



View of B. & O. Jct. layout with a westbound P. & L. E. train passing junction switch

THE Pittsburgh & Lake Erie has made certain track changes and installed new signaling facilities at two important junctions as a part of an arrangement made so that the Baltimore & Ohio could operate its through passenger and freight trains over the P. & L.E. tracks through Pittsburgh, Pa., the joint-trackage extending 59 miles from a point near New Castle Jct. to McKeesport, Pa.

Between New Castle Jct. and Pittsburgh, the Baltimore & Ohio line follows a round-about route, involving some heavy grades in each direction. The ruling grades over which the assigned locomotives could handle tonnage, range up to 0.6 per cent, while the heavier grades, on which helpers were necessary, range as high as 1.59 per cent. From Pittsburgh eastward, the B. & O. line extends along the Monongahela river 14.8 miles to McKeesport. Another disadvantage of this line is that the passenger station in Pittsburgh is about three miles from the main line, requiring the operation of trains over a stub line, entailing backup and wye movements which introduced considerable delay.

In contrast, the Pittsburgh & Lake Erie main line from New Castle Jct. to McKeesport follows a river route on practically a water-level grade, and a further advantage is that the Pittsburgh passenger station, on a through track layout, is located directly on the main line.

In order to reduce the running time

Centralized Traffic on the Pittsburgh

and eliminate the delays occasioned by the heavy grades on the Baltimore & Ohio, the arrangement was made between the two companies for the B. & O. to operate its through freight and passenger trains over the P. & L.E. tracks between McKeesport and a point now known as B. & O. Jct., near New Castle Jct. The average elapsed time for B. & O. passenger trains between McKeesport and New Castle has been reduced 30 minutes, and similar reductions have been made in the freight train schedules.

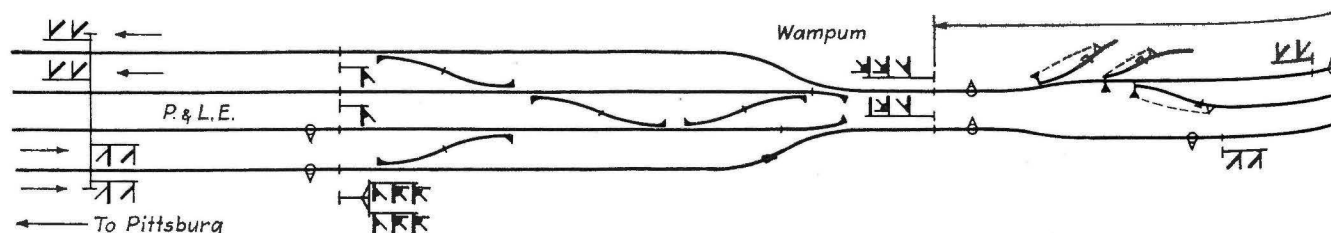
At McKeesport, a connection between the B. & O. and the P. & L.E. was easily arranged. However, at New Castle Jct., the westward end of the joint track, the contact was made at the east end of the B. & O. yards, at which point the B. & O. tracks are at a higher elevation than those of the P. & L.E., thus necessitating the construction of a new single-track connection about one mile long in order to provide a satisfactory grade. The

new junction between this connection and the P. & L.E. tracks is now known as B. & O. Jct., being about four miles east of New Castle Jct. In addition to the junction switch, the new track layout at B. & O. Jct. includes two normally trailing-point crossovers.

The P. & L.E. line from B. & O. Jct. eastward to Wampum, 3.2 miles, is double track while from Wampum eastward to Pittsburgh the line is four track. Therefore, in so far as track capacity to handle the additional B. & O. trains was concerned, the principal problem was between B. & O. Jct. and Wampum.

