C. T. C. on Single Track

Permits Removal of Second Main

On 22.4 Miles on Boston & Maine

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The intermediate signals on the siding increase the number of the nonstop meets

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ON a total of 34 miles of double-track main line on the Boston & Maine, between Nashua, N. H. and Concord, 22.4 miles have been converted to single track with centralized traffic control. Nashua is 39 miles northwest of Boston, and Concord is 34 miles further in the same direction. Manchester, N. H., midway between Nashua and Concord, is an important manufacturing city and railroad traffic center. At Concord, there is a junction to three lines: (1) To Wells River, Vt., where the B. & M. connects with the Canadian Pacific for through train service between Boston and Montreal, (2) to White River Junction, Vt., where the B. & M. connects with the Central Vermont for through train service between Boston and Montreal and (3) the Claremont branch.

Along the Merrimack

Throughout the Nashua-Concord territory, the railroad follows the Merrimack river with a very low grade ascending northward. Outside the cities, the curvature is light, being 2 deg. maximum for the most part, although there are a few 3-deg. curves, and in Manchester, there is a 4-deg. curve. The track is well constructed with heavy rail, good ties and rock ballast. Therefore, all factors contribute to train speeds of up to 70 m.p.h. for passenger trains and 45 m.p.h. for freights.

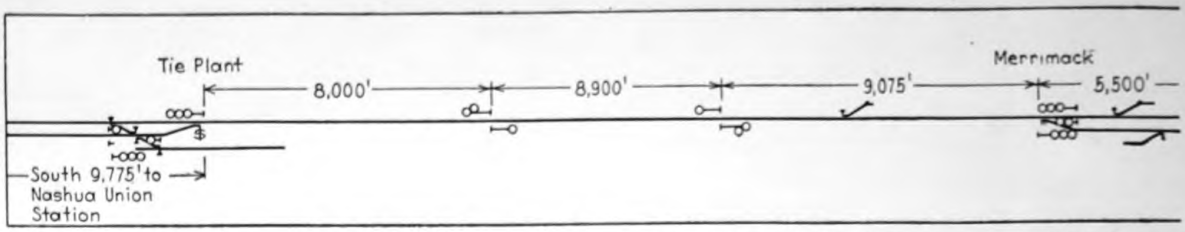
Long sidings, with special signaling, increase number of non-stop meets on territory handling 26 to 30 trains daily

Sixteen passenger trains, six freight trains and two milk trains are operated daily on the 16.7 miles between Nashua and Manchester, and 18 passenger trains, 6 freights and 2 milk trains on the 17.6 miles between Manchester and Concord. Including some extra trains, a total of 26 to 30 trains are operated daily.

Based on extensive experience with centralized traffic control on single track on other territories, the Boston & Maine decided to investigate the possibility of a change from double to single track on certain sections of this Nashua-Concord territory. Studies of time-distance train charts and investigations in the field showed that the proposed change could be made without material loss of train time, providing long sidings were located as indicated by the studies. Action on this proposal was brought about in 1950 because of the need for rail elsewhere on the railroad. Much of the rail to be taken up in the Nashua-Concord territory was 112-lb., laid in 1941 to 1944, and was in good condition for relaying in main track service elsewhere. Also about 85 per cent of the ties were in good condition for reuse. Furthermore, to a certain extent, the crushed rock ballast is being picked up, cleaned and loaded on cars by machines, ready for use again at other places.

Sections Taken Up

A plant for treating ties is located at Tie Plant, 2 miles north of Nashua. Several switching moves



Track and signal plan of new single-track C.T.C. between

are made between this plant and Nashua every day. For this reason, and also to provide plenty of track capacity through Nashua, the two main tracks were left in service from Nashua north to Tie Plant.

Manchester, 16.7 miles north of Nashua, is an important junction point, with an extensive multiple-track layout, which was modernized in 1944 and was equipped with a new extensive interlocking at that time. This layout and local operating circumstances called for the retention of double track main line from Manchester, south to a new end-of-double track switch at South Manchester, as shown on the plan.

Power switch machines are used at the ends of the sidings

Between this end of double track and the end of double track at Tie Plant, as mentioned before, there are 13 miles of new single track main line instead of previous double track. Detailed studies of train operations, as discussed above, indicated that, in this 13 miles, there should be a siding in the vicinity of Merrimack. This siding was formed merely by leaving the previous northward main track in place between Merrimack South and Reed's Ferry. A factor in the selection of the exact location was the chance to include four industrial sidings, thereby enabling a through train to pass on one track while switching was being done on the other track.

