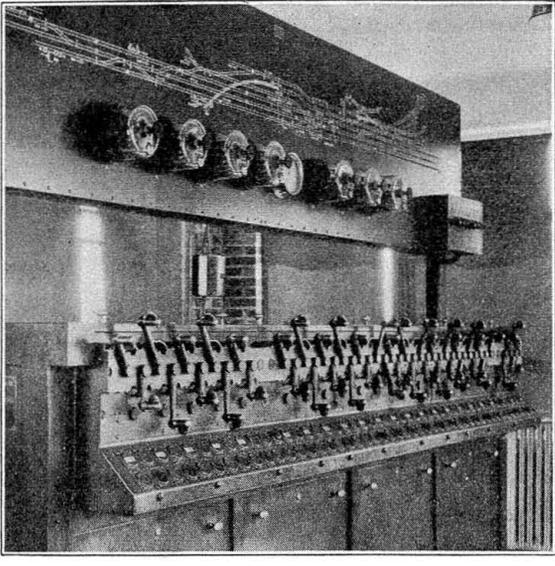


Extensive Interlocking Changes Made By Boston & Maine

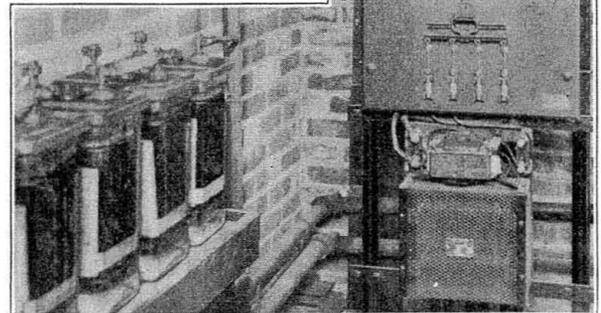
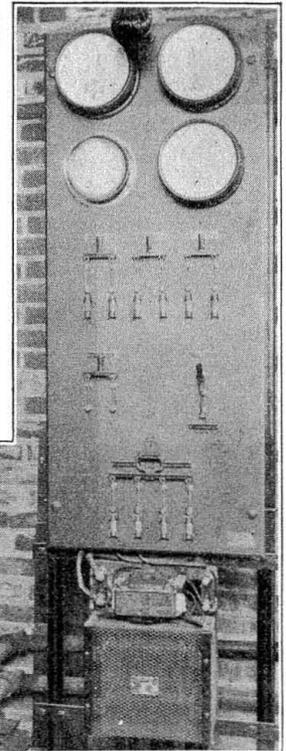
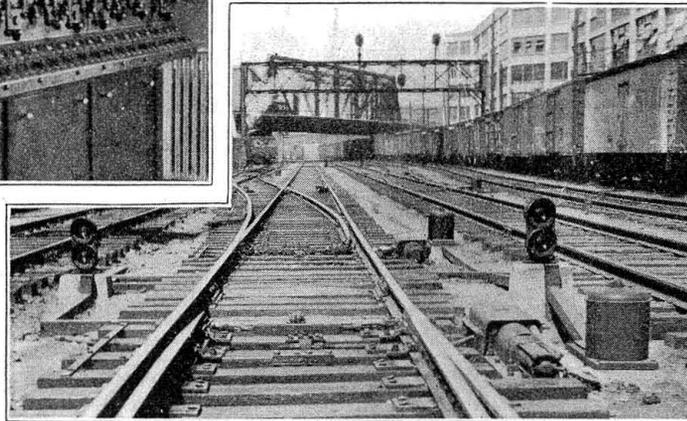
*Reconstruction work in Boston terminal effects
substantial economies*

By E. N. Fox

General Signal Inspector, Boston & Maine



The new electro-pneumatic plant, Tower H, extends over a large area, and also includes several non-interlocked direct acting switches. Note small cabinet for miniature levers at right end of diagram.



THIS article concludes the series describing the extensive rearrangement of terminal facilities, car retarder and yard switching installations, and interlocking reconstruction program carried out by the Boston & Maine over a three-year period. The article published in the July issue, page 255, covered the general engineering features of the Boston terminal improvement program and the installation of car retarders and power switches.

New Tower H is located on the Fitchburg route, about 2,500 ft. west of where that route diverges from the Portland and Southern routes. The interlocking machine has 47 levers, 5 spare levers and 4 spare spaces, and controls 31 switches, 1 derail and 46 operative signal color-light units. The machine is housed in a new two-story brick tower, of 25 ft. by 17 ft. outside dimensions.

The old tower was a small wooden building, located adjacent to present signal R10, and housed a 32-lever S. & F. machine. Its primary function was the protection of movements on a B. & A. single-track freight line across two passenger and two freight tracks of our Fitchburg route.