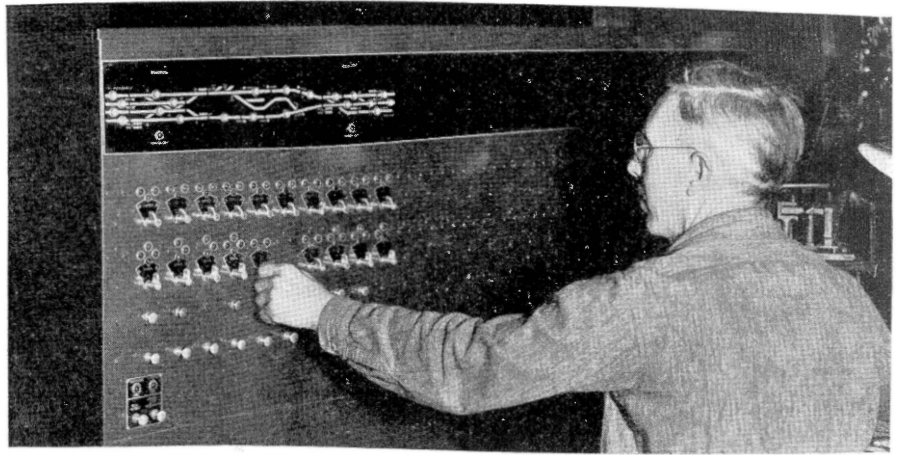
Problem on Double Track Section

The problem of track capacity in this territory is complicated by the fact that passenger and freight trains are interspersed and, of course, all trains must be accepted and handled without delays or stopping, if at all possible. Although the P. & L.E.



Track and signal plan of the C.T.C. territory

The operation of Baltimore & Ohio trains over a section of the P. & L. E. in Pittsburgh area requires new signaling facilities at two important junctions and on a section of the intervening double track



The control machine is located in the P. & L. E. office at New Castle Junction

Control Installed & Lake Erie

line is constructed through the valley of the Beaver river, the grade gradually ascends westward at about 0.2 per cent for about 3.3 miles just approaching B. & O. Jct. Furthermore, the grade on the B. & O. connecting track out of B. & O. Jct. is about 0.45 per cent for about 5,000 ft. The westbound tonnage freight trains often handle 115 loaded cars of coal totaling about 9,500 gross tons. Therefore, it is highly important that these trains be kept moving if at all consistent with safety.

The average daily traffic now operated over this section of line includes 18 passenger and 20 freight trains of the P. & L.E., as well as 10 passenger and 10 freight trains of the B. & O., thus totaling 58 trains daily, which is frequently increased to 65 or more by the operation of extra sections. In view of the problem of track capacity on the 3.2 miles of double track between B. & O. Jct. and Wampum, it was decided to provide for either-

direction train operation on each of the two tracks. For this reason, two additional crossovers were installed at Wampum in order that trains could be routed from any of the four tracks to either of the two tracks and, likewise, trains can be routed from either of the two tracks to any of the four tracks. The switches at Wampum had previously been handled by a mechanical interlocking, but on account of the extensive track changes, it was not practicable to reconstruct the interlocking as such. Therefore, power-operated switch machines and a new layout of color-light signals were installed.

Likewise, in order to complete the arrangement for either-direction operation, a second crossover was included in the new track layout at B. & O. Jct., this crossover being located west of the junction switch so as to permit two parallel train movements simultaneously. Power-operated switch machines and color-light sig-

nals were likewise installed at the B. & O. Jct. The crossovers at Wampum, as well as the junction turnout and crossovers at B. & O. Jct., are No. 16, so as to permit diverging train movements at medium speed of 30 m.p.h.

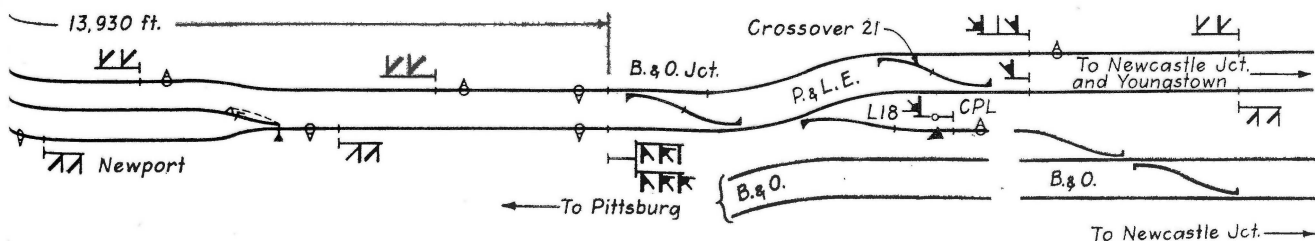
C.T.C. Control System

The two interlocked layouts at either end of the jointly-operated section of double track, one at Wampum and the other at B. & O. Jct., are controlled by an installation of centralized traffic control, the control machine being located in the P. & L.E. operator's office at New Castle Jct.

