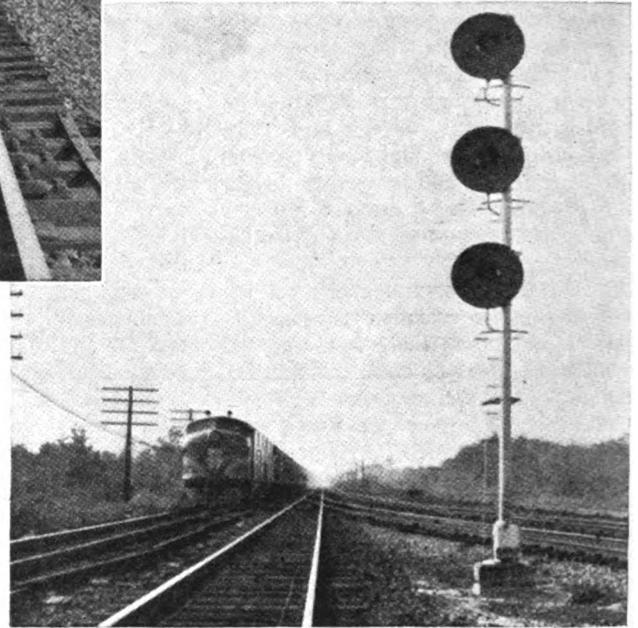


Left—The power switch layouts are equipped with special rods. Below—View of junction looking west showing signal L60

Plant, including three switches, three crossovers and seven signals, facilitates train movements and permits release of 2.2 mi. of double track line



C.T.C. Extension

on the Boston & Maine

At Willows, near Ayer, Mass., the Boston & Maine has installed a remotely-controlled interlocking with C.T.C. operation between the two interlockings, which has reduced train delays and permitted the release of 2.2 mi. of double-track main line. The new C.T.C. territory is adjacent to an existing 10.6-mi. C.T.C. installation on the Stony Brook branch between North Chelmsford and Willows, Mass.

Ayer is 36 mi. west of Boston on the Fitchburg division which is an important east-and-west route between New England cities and points of connection with other railroads in the Hudson River valley such as the New York Central at Rotterdam Junction near Schenectady, N. Y., and the Delaware & Hudson at Mechanicville, N. Y. The Boston &

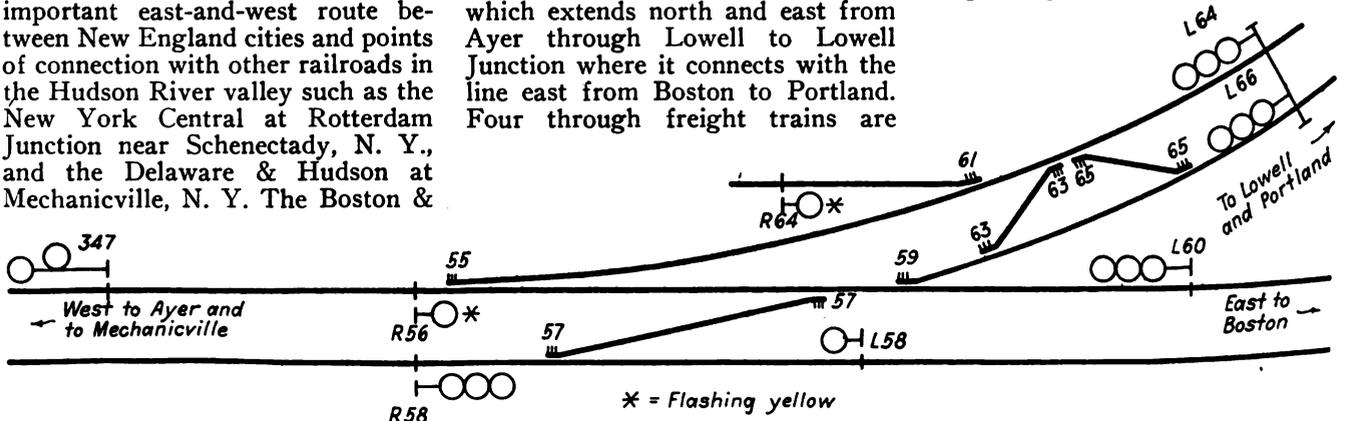
Maine handles about 900 freight cars each way daily on this east-and-west route.

