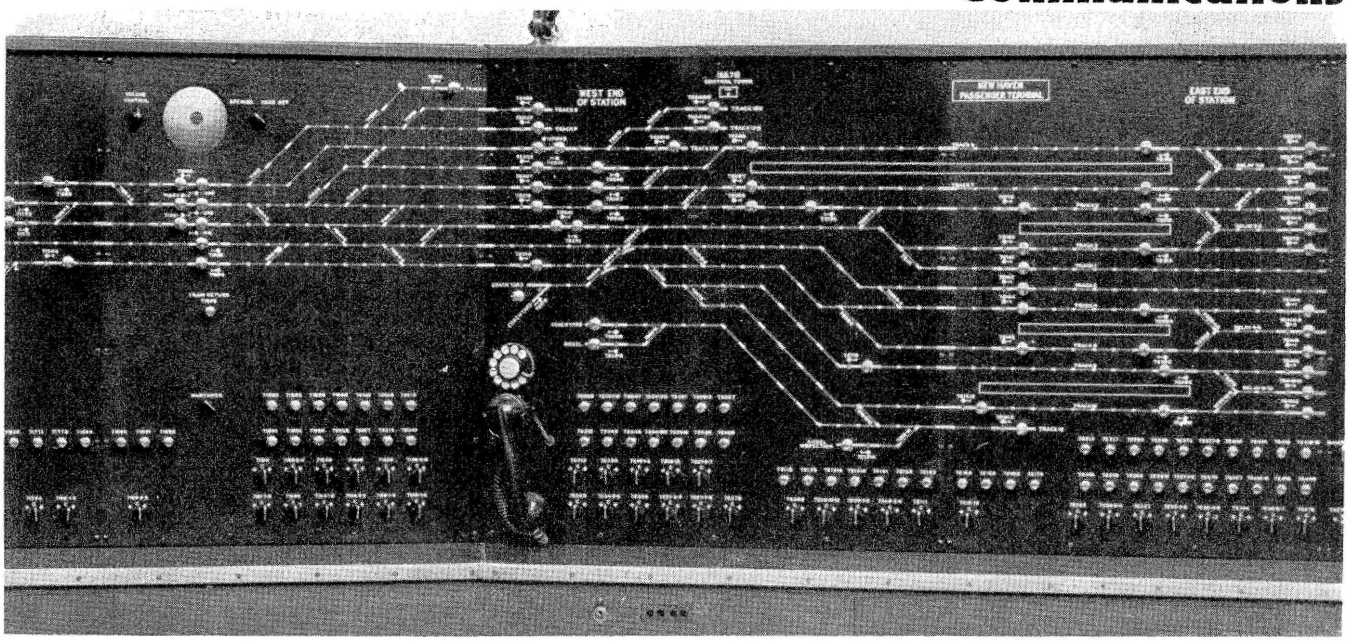
Railway Signaling and Communications



THE CONTROL MACHINE consists of five sections such as the one shown here, each of which is 6 ft. 7 in. long

New Haven Consolidates Control of Nine Interlocking Layouts

Largest project of its kind, now 75 per cent completed at New Haven, includes nine layouts, and plans are underway for all interlockings on 157 miles, with signaling both ways on both tracks, New Haven to Boston, using microwave in place of CTC code line wires

AT NEW HAVEN, CONN., the New Haven Railroad has completed the installation of four new electric interlockings that are controlled from one pushbutton-type route control interlocking machine, which will also control five more interlockings within a radius of 10 miles either side of New Haven, totaling 47 single switches, 58 crossovers, 70 home signals and 155 dwarf signals. A new fireproof building, constructed to house the control machine, is designed for expansion so that additional machines to control all the interlockings from New Haven to Boston, 157 miles, and New Haven to Springfield, 62 miles, as well as new signaling for train movements both ways on both main tracks. Because of the hurricane damage to line wires and pole lines in this area during the past few years, the New Haven is studying the possibility of installing microwave systems for the transmission of CTC controls and indications, as well as for through communication circuits.