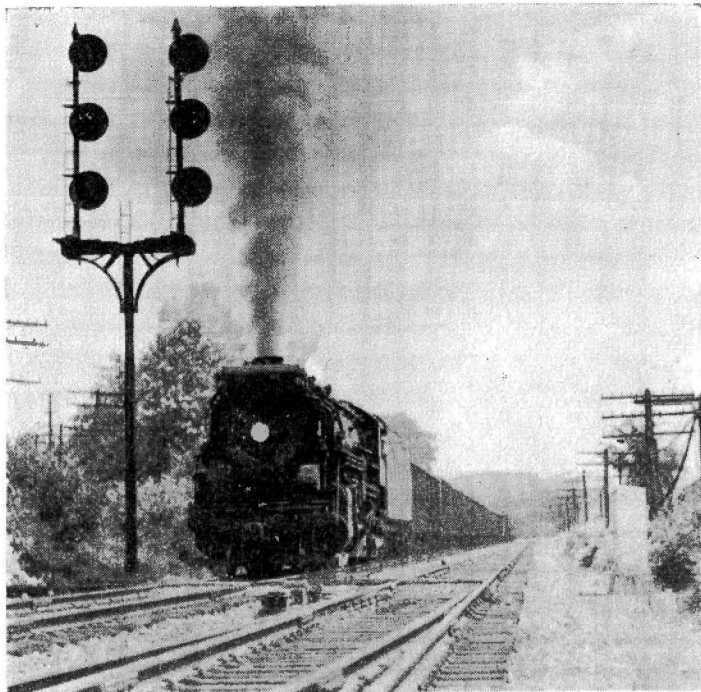
The automatic block signals, previously in service to provide protection for train movements in the normal direction for right-hand running on the double track, were not changed, except that signals were provided at Wampum and at B. & O. Jct. for directing train movements by signal indication between these points in either direction on either track, these signals being controlled by the C.T.C. system.

Benefits of Control System

Thus with the use of the centralized control system throughout the Wampum to B. & O. Jct. section, and placing the control in the hands of one man, train operation in the entire area can now be co-ordinated most efficiently. A few instances of special routings used to meet circum-



between Wampum and B. & O. Junction



Westbound loaded trains must be kept moving—View shows train passing the w. b. home signal at B. & O. Jct.

stances as they arise are as follows:

A westbound P. & L.E. tonnage train ordinarily handles about 115 loaded coal cars totaling 9,500 tons, requiring about 32 minutes to go from Tower JA to New Castle Jct., 11 miles. Such a train should not be stopped in this territory. Therefore, if a westward passenger train should overtake the freight train, the usual practice is to run the freight train on the regular westward main track, allowing the passenger train to operate on the left-hand track between Wampum and B. & O. Jct. at which point the passenger is crossed over to the normal westward track or, if it is a B. & O. passenger train, it is diverted over the connection to the B. & O.

Example of Train Operation

Under different circumstances a westbound P. & L.E. freight may be so timed as to conflict with an eastbound B. & O. train on such a schedule that they might conflict in the vicinity of B. & O. Jct. In this instance, if no other trains conflicted with the move, the westward P. & L.E. freight train would be run on the left-hand or eastward track from Wampum to B. & O. Jct., taking cross-over 21 to divert to the normal westward track. During this time the eastbound B. & O. train can be run left hand on the westward track from B. & O. Jct. to Wampum. Crossover No. 21 was provided and located in order to permit parallel simultaneous train movements as just explained.

When a P. & L.E. eastbound train is to be operated at the same time

that an eastbound B. & O. train is due, the P. & L.E. train is run on the normal eastward track between B. & O. Jct. and Wampum, while the B. & O. train is run on the normally westward track between these two points. These are only a few of the examples of various special line-ups that can be used to so route trains as to keep them all moving. Although as many as 70 trains have been operated daily, the system of C.T.C. and direction of train movements by signal indication without written train orders, proves to be so flexible that on rare occasions only has it been necessary to stop any trains.