Through Train Movements

A considerable proportion of this traffic is from and to Portland, Me., and this traffic is made up in solid trains which operate through between Portland and Mechanicville. These trains do not go through Boston but rather are routed over a cut-off known as the Stony Brook branch which extends north and east from Ayer through Lowell to Lowell Junction where it connects with the line east from Boston to Portland. Four through freight trains are

scheduled each way daily between Portland and Mechanicville, and as a general rule two or three extra trains are required each way every day. A local freight train and a local passenger train are operated each way daily on the Stony Brook branch between Ayer and Lowell. The new remotely-controlled interlocking at Willows saves time for all these Stony Brook trains.

The daily traffic on the double-track through line to Boston includes 16 passenger trains each way daily



and 12 through freights in addition to a local freight each way daily between Boston and Ayer. Previously the double-track Stony Brook branch connected with the main line in the interlocking at Ayer, and the Stony Brook tracks ran along the north side of the main line east for about 2.2 mi. to what is now Willows where it turned off north and east toward Lowell. In order to reduce track maintenance expenses by eliminating this 2.2 mi. of the Stony Brook line, new junction switches and three crossovers were installed at Willows, and this layout, including seven signals, constitutes the new interlocking which is controlled remotely from the previous interlocking tower at Ayer.

Track Layout Saves Train Time

The old junction turnout and crossover in the Ayer interlocking were No. 10 which necessitated that the trains to and from the Stony Brook line had to slow down to 15 m.p.h., through the junction. On the other hand the new junction turnout and crossover at Willows are No. 20, good for about 40 m.p.h., thus saving considerable time compared with the old track layout. The fact that the Stony Brook trains clear the junction layout more quickly thereby reduces delays to through trains on the east-and-west main line.

Referring to the track plan the purpose of the two crossovers No. 63 and No. 65 on the Stony Brook branch east of the junction is to route trains for either direction on both tracks on the Stony Brook line. Either-direction operation between Ayer and Willows and signaling for this purpose at Willows is part of the new project.

The interlocking layout at Willows includes three crossovers, two junction switches, one spur switch, four high signals and three dwarfs. The switch machines are the style M-22A with 110-volt d.c. motors, controlled by DP-25 relays with OR11 overload relays mounted in cast-iron cases on separate concrete foundations, the wires extending through a hose connection between the controller and the switch machine. As a means for preventing frost formation on contacts, a 15-

watt electric heater unit is mounted in the contact housing in each switch machine. These heaters are fed from the 110-volt a.c. circuit, and are energized continuously during the winter season.

Insulated Gage Plates

On the tie ahead of the switch points there is an insulated gage plate $\frac{3}{4}$ in. thick and 7 in. wide. Adjustable rail braces are used on this tie, as well as on the first two ties under the points. On two ties, the plates extend and are bolted to the switch machine, thus preventing lost motion between the rail and the machine. Ramapo Ajax Type M and MF switch clips and vertical rods, with vertical pins are used as a means for minimizing the "roll" of the switch points.

