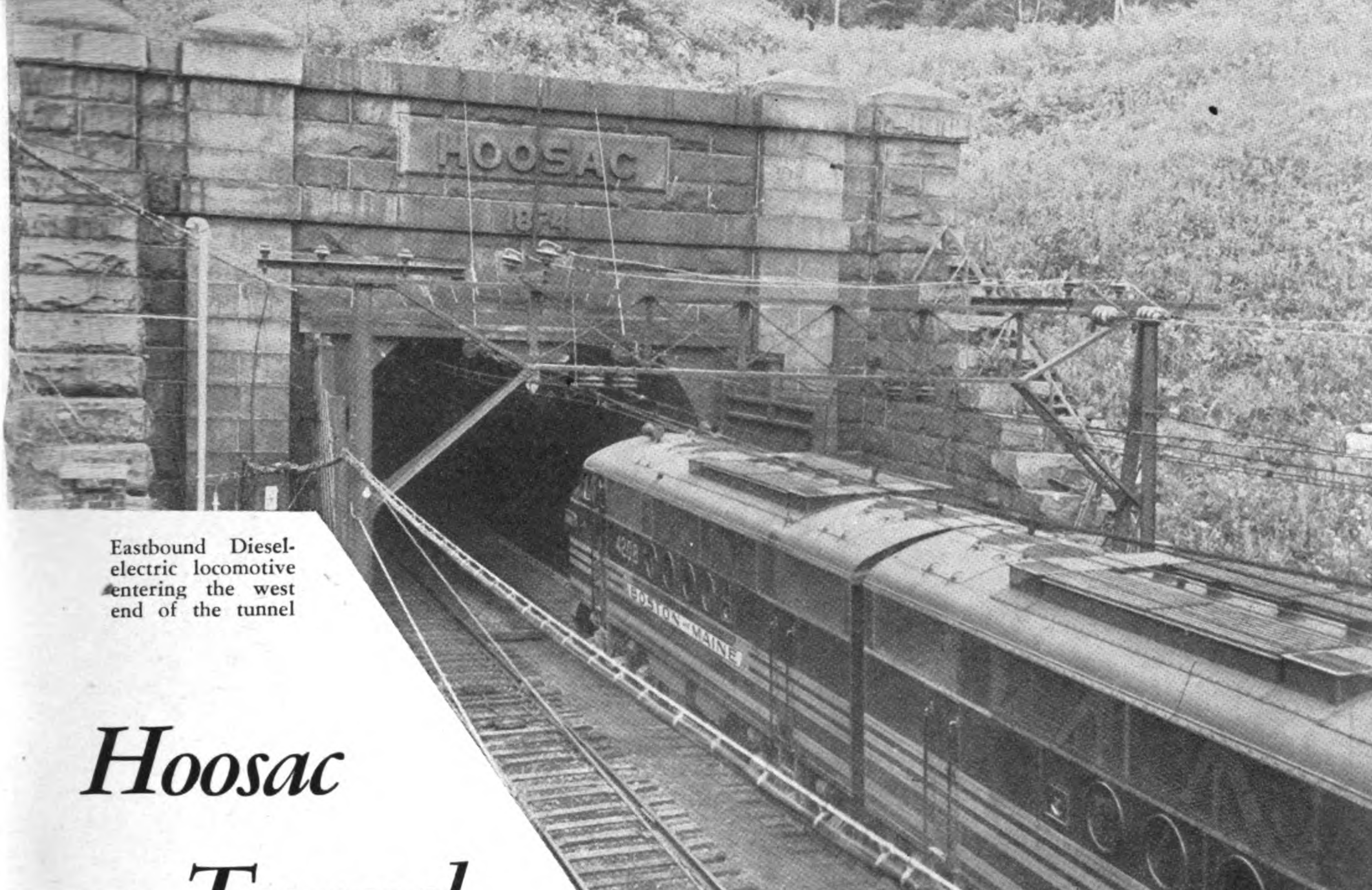


Eastbound Diesel-electric locomotive entering the west end of the tunnel

Hoosac Tunnel Interlocking and C. T. C.

Train operation by signal indication in both directions on all tracks is a means to reduce delays and to increase track capacity

---

THE Boston & Maine has recently completed a re-signaling project on the Fitchburg division between Soapstone, Mass., and Hoosick Falls, N.Y., including 16.2 miles of double track equipped with automatic block signaling, and 14.1 miles of two-track and three-track road equipped with centralized traffic control for train operation by signal indication in both directions on all tracks, this C.T.C. section including the 4.75 miles of double track through the Hoosac tunnel.

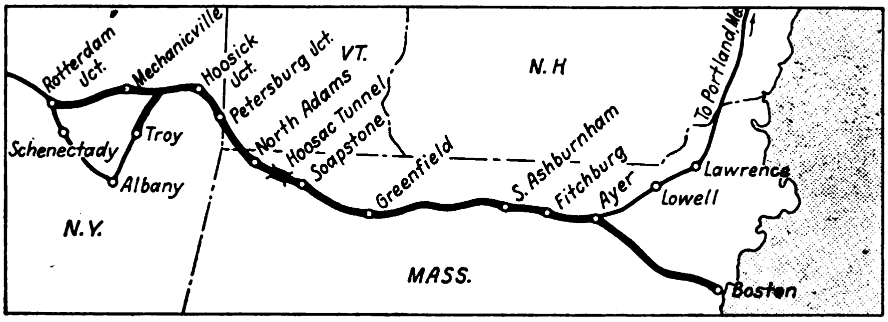
The Fitchburg division of the Boston & Maine is an important east and west line between Boston and points of connections with other railroads in the Hudson River Valley such as the New York Central at Troy, N.Y., and Rotterdam Junction near Schenectady, N.Y., and the Delaware & Hudson at Mechanicville, N.Y. This route is not only the most direct but also at low grades because it includes the famous five-mile double-track Hoosac tunnel which pierces the highest range of the Berkshire mountains at a low level of only 837 ft. above sea level. On the other hand, various factors in the operations of trains in the vicinity of and through this tunnel were the causes of delays to trains, so that this section was the bottleneck of the entire division. The recently completed signal construction was part of an improvement program to expedite train operations in this section.

Physical Characteristics

At Greenfield, Mass., 105 miles west of Boston, the railroad crosses the Connecticut river, and from there westward the railroad follows up the valley of the Deerfield river for 30 miles to the east portal of the Hoosac tunnel. From the west portal, the railroad follows down the valley of the Hoosick river to the valley of the Hudson river near Mechanicville, N.Y. Approaching the tunnel from the east, the heavy grade ascending westward, ranging from 0.68 to 1.1 per cent, extends about 2.5 miles up to the east portal. Approaching from the west, the heavy grade ranging from 0.6 to 1.1 per cent ascending eastward, extends for about 3.5 miles between Fairgrounds and the west portal.