The control machine in the office at New Castle Jct. has nine two-position levers in the top row, for the control of six crossovers, two single switches and one switch and a derail, totaling 16 switch machines. Seven three-position levers in the bottom

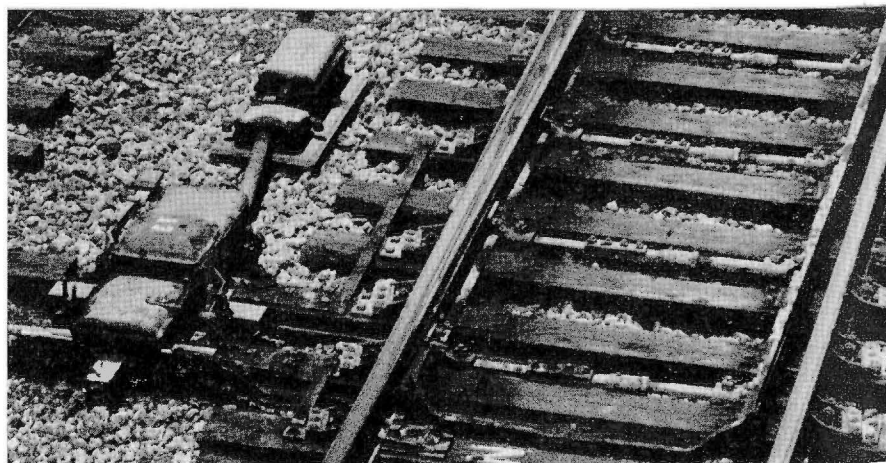
row control 22 signal units. When a signal lever is in the center position, the corresponding signals indicate stop, when thrown to the left the eastward signal is cleared, and when thrown to the right the westward signal is cleared.

Lever No. 15 is for traffic-direction control on the B. & O. single-track connecting line between B. & O. Jct. on the P. & L.E. and the junction with the B. & O. main line. Two levers at the bottom, No. 12 and No. 16, are used to control electric locks on the outlying hand-thrown switches at the two ends of the center siding west of Wampum and on the two team tracks at Wampum respectively. All levers are equipped with indication lamps to repeat the position of the switch or indication of the signals, locks or direction of traffic established.

Illuminated Diagram

The illuminated track and signal diagram above the levers is equipped with lamps to show the location of trains on all main tracks approaching or passing through the C.T.C. territory. In addition to the lamps, the approach of a train is indicated by a bell. The two-wire time-coded system of C.T.C. control is used on this installation. The operator actuates the levers for a switch and the signal, and then pushes a starting button; as soon as the functions in the field have operated, indications are returned to light the indication lamps on the machine.

The 16 electric switch machines on this installation are the Style-M-22 equipped for operation on 22 volts d-c., and each machine is equipped with a point detector. A special feature is that the plates on the two ties on which the machine is mounted extend under the switch machine, and the ends are turned up in such a way as to fix the position of the machine with reference to the rail. With this



The switch layouts are well constructed

arrangement, a switch machine can be replaced readily and the new machine is always in exactly the right place. Adjacent to each machine there is a Type-F contactor with a 22-way junction box. The wires between the controller and the switch machine are run in a 2-in. flexible cotton woven conduit known as Duratube.

All of the turnouts are No. 16, using 30 ft. switch points of 115-lb. rail section. Each switch layout is equipped with adjustable rail braces on five ties, including the one ahead of the points. New York Central type front rods and N.Y.C.-6100 type switch adjusters are used. A ball and socket joint is used at the switch-foot connection of the rod to the point detector. This joint permits operation of the device without binding, and at the same time affords an excellent means of taking up wear.