Manchester-Concord Section

Conventional double track was retained in service from South Manchester northward through Manchester to Amoskeag, which is 2.2 miles north of the station at Manchester. In order to allow increased track capacity for entering and leaving the terminal at Concord, conventional double track was retained from Concord station south for 2 miles to a new end of double track at Bow. Between Bow and the end of double track at Amoskeag, as discussed above, there are 13.4 miles of new single track main line, instead of the previous double track. Studies of train operations indicated that in this 13.4 miles, a siding should be located about midway.

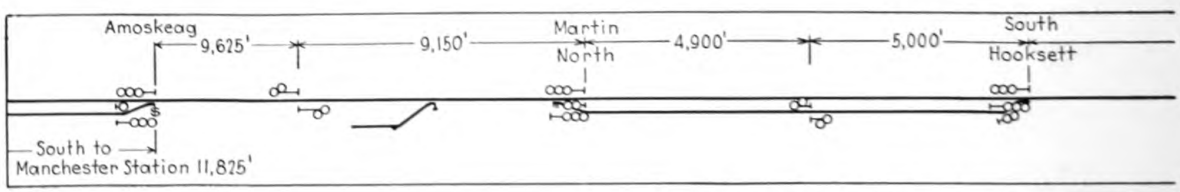
In order to eliminate road crossings at grade within the length of the siding, it was located between Martin North and South Hooksett, which is somewhat south of the midpoint between Amoskeag and Bow. This siding was formed by leaving the previous northward track in place.

Why The Sidings Are Long

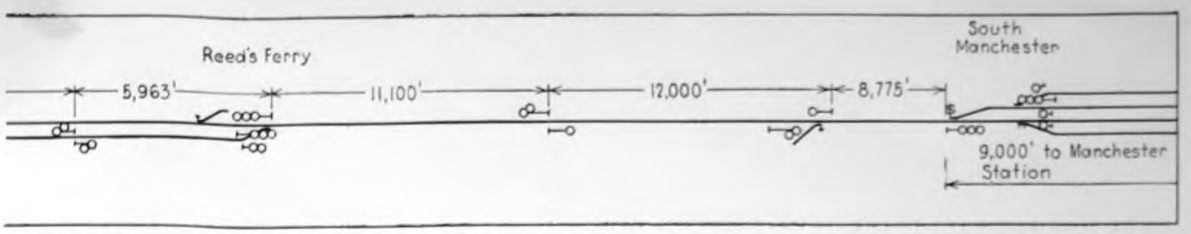
Both the Merrimack siding and the Hooksett siding are 2.0 miles long. These sidings were made long to serve two advantages: (1) To increase the number of opportunities for trains to make running meets, in which neither train stops and (2) if necessary, the long sidings will each hold two trains.

When making the track changes, new No. 20 turnouts with 30-ft. switch points were installed at the ends of the sidings so that trains can enter or leave at speeds up to 30 m.p.h., thus minimizing the time required for such diverging moves. Of further importance is the fact that the signaling is specially arranged to direct trains to use these new turnouts and long sidings efficiently.

Track circuits on these sidings enter into the control of the signals. Sketch given herewith shows the signaling at the Merrimack siding. At a midpoint on this siding, there



Track and signal plan of the new single-track C.T.C. on



Tie plant and South Manchester, 13 miles

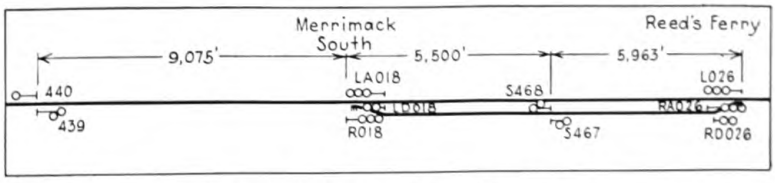
is a double signal location consisting of two-unit automatic block dwarf signals.

With no train on the siding, these intermediate siding signals are normally set to display the Approach aspect, yellow-over-red. If the south switch is reversed for a northbound train to enter the siding, the station-entering signal R018 will display the Medium-Clear aspect, red-over-green-over-red. At the same time, the signal in approach, i.e., 439, displays the Approach-Medium aspect yellow-over-green. Thus, these aspects on signal 439 and R018 give an engineman the information needed to bring his train up to and through the turnout and into the siding at the maximum permissible speed.