The new tower handles more than double the territory handled by the old tower, 3,300 ft. of main line as compared with 1,600 ft., and handles 17 switches formerly operated by ground switchmen. It also has a 7-lever miniature machine, controlling 9 direct-acting electro-pneumatic switch movements, of the same type as previously described. Consequently it not only handles our main line and B. & A. movements through a greater territory than previously, but it also handles outbound Fitchburg freights from Tower 5 to the main line, as well as movements into Yard 14, and between Yard 8 and Tower 5. By

eliminating three ground switchmen, an annual saving in wages of \$5,476 resulted. The actual net saving is difficult to figure, as the saving in wages is more or less offset by the interest on the increased investment, while on the other hand the speeding up of yard movements results in an appreciable monetary saving, even though somewhat intangible.

The new machine is a Model-14 electro-pneumatic type and is provided with two rows of lever light indicators, which indicate whether the switches are unoccupied and free to be thrown, whether the high or medium-speed signal routes are clear, and whether or not the indication given by the signal corresponds with the position of the signal lever. An illuminated track model is provided, which is necessary, as the view to the west is obscured by overhead bridges. Complete route and electric detector locking have been provided, as well as approach locking with clockwork time-releases on all high signals.

Fifty neutral and 18 polarized relays are housed in the tower in steel relay cabinets, located directly under the machine. Power for the d-c. control circuits is obtained from 7 cells of lead storage battery, operated on floating charge through a copper-oxide

rectifier. Normal low-voltage current consumption for the plant is about 2.4 amp.

The high signals are of the Union Style-R, two-position color-light type, there being 16 operative signals and 6 one-light fixed signals. There are 26 Style-N dwarf signals. On the B. & A. track the colors used in the high signals are purple for stop and yellow for proceed, in accordance with their standards for this type of movement. Until recently, the B. & M. used purple and green for the call-on signals, but the standard has now been changed to red and yellow for both high and dwarf signals. The switches are operated by Type-A-1 electro-pneumatic movements, requiring 50 to 60-lb. air pressure.

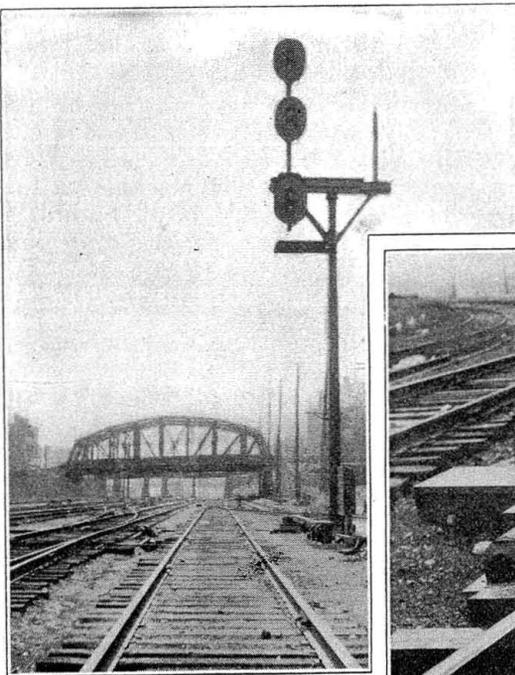
Track circuits are operated by 3 cells of Waterbury unit cylinder primary battery. Track wires are No. 9 while wires and cables for switches, signals, line drops, relays, are No. 14. Main battery and common wire is No. 8 and the a-c. lighting mains are No. 10. Within the home signal limits, wires are run in yellow pine trunking, supported on concrete piers or oak stakes, according to the size of trunking. The 2-in. main air pipe is carried on the concrete piers beside the trunking. Branch air lines are 3/4 in., buried 20 in. below the base of the rail.

Tracks 1, 3 and 5 for outward movements, and 2, 4 and 6 for inward movements, although trains can be run against traffic on any track at the discretion of the tower director. Between Towers B and C, complete signaling and traffic locking are in service for movements in either direction on all four tracks, and the same is true on Tracks 1 and 2 between Towers C and D. The only track changes in the new layout were those caused by the bringing in of the Southern route main line at Tower B. This resulted in new signals *R16, R32, R34, L16, L32, L34*, new movable point frogs 23, and double slips with m.p.f. 21-25. (See pg. 303.)