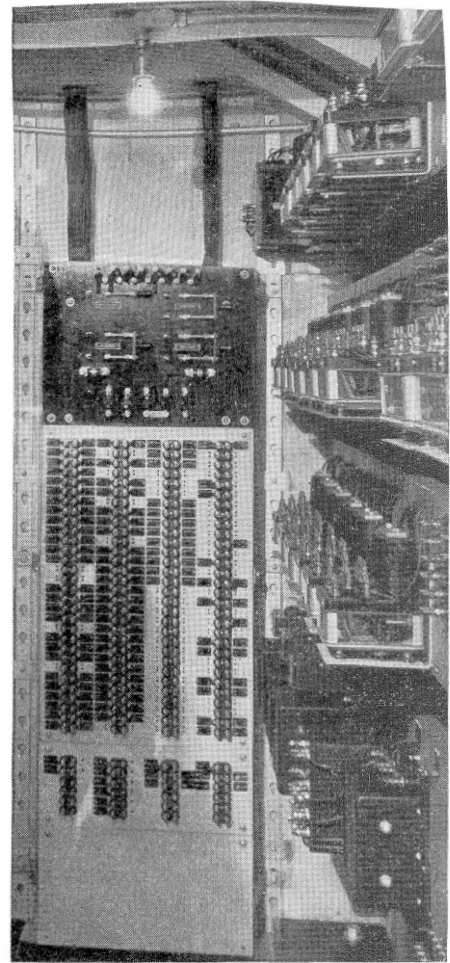
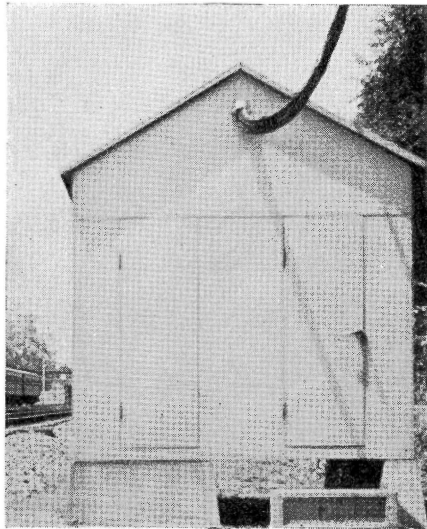
The signals are the Style H-2 searchlight type except for signal L18 which directs eastbound trains from the B. & O. connection, this signal being the B. & O. standard color-position-light type.

Instrument Housings

At Wampum and at B. & O. Jct. an 8.5-ft. by 12-ft. welded sheet-metal house is provided to house the instruments and battery. As shown in one of the illustrations, the entrance door to the house is located toward one side of the end. The instruments are arranged on racks along the two side walls and on a rack through the center of the house, thus affording adequate room for equipment, and at the same

time allowing two full-size aisles for use by the maintainers in inspecting the apparatus.

A new and special feature of these houses is the cable entrance and terminal boards. As shown in one of the illustrations, a separate outside door opens to the rear of the terminal board, thus facilitating the pulling-in and connection of cables, both those coming in from underground and overhead. The house is set on concrete piers poured in place to exact level. The pier under the location of the terminal board was constructed with a duct leading below the ground line. After the underground cables were in place, the spare space in the foundation was filled with sand and topped over with insulating compound, thus reducing to a minimum



Above: Terminal board in end of house

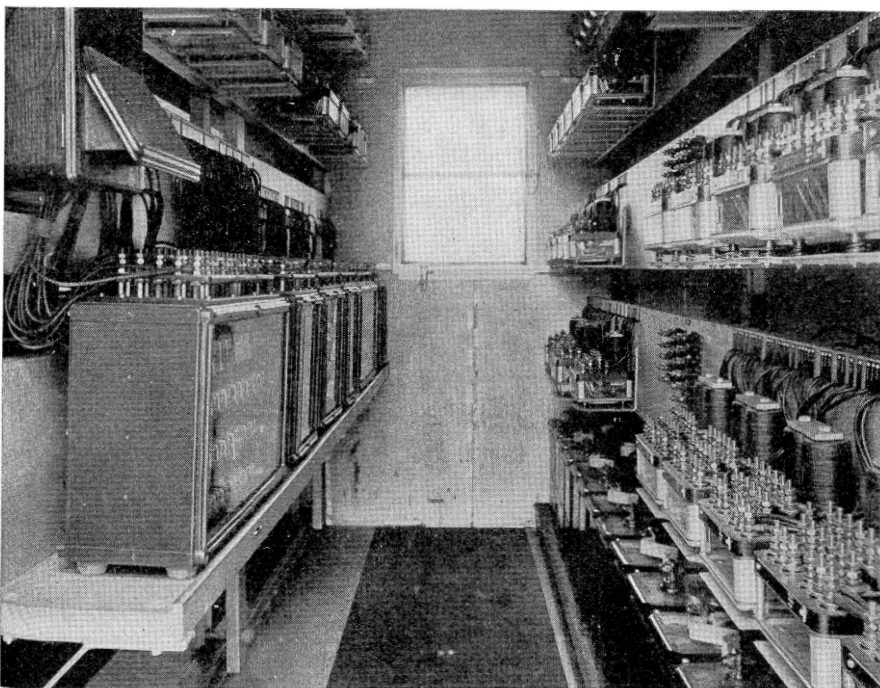
Left: Door at left opens to wiring space

the effect of dampness and evaporation on the coverings of the cable at or near the ground line.