If a leading train has already occupied the far end of the siding, i.e., between intermediate siding signal S467, and signal RD026, then signal 467 displays its most restrictive aspect, red-over-red, staggered, and the best aspect on signal R018, for a train to enter the siding, is Medium Approach, red-over-yellow-over-red. An Approach-Medium aspect, yellow-over-green, is still obtained at signal 439, as there is sufficient braking distance for a train passing signal R018 at 30 m.p.h. to stop before reaching signal S467.

When a northbound train on the siding is to depart, the switch is reversed, and the two-unit leave-siding dwarf RD026 is controlled to display the Medium-Clear aspect, green-over-red, and if the train is south of the intermediate siding signal S467, that signal then displays the Approach Medium aspect, yellow-over-green. The above statement, with reference to the Medium-Clear aspect of leave-siding signal RD206, applies if two or more automatic blocks ahead are unoccupied. If the next intermediate signal is at red, then the best aspect on RD026 is Slow Approach, red-over-flashing yellow.

Spring switches are used at the ends of double track

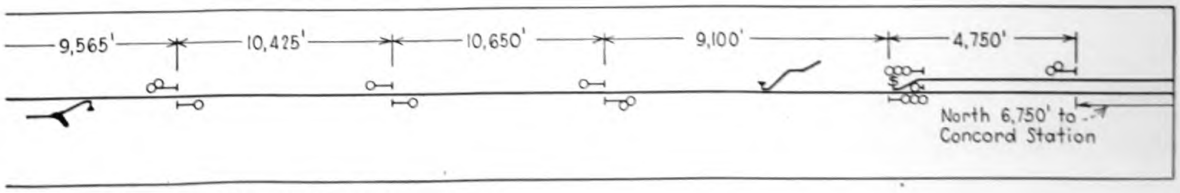


Plan illustrating signals on the siding

If a northbound train which has passed, is still occupying the block between signal RA026 and the next northward signal; with the switch reversed, leave-siding dwarf signal RD026 can be cleared to the Restricting aspect, red-over-yellow.

Example of Non-Stop Meet

One recent day, passenger trains 332 southbound, and 313 northbound made a non-stop meet at Merrimack siding. The southbound train got in the clear at 4:35 p.m. At 4:36 p.m., the northbound train accepted the main track signal at the south end, and cleared the north switch at 4:38 p.m. The southbound train went through the siding in



13.4 miles between Amoskeag and Concord

four minutes, clearing the south switch at 4:39 p.m. This is typical of many of the non-stop meets made on this territory.

The switches at the ends of the sidings are operated by Union Switch & Signal Company Style M22 d.c. switch machines, which are controlled as part of the C.T.C. system. Each switch machine is controlled by a DP-25 relay and OR11 overload relay which are mounted in a cast-iron case on a small concrete foundation. As a means of preventing frost trouble on concrete, a 15 watt heater unit is mounted in the contact housing. Spring head rod type oil-buffer spring switch mechanisms, and Style T-20 switch stands, including automatic facing-point locks, made by the Union Switch & Signal Company, were installed at each of the spring switches.

All of the new ends of sidings and ends of double-track include new No. 20 turnouts with 30-ft. points. An insulated gage plate, ¾-in. thick and 7 in. wide is used on the No. 0 tie. In each power switch layout, Ramapo-Ajax adjustable rail braces are used on the No. 0, No. 1, No. 2, No. 5, No. 8 and No. 10 ties. The No. 1 rod is a Ramapo-Ajax type MF, and the same type rod is used on each spring switch as the No. 4 rod to which the connection is made for the plunger in the facing-point lock. The front rods on the power switches and the spring switches are the Union Switch & Signal Company swivel type. A pair of U. S. & S, Co. roller bearings was installed under the switch points on each spring switch.

When making a converging move from double to single track over one of these turnouts trailing out through the spring switch, the train speed is limited by interlocking signal indication to 30 m.p.h.

As part of the C.T.C. project, electric locks were installed at both ends of a hand-throw crossover at Tie Plant, and at eight hand-throw switches leading to industry spurs. One of these hand-throw switches leads from the siding at Merrimack. The control of these electric locks, except for those on the hand-throw crossover at Tie Plant which are lever controlled, are as follows:

For movement from main track to sidetrack the lock will be automatically released when any part of train is within 100 feet in approach to the switch to be unlocked.

For movements from sidetrack to main track, after permission has been received from the train director, it is necessary to push a button in face of lock to be unlocked. This action sets all conflicting signals to "Stop" and lock will release under the following conditions:

1. At once, if no conflicting northward or southward interlocking signal has been cleared and no conflicting northward or southward movement is in progress.