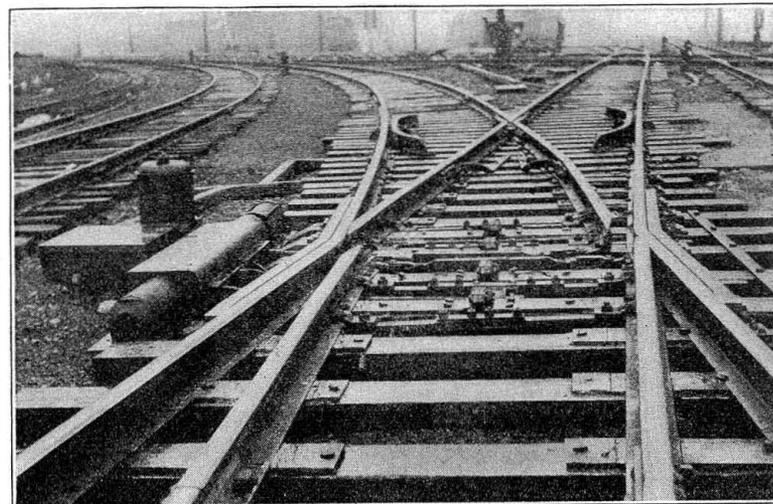
The old interlocking machine was an 83-lever electro-pneumatic type, which had been installed in 1905 and had become worn so that it was in need of a thorough overhauling. Moreover, the switches and signals were so numbered, and the spare levers so scattered, that it was impossible to number the new work in logical sequence. Consequently, it was decided to install a new 71-lever machine, and practically renumber the entire layout. The major problem at this tower was to set up the new machine in the same room with the old machine, and cut over from one to the other under heavy traffic, which was further complicated by the fact that the towermen at the same time were obliged to familiarize themselves with an entirely new combination of lever numbers, and handle in addition the entire traffic of another passenger division.

An idea of the amount of traffic handled may be obtained from the statistics covering a typical week day, as shown on the next page.

Fortunately, the tower was large enough, and there was sufficient slack in most of the wires running from



Looking south toward Tower D. New signal and crossover in foreground

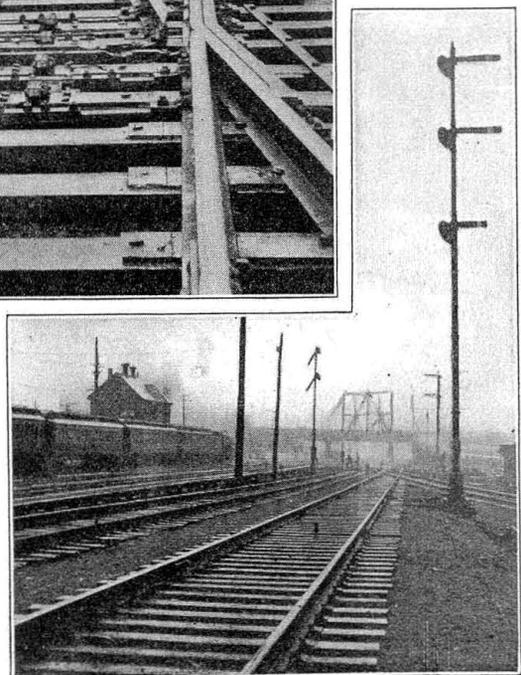


Movable point frog at Tower B operated by electro-pneumatic machine

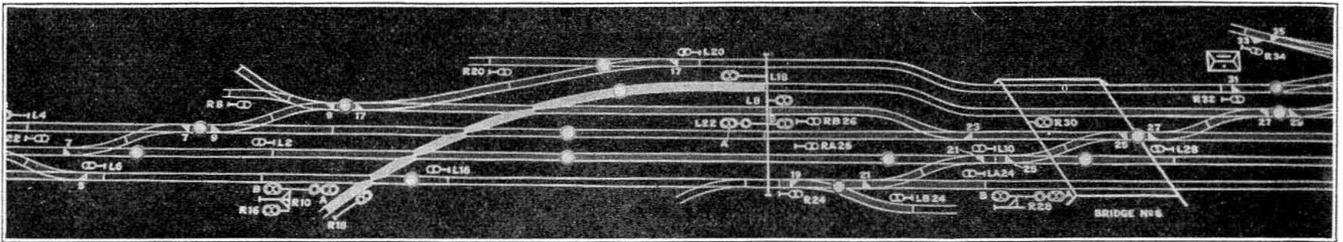
Quick Cutover Effected at Tower B, Boston

Under the old layout, Tower B handled the following kinds of movements: Divergence of Fitchburg route trains from the Portland route; crossing over of Portland route trains, between Tracks 1, 2, 3 and 4, when necessary; handling of passenger drafts to and from Yards 2 and 5; handling of locomotives to and from the Charlestown and Prison Point enginehouses; handling of freight trains between Yard 13 and the Fitchburg route; also miscellaneous but numerous engine and freight shifting movements in back of the tower, in what is known as "the hole."