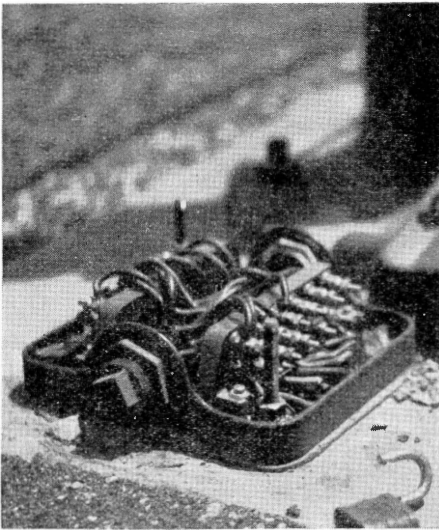
The terminal board is constructed of asbestos board $\frac{3}{4}$ in. thick and each wire terminates on bakelite-based terminal posts set on this insulation board. General Electric Thyrite-type lightning arresters are used on the code control line circuits and Raco Turret type arresters on signal line-control circuits. Expulsion-type G.E. arresters, mounted on the crossarms, are used on the 440-volt a-c. power circuit.

Instrument Racks

The instrument racks are constructed of $1\frac{1}{2}$ -in. pine board 12 in. wide, bolted to 2-in. by 4-in. angle-iron uprights, the board being set out from the wall 6 in. to allow a wiring space. The relays are set on spring-mounted brackets. All wiring within the house is No. 14 flexible conductor, and at the instruments each wire is brought out through an individual hole in the board with the fiber tag screwed against the board. Type TH-10 thermal relays are used to



The interior of the instrument house is well arranged



At a signal the underground cable terminates in a junction box

effect time releases automatically.

At Wampum, as well as at B. & O. Jct., a set of 16 Exide EMGO-9 storage cells is provided for the operation of the switch machines and serves also, on a split-battery arrangement, to feed line-control circuits. The track relays are the DN-11, 4-ohm type, and ANL power-off relays are used. At each of the signal locations the instruments and battery are housed in a sheet-metal case equipped with two doors at the front, and removal sections at the rear give access

to the back of the terminal boards and wiring space. At each signal location a set of five EMGS-11 storage cells is provided to feed line circuits and to serve as stand-by for the signal lamps.

A-C. Primary Track Circuits

Normally each track circuit is fed by interrupted direct current from a full-wave RV-22 rectifier. In case the a-c. power is cut off, a power-off relay switches the track circuit feed to one 500-a.h. LeCarbone primary cell which normally is on open circuit. On these circuits the rectifier feed to the track is adjusted to provide proper operation, and then the limiting resistance in series with the battery, is adjusted so as to feed the same voltage to the track in case the power-off relay operates. The changeover is so rapid that the track relay does not have time to release; in fact the needle of a meter in the circuit does not return to zero but merely swings slightly. The life of the primary cells in this service depends on the number of a-c. power outages. Tests determine whether the cells are active.

Power Supply System

A two-wire 440-volt, 60-cycle power distribution circuit on two No. 6 weather-proof wires extends over the territory. At each location this