In these territories, several curves range up to 5.5 degrees with a few 6.0 deg. The tunnel is tangent. The track is level for 1,650 ft. near the center of the tunnel. Approaching this level section from each portal there is an ascending grade of 0.48 per cent. The elevation at the center of the tunnel is only 837 ft. above sea level, whereas the top of the mountain above the tunnel is 2,508 ft. above sea level, although the top of the mountain at the central shaft location is only 1,865 ft. above sea level.

On this section of railroad, five passenger trains are scheduled each direction daily and an average of 14 through freight trains are operated each direction daily. The freight traffic includes about 900 loaded cars eastward daily, and a similar number of cars including loads and empties are moved west. Eastbound traffic, espe-



Map showing the location of the Hoosac tunnel on the Boston & Maine

cially perishables, is scheduled for early morning deliveries in Boston and other cities in New England. Likewise cars loaded at mills and factories in these cities are started west the same evening for delivery to western connections. The eastbound peak is handled through the Hoosac tunnel between 6 p.m. and 10 p.m., and the westbound peak between 8 a.m. and 11 a.m.

Diesel Locomotives Now

The Hoosac tunnel was completed in 1875. Until 1911 trains were operated by steam locomotives. In order to minimize locomotive smoke, electric propulsion, installed in 1911, extended through the tunnel as well as 0.8 miles east and 2.04 miles west. The practice was to stop each train and couple an electric locomotive on the head end to pull the entire train, including the steam locomotive, through the tunnel. The fires in the steam locomotives were banked, so that there was a minimum of smoke.

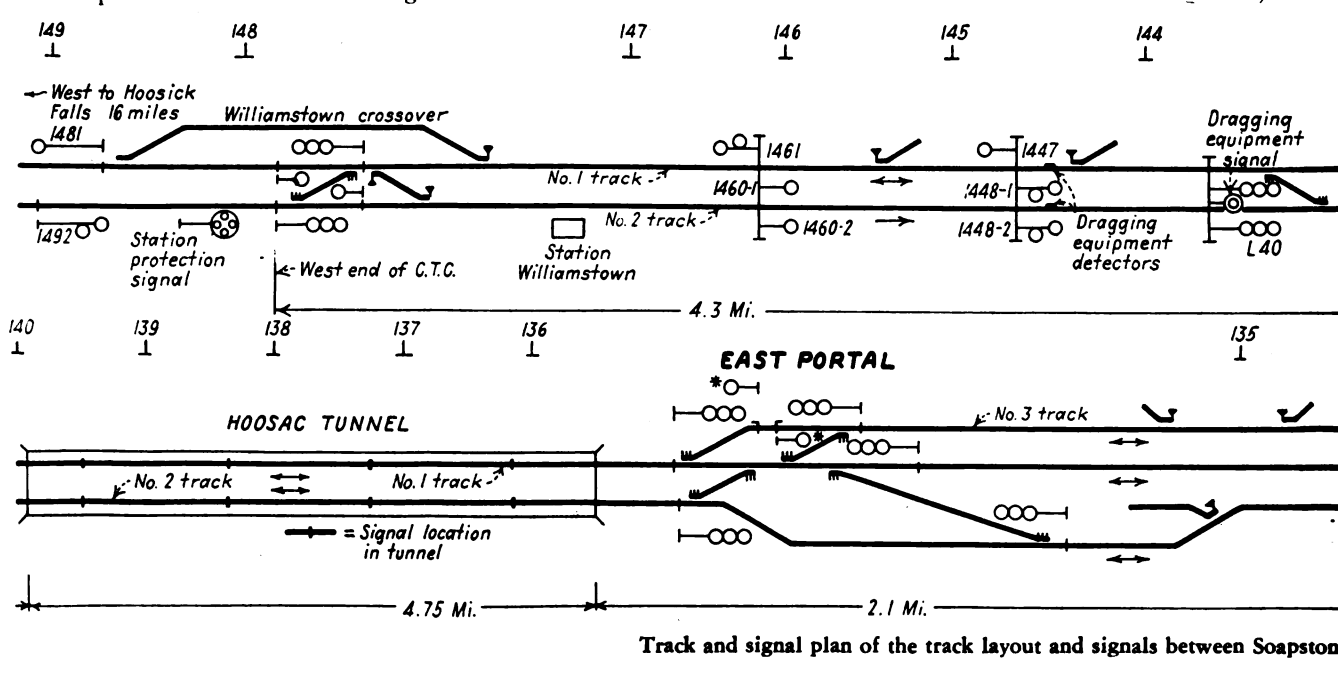
Within recent years, Diesel-electric locomotives have been used on certain through freight trains, and these locomotives pull their own trains through the tunnel without the use of electric locomotives. As of August 25, 1946, a sufficient number of Diesel-electric road locomotives were available for the operation of all trains through this territory, and therefore the electrification was abandoned, the electric locomotives being stored for sale, and the overhead trolley and power supply equipment was removed.

The new signaling was designed to handle train operations with either the electrification in service or with Diesel-electric locomotives for all trains. The principal objective of the 1946 improvement was to increase the flexibility of operations, so that trains can be operated in the territory up the grades and through the tunnel, just as promptly as on an equal mileage in open territory. The number of tracks, especially through the tunnel could not be increased, and, therefore, the only means of increasing the capacity of existing tracks which were already signaled for either-direction C.T.C. operation through the tunnel and east thereof, was to improve the track and interlocking layouts each side of the tunnel, and to extend the either-direction C.T.C. operation on the west side of the tunnel westward to Williamstown. Sets of power-operated crossovers were installed at various locations in approach to the tunnel from both directions, replacing, at some locations, short mechanically-operated crossovers. In order to bring the trains through these crossovers on ascending grades without losing momentum, the crossovers were built for normal speeds, i.e., No. 20 crossovers, and signaling was provided to tell the enginemen what to expect ahead, so that they can bring their trains up to and through the crossovers at the speeds for which they were designed. The maximum permissible speed in the tunnel is 30 m.p.h. The heavy grades approaching the tunnel from each direction naturally limit the train speeds to about 30 to 35 m.p.h. Therefore, with No. 20 crossovers including special 30-ft. points, the trains can make diverging moves between main tracks at the normal road speeds, even though certain crossovers had to be located on curves. The overall result is that the trains now swing up the grades and through the tunnel on either track without stopping or even reducing speed.

Previous Interlockings

A third track extending 2.5 miles from Soapstone to East Portal was provided years ago, primarily to hold westbound freight trains when waiting to go through the tunnel. At East Portal, a 40-lever mechanical interlocking included 4 crossovers and 4 single switches. A panel type machine in this tower was for the remote control of the switches and signals at the east end of the third track at Soapstone, with C.T.C. operation on all three tracks between these points.

