is released.

In a system as described above, the controllers at each end of a route would be operated in the direction in which the train is to move. It will, therefore, be seen that the three-position circuit controllers 2, 4, 6, 8 and 10, may also serve as signal control levers and control the signals by means of circuits which are practically the same as in a standard relay interlocking.

Stick Relays Provided

The system shown in Fig. 2 would require the operator to return all circuit controllers to their normal position after each train has entered the route. A simple arrangement using a push button and a stick relay in place of each of the three-position controllers, described in connection with Fig. 2, is provided in the UR interlocking as installed at Chicago, to avoid the manipulation which would be involved in restoring the controllers to their normal position.

The route relay circuits in UR interlocking then take the form shown in Fig. 3, and the stick relay circuits are as shown in Fig. 4. With the circuits as shown in Fig. 3 and Fig. 4, a route may be set up from 2 to 8 by pushing buttons 2 and 8 in sequence. The pushing of button 2 closes two contacts, one in the circuit of relay 2PBS (Fig. 4) and the other in the circuit of the route relays (Fig. 3). The route relay circuit is open at other points so that the route relays are not affected. However, the contact of button 2 in the circuit of relay 2PBS closes the pick-up circuit, and relay 2PBS picks up and sticks through the pull contact of push button 2. One contact of relay 2PBS now connects the route relay network to common.

The pushing of button 8 also closes two contacts, one in the route relay network (Fig. 3) and one in the pick-up circuit of relay 8PBS (Fig. 4). The contact of push button 8 in the route relay network connects battery to the network, and as common is now connected to the network at a front contact of relay 2PBS, a circuit is closed which picks up relays 1RR and 3NR in series. A front contact of 3NR then provides a stick circuit to hold the route relays energized so that button 8 may be released.

The second contact of push button 8 closed the pick-up circuit for relay 8PBS, but the PBS relays are slower in picking up than the route relays. When button 8 was operated, relay 3NR picked up quickly and opened its back contact in the circuit of relay 8PBS and relay 8PBS did not pick up. A push button relay PBS is picked up when the first button is pushed and its contacts select the signal to be cleared.

The tower building is constructed with brick walls and poured concrete floors and roof. The walls of the operating room are finished with tile. The building is, therefore, practically fireproof, the only wood used being that for the windows and doors and