Traffic between Tower A and B normally uses



Looking south along new Southern connection into Tower B plant



The illuminated track diagram in the tower at the new electro-pneumatic plant Tower H, gives a good idea of the extent of the layout

the machine to the relay racks on the floor below to allow the old machine to be moved forward a few feet, and thereby obtain just enough room to set up

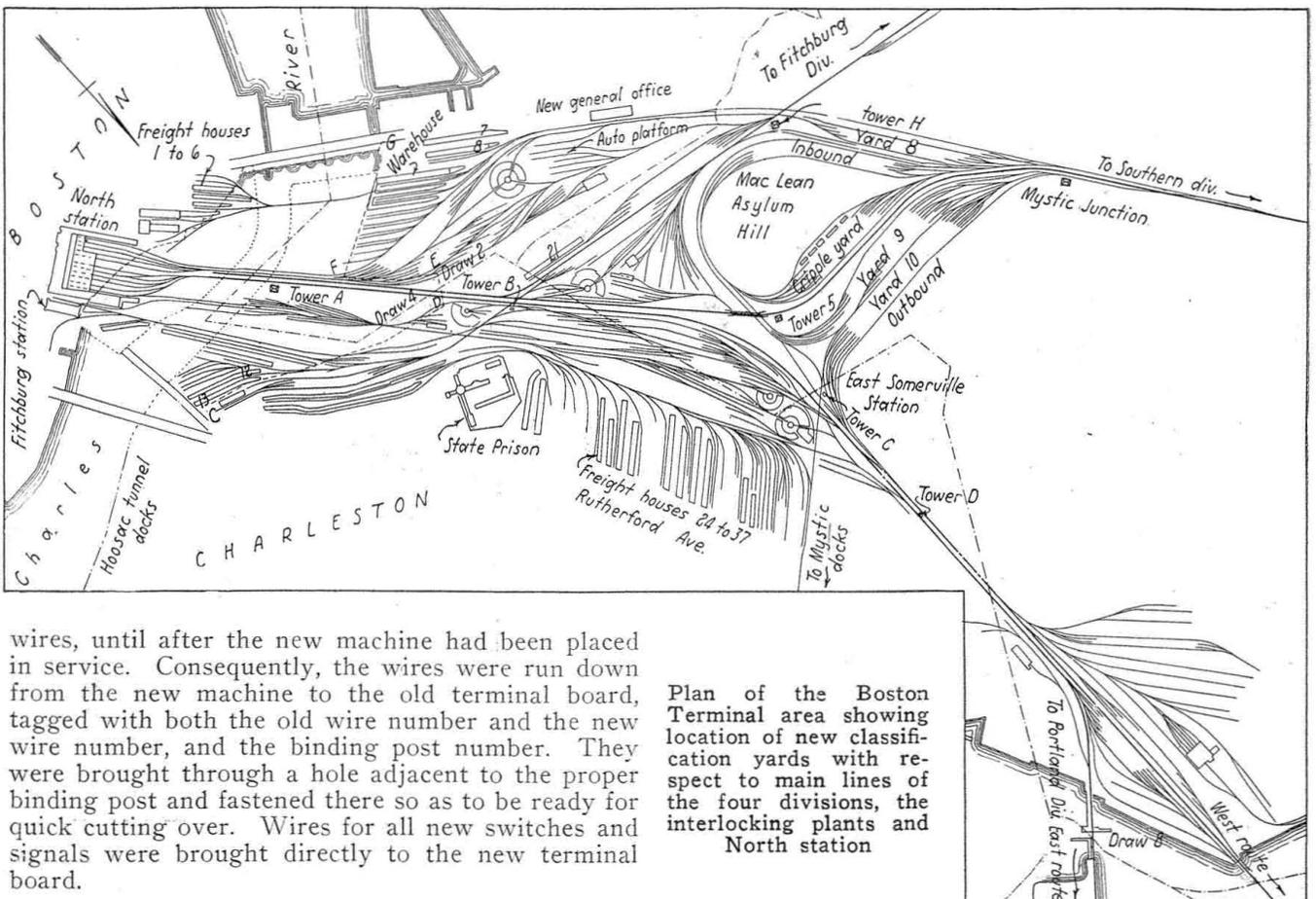
TABLE OF NUMBER OF MOVEMENTS AT TOWER B IN 24 HOURS

	Number of Train movements	Total No. of all movements including drafts and engines	Heaviest hours on each trick		Total No. of lever movements
			Train movements	All movements	
1st trick.....	174	663	7-8 a. m.	7-8 a. m.	9,707
			45	133	
2nd trick.....	170	660	4-5 p. m.	4-5 p. m.	
			51	90	
3rd trick.....	43	368	10-11 p. m.	10-11 p. m.	
			18	65	
Total 24 hr.....	387	1,691			