The daily traffic through New Haven includes 50 freight trains, 70 through passenger trains, and 30 passenger trains that originate or terminate at New Haven. Electric locomotives are used on the four-track electrified main line between New York and New Haven, and diesel locomotives are used east of New Haven. Therefore, while each eastbound passenger train is at New Haven, the electric locomotive is replaced by a diesel locomotive, and on each westbound train a diesel is replaced by an electric locomotive. The electric locomotives are kept ready on the stub tracks just west of the station. The diesel locomotives are held in the yard, and moved to the relay tracks prior to the change of power for eastbound trains. The change of locomotives must be completed within an allotted time. Consequently no delay in the operation of the interlockings can be tolerated. Ordinarily, westbound freights pass through the New Haven passenger station area on track No. 1, and the eastbound freights on track No. 2, no platforms being located on either side of these tracks.

Mail and express cars are taken off or placed on certain trains at each end of the station. Numerous ware-

This is article No. 5 in our series on "Modern Systems of Signaling Control Systems." The No. 1 article on Reading's new type interlocking machine, October issue; No. 2 article on NYC four track to two, with CTC, December issue; No. 3 article on SP flat-top interlocking machine, January issue; and No. 4 article on SP automatic yard control, February issue.—Editor.

INTERLOCKING S.S.75 is one of nine in the consolidation

houses and a new mail terminal are located in the area north and south of the tracks east of the station. A conservative count, for the four consolidated interlockings in service, shows about 1,600 interlocking lineups daily for switching moves which, added to the 150 regular trains, makes a total of about 1,750 lineups daily on the new interlocking machine in the New Haven area.

Large Interlockings are Included

At New Haven, 10 tracks extend through the passenger station area, converging to four main tracks going west toward New York. Also in this area, at the west end of the station, there are several switches to stub-end engine tracks and spurs leading to shops and warehouses. Formerly in this area, there was an 80-lever mechanical interlocking, S.S.75, which has been replaced with electric switch machines and searchlight signals, a total of 14 single switches, 16 crossovers, 2 slip switches and 53 home signals.

At the east end of the station area, 14 hand-throw switch stands were in service on single switches and crossovers connecting to "relay" tracks which are used to change locomotives on all eastbound through passenger trains. As part of the new project, electric switch machines and searchlight home signals were installed at these switches and crossovers.

The ten station tracks converge to four tracks just east of the station, with reverse traffic. The switches and signals in this area, and further east, were previously in a 53-lever electric interlocking known as Fair Street, S.S.78, with the tower 2,350 ft. east of the new control station just west of the passenger station. As part of the new project, the old switch machines and signals in this interlocking were replaced; a total of 47 switch machines and 46 home signals being involved.

At Woodmont, 6 miles west of New Haven, there are five crossovers between main tracks with provision for a sixth, this layout being used to route trains to and from the station area to the assigned tracks. Formerly these crossovers were in a 28-lever mechanical interlocking. As part of the new project, the mechanical plant was removed, new electric switch machines and new signals installed.

