Railway Signaling

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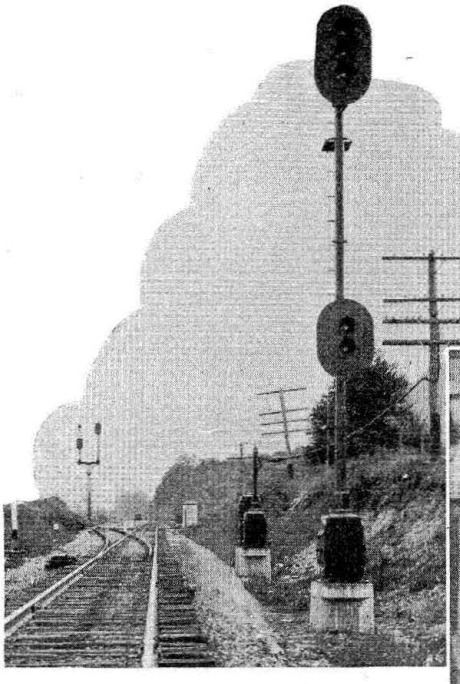
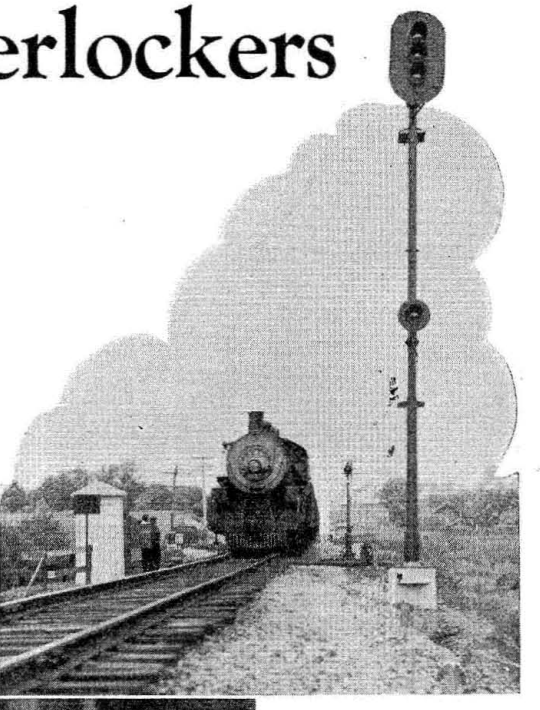
Erie Equips Complete Division with Signals and Interlockers

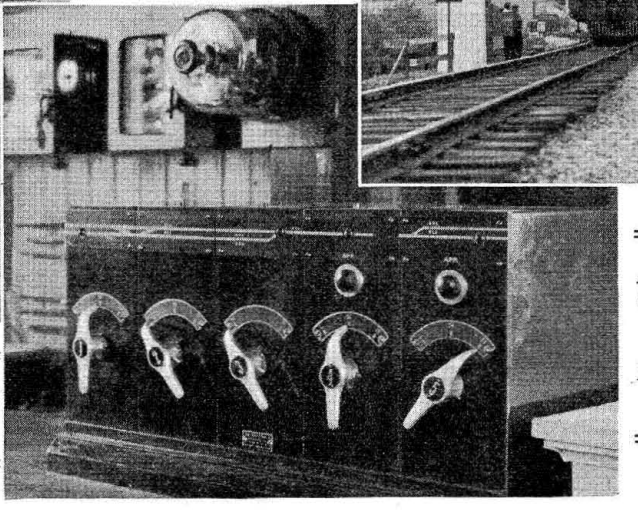
Color-light train-order signals and remote control of absolute signals are features of installation — Solid conductors used for wiring cases



Remote-control switch and signals at end of siding



Above — View of controlled signal at east end of Randolph



Left — Control levers at "RH"