To the west of the tunnel, a third



Track and signal plan of the track layout and signals between Soapstone track was provided years ago between Spragues and the west portal to hold eastbound freight trains when waiting. At West Portal there was a 24-leved mechanical interlocking including two crossovers and the switch at the east end of the third track. The crossovers at Spragues, the west end of the third track, were operated by hand-throw switch-and-lock movements, which were handled by a switch tender who also operated a set of desk levers for the control of the signals at this layout.

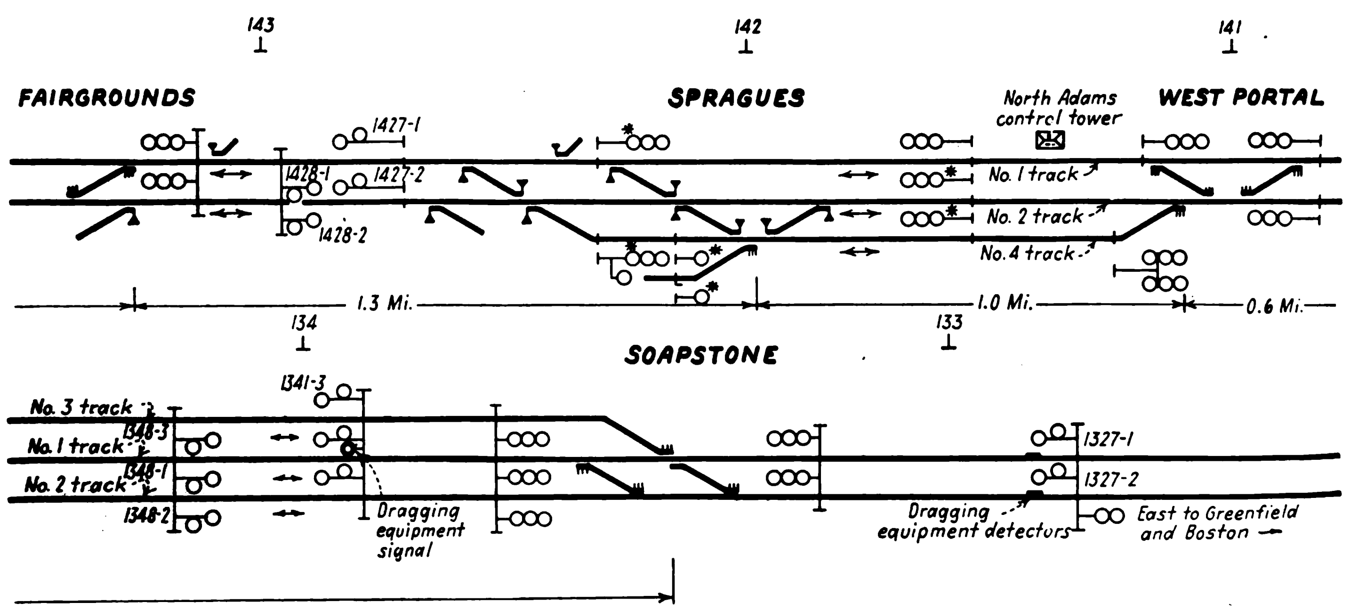
The 1946 program included track changes to increase the flexibility of either-direction operation and to consolidate the control of the entire area in one centralized traffic control machine, thus dispensing with separate interlocking control locations at East Portal, West Portal, and Spragues.

Either-Direction Signaling

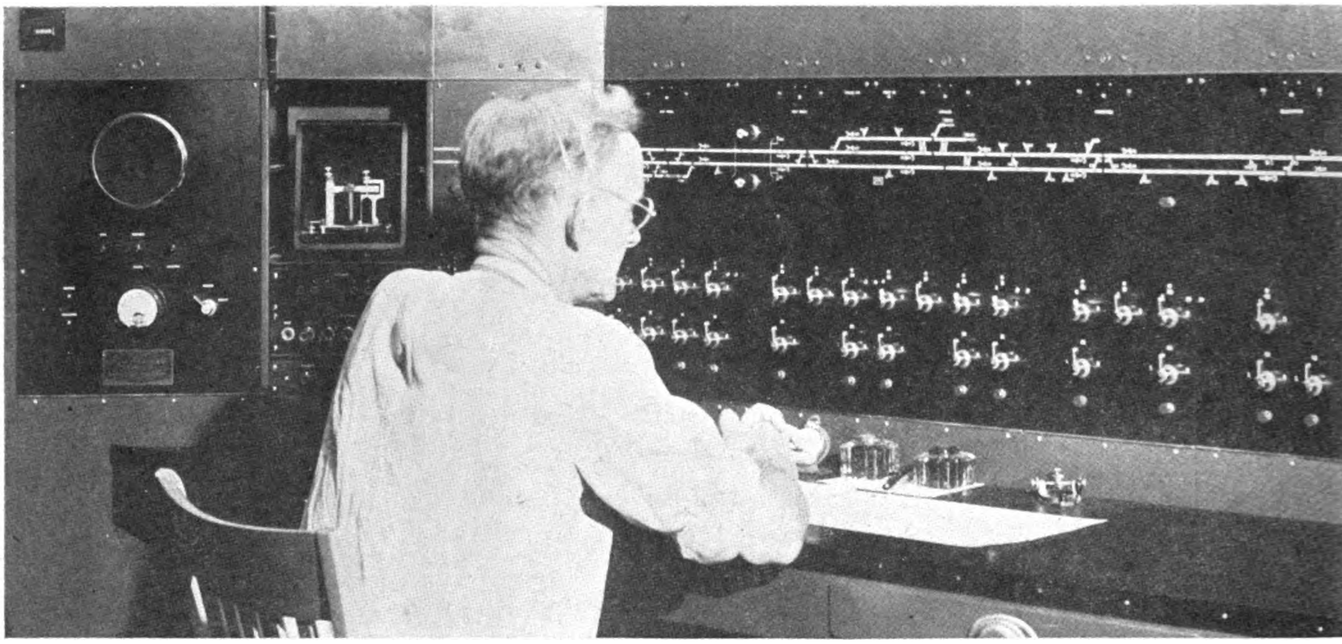
In order to extend the either-direction running further westward, one new power-operated No. 20 crossover was installed just west of Williamstown, 8 miles west of the west portal. With this new Williamstown layout, either-direction train operation is in effect on the No. 1 track eastward from this location. At Fairgrounds, 4 miles east of Williamstown, two new No. 20 crossovers were installed and equipped with electric switch machines and signals arranged for either-direction train operation on both main tracks east of Fairgrounds. At the previous layout at Spragues one switch was made power operated, but the crossovers were left on hand-throw. At the old West Portal interlocking the old crossovers and turnouts were No. 10, and the train speeds when making diverging moves were further limited because the entire layout was on a curve in the main tracks. For this reason, the old crossovers and turnout, as well as the mechanical interlocking, were removed. On straight track about 2,000 ft. west of the old layout, two new No. 20 crossovers and a new turnout were installed with power switch machines and signaling for train operation in either-direction on both tracks, both east and west from this new layout.