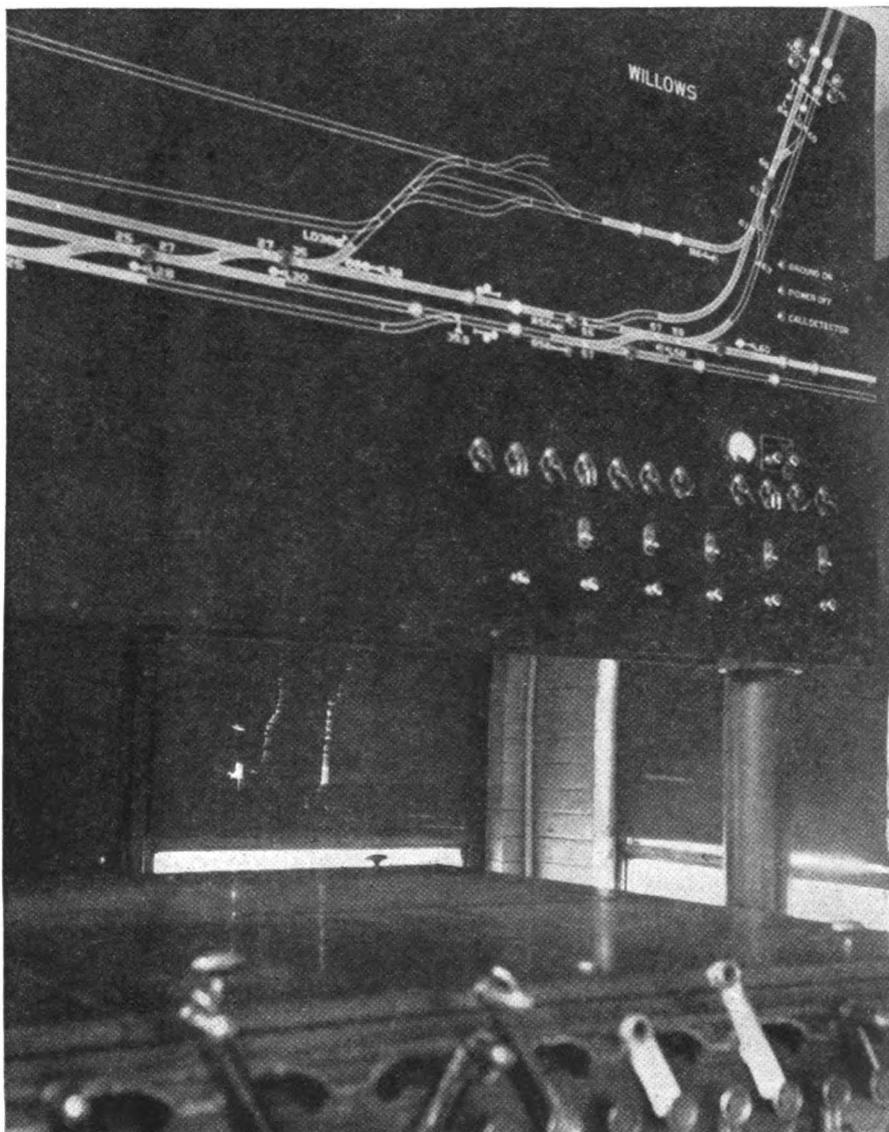
The signals on this new interlocking are the H-2 searchlight type with plug-in couplers. The main-track normal-direction signals are on high masts or on the signal bridge on the Stony Brook line. These high signals

each have three operating units. Each of the three dwarfs has one operating unit.

At certain dwarfs marked with an asterisk on the drawing, arrangements are provided to flash the yellow by means of certain controls. The use of the flashing yellow, as a "slow-approach" aspect, indicates "proceed through crossover or turnout at not exceeding slow speed prepared to stop at next signal." This aspect is readily distinguished from the steady yellow which indicates "proceed at restricted speed." The flashing-yellow indicates to the engineman that the track on the slow speed diverging (or converging) route is clear to the next signal. It is used over No. 10 or No. 12 turnouts which do not permit the use of medium speed aspects.

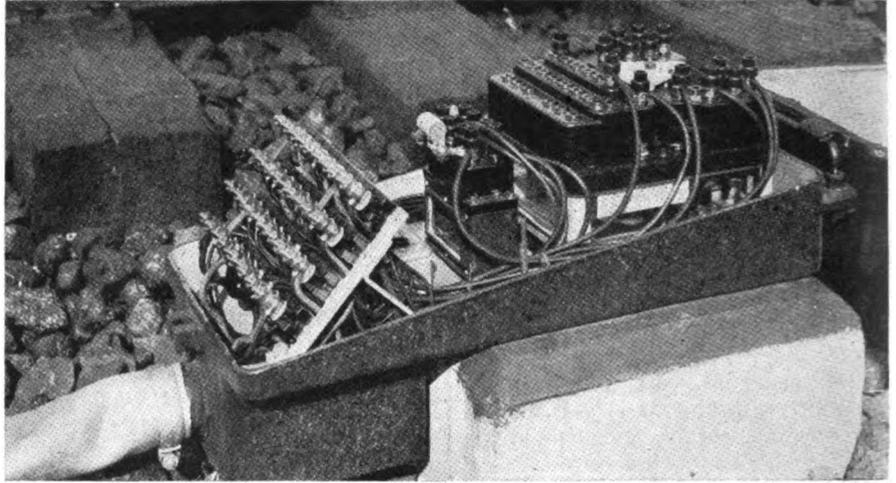
Controlled from Ayer

The three single switches, three crossovers and seven signals at Willows are controlled remotely by mini-



Right—The miniature levers for controlling the switches and signals at Willows are in the lower corner of the sheet-metal illuminated track chart

Right—A switch control and overload relay in a cast-iron case at a switch



ature levers which are mounted in the lower right corner of the illuminated diagram of the model-14 interlocking machine for the electric interlocking at Ayer. The illuminated track and signal diagram for the Ayer plant was extended to include a diagram of the Willows layout, shown just above the levers for Willows. The controls are sent out and indications are returned by means of a 506B time-code system using two line wires from Ayer to Willows.