Five More Layouts

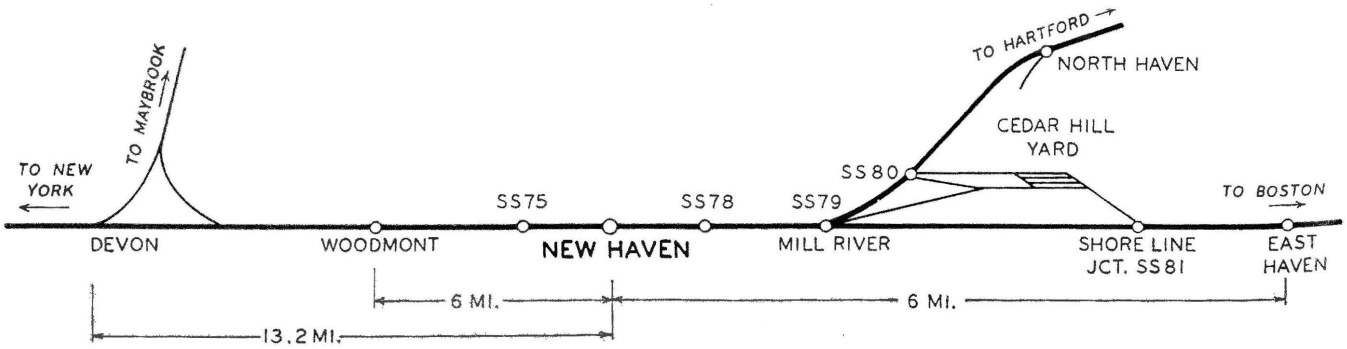
Five more interlockings are now under construction which will also be controlled from this consolidated control system. At S.S.79 Mill River Jct., 5,280 ft. east of New Haven station, the four main line tracks diverge into 6 tracks; 2 tracks east to Providence and Boston on the Shore Line; one track for through freight to the Cedar Hill classification yard, and three tracks to S.S.80, where a double-track line diverges on the route to Hartford and Springfield. At S.S.79 there is, at present,

With control at one point for all the interlockings, train movements can be planned and coordinated better than previously when towermen at seven interlockings, and switchmen at two layouts of hand-throw switches, were involved.

With the previous arrangement of interlockings from Woodmont through New Haven to Branford and North Haven, a minimum of 33 tower operators' tricks were required, and, based on the 40-hour week, this meant 46 full-time positions, not including vacation relief. When all of the program is completed to consolidate the controls in one tower, the estimated requirement will be 9 tower operator's tricks, which is 12 positions. This does not include vacation relief.

As stated by W. A. Ford, Chief Signal Officer of the New Haven, "Our preliminary investigation and our experience of several months with the more dense area of the consolidation in service is that, with the pushbutton, route-control system, and complete indications on the machine, there is virtually no limitation of the extent of territory which can be controlled from one single station. The limiting factor in such consolidation is rather, that of determining whether the area to be controlled constitutes a reasonable grouping of related operations which can effectively be controlled from one point.

"On the technical side, we know that the use of multichannel code apparatus (for transmitting controls and returning indications) has so greatly broadened the field for consolidating interlockings, that distances from the control point is no longer a factor. In our New Haven area, these coded line circuits are on wires on the pole line or in cables. However, our plans for extending the system eastbound to Boston, 157 miles, includes the use of microwave, thereby avoiding failures due to hurricane damage to pole lines."



THE NINE INTERLOCKING LAYOUTS will all be controlled from one machine at New Haven

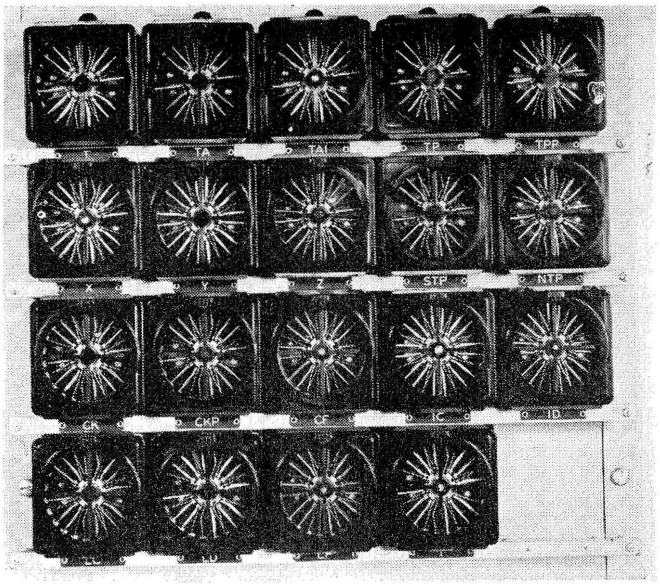
a 52-lever mechanical interlocking machine controlling both electric and mechanical functions, including three single switches, 8 crossovers and 40 home signals. The track layout will be modified and will have 4 single switches, 7 crossovers and 36 signals.