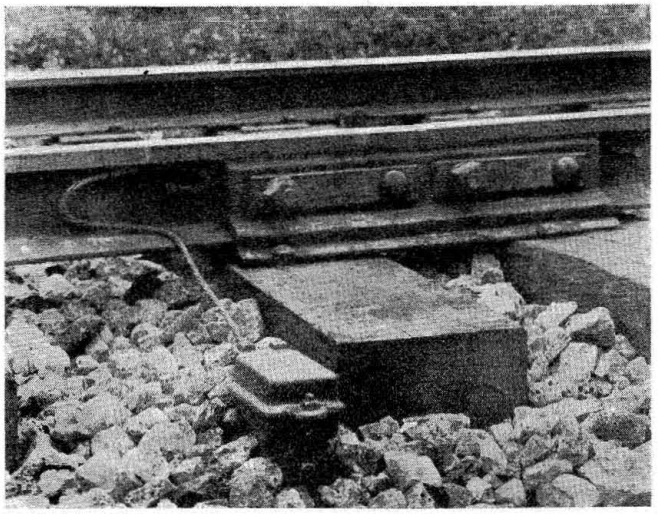
AS a part of the program to complete the signaling of the main lines of the Erie, the Meadville division from Salamanca, N. Y., to Meadville, Pa., 106 miles, has been equipped with color-light automatic block signals, including four remote-control power switch layouts, two new interlockings and the reconstruction of several old plants. The signaling is unique in that it includes sections of single-track A. P. B., having head-block signals lever controlled and one section of double track on which trains are run in either direction; the remainder being regular double-track signaling. The complete installation makes possible the direction of all regular and some irregular train movements by signal indication over the entire division.

The Track Layout in General

In brief, the track layout of the division from east to west is as follows: About 1.5 miles west of the Salamanca station, a single-track line branches off, going northwest to Dunkirk, N. Y. At this junction a new 16-lever electro-mechanical interlocking plant was constructed to handle the signals and the switches for the junction, the end of the yard and the crossovers. From this new "WC," plant color-light signaling was installed on the double track which extends westward for 6.5 miles to Red House. Two color-light telephone train order signals are located at this station. From Red House westward to Steamburg, about 4.3 miles, the two tracks are separated from 500 to 1,500 ft. on account of the eastbound track, which was built years after the old line, being constructed on a different location to secure a better grade line. Regular double-track signaling was employed in this territory. However, in view of the fact that there is no pole line along the westbound track, the signals are operated by primary battery and the track circuits are polarized, using primary battery. DNL track relays are used for approach lighting. Wherever the pole line is available, the signal-

ing is operated from storage batteries charged by the a-c. floating system. From Steamburg to "R.H." tower, about 0.7 mile, regular double-track signaling was installed.

The end of the double track was formerly located at "R.H." tower, but under the new arrangement, the passing track was rebuilt and the second main track extended to the west switch, where an electric switch machine, with the proper signaling, was installed and the control placed in the "R.H." tower. From the new



The parkway terminates in an outlet at the rail

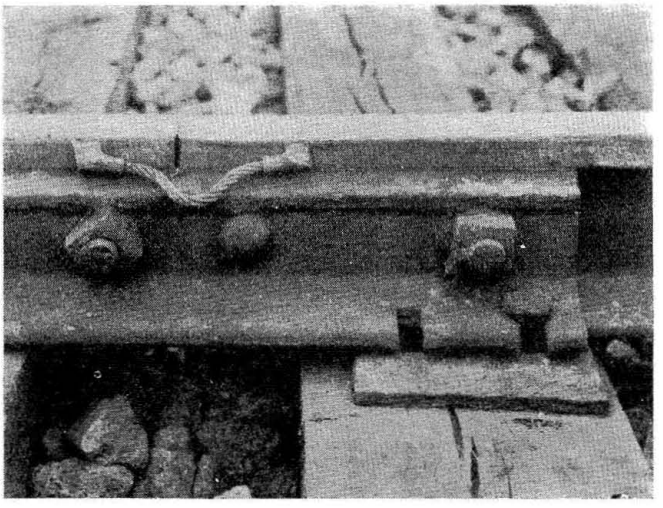
end of double track west to Waterboro, "WO," nine miles, the line is single track, on which A.P.B. signaling with special control is used.