The work was further complicated by the fact that the machine, as received from the manufacturer, was designed for a seven-track main line layout. A few weeks before the work was to be put into service, a decision was made to retain a six-track layout. This meant radical changes in the mechanical locking, the spring combination wiring, and the circuit wiring. It was only through the co-operation of the manufacturer in furnishing new plans and material, and of the railroad's signal forces in supervising and installing the same, that the desired installation date was met. Even with considerable overtime work, the final check on the circuits and locking was not completed until eight hours prior to the time of cutting over. One feature which greatly facilitated the checking of the locking was the disconnecting of all indication locks from the levers.

the new machine, directly back of the old machine. New steel relay cabinets were installed on the floor below, to house all relays. Provision was made in these cabinets for all terminals, but it was thought best, on account of lack of time to make use of the old terminal board for all existing switch and signal

The new Southern division tracks were to be put in service on Sunday, with the first train, an out-bound paper train, scheduled at 12:45 a. m. The work of cutting over from the old machine to the new machine was started at 10.50 p. m. Saturday, following the passage of the last of the theatre trains,



wires, until after the new machine had been placed in service. Consequently, the wires were run down from the new machine to the old terminal board, tagged with both the old wire number and the new wire number, and the binding post number. They were brought through a hole adjacent to the proper binding post and fastened there so as to be ready for quick cutting over. Wires for all new switches and signals were brought directly to the new terminal board.

Plan of the Boston Terminal area showing location of new classification yards with respect to main lines of the four divisions, the interlocking plants and North station

at which time all wires leading to the old machine were cut.

Unique Method of Communication

A pre-arranged systematic list had been drawn up, denoting the order in which the switches and signals were to be cut over. Copies of this were given to the wiremen who were cutting over at the terminal board and relay rack, to the men outside checking the positions of the switches and cutting in new apparatus there, and to the supervisory officers directing the work.

Communication between the tower and the ground was carried on by means of red and green lanterns. To illustrate by a specific example, as soon as crossover 37 had been placed in service, a red lantern was placed in the tower window where it could be seen by the ground men. This indicated that the tower wiremen were cutting over the next switch on the list, crossover 39, to which the ground men were to proceed. As soon as the wires were cut over in the tower, the red lantern was replaced by a green, and the switch lever was reversed. Upon the reversal of the crossover on the ground, a red lantern was swung across the track by a man at each end of the crossover, indicating to the tower that both ends of the crossover had properly reversed. The switch lever was then placed normal, and each of the ground men gave a highball with a green lantern, indicating to the tower that the crossover was in normal position. This test of reversing the crossover and putting it normal was repeated for a double check, whereupon the man in the tower gave a green highball to the ground man and then placed his red lantern in the window, indicating that work was proceeding in cutting over the next switch on the list.

Cut-Over Work Expedited

As soon as the switches had been cut in on any of the main line routes, the signals were cut in and tried out for that route. No attempt was made during the night hours to cut in and try out the signals for numerous diverging routes, for which there would be no necessity during the night. The first scheduled train outbound for the new Southern route track (at 12:45 a. m.) passed the tower on time without stopping, running under clear signals.

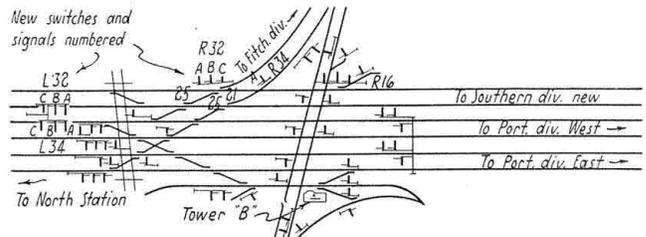
All of the switches were cut over and in service by 4 a. m., and all of the main line signals by 5 a. m. Work was then commenced, trying out each signal for all combinations of routes. On account of fairly heavy traffic, even on a Sunday, and the great num-

ber of possible routes (for instance, signal LB36 goes to 14 different routes), it required the entire morning to obtain the use of the levers long enough to set up and try out the various routes. However, during the cutting over and testing, only two trains were stopped, and these with but slight delays.

During the afternoon the old machine was dismantled and hoisted out of the tower windows, and the new machine moved forward to its final location by use of screw jacks braced against blocks of wood nailed to the floor, the machine itself being slid on pieces of No. 10 gage sheet iron.

The storage battery, panel boards, etc., for the old layout had been housed in the lower floor of the tower. It became necessary to use this space for new relays and relay cabinets, therefore a separate brick battery house was erected beside the tower containing two rooms, one for a new switchboard, and one for the battery which consists of two sets of seven cells of storage battery.