At Air Line Jct., S.S.80, 2.3 miles east of the control station, there is a 24-lever electro-mechanical machine. This is the westbound exit from Cedar Hill classification yard. Switches and signals for leaving trains are controlled, as well as crossovers and signals on the Hartford line tracks. This interlocking includes 3 single switches, 3 crossovers and 13 signals. This track layout will be modified, and will include 5 single switches, 4 crossovers and 15 signals.

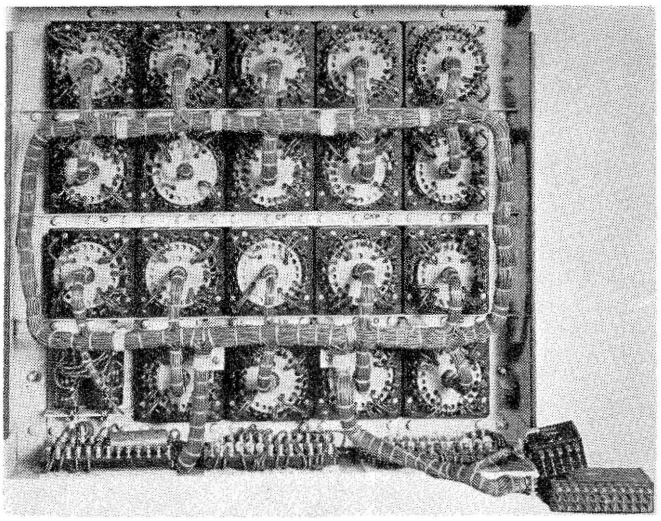
At North Haven Junction, 7 miles north of the control station, which is both the exit and entrance for freight to Cedar Hill classification yard on the Hartford Line, there is a group of 2 single switches and 1 crossover which are hand-throw. These will be operated from the control station.

At Shore Line Jct., 3 miles east of the control station on the Shore Line, which is the entrance and exit for freight to the Cedar Hill classification yard, there is a layout of 3 single switches and one crossover with 16 electric signals operated by a 24-lever mechanical interlocking machine. This track layout will be modified, and will include 3 single switches, 2 crossovers and 11 signals. At Branford, 9.4 miles from the control station, also on the Shore Line, there is a 16-lever mechanical interlocking machine which controls 2 single switches, 2 crossovers and 8 signals. New power switch machines and signals with new local circuits are to be installed at these five layouts.

The electric switch machines on the entire project are high voltage dc Union Switch & Signal type M-3, with a split-field connected motor using only three wires for control between relays and motors. The control and overload relays are placed in an instrument house at each interlocking, this arrangement centrally locates all switch control relays. The new signals are of the Union H-5 searchlight type for both high and dwarf signals.



OFFICE CODING UNIT, front view



OFFICE CODING UNIT, rear view

High-Speed Line Code

The new construction at each of the four layouts—Woodmont (S.S.73); S.S.75 at the west end of the station; relay tracks at each end of station (S.S.77); and S.S.78 Fair St.—include a completely new system of local circuits and arrangements for consolidated control from the one new pushbutton UR route-control interlocking machine which is in a new brick building on the north side of the track about 100 ft. west of the passenger station. Direct-wire remote control and indication circuits are used at S.S.75; east end of the passenger station (S.S.77); and S.S.78 Fair St. The multiplex high-speed code system is used between the control tower and Woodmont to transmit controls and indications. The multiplex system will also be used for the five interlocking locations east of S.S.78 which are now under construction, namely S.S.79 Mill River Jct.; S.S.80 Air Line Jct.; S.S.81 Shore Line Jct.; Branford; and North Haven.