2. After a fixed time interval, varying from 4 to 8 minutes dependent on location of lock, if a conflicting northward or southward interlocking signal has been cleared, or, if a northward or southward conflicting movement is in progress.

At sidetracks equipped with a hand thrown derail, the electric lock on the switch must be released **before** the derail is thrown.

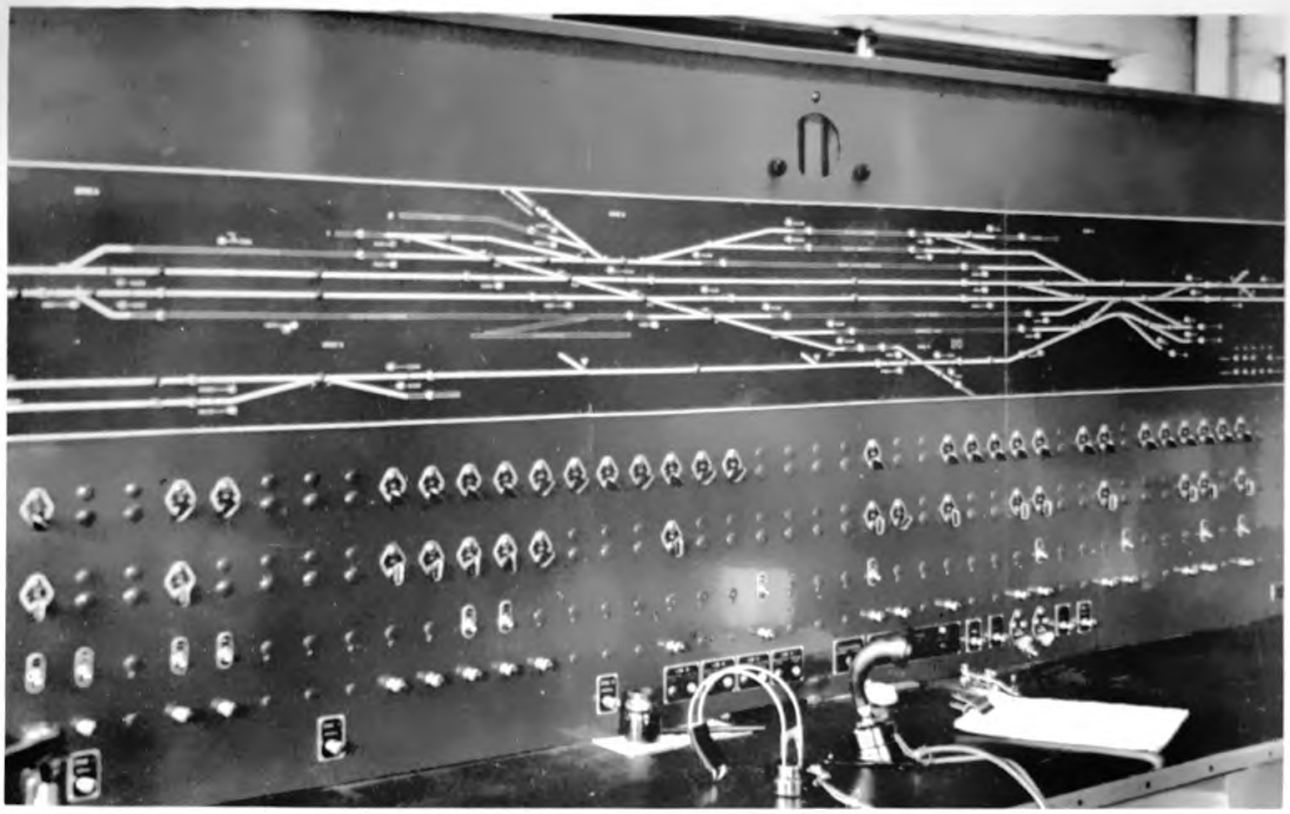
If for no apparent reason a lock does not release under the above conditions, then a sealed button in face of lock must be pushed. Permission to break seal and push this button must always be obtained from the train director at Manchester tower. If, at any time, the seal on this push button is found broken, the fact must be at once reported to the train director at Manchester.