Style-A-1 electro-pneumatic movements are used on the new work. The new high signals are of the electro-pneumatic lower-quadrant semaphore type, in accordance with the existing signals at this tower. All wires from the tower to switches and signals are run in cable, in trunking, or in conduit where pass-



New track plan of Tower B, showing new Southern route connection

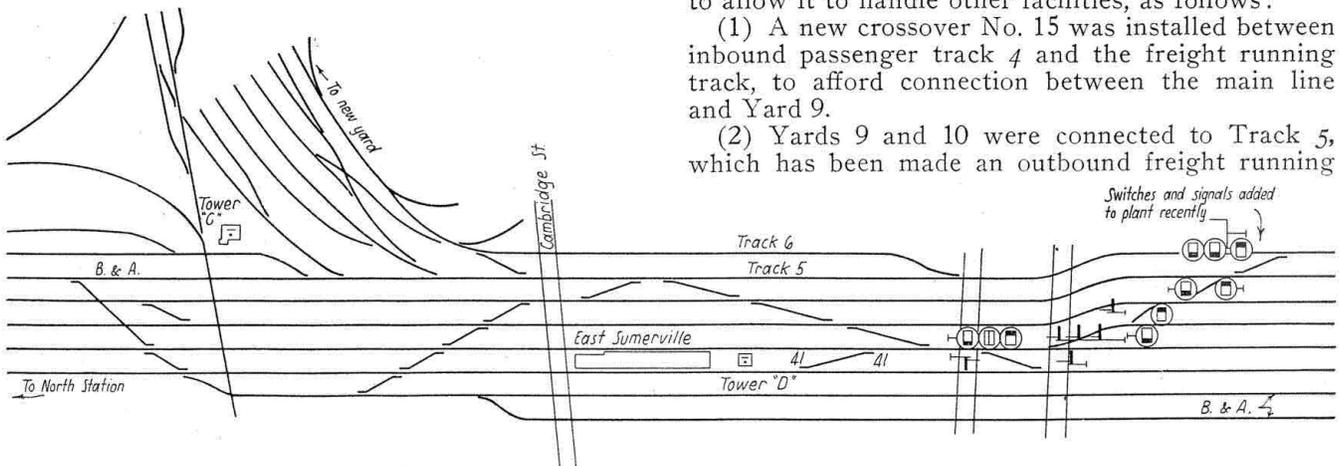
ing under main line tracks. The main air line is three-inch extra heavy galvanized iron pipe.

Change at Tower C, Boston

Tower C, Boston, is a 71-lever electro-pneumatic plant installed in 1919. As installed, it served to handle primarily freight movements of two single-track lines, one line the B. & A., and the other our own Mystic Wharf branch, across the four main line passenger tracks of our Portland routes. It also handled freight movements between the main line and Yards 19 and 20 and engine movements from East Somerville enginehouse, besides various freight shifting moves. Additions have been made recently to allow it to handle other facilities, as follows:

(1) A new crossover No. 15 was installed between inbound passenger track 4 and the freight running track, to afford connection between the main line and Yard 9.

(2) Yards 9 and 10 were connected to Track 5, which has been made an outbound freight running



Track plan through Tower D, showing only the new signals and switches for rerouting trains

track for the Portland route freights departing from the classification yard.

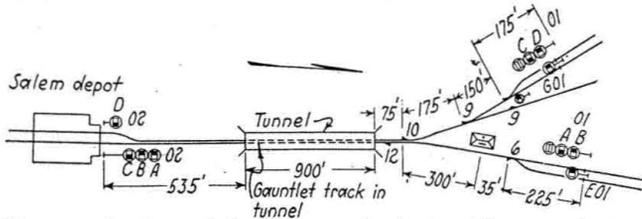
(3) A signal was relocated, and two more switches and were connected with the tower, and two new dwarf signals were installed. This facilitated freight movements, and eliminated three ground switchmen with a net saving in wages of \$4,989.

Revisions at Tower D, Boston

Tower D is a 60-lever mechanical interlocking plant located just west of where the Portland East route diverges from the Portland west route. The only interchange of route traffic it formerly provided was outbound from the West route to the East route (Track 3 to Track 1) and inbound from the East route Track 2 to West route Track 4. East Somerville station is located just west of Tower D and formerly had a passenger platform between Tracks 1 and 2 and between 3 and 4, the station itself being on an upper level adjacent to the Cambridge street bridge.

For the benefit of yard switching moves, a new track, No. 6, was desired on the northerly side extending west from Main street bridge to Yard 10. On account of the right-of-way being restricted by adjacent property, the passenger platform between Tracks 3 and 4 had to be eliminated, to permit the tracks to be relocated closer together, before room could be obtained for the new track. The problem was to bring such West route trains as made this station stop, across on to Tracks 1 and 2. It was decided to make use of two hand-operated crossovers, located just beyond the tower limits, and to operate them by remote control from the tower. A five-lever Union table interlocker was installed in the tower, two levers for the control of crossovers 2 and 3, and three levers controlling eight signals.