Numerous track changes were made at East Portal. An eastward passing track, formerly located between the two main tracks, was cut east of the plant, the west portion being removed and the east portion being retained as a set-out track, connected to the No. 2 track by a hand-throw switch with an electric lock. The remaining tracks were re-arranged, so that the number

Crossovers and signals at Soapstone



and Williamstown which are now included in the C.T.C. system



In the new system, one C.T.C. machine controls not only the tunnel but also the track layouts formerly included in the interlockings on the entire territory between Soapstone and Williamstown crossovers

of switches to be equipped with electric switch machines was reduced to three crossovers and one single switch, as shown in the accompanying plan. The new crossovers are No. 20, and the single switch is a No. 10. No changes were made in the track layout at Soapstone.

With these various changes the new electric switch machines and new searchlight signals for authorizing train movements at Soapstone, East Portal, West Portal, Spragues, Fairgrounds and Williamstown are all included in one C.T.C. system, with the control machine in a new brick tower at a location about 4,500 ft. west of the west end of the tunnel. This machine also includes controls for the signaling in the tunnel.

Signals in the Tunnel

The distance through the tunnel, from East Portal to West Portal is 25,081 ft., which is divided into five automatic blocks, each about 5,000 ft. long. This results in four intermediate locations at each of which there are automatic signals for both directions on both tracks, thus totaling four signals at each location. The signals are the color-light type with 6-in. cover glasses. These signals are on the wall of the tunnel. The signals for right-hand running are at the right of the track governed. The signals for left-hand running are on the wall to the left of the track governed, but this is not a handicap because the cabs on the Diesel-electric locomotives afford a full view ahead on both sides of the track. These automatic signals in the tunnel are controlled by coded track circuits thus obviating the need for so-called line circuits which would require cable in the tunnel.

At west portal there is a tunnel door which is closed by a door man when necessary to control the ventilation through the tunnel. In the tunnel, at a location 4,750 ft. from the West Portal, there are two westward three-light interlocking signals, one for each track, which display the Stop aspect unless the tunnel door is in the open position and locked by a boltlock.

The C.T.C. Control Machine

The one C.T.C. control machine in the new tower at North Adams controls the entire territory from Soapstone to Williamstown. This machine is operated by a train director who works under the supervision of the division train dispatcher located at Greenfield, 36 miles east.

On the control machine, in the line of the diagram representing tracks, there are small lamps which are lighted when corresponding sections of track are occupied by trains. The lamps which represent sections within home signal limits are red, and those representing approach sections are yellow. Each track in the tunnel is represented by three separate track-occupancy lamps, each controlled by corresponding sections of track, so that the train director has accurate information of the progress being made by trains in the tunnel. On the track diagram, each lever-controlled signal is represented by a symbol which includes a lamp that is lighted green when the signal has been controlled to display a proceed aspect.

The upper row of levers are for the control of power-operated switches, and for the control of electric locks on some of the hand-throw switches, the levers for control of locks being shorter. Immediately above each lever in this row, there is a lamp which is lighted amber when the corresponding switch in the field is in a position which is out of correspondence with that of the lever. In the barrel of each of these levers there is a red lamp which is lighted when the electric locking is in effect to lock the corresponding switch, that is, it cannot be operated because there is a train approaching or there is a signal cleared for a movement over the switch.

The signal levers, which are in the second row, normally stand in the vertical position to control signals to the Stop aspect. Such a lever is thrown to the left to clear an L signal, or to the right to clear an R signal. A push-button, known as the code starting button, is mounted in the barrel of each of these signal levers. After the train director has set the switch lever, and/or the signal lever in a vertical row, he pushes this button to start the transmission of the C.T.C. code to the corresponding field station.

Exit Lamps

A new practice, as applied to C.T.C., is that on this machine there is an amber lamp corresponding with the exit of a route from each home signal limit of a crossover layout, for example at Fairgrounds, West Portal, etc. When the director positions the switch and signal levers, the amber lamp corresponding to the exit of the route to be set up is lighted, so that he can check at a glance to know that he has lined the levers properly for the route intended, before he pushes the code starting button. The exit lamp stays lighted until he returns the signal lever to normal.

Below each signal lever, there is a red push-button which is used in conjunction with the signal lever and its start button to control the display of a call-on aspect. The manipulation is to set the signal lever, push the start button, push the call-on button, and then again push the start button. This procedure practically eliminates the possibility that the director would clear a call-on without taking thought to know exactly what he is doing.

Besides being inoperative within interlocking limits, the advancing signals are displayed only for following moves except that special arrangements were made at East Portal, West Portal and Spragues to couple locomotives to standing trains after a special predetermined time interval had elapsed to insure that the train had come to a stop and that the coupling locomotive had come to a stop before the restricting signal for this move could be made. This feature was further limited by permitting such moves away from the tunnel only.

Control of Signals in the Tunnels

As mentioned previously, the signals in the tunnel are controlled by coded track circuits, and the direction in which trains are to be run on a given track is established by a traffic-direction knob, the one for the normally eastward track being above the lines representing the tracks in the tunnel, and the knob for the normally westward track being below these lines. These knobs include contacts which are operated when the knurled outer rims are rotated. In the face of each knob there is a black arrow which turns with the knob, and behind the arrow there is a lamp.

When the direction of traffic on the normally eastward track, for example, is to be changed from eastward to westward, the train director rotates the knob 180 deg. so that the arrow points west. When he does so, the lamp behind the arrow is lighted and stays lighted until traffic direction is established westward on that track.