A single-track line from Buffalo, N. Y., joins the main line at "WO" tower. This line (the Buffalo & South Western) was constructed as a separate single-track line, the section from "WO" to Falconer, 7.25 miles, being located 66 ft. from the main line of the Erie. In addition to the regular main-line traffic the trains to and from the Buffalo line must be handled between "WO" and Falconer. It was decided, therefore, to install, not only the regular double-track automatic signals, but also to provide means for controlling the movement of trains by signal indication in either direction on either track.

At Falconer "DV" the tracks were rearranged to simplify the crossing layout, and the yard tracks were extended to give longer passing tracks and to connect up these switches in the plant. An entirely new electro-mechanical interlocking is being constructed at this point to replace the old plant, which has been in service for many years and is the last machine on the Erie employing "flop" locking. Regular double-track signaling was installed from Falconer westbound through Jamestown and on to Niobe Junction, 16.75 miles, remote-control color-light train order signals being provided at Lakewood, controlled from Jamestown four miles distant.

From Niobe Junction "NE" to Columbus Junction "CM," about 12.5 miles, the old main line, which is used for all passenger trains and local freight trains in both directions, has been equipped with d-c. semaphore signals since 1916. The automatic signaling is to remain practically as is, and the starting signals at each end of this section, will be controlled remotely from "NE" or "CM" so that the operation of trains will be directed by signal indication.

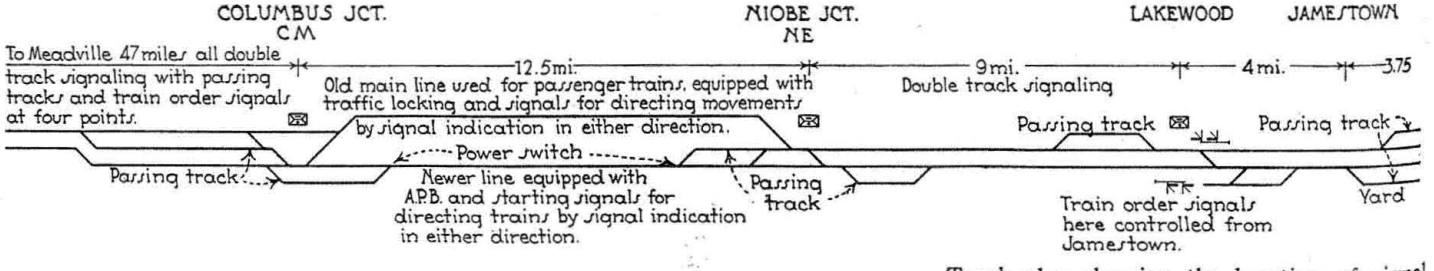
On the new line from "NE" to "CM," which was built on an entirely different location to secure a better grade line, a new system of single-track color-light signaling was installed. The switches at the end of the passing track at both "NE" and "CM" are equipped with power switch machines and together with the surrounding signals are controlled remotely from the re-