Control Machine at Manchester

As stated above, a modern interlocking, controlling an extensive area through Manchester, was installed six years ago, and was described in an article in the August, 1945 issue. For the control of the new C.T.C., a panel 2.5 ft. wide was added at each end of the interlocking machine installed at Manchester in 1945. The levers, indication lamps, and other operating features of the C.T.C. panels are identical with those of the interlocking panel,

Signals at end of siding

Signals at end of double track



This control machine has unique indication and operating features

so that, in effect the operation is practically the same as if the interlocking had been extended 14.5 miles south to Tie Plant, and 15 miles north to Bow. Of the special features of this control machine, the following are the most important:

(1) A normally dark face plate or diagram with an indication light appearing only when it is serving an immediately useful purpose of actually indicating something, thereby preventing confusion caused by a multitude of adjacent lights.

(2) A single "out of agreement" indicating light instead of two or more over each switch or signal lever.

(3) "Route checking" the route lined up in the machine after all indications have been properly received, even for a complex route, before a signal can be coded clear.

(4) An exit light on the diagram at the exit end of each possible route, which appears when the signal lever for a route is operated and before the starting button for the clearing code has been depressed. This serves as a true visual check that a route has been set up as shown by the exit light. This light is white with a black arrow indicating the route direction.

(5) Track - occupancy indication lights on the diagram are differentiated between approach yellow lights, and red section-locking indication lights, lighted only when track is occupied.

(6) Signals are indicated clear by a green light in each respective signal symbol on the diagram itself.

More detailed description of these features will follow.

The levers are of the "push-to-turn" type, which means that the handle must be pushed in about ⅛ 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. These switch levers are in the top row, the signal levers in the second row, the call-on and maintainer's call toggle switch handles in the third row, and the code-starting buttons for signals in the fourth row.

Only One Lever-Indication Lamp

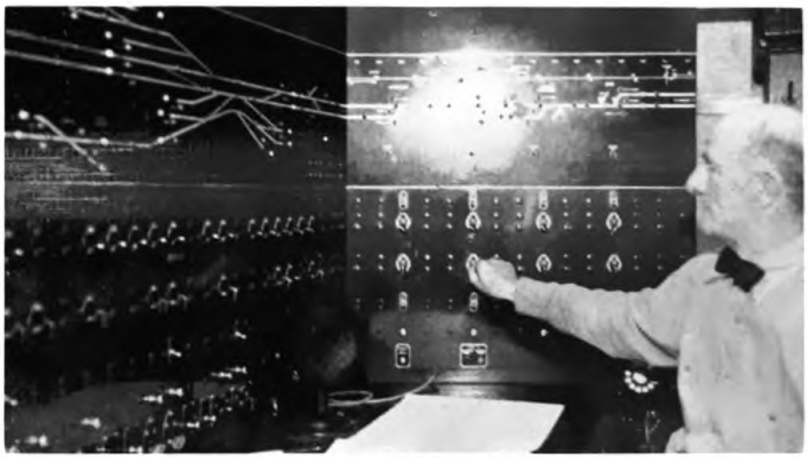
Above each switch lever there is one red indicating lamp. This "out of agreement" lamp is lighted whenever the position of the lever and the switch it controls are not in agreement. For example, if a lever is moved to reverse, the lamp above that lever is lighted immediately and remains lighted until the switch has moved to the fully locked reverse position; then it becomes dark. If it stays lighted longer than usual, it is an indication to the train director that it has not followed the lever to its final controlled position, and cause should be ascertained.

Similarly, there is only one red indication lamp above each signal lever, which is normally dark, becoming lighted whenever the lever position and corresponding signals are not in agreement. Each signal lever is normally set on center, being moved to the left to clear a southward signal, or to the right to clear the opposing northward signal. After a signal lever has been moved, the code-starting button in the bottom row under the lever must be pushed, but not until the exit light appears, denoting just where the train will leave. Control will not be as effective until the "exit" light appears. As an example, when a signal lever is moved for a proposed route, the switches involved must first be set to afford the proper destination. When the switches concerned are properly positioned and locked, the exit light will appear at the point determined by switch positions. This affords the operator a quick and correct check that the route anticipated is ready for the signal without individual switch lever check, and prevents him from finding himself "locked up" by hav-

ing inadvertently set up a route other than the one intended.

This feature is accomplished by locating the route check network in the machine which location checks the transmission of the control and indication circuit and also enables the signal control to open field locking relays, back contacts of which must be placed into signal mechanism control circuits before the signal will clear.