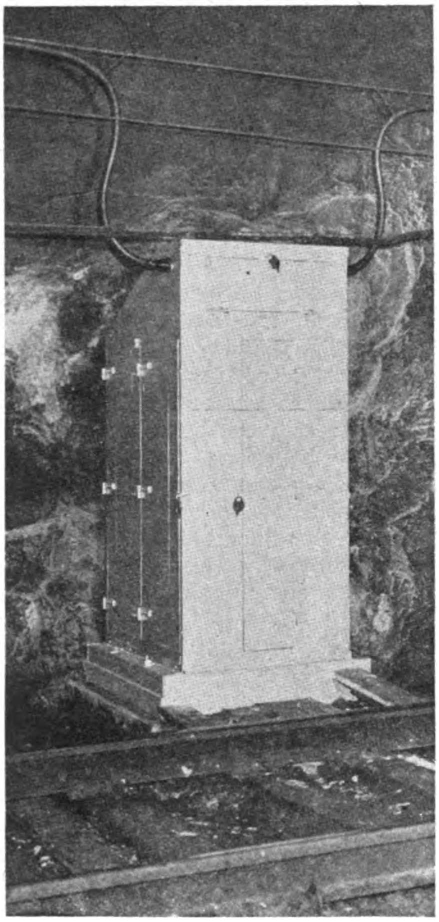
When the director thus turns a knob, a C.T.C. control goes to the "leaving" end of the tunnel, which in this instance would be the west end, at which point the receipt of the C.T.C. code energizes a "traffic" relay which causes steady energy to be fed eastward on that track to the first signal location in the tunnel, at which point a "traffic" relay is picked up to cause "steady" energy to be fed on the track to the east, thus steady energy is fed cascade through all the track circuits to the location at East Portal which in this instance is the entering end for the train for which the line up is being established. Upon receipt of this steady energy at the entering end, an indication is transmitted to the control machine to cause the light behind the arrow to be extinguished, and at the same time an outgoing C.T.C. control is sent automatically to the leaving end of the tunnel, in this instance the west end, which causes steady energy to be removed from the track feed, and, instead thereof, coded energy, that is 75 or 180 code, is fed eastward, cascade through all the track circuits in the tunnel to the East Portal. This causes the westward signals for that track in the tunnel to display proceed aspects. Track code at 75 per minute controls a signal to the Approach aspect; 120 per minute, the Approach-Medium aspect; and 180 per minute, the Clear aspect. Absence of energy or steady energy causes a signal to display the red aspect.

Having thus established traffic direction on a track through the tunnel, the train director can then clear a home signal at East Portal to authorize a westward train to use the normally eastward track through the tunnel. The procedure of changing the direction of traffic and clearing the signals required about 30 seconds. Having established a direction for a given track, the signals in the tunnel continue to be controlled by coded track circuits, and thus to operate as automatic block signals which clear for following trains with no further attention by the train director.

In addition to the track circuit code which feeds from the leaving end to the entering end of the tunnel to control signals, there are also pulsations of energy which feed in the opposite direction in the intervals between the signal control codes. This opposite direction code is known as the "inverse" code, and is used to control approach locking, annunciators, and block-occupancy lamps on the control machine.

A review of the foregoing discussion shows that the entire length of track between East Portal and West Portal home signals must be unoccupied in order for the steady energy to feed through between these locations, and in order for this to occur, there must be no train on this track. Thus traffic direction cannot be changed unless the entire section of track be-

This dragging equipment detector is a new type which is directional and self-restoring



Redwood relay case in tunnel

tween the East Portal and West Portal layouts is unoccupied.

Electric Locks on Hand-Throw Switches

In the C.T.C. territory between Soapstone and Williamstown crossovers, there are 25 hand-throw switches which are equipped with electric locks. Where such a lock is located between C.T.C. interlocking layouts, as for example between Williamstown and Fairgrounds, the locks are controlled automatically. However, where a lock is within interlocking limits, as for example between the home signals at Fairgrounds, the control of that lock is from a lever in the C.T.C. machine.

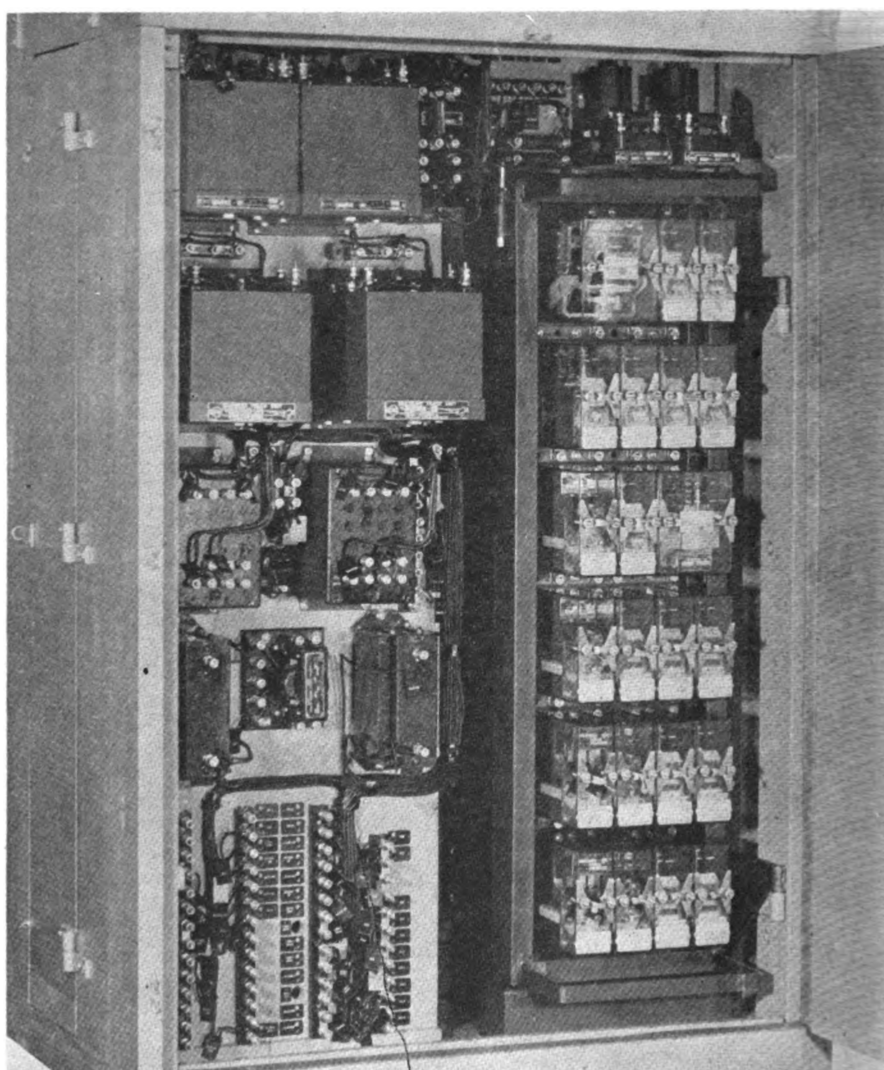
On track No. 1 between Fairgrounds and Williamstown, which is signaled for trains in both directions, there are three hand-throw switches equipped with General Railway Signal Company Model 9A electric locks. These locks are controlled automatically without action on the part of the train director at the C.T.C. machine. When a local freight train gets in on one of these spurs, and is ready to depart, the conductor telephones the train director, and, if no trains are coming, the conductor removes the padlock and opens the door of the lock case. If the C.T.C. controlled signals at Fairgrounds and at Williamstown, which govern to this section of track, are at Stop, and there is no train in this section, the electric locks are released at once and the conductor can throw the small crank to pull the plunger out of the lock rod. Operation of this crank holds the C.T.C. signals at Stop, regardless of lever control.

If cars have been left on the main track or if some other train is standing on the main track so that an automatic release cannot be effected, the conductor can operate an emergency release button in the lock case. This initiates the operation of an automatic time-element release set at 5 to 6 minutes, after which interval the lock is released. The emergency release is self-restoring. When a local freight train on the main track is to enter one of these spurs, a part of the train is stopped on a 100-ft. track circuit at the switch, thus effecting a release.