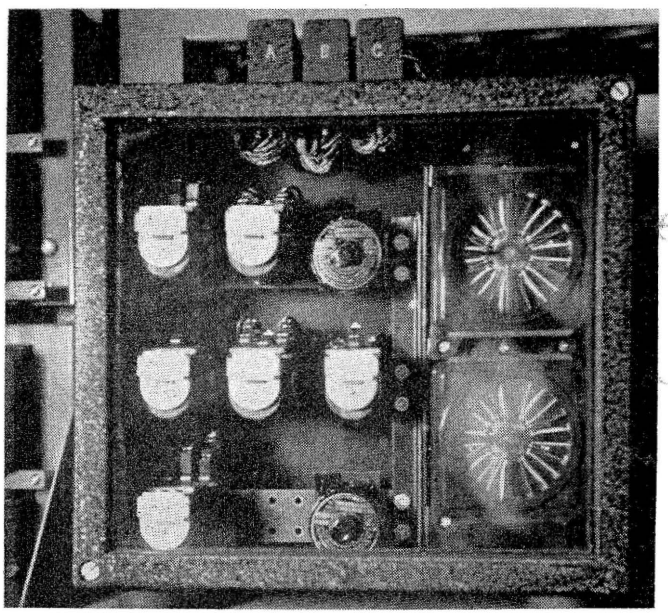
The multiplex code control system is a single-station, high-speed system in which control information and indication information are transmitted concurrently. A code to or from any one function or a group of functions automatically contains information for positioning all control functions and all indication functions.

The multiplex system used between the New Haven control office and Woodmont has the capacity of controlling 48 functions, and indicating 96 functions, concurrently in 1½ seconds. This is a dc system, using five wires between the control tower and Woodmont. Also, dc code systems will be used at Mill River Jct., Air Line Jct., and Shore Line Jct.

The code system for North Haven and Branford will also be the multiplex type, operated over a two-wire line circuit by four separate and distinct carrier frequencies. This New Haven project includes the use of the newly developed Union RD radial contact type line code relay which provides more contacts than previous types.

Control by One UR Machine

All of the nine interlocking layouts, as well as train operation by signal indication in this area, are controlled or will be controlled by the one UR interlocking control machine in the new two-story building north of the track and just west of the New Haven station. The control machine is made up of four sheet-metal cabinet sections each 6 ft. 7 in. long and 61 in. high, making the total length of the machine 26 ft. 4 in. The four cabinet sections are joined together at 150 deg. angle into a semi-circle. This was done in order to



ROUTE INTERLOCKING SELECTION UNIT, a new feature

give the train director, who is located approximately 10 ft. in front of the machine, full view of the territory under control.

The control panel is made of steel plate, painted non-reflecting black. Each track is represented by a line which consists of slots ⅛ in. wide and 1 in. long, placed end to end, about ⅛ in. apart. Behind each slot are translucent plastic pieces, backed by units containing two lamps with color filters. This makes three indications available: (1) normal unoccupied condition indicated by no illumination; (2) white illumination, indicating the complete route as set up through the limits of the interlocking; and (3) red illumination, as corresponding track sections are occupied by a train as it proceeds through a route. On the panel, on the line representing each track, and at the location corresponding with each home signal, there is a pushbutton which represents that signal.

The manipulation for UR operation is simple. Only two pushbuttons, one at the entering signal, the other at the opposing signal, which are located in the track diagram, need to be operated in sequence to set up a route and clear a signal. No manipulation of individual switch levers is normally required. When the entering route button is pressed, a red light appears at the button, thereby marking the entrance to the route and indicating that a route has been initiated, but the signal has not yet cleared. A white light also appears in the last track section of each available route, showing points to which a train may be routed. The operation of the second button (at one of the indicated destinations) completes the route selection. The lights marking other possible destinations go out.

A flashing red light appears at each switch section when its switch is not positioned for the route, and this indicates that the switch is in transit. When the flashing red changes to a steady white light, a switch is in the desired position. When all switches are properly positioned, the complete route is shown by a white line of light from entrance to exit. This indicates that the route is set up and locked. The signal indication lamp will then change from red to green when the wayside signal clears. The route is established and the signal-clear indication is received on the panel in approximately 5 seconds.