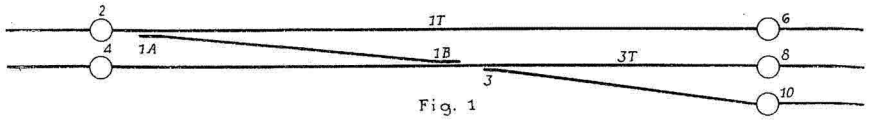


Fig. 1

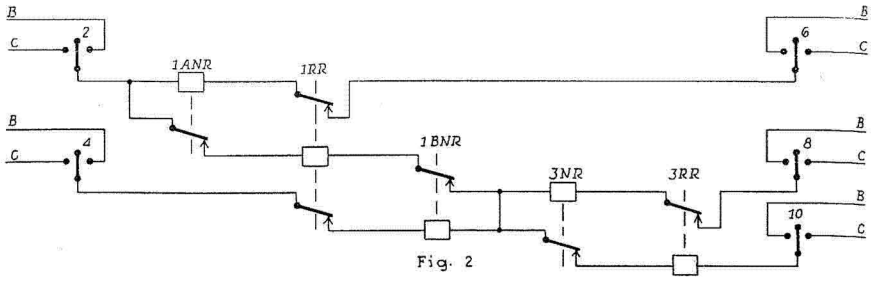


Fig. 2

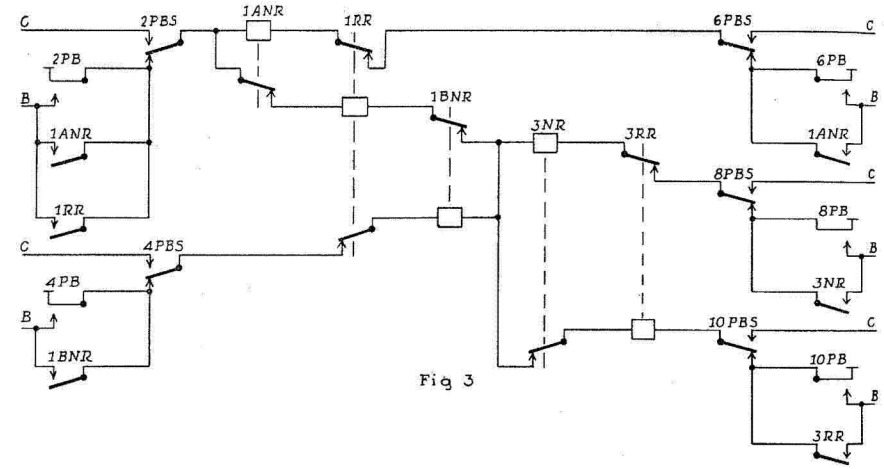


Fig 3

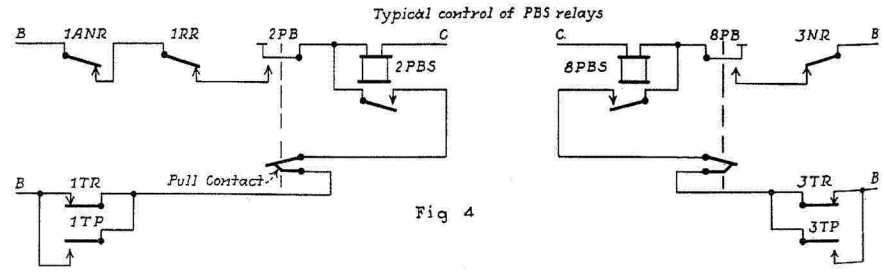


Fig 4

Typical route-control circuits

frames. Heat is provided by a warm-air furnace fired by an automatically-controlled oil burner. Toilet facilities are provided in the basement and also in the operating room.

The signals on the B. & O. C. T. tracks are the color-position-light type, presenting a complete range of aspects and indications, as explained in an article on page 517 of the September, 1937, issue. The signals on the Chicago Junction and the C. & N. W. are the color-light type. The switch machines are the Union Model M-2 operating on 110-volts, d-c., and are equipped with lock rods and point-detectors. The Hayes derail on turnout No. 7 is pipe connected to the machine at switch No. 7.

The crossover connecting track between the B. & O. C. T. westward main track and the P. C. C. & St. L. is used infrequently. These switches are hand-operated, and are equipped with Union electric switch locks controlled by the control machine in the tower.

The wiring distribution between the tower and the various units over the plant is in underground cable. At each signal, the underground cable is brought up to terminals in a cast-iron junction box near the base of the mast. A cable made up of single-conductor insulated wires extends from this box to the signal heads. The section of underground cable from the box to a point well below the ground line is protected by iron pipe.

Instrument Racks in Tower

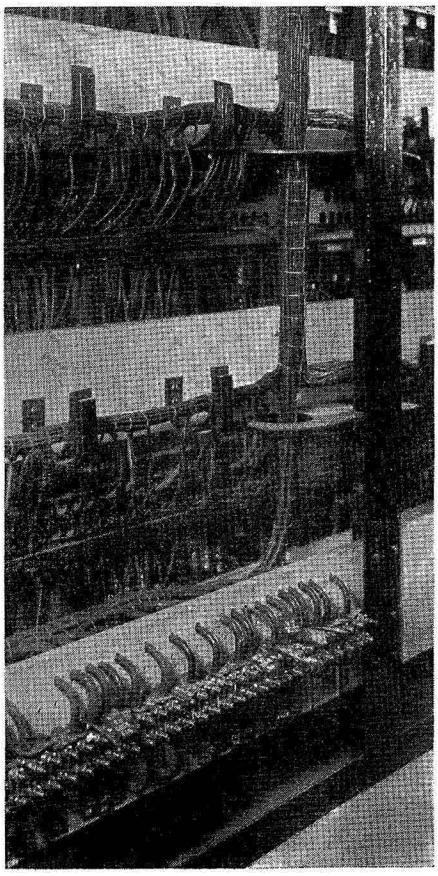
A separate room, 17 ft. by 22 ft., on the ground floor of the tower, is used exclusively for housing the relays and other instruments. The frame work for the relay racks is made up of 2-in. angle-iron welded together. Each rack is made up of 6 shelves, set about 14 in. apart, each shelf being 13 in. from front to rear and 44 in. long. The shelf, as well as the back board, 6 in. high, is made of ½-in. asbestos board. Single-post Everdure terminals, as required, are mounted in a composition terminal board near the top of the rear of each shelf. Behind the backboard there is a 6½-in. wiring space, in which the wires are run in hooks and rings, which are insulated with pieces of fibre.