Within the home signal limits at Fairgrounds, there is a hand-throw switch equipped with an electric lock. Release of this lock, for a train entering the spur or departing from the spur to the main track, is by C.T.C. lever control. When a release is effected, and the trainman has operated the switch, switch repeater indications are displayed on the C.T.C. machine the same as for a power switch. In a similar manner, lever control is provided for electric locks on certain other switches.

A New Development in Dragging-Equipment Detectors

A derailment in the tunnel or in the vicinity of the crossovers near either of the portals might cause extensive damage and require considerable time to restore the tracks to service. For this reason, dragging-equipment detectors were installed on both main tracks on both directions of approach to the tunnel. For eastbound trains the detectors are at Greylock, at signals 1448-1 and 1448-2, about 4 miles west of the tunnel. The westbound detectors are at 1327-1 and 1327-2, about 3 miles east of the tunnel.



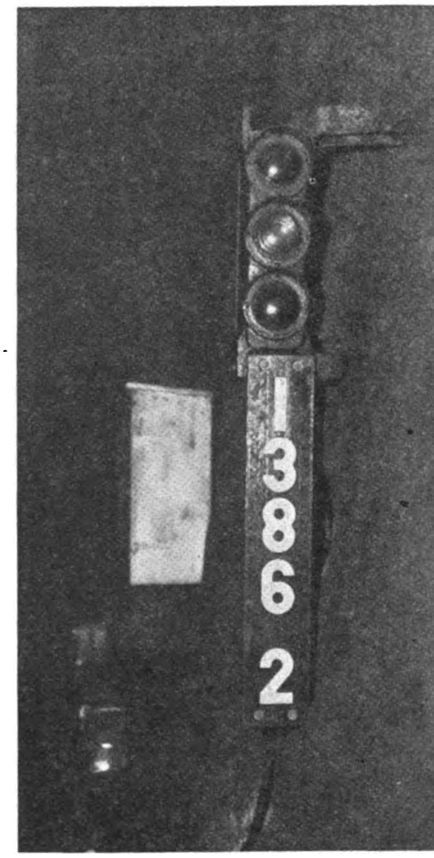
Interior of a case with plug-in relays at right

The dragging-equipment detectors are a new type, installed for the first time in regular service on this project. The unique features are that the operative elements are hinged to swing or tip over, and are self-restoring automatically. As shown in the accompanying picture, the device extends across the track between two ties. A section of rocker shaft, the same as used in mechanical interlockings, 2 in. by 2 in. and 9 ft. long is supported in rocker shaft bearing bolted to ½-in. by 2-in. strap iron hangers bolted to the tops of the two ties. Attached to the top side of the square rocker shaft are the three sheet-metal "flipper" panels, one extending between the rails and one on each side of the track. When in the normal position, standing up, the top edge of the outer panels is level with the top of the rails and the inner panel is 2 in. below the top of the rails. The flipper panels and rocker shaft as a whole are free to swing within a limited angle.

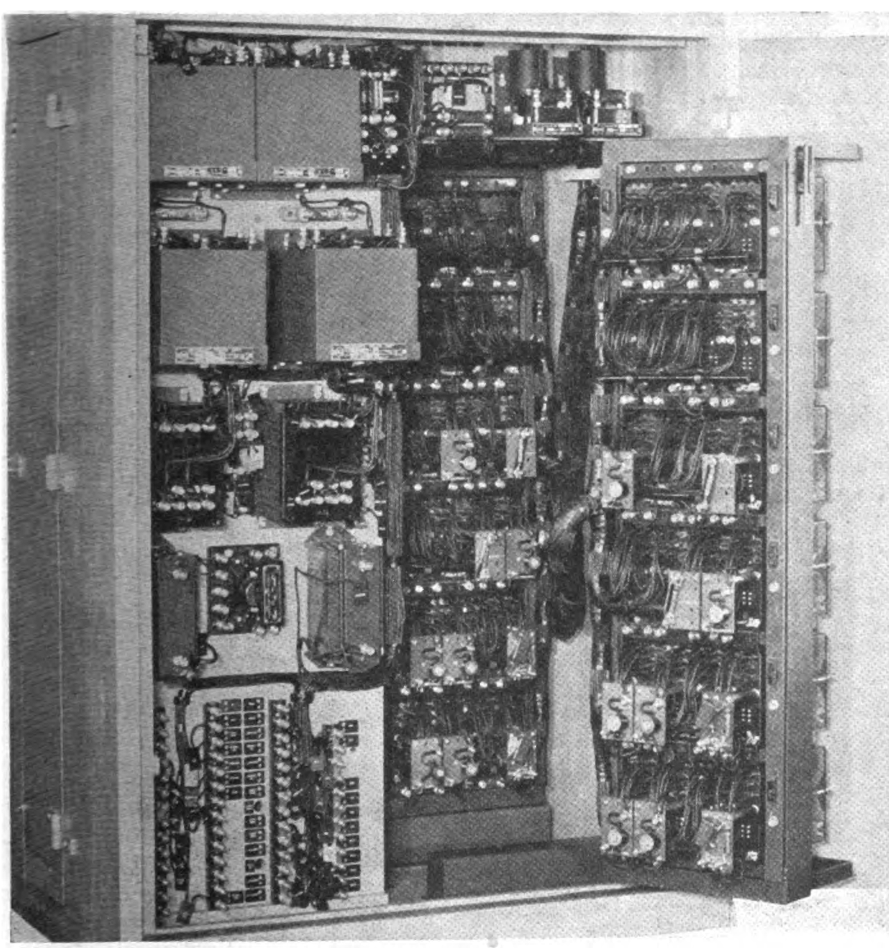
At the far end, as shown in the picture, there is a crank arm on the end of the rocker shaft, with a pipe connection to operate a plunger in a circuit controller box mounted on a tie. For an eastbound detector, the crank and controller are mounted so that if the flipper panel is flipped to the east by something hanging or dragging from the train, the plunger in the controller is pulled to open contacts which release a relay. On the other hand, if a westbound train is being operated on this track and something hanging from the train flips the panel to the west, the plunger is pushed, but this action does not open contacts in the controller. After being flipped either way, the board is brought back to normal position by spring action. The operation of the flipper is not effective in establishing controls of signals unless the track circuit, in which the detector is located, is occupied by a train. This feature prevents false controls of signals if some mischievous boy operates the flipper.

Controls Effected By Detector

When a dragging-equipment detector is operated by something hanging from a train which is moving toward the tunnel, as for example the detector on the eastward track at signal 1448-2, then a special lunar white signal unit on signal L40, which is on the eastward signal bridge at Fairgrounds, is lighted as a warning to the engineman, and accordingly he is to stop his train for inspection. At the same time, if the eastward signal at Spragues had been cleared, it is automatically controlled to the Stop aspect, and signals 1428-2 and L40 will be controlled to Approach aspects. Also a red indication lamp is flashed and a buzzer sounded on the C.T.C. control machine, so that the director is informed of the circumstances.