Although Tower D is a mechanical plant, at the time Tower C was constructed, a 3-in. air main was



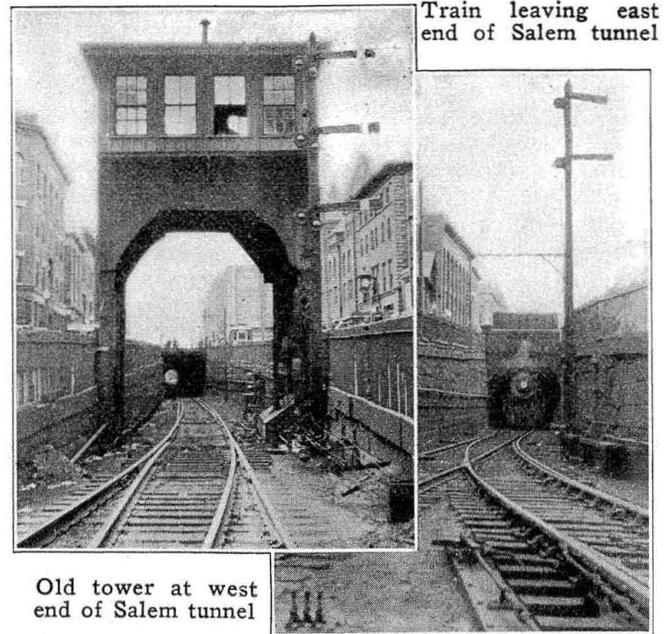
New track plan of Salem tunnel plant with new electro-mechanical plant at the east end

built as far as signal L58 at Cambridge street bridge, with the thought that Tower D would eventually become an electro-pneumatic plant. Hence, it was only necessary to extend this main 1,400 ft. to provide compressed air for operating the four new switches. The new signals are of the color-light type, the high signals having the Union Style-R, two-color light units, and the dwarf signals being Style-N. All wiring between the tower and the installation is cable, run in existing conduits. In all other respects the installation is similar to a remote-control layout at Hill Crossing, which will be described later, in more detail. This installation also permitted the release of two switchmen at a saving in wages of \$3,650 per year.

Salem Tower

Fourteen miles east of Tower D, the Portland East route passes through Salem, the "Witch City." Just east of the passenger station, the railroad runs through a 725-ft. single-track tunnel, lying directly beneath one of the main business streets, with the

tunnel approach at each end crossing a public street. The present track layout consists of a double-track road coming together at the west end of the tunnel,



immediately followed by a gauntlet track switch to separate the main line traffic from the Danvers branch traffic, the two lines diverging at the east end of the tunnel.

This tunnel was opened for traffic in 1839 and for many years trains were handled through the tunnel by means of a ball signal at the east end with a crude form of a train describer repeating the ball signal at the west end. On May 21, 1883, a mechanical tower was placed in service at each end of the tunnel, using Sykes and Stevens machines imported from England. These were replaced in 1889 by two Saxby & Farmer machines using the so-called flop or grid locking, and the machine at the west end remained in service with the original locking until 1925, at which time it was replaced by an improved S. & F. machine. The machines in each tower were connected by a pipe line controlled by a master lever in each machine to give interlocking protection between the two towers.

At the present time, a new electro-mechanical tower is under process of construction to replace these two mechanical towers. This tower is being located adjacent to Bridge street so as to enable the towerman to handle the crossing gates, thereby eliminating three crossing tenders as well as three towermen.

As can be seen from the new track layout, the double track and gauntlet track switches are being relocated from the west to the east end of the tunnel to permit ease of mechanical handling from the new tower. The other switches remain unchanged, except for being connected to the new tower lead-out. All signals are of the color-light type, operated by Union Type-S8 lever units. An interesting feature is that all signals, consisting of 11 two-color-light units, could have been controlled by one lever. Two levers were used, as the machine being installed is the one that was formerly in service at the abandoned North Cambridge tower, which had several S-8 units. The use of two levers somewhat simplified the circuit wiring.

With every unusually high tide, the Salem tunnel

tracks are covered with salt water, which has proved to be most discouraging for the operation of track circuits, so much so that the tunnel has remained without them. With the new tower, however, a determined effort is to be made to operate track circuits, using shorter track circuits and better bonding. The estimated cost of the new tower, including the building and track changes is \$37,200 and the net annual saving, allowing for interest and depreciation, will be \$6,102.