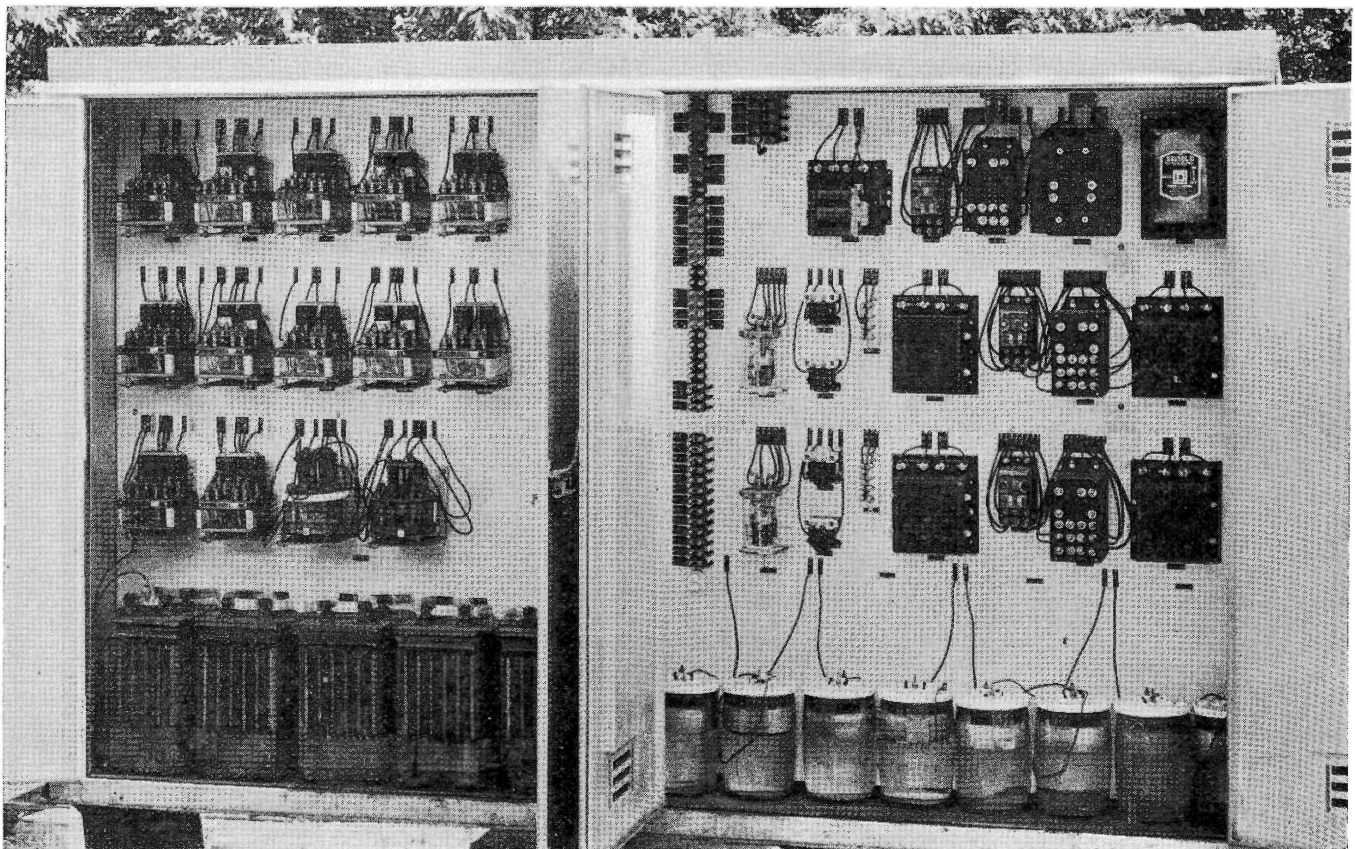


View of cable entrance compartment in end of instrument house

440-volt circuit is taken into the instrument case to an enclosed switch and fuse outlet box that cannot be opened until a lever is operated to open the circuit. A W-20 300 v-a. transformer is used to reduce the potential to 110 volts to feed the various rectifiers and the lights. Type RT-21 rectifiers are used to charge the storage cells, and RV-22 rectifiers to feed the track circuits.

The line control circuits, including the two code control line wires be-

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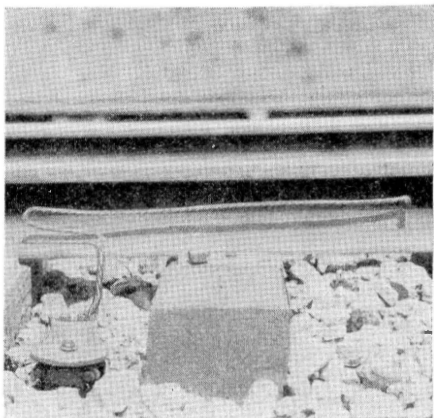


A large sheet-metal case is used at each signal location to house battery and instruments

C.T.C. on the P. & L.E.