Signal mounted on wall in tunnel

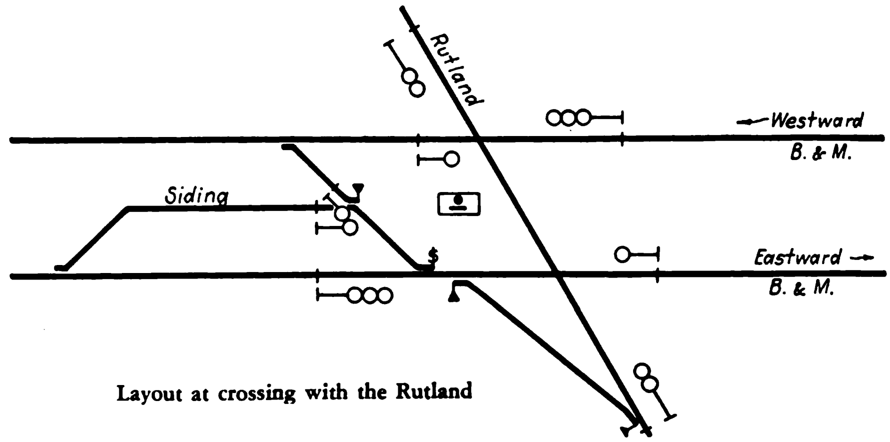

Plug-in relay rack is hinged to swing out for inspection

After the train has been inspected, the conductor informs the director accordingly.

Information is sent ahead of the detector in the field, route locking wise, to cause the proper westbound home signal at East Portal or eastbound home signal at Spragues, via the route selected at the intervening control points of Soapstone or Fairgrounds, respectively, to be put to Stop, if clear, or to prevent the immediate clearing of these home signals. In this connection a second flashing red light will be displayed. The lunar white light is used in addition to the usual approach signal displayed for the home signals put to Stop or held at Stop by the detector. This changes the usual "approach" indication to "approach next signal prepared to stop because of dragging equipment."

When the train director has been assured that the necessary inspection and repairs have been made, he may clear the affected home signal in the manner described under "Control of Call On." In this instance the signal then displayed will be a true reflection of the conditions of the blocks ahead and switch positions. Under these circumstances the signal responding to the operation of a Call-On button will not necessarily be a restricting signal but may be a high-speed proceed signal. This is another reason for the use of the term "Advancing" rather than "Call On."

Since the approach signal with lunar white will be the first indication to an engineman that his train has dragging equipment it will be passed by this train and since the circuits send information ahead of the train, route locking wise, they clear themselves automatically as the train proceeds. In the event that a train is able to stop in the rear of the lunar white signal, the home signal affected cannot be cleared and the lunar white light cannot be extinguished by the operator. Only after the train has passed the approach signal may the home signal be cleared.

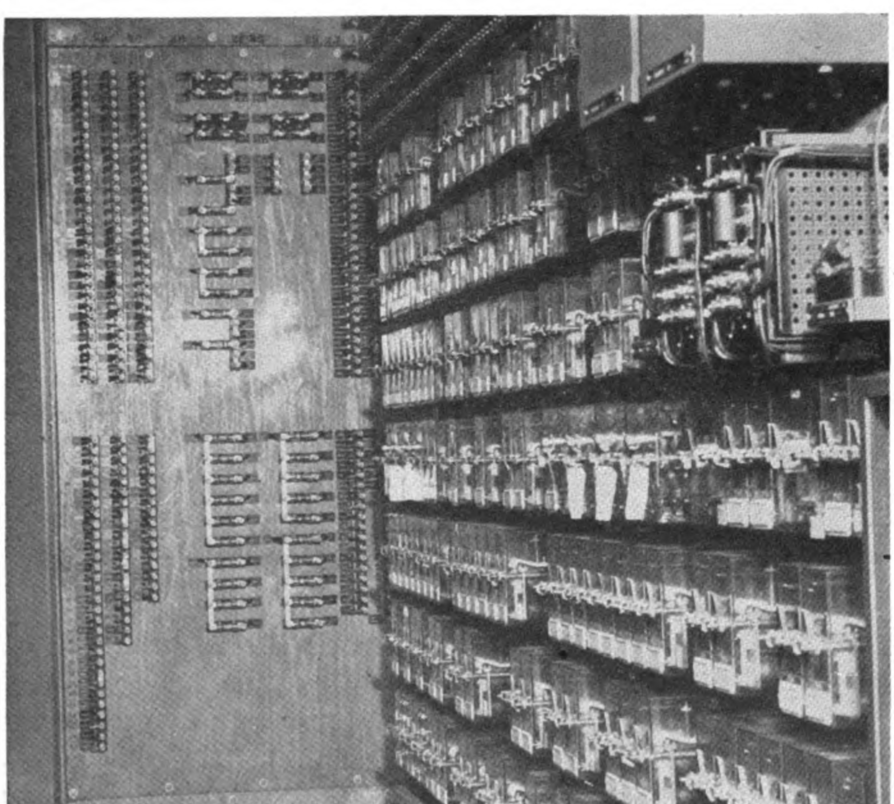


Layout at crossing with the Rutland

Signals and Signal Aspects

On the entire project the signals are the searchlight type with the exception that the signals in the tunnel are the color-light type. The semi-automatic C.T.C. controlled home interlocking signals have three SA signal heads in a vertical row. Those automatic block signals, which serve also as signals in approach to home signals, have two SA heads, the upper one to the left of the mast and the lower one to the right. On these "two-arm" signals, the Clear aspect is green-over-green instead of the conventional practice of green-over-red. The use of green-over-green eliminates the red which, because of greater range of visibility, creates the disadvantage of being seen by an engineman before he sees the green, and, in the interval, he is uncertain concerning the aspect, or else he "jumps the gun" to apply the brakes.

At certain dwarfs and for the lower unit on certain high signals marked with an asterisk on the drawing, arrangements are provided to flash the yellow under 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", and 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.


Interior of one of the sheet-metal instrument houses

On account of a curve, the engineman of an eastbound train cannot see the station layout at Williamstown until he is close to it. The passenger station is on the south side of the tracks. In some instances a westbound passenger train could be making a station stop with passengers coming and going across the eastward track, about the time that an eastbound train comes around the curve, thus creating a hazard. For this reason, an eastward station protection signal is located approximately 4,000 ft. west of the Williamstown station. This signal performs no function except to display information as to whether the westward track in approach to and at Williamstown is occupied, and, therefore, except for a directional stick control, it is controlled only through track relays on that track. A position-light signal is used so that it is entirely different from the other signals. When an eastbound train approaches this signal, it displays two lights in a vertical row if no train is occupying the westward track at Williamstown. Or it displays two lights in a horizontal row if there is a train on the westward track at Williamstown. In the latter instance, the engineman of the eastbound train reduces speed and pulls on around the curve. If the passenger train is still standing at Williamstown, he stops his train short of the platform.