Push-To-Turn Levers

The six switch levers and five signal levers are all in one row. These levers are the push-to-turn type which means that each handle must be pushed in about $\frac{1}{8}$ in. before it can be turned. This feature serves two purposes: (1) to prevent accidental operation of a lever and (2)

as applying to a switch lever, the "push" movement is utilized to perform the function of a code-starting button, thus facilitating operations.

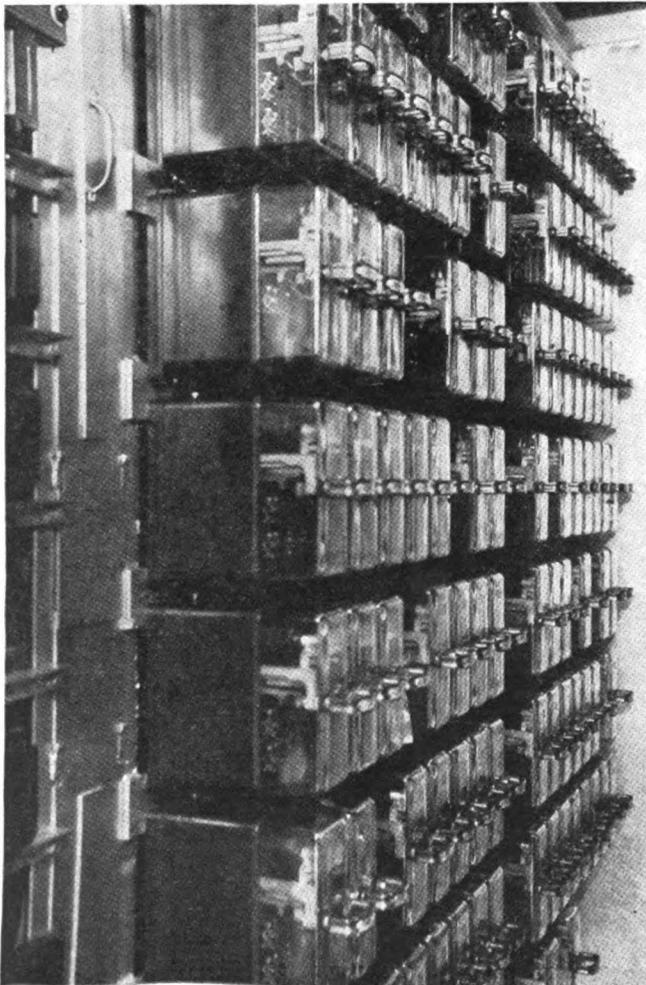
The new portion of the illuminated track diagram applying to Willows has several special features. At each location on the track diagram which represents the end of a route in the home signal limits, there is an "exit" lamp. These lamps are normally dark but, when lighted, they are white with a black arrow pointing in the direction of the train movement. On

this diagram each signal is represented by a symbol including a green lamp which is lighted only when the corresponding signal has been controlled to display a proceed aspect.

Each lever has only one indication lamp, which is above the center of the lever, the indication lamp above each switch lever is red, and it is lighted whenever the position of a lever and the switch it controls are not in agreement. For example, if a lever is moved to the reverse position, the lamp above that lever is lighted immediately and remains lighted until the switch has moved to the reverse position and is locked; then the indication lamp becomes dark. If it stays lighted, this is an indication to the towerman that the switch has not followed the lever, and the cause should be investigated.