When the lever is moved, the red light on the lever appears until the signal indication is received, at which time the lever light becomes dark and the green light in the signal symbol on the diagram becomes lighted. The signal lever light also is provided with a flashing indication denoting when the approach locking is effective. As an example, assume that the operator restores a signal to stop with a train on the approach with intent to change the route. When the Stop indication is received, the light will flash, denoting that the route, controlled by the signal in question, is locked. Under this condition, the exit light will persist.



This right wing panel controls the new Amoskeag-Concord section

At the expiration of the time period, the flashing light of the signal lever and the exit light will both become dark. Any attempt on the part of the train director to move a switch in the route during the flashing of the light will simply be non-effective, and the switch lever must be restored to its former position and again moved after the flashing desists, that is, after the circuits become unlocked, before the control becomes effective. In other words, a switch control cannot be stored during the time the circuits are locked.

For all semi-automatic signals, no Stop control is required. A train, passing such a signal restores it to Stop through the track circuit, at which time the light will appear at the lever (because the two do not agree) and the signal clear indication light on diagram will become dark. In this instance, the train director need only restore the lever to normal without using the start button and the lever light will go out. With the controls normal, the machine is completely dark.

All New Signaling

The previous double-track between Nashua and Concord was equipped with searchlight type automatic signaling for right-hand running. When changing over to single track, the old signaling was removed and entirely new signaling was installed in the section equipped with C.T.C. The new signals are the U.S.&S. Co. H-2 searchlight type. All signals are at the immediate right of the track governed. The C.T.C. controlled high home signals have three searchlight units, and the dwarfs have two units wherever the turnouts from siding to main track are good for 30 m.p.h. or more. On short turnouts, a one unit dwarf allows not more than 15 m.p.h. speed. The lamps in the signals are rated at 11 watts 11 volts, and are approach lighted.

Track and Line Circuits

Throughout the C.T.C. sections new coded track circuits were installed on all track circuits, except at OS points, releasing sections for electric locks and operating sections for highway crossing protection where conventional neutral track circuits were used. Conventional 75, 120 and 180 codes were used with inverse code when required for approach locking purposes. Relayed cut sections were used at a number of points where distances were greater than a single coded track circuit could reliably operate.

Line Circuit

In order to keep to a minimum the number of line wires, reversible HD circuits were used so that the same pair of wires was used to control both northward and southward signals. At a number of locations where an additional aspect was required, these line circuits were coded as well as polarized.

The C.T.C. code line circuit from Manchester south to Tie Plant, and from Manchester north to Bow, is on two new No. 8 copper wires with braided weatherproof covering. A telephone circuit for the use of train crews and others requiring communication with the train director at Manchester is superimposed on the code line. Also, as a part of the new project, two new No. 6 copper line wires with weatherproof covering were installed for a 550-volt a.c. power distribution circuit. The local line control circuits are on No. 10 weatherproof Copperweld wire.

At each power switch, there is a set of 16 cells of storage battery for operating the switch machine. Eight of these cells are used also to operate the line code equipment. In addition, there are five cells for local controls and as standby for signal lamps. Each track circuit is fed by one cell. All this battery is Exide, 80 and 100 a.h. Manchex type cells.

New insulated wires and cables were installed throughout the C.T.C. project, being furnished for the most part by the Simplex Insulated Wire & Cable Company. Solderless terminals, made by the Aircraft-Marine Company, were used in practically all of the wiring in houses, cases, signals, switch machines, etc.

This C.T.C. project was planned by the forces of the Boston & Maine with the engineering detail plan furnished by the Union Switch & Signal Company, and was installed under contract by the Union Switch & Signal Construction Company. The installation was made under the jurisdiction of E. N. Fox, engineer of signals and telegraph, and the field construction was under the direction of H. W. Williams, superintendent of construction for the signal company and W. W. Hartzell, field engineer signals for the railroad.

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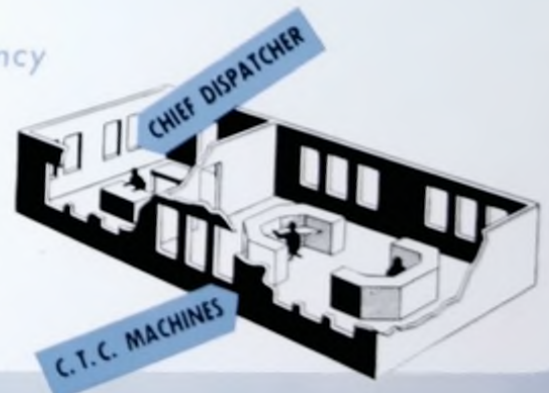

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