Train Stop System

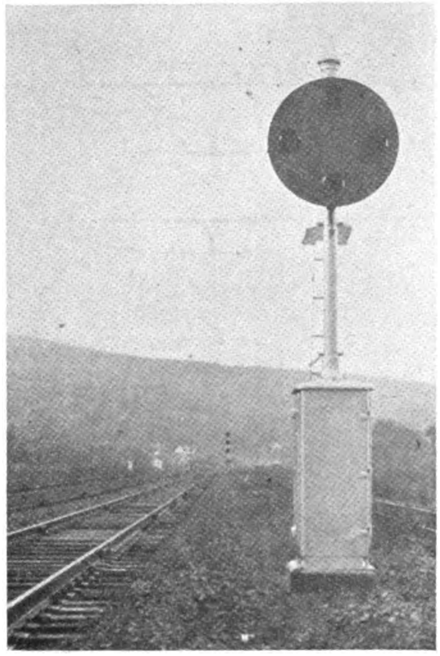
Throughout the Hoosac tunnel and the approach territory at each end, the protection includes the General Railway Signal Company type of intermittent inductive train stop system. All of the locomotives regularly operating on this territory are equipped with this train stop apparatus. Wayside inductors, connected with the signal system, are located at the home signals for the tunnel, as well as the Approach signals, and at all signals in the tunnel. In the operation of this train stop system, if a wayside signal is displaying an aspect which is more restrictive than Clear, the air brakes on the train will be applied automatically unless the engineman observes the signal aspect and acknowledges by operating an acknowledgment lever in his cab.

As a part of the 1946 project, the old semaphore automatic block signaling between Williamstown and Hoosick Falls, 16.2 miles of double track, was replaced with new searchlight signals, these new signals being arranged for single-direction right-hand running with block lengths ranging from 4,760 ft. to 8,670 ft., depending on train speeds, grades and curvature. Where the blocks are cut into several track circuits on account of highway crossing signals, conventional d.c. track circuits are used with signal line control circuits. Where there are no crossing signals, modern coded track circuits were used.

An item of special interest is that plug-in relays were used throughout this entire C.T.C. and automatic block signal project. These relays not only have the advantage of being easily replaced, but also the chances for connecting wires incorrectly is eliminated. Furthermore, the plug-in type relays require only about one-third the space used by conventional relays, which was an important item when designing housings.

The instrument housings in the tunnel were constructed of redwood, because this was the best material available to withstand the moisture and corrosion. The nails, screws, hinges and clasps are made of brass. These cases had to be constructed to fit in the existing niches in the solid rock at the signal locations. Each of these housings is 3 ft. 7¼ in. deep, 2 ft. 11 in. wide (parallel with the track), 6 ft. 6½ in. high on the track side, and 5 ft. 3½ in. high at the rear, which fits back into the stone niche. The relays, which are the plug-in type, are on racks which are hinged to swing out of the case for inspection. One half of the case is for equipment applying to one track, and the other half for the other track. The 550-volt a.c. power equipment, transformers, etc., are in a separate compartment at the top. There are four of these special redwood housings, one at each of the four signal locations in the tunnel, and one at a track cut.

Inside the tunnel, the local circuits and the coded track circuits are fed from full-wave rectificers. Low-voltage a.c., from transformers, feeds the signal lamps. Thus all the signaling apparatus in the tunnel is fed from the a.c. supply, which is distributed through the tunnel at 550-volt three-phase on a three-conductor No. 2 cable. At each of the four signal locations in the tunnel, there are sectionalizing switches arranged to feed through, or to feed from either end of the tunnel, or to cut out the cable between any given location and the next. With certain exceptions, a 550-volt three-phase power circuit was constructed either in cable or open wires throughout the remainder of the C.T.C. territory. This 550-volt circuit is fed from 2,200/500-volt transformers on H fixtures at each end of the tunnel and at Brown street in North Adams.



The station-protection signal

Cross With the Rutland

At Petersburg Junction, 18 miles west of the Hoosac tunnel, the single-track main line of the Rutland Railroad crosses the double-track main line of the Boston & Maine. This layout was previously protected by a mechanical interlocking, which, as a part of the 1946 program, was replaced by modern facilities, including new searchlight signals. The east switch of the B. & M. siding, which is equipped with a spring switch mechanism, is located in the home signal limits, as shown in the accompanying plan. Electric locks were provided on the two-hand-throw switches of the interchange connection between the Rutland and the eastward track of the B. & M., as well as at one other switch.

This is a branch line of the Rutland, and the trains over this crossing are operated during the day trick, therefore, this new interlocking was designed to be controlled part time by a machine, and the remainder of the time on automatic control, if so desired.

A miniature-lever desk-mounted machine in the office is used by the agent-operator to control the interlocking. This machine has levers for the control of 4 high signals, 4 dwarf and 3 electric locks on hand-throw switches.

Track Circuit Feeds

This new signaling was constructed and completed prior to the abandonment of the electric propulsion. Therefore, in the electrified zone the new track circuits were installed as conventional 60 code a.c. or as coded a.c. to prevent interference from the 25-cycle a.c. propulsion. Outside of the previous electrified zone, the track circuits are all the d.c. type fed from batteries. Where a.c. power is available to charge batteries, each track circuit is fed by one cell of 80-a.h. Exide lead storage battery. Between Petersburgh Junction and Hoosick Falls the eastward and westward tracks are separated varying distances up to a mile or more, and there is no pole line along the eastward track. For this reason, primary battery is used at certain locations, each track circuit being fed from three cells of 500-a.h. Waterbury primary battery.

The C.T.C. line coding system operates on a two-wire line circuit. From the control office it is run over the mountain to East Portal rather than taking it through the tunnel. This line circuit is in a four-conductor No. 10 aerial cable on an existing pole line. The two extra conductors are reserved as spares, and five sectionalizing locations are provided to switch over in case of trouble on the wires being used.

The three-conductor No. 2 cable for the 550-volt a.c. through the tunnel was made up specially with a smooth covering of Anhydrex, which is said to be immune from the effects of moisture, locomotive smoke and other corrosive effects.

Underground type of cable with a smooth covering made of Neoprene, was used not only for underground runs but also for runs up the signal masts and for line drops. The aerial line cable has double braid weatherproof covering. All of these cables, including the three-conductor 550-volt cable through the tunnel, were manufactured by the Simplex Wire & Cable Company. This installation of centralized traffic control and automatic block signaling was installed by the General Railway Signal Company.