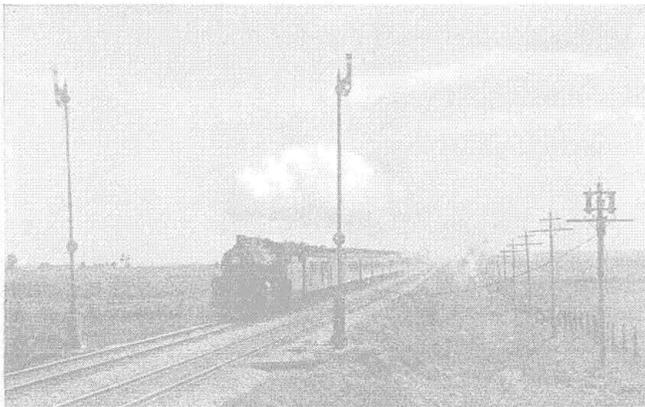
Medford Junction Tower

A 28-lever mechanical interlocking plant located at Medford Junction on the Portland West route, 1.8 miles east of Tower D, Boston, was originally installed to take care of a 2-mile suburban branch extending to Medford, Mass. It was earlier mentioned under Tower C that Yards 9 and 10 were connected to Track 5, which was turned into an outward freight running track for Portland division trains leaving the classification yard. East route freights are of necessity diverted from Track 5 at Tower D across three main line passenger tracks to the East route outbound track, and West route freights are similarly routed across the inbound West route track when traffic will so permit. As inbound West route passenger traffic is very heavy, it was decided to make use of an existing extension of Track 5 and run the outward West route freight on this track as far as Medford Junction tower, crossing them over at this point, and thereby eliminate holding these freights at Tower D, with the resultant blocking of yard tracks and switches.

To allow this move at Medford Junction, it was necessary to install a new crossover between the two main line tracks, relocate two dwarf signals and move the switch connecting track 5 and the inward main 200 ft. west. The new facilities are all handled mechanically from the tower, requiring one new lever for the crossover, and two for facing point locks.

Within the past year or so, automatic flashing-light crossing protection has been installed at 11 crossings on the Terminal division, replacing, in most instances, manual protection. The cost of this work totaled \$17,855, rather higher than average on account of several of the crossings having complicated layouts. The net annual saving is \$5,758.

All of the signal and interlocking work described in this article has been handled by the railroad's signal department forces, with the exception of Tower H, and Yards 8 and 9 retarder layouts, which were installed under contract by the Union Switch & Signal Company.



A-C. semaphore signals on the Milwaukee

I. C. C. Reports on Accident Investigations

THE investigations of train accidents made by the Bureau of Safety of the Interstate Commerce Commission in the month of January included three collisions and three derailments. The reports of the director of the Bureau on two of these six investigations are given in abstract below:

Chicago, South Shore & South Bend, Parsons, Ill., January 1, 3:05 p. m.—Eastbound first-class passenger train No. 17, consisting of an electric motor and one trailer, stopped because of a disabled train ahead, was run into at the rear by eastbound second-class passenger train No. 73, consisting of three electric motors. The speed is estimated to have been from 15 to 50 miles an hour, and the standing train was driven forward into the one ahead of it, coming to rest after moving about 300 ft. One of the motor cars took fire and was consumed, with the exception of its steel framework. The motorman of No. 73 was killed and 48 passengers were injured. The conductor and a ticket collector of the standing train are held responsible for not properly protecting their train, and the motorman of No. 73 did not maintain a proper lookout. The rules call for a time interval of only three minutes between trains on this section of the road and the collector, on whom devolved the duty of flagging, was a man of limited experience, having been employed on July 1, 1927. The conductor, however, is held blameworthy, he knowing that the collector lacked experience. How the motorman came to neglect the lookout, cannot be determined but it appears that the windows were covered with frost so that he had to be specially vigilant to maintain a view of the line ahead. It was, of course, his duty to reduce speed or stop if he could not keep the windows sufficiently clear of frost.

Great Northern, St. Paul, Minn., January 9, 7:41 p. m.—Collision between express train No. 514 of the Chicago, St. Paul, Minneapolis & Omaha and westbound passenger train No. 17 of the Chicago Great Western, wrecking one car. A brakeman of No. 514 was killed and three other employees were injured. Train 514, consisting of a locomotive and four cars, was backing out of the "Y" about 1¼ miles west of the Union Station, proceeding toward a cross-over in the face of train No. 17, and the fault is laid on the latter train, which disregarded distant and home signals. These signals were color-light; red for stop and yellow to proceed. The report cites statements of trainmen tending to show inconsistency in the indications of the signals, but the conclusion of the inspector is that the signals functioned normally and that there was no evidence of anything to cause display of a false proceed indication.

Grade Crossing Fatalities Reduced

Despite an increase of 5 per cent in the number of automobiles in operation in 1927 compared with the preceding year and an increase of 10 per cent in the number of fatalities due to the operation of motor vehicles on the highways, there was a decrease of 4 per cent in the number of persons killed as a result of highway grade crossing accidents. One fatality due to the operation of motor vehicles occurred on the highways for each 984 motor vehicles in operation, while there was one grade crossing fatality for each 11,716 automobiles. Persons killed in highway grade crossing automobile accidents in 1927 totaled 1,974, compared with 2,064 in 1926, a reduction of 90 or four per cent.