When a train passes the signal, the indication changes to stop, and the corresponding signal indication on the control machine is extinguished. Also, the white line for the first track section will change to red to show the train's location. The remaining lights, in the route for track sections ahead of the train, remain lighted white, and will change to red as occupied by the train. After the train leaves each track section, that track section will become dark. 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.

The control machine is also arranged for fleeting control to hold the line-up of routes, and automatically clear the signal for succeeding trains. This is established by pushing and turning the entrance button for a route. If a signal which has been cleared is to be taken away, the entrance button for a route is pulled. Likewise to cancel "fleeting" control, the entrance button for a route is pulled and turned to its normal position. Time locking applies for all routes, and approach locking for all the high home signals.

A New Feature—Route Interlocking Selection Units

In large interlockings such as the one at the west end of New Haven station, certain combinations of circumstances will enter into numerous route-selection circuits, locking circuits, etc. In order to standardize the circuits and simplify maintenance, a new device known as "Union Route Interlocking Selection Units" was developed for the New Haven project. Maintenance will be performed quickly and easily to restore the system to its operating condition in case of failure as, in this respect, these units will have the advantage now claimed for plug-in relays.

Formerly, a maze of circuit networks had to be checked before the trouble could be located. Now the trouble can be isolated to a given group unit which can be replaced quickly with a spare unit. The "Route Interlocking Selection Units" have been designed on a function basis and have resulted in five different function units and one standard repeater unit. Thus packaging the several relays and their circuits is associated with a given controlled function.

Non-Vital Circuits in Control Tower

In the relay room in the control building of this consolidation, all the route selection circuits are classified non-vital, because no hazard could result due to a failure of a circuit or equipment. All the safety is included in the vital circuits and relays, centrally located at each interlocking area. Therefore, as a means for reducing the space for wire and terminals, as well as to reduce the cost of wire required, the New Haven adopted the practice of using wire with light insulation, and miniature terminals. The terminal connections are spaced ⅝ in. on strips such as are used in railroad telegraph and telephone switchboards.

The wire for the vital circuits, at each of the interlocking groups, such as switch control, signal control and route locking, have insulation according to signal section AAR standards. These wires are terminated on standard AAR terminals using solderless connectors.

The cable to each switch is a 12-conductor, made up of three No. 9 conductors and nine No. 14 conductors. Two of the wires are used for a telephone circuit to a jack in the switch machine. The maintainer has a portable telephone which he can plug in at any switch to call the operator.

(*Continued on page* 31)

prevent thieves, with hitches at conventional level, from stealing these trailers. Another reason is to get the hitch high enough on the trucks so that when trucks are in use independently, the hitch will clear ordinary obstructions even in rough going.

Trucks are Other Half of Story

In this new practice of using highway vehicles, trucks are equally as important as the trailers. The power-operated vehicles assigned to each 10-man crew include one 2-ton truck, and one ¾-ton truck. Also, for use by any one of two or more crews, there is a 4-wheel drive jeep, which has two attachments, one for digging pole holes, and the other is a Jeep-A-Trench to dig trenches for pipes or buried cables. Also these machines are equipped with power winches. Where a field location is not accessible from a highway, the track motor car is hauled on the ¾-ton truck to the road crossing nearest the field locations.

For each signal crew, the 2-ton truck is the cab-over engine type with an overall length, bumper to bumper, 19 ft. With a 30-ft. trailer hitched to this truck, the combined length of truck and trailer is 49½ ft., which is less than the 50 ft. limit in some states.

This 2-ton signal truck has a 7 ft. by 12 ft. flat-bed army-cargo type body, including hoops and fitted canvas to form a windproof and waterproof cover. The entire bed area, 84 sq. ft., can be used when hauling materials. When riding to and from work in the field, seats for 12 men can be folded down from the sides of the truck body. Built-in boxes and bins, included in this truck body, provide space for all the tools which a signal gang may need for "on the road" construction work. On some types of construction, a freight car used for heavy tools and light materials may be moved along from station to station by the way freight, as work progresses.