Exit Indication Lamp

Similarly, there is only one indication lamp above each signal lever. This lamp is red, and it is normally dark, being lighted when the lever position and the corresponding signal are not in agreement. Each signal lever is normally on center, being turned to the left to clear a westward signal, or to the right to clear the opposing eastward signal. After a signal lever has been positioned, the corresponding code-starting button in the bottom row under the signal lever, must be pushed, but not until an exit lamp appears on the diagram. Control will not be effective unless the switches are positioned to complete a route starting at the signal controlled by the lever thrown. Thus the lighting of an exit lamp provides the leverman a quick check of the positions of the switches. If no such lamp is lighted, he knows no route is complete; or if the wrong exit lamp is lighted, he is warned not to push the code-starting button. By thus not pushing the button, he avoids locking himself up.



Plug-in relays are used in the new sheet-metal house at Willows

These special features, including the exit lamps, are accomplished by locating the route locking network in the tower at Ayer, which location checks the transmission of the controls and indication circuits and also enables the signal control to open field locking relays whose back contacts must be placed into the search-light signal mechanism control circuits before the signal will clear.

Lamp In Symbol

When the signal lever is moved, the red lamp above the lever appears until the signal indication is received, at which time the lever lamp becomes dark and the green lamp in the signal symbol on the track diagram is lighted. The signal lever lamp also is provided with a flashing indication denoting when the approach locking is in effect. As an example, if the leverman restores a signal to Stop with a train on the approach with the intent of changing a route. When the Stop indication is received, the lever lamp will flash, denoting that the route controlled by that signal is locked. Under this condition the exit lamp will persist. At the expiration of the time period, the flashing lever lamp and the exit lamp both become dark. An attempt on the part of the leverman to move a switch in the route while the lamp is flashing will not be effective, and the switch lever thus moved must be restored to its former position and again thrown after the flashing light desists; that is, after the circuits become unlocked. In other words, a switch control cannot be stored during the time the circuits are locked.

For the semi-automatic signals, no lever operation is required to restore the signal to the Stop aspect, because a train passing such a signal restores it to Stop through the track circuit, at which time the light will appear above the lever (because the two do not agree) and the "signal-clear" indication on the diagram will become dark. The leverman restores the lever to normal, at which time the lever light will go out. With the plant normal, the diagram and lever lamps are dark.

Control of Restricting Aspect

If a Restricting aspect is to be displayed to authorize a train to pass when the home signal block on that route is occupied, the leverman positions the signal lever, tips up the toggle switch below the lever, and pushes the code-starting button corresponding with that lever. A special feature is that the restricting aspect automatically improves to the high

aspect if the block becomes unoccupied. For example, when the restricting control is used as applying to westward signal 60, the restrictive aspect would be displayed when the rear of the train ahead had cleared the home signal limits, i.e., west of signal R56. When the rear of the train ahead passed beyond automatic signal 347, then the restricting control on signal L60 would drop out, and the high yellow would come in automatically. This result is accomplished by a stick relay which is picked up when the restricting control is placed in effect, and this stick relay is released when the track relay for the block ahead is picked up.

Traffic-Direction Lamps

On the Stony Brook double track, signaling is arranged for train movements in either direction on both tracks, under C.T.C. control located at North Chelmsford. Ordinarily no line up is in effect, and as a consequence, a red traffic-direction lamp is lighted on the Willows control panel at Ayer. When an eastbound train for the Stony Brook line is approaching Ayer, the leverman informs the C.T.C. leverman, and he lines up the traffic direction. Accordingly a green traffic lamp is lighted on the panel at Ayer. With traffic

thus established, the leverman at Ayer can clear signal R58 or R56, to whichever of the two tracks is to be used beyond Willows.

Relays and Housing

At Willows the relays and batteries are in a sheet-metal housing 8 ft. by 16 ft. The wires and cables entering this house are terminated on terminals, resistance units and fuses which are mounted on a large plywood board at the end of the house. The relays, which are the plug-in type, are mounted in the middle of the house, and the coding equipment and batteries are on shelves on the sides. The 110-volt switch machines are operated from 55 cells of 40-a.h. storage battery. Eight cells of 110-a.h. capacity feed the coding equipment. Five 80-a.h. cells feed the relays circuits and acts as standby feed for the signal lamps. Each track circuit is fed by one 80-a.h. cell. These batteries are the lead type furnished by the Electric Storage Battery Company.

This remotely-controlled interlocking and C.T.C. extension was planned and installed by the signal forces of the Boston & Maine, the principal items of equipment being furnished by the Union Switch & Signal Company.

View of terminal board at rear and the C. T. C. line code equipment and the storage batteries at Willows plant