(Continued from page 630)

tween Wampum and B. & O. Jct., are in No. 14 aerial cable with braided covering, which is run on Copperweld messenger using Copperweld rings except near each line pole where two Raco cable straps are used on each side of the pole to reduce injurious



friction on the cable. Two No. 8 copper weather-proof line wires are used for the C.T.C. control.

The connections to the rail are single-conductor trench cable, using No. 6 single-conductor for the connection to the relay end of a track circuit and No. 9 at the battery end. At the rail the cable is brought up through a Union bootleg outlet from the top of which a 5/16-in. stranded copperweld connection extends to a 3/8-in. plug driven in the rail.

The runs from the instrument house to signals are trench cables which terminate in junction boxes on the signal foundations, from which points single conductors run up the masts to the signals.

The C.T.C. system as well as the switch machines, signals, relays, etc. on this installation were furnished by the Union Switch & Signal Com-

pany, the construction being handled by signal department forces of the Pittsburgh & Lake Erie.

Signals Disobeyed— Flagman Negligent

ON SEPTEMBER 27, 1935, there was a rear-end collision between two freight trains on the New York, New Haven & Hartford at Westport, Conn., which resulted in the death of one employee and the injury of three employees. An abstract of the report of the Bureau of Safety to the I. C. C. is as follows:

This accident occurred on the New Haven division between New Rochelle Junction, N.Y., and New Haven, Conn.; in the vicinity of Westport this is a four-track electrified line over which trains are operated by time table, train orders and an automatic block-signal system. The accident occurred on a lift-type drawbridge over the Saugatuck river, within the limits of an interlocking plant at Westport which was closed at the time of the accident.

This interlocking station is located in the cabin on the drawbridge. The drawbridge is not in operation from 9 p. m., until 5 a. m., and no operator is on duty between those hours, during which period all drawbridge signals function as automatic signals. These signals are of the two-arm two-position, semaphore type, with normal-clear color-light indications, illuminated by high-power lamps, and are mounted on signal bridges spanning the tracks.

Train Second NE-2, an eastbound freight train consisting of 73 cars, passed an eastbound extra which had stopped at New Rochelle to release a sticking brake. On reaching a point in the vicinity of Westport, members

of the crew observed fire flying from under a car near the forward end of the train, due to a brake beam being down, whereupon the train was stopped, at 12:07 a. m., with its rear end on the drawbridge, at a point 1,150 feet east of a signal. After standing at this point about 15 minutes, the rear end was struck.

The second eastbound freight train, consisting of 94 loaded cars and 16 empties, departed from New Rochelle Junction nine minutes behind train Second NE-2. Shortly before arriving at Westport this train passed signal 16-F, which apparently was displaying yellow over red, an approach indication which required this train to reduce speed at once and proceed at a speed not exceeding 25 m. p. h. prepared to stop at the next signal. Continuing, it passed signal 12-F, which was displaying double red, a stop indication, passed the flagman of the train ahead, who was back only a few car lengths behind his caboose, and then collided with train Second NE-2 while moving at an estimated speed of 19 to 25 m.p.h.

The engineman of the extra freight train was killed as a result of the accident; consequently it is not known why he failed to obey the indications displayed by distant signal 16-F and home signal 12-F, which were operating properly. From the evidence, it appears that he experienced a temporary lapse, possibly fell asleep momentarily, having been on duty 14 hours 7 minutes, and did not awaken until very near home signal 12-F.

A conductor is required by rule to see that trainmen properly perform their duties and that the flagman goes back to give flag protection promptly when safety or the rules require. In this instance train Second NE-2 stood at Westport, with the rear end of the caboose on the drawbridge, for a period of about 15 minutes during which time the flagman, a qualified conductor, went back only a few car lengths behind his caboose. There was ample time for this flagman to have afforded proper protection for his train, and he should have gone back a sufficient distance, placed torpedoes on the rail on the engineman's side, and protected his train according to rule; by so doing probably the accident would have been averted. The conductor is at fault for failure to require the flagman to protect the train according to rule.

This accident was caused by failure of an engineman properly to observe and obey signal indications, and by the failure of a flagman and a conductor to provide proper flag protection for their train while standing on the main track.



At the summit of the Sierra Mountains on the Southern Pacific