These 2-ton trucks with flat-bed, army-cargo type body, are for the five signal crews only. Each of the three communications pole line crews has a 2-ton truck with a special pole-line body made by the J. H. Holan Company.

Each 10-man crew, signal or communications, has a ¾-ton truck with a pickup body. Also, the same type of truck is assigned to each of the 20-ft. trailers. These ¾-ton pickup trucks can be used to transport two or three men in the cab, as well as to haul materials or a motor car in the truck bed. Special ramp rails are made of ½ in. by 3 in. "H" section rails, 6½ ft. long. A two-speed, hand-operated winch with a ¼-in. stranded steel cable, is used to pull the car up the ramp rails into the truck bed.

Also these same ramp rails can be set into special bracket seats, in the bed of the truck, without using bolts or pins, to form an "A" frame, at the rear end of the truck. This frame, in combination with the winch and cable, are used to set line poles, or to lift and set various kinds of equipment such as switch machines, relay cases, welding equipment, etc. The capacity of the "A" frame and winch is 1,000 lb.

Truck Hitches

When the ¾-ton truck is to be used to haul a house trailer, a special bracket with the hitch ball is attached by 1-in. bolts on top of the rear cross-member of the truck frame, which brings the center of the ball 8 in. above the frame, and 30½ in. above the surface of the roadway. This bracket has a hinge to swing it down to a normal position so that it is out of the way to clear the tail gate in the lowered position and also to clear the standard pintel hitch for use with two-wheel pole trailers.

The 2-ton truck has an extended trailer hitch, welded to the rear crossmember of the frame, at the proper level so that the center of the hitch ball is 30½ in. above the roadway, and will clear the spare tire bracket. This is true also on the ¾-ton truck.

New Haven Interlocking

(*Continued from page 26*)

At each of the remote interlockings there is to be an emergency control panel which can be used in an emergency, such as loss of cable or failure of control station energy, that would make it impossible to control a remote location from the central control machine. Each emergency panel will have a track model, complete with indication lights, and individual switch and signal levers which will be connected by a special key-operated controller to the relays normally operating from the multiplex code control system.

Permission must be obtained from the Superintendent to use the key to make the transfer from central to local operation. This insures that cooperation between all employees involved is obtained, and that they are aware of all conditions before a given interlocking control is surrendered from the central point to the local point.

Power Supply

The ac primary power supply consists of normal and emergency lines throughout the electrified territory. Automatic transfer power panels switch the local power from normal to emergency source, or vice versa, almost instantaneously, assuring constant power supply. The 110-volt dc for operation of switch motors in each interlocking area is supplied from a set of 60 cells lead storage battery on floating charge from rectifiers. Each set of batteries is equipped with automatic ground detectors.

In each interlocking area the local 12 volt dc circuits are fed by a constant-potential rectifier. The direct wire, non-vital communication circuits between the control tower and the subtowers at west end of Station S.S.75, east end of Station and Fair St. S.S.78 are 12 volts dc fed by constant-potential rectifiers over No. 19 wire in communication type cable. The route-selection circuits in the control tower are 16-volt dc, supplied by lead storage battery on floating charges by rectifiers.

The track circuits at New Haven, Branford S.S.81 are dc. In electrified territory, where 25-cycle ac is used for propulsion, the track circuits are ac type, using 60-cycle centrifugal track relays. The ac track relays are the shelf type, and are equipped with plug couplers. All the other relays and route-selection units on this project are the modern plug-in type, mounted in racks. A special feature of the relay rooms is that the wiring between racks is supported overhead on the rungs of ladder-type wire chases, made of aluminum.

These interlocking consolidation projects were planned and are being constructed by the New Haven signal forces, under the direction of W. A. Ford, Chief Signal Officer, the principal items of equipment and engineering being furnished by the Union Switch & Signal Division of Westinghouse Air Brake Company.