The relays are practically all of the DN type, but are made up with different contact arrangements, coil resistance, and operating characteristics to meet various requirements. A special feature in the instrument room is the oscillating code transmitter, which is used for the sole purpose of flashing the indication lamps in the signal buttons on the control machine when a call-on aspect is being displayed. The relays which directly control the various indication lamps on the panel of the control machine are of the L type, of the same construction as those used in centralized traffic control systems, these relays being enclosed in two steel cases, with glass panels through which the relay armatures and contacts can be viewed. The L relay cases are located in the back of the machine.

Power Supply

The control of the power supply for the interlocking is concentrated on a two-panel switchboard located in the maintainer's room, where he can see it frequently to check readings. The main battery is on floating charge by an RP-41 rectifier. Another RP-41 rectifier is used to charge the low-voltage battery. Both of these rectifiers are mounted on the switchboard.

A six-way rotary switch is used to test battery voltage of operating battery and to make ground tests of high-voltage positive and negative on high-voltage buses east and west of the tower. A ground as low as three volts will register on the meter. A three-way plug switch is used to check the charge rate of high- and low-voltage operating battery and the discharge of low-voltage battery. The discharge of high-voltage battery is indicated on a separate meter connected at all times.



Behind the backboards the wires are made up in cable form

The battery on this installation is of the lead type furnished by the Electric Storage Battery Company, the EMGS type cells being used throughout. The main battery, as well as standby battery for lighting, and some of the track cells, are located in a room at the east end of the basement. The battery for operating the switch machines consists of 55 EMGS-7 cells. One set of 6 cells is used for control circuits, and 6 sets of 6 cells of EMGS-5 batteries are used for standby lighting. One cell is used to feed each track circuit. The 6-cell batteries are each charged by a Type RX-21 rectifier, and each track battery is charged by an RX-10 rectifier.

Arresters, Wiring and Relays

Triple-path, Type-390, vacuum lightning arresters, made by the Western Railroad Supply Company, are used throughout the plant. Copperweld ground rods, 15 ft. long and ¾ in. in diameter, were installed. A special grounding arrangement was provided in the instrument room in the tower. A hole was drilled in the metal frame of each relay rack and a terminal bolt was mounted in each of these holes. These terminals are connected in multiple to ground by No. 6 insulated wire. Incoming underground cables are brought in through an enclosed opening at the front of the tower, and extend through concrete channels or chases below the level of the floor in the instrument room. In the walk ways, these chases are covered with sections of steel foot plates. The wires between different racks and to the machine on the floor above are run in made up cable supported by a messenger of stranded Copperweld wire. Insulation with flame-retarding finish is used on all wires.

This new Western Avenue interlocking was installed by the railroad's signal department forces, under the general jurisdiction of G. H. Dryden, signal engineer of the Baltimore & Ohio, and under the direct jurisdiction of G. P. Palmer, engineer maintenance and construction, and C. O. Siefert, signal supervisor, of the B. & O. C. T. J. J. Clancy was the general foreman in charge of construction. The principal items of interlocking materials were furnished by the Union Switch & Signal Company.