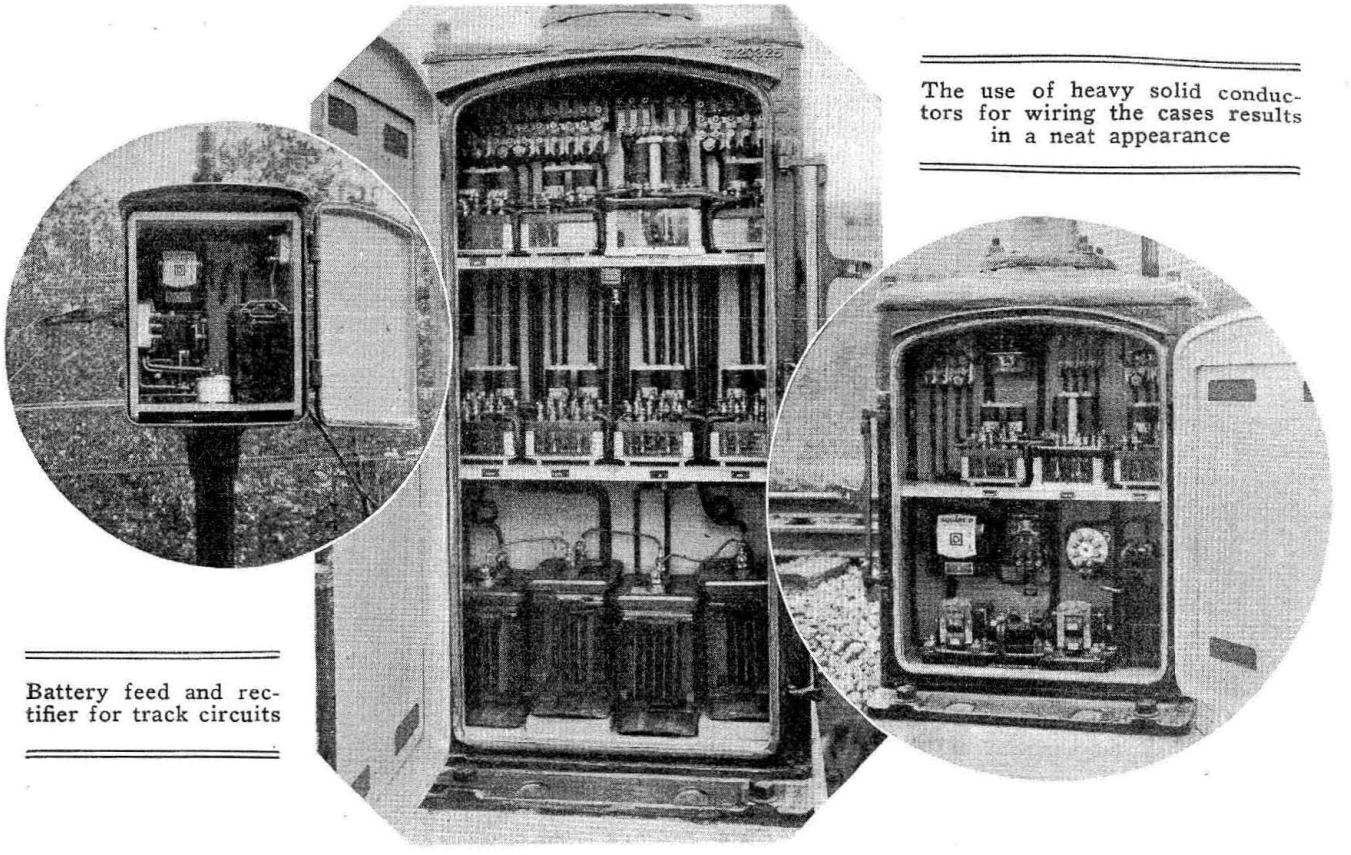
Welded bonds are used

spective towers. This line handles most all of the freight trains in both directions and arrangements are provided to direct the train movements by signal indication, the control apparatus being located in the interlocking towers at either end of the section. Type S-8 electric units were added for the new levers. A new pole line for the signal control and power supply line wires was built along the freight line from "NE" to "CM."

From Columbus Junction, "CM," the line continues west 47 miles to the end of the division at Meadville as a double-track line, being signaled for regular double-track operation. For a section of 14 miles of this territory, the two tracks are from 100 to 2,000 ft. apart. As no pole line is available near the eastbound track, the signals and track circuits on this track are operated from primary battery, as previously described for the section from Red House to Steamburg. At Corry, Pa., there are two interlockings at crossings with other railroads, at which plants the home signals were changed from lower quadrant semaphore signals to three-posi-



Track plan showing the location of signal



The use of heavy solid conductors for wiring the cases results in a neat appearance

Battery feed and rectifier for track circuits

tion color-light signals. Track circuits with electric locking were also provided on the Erie tracks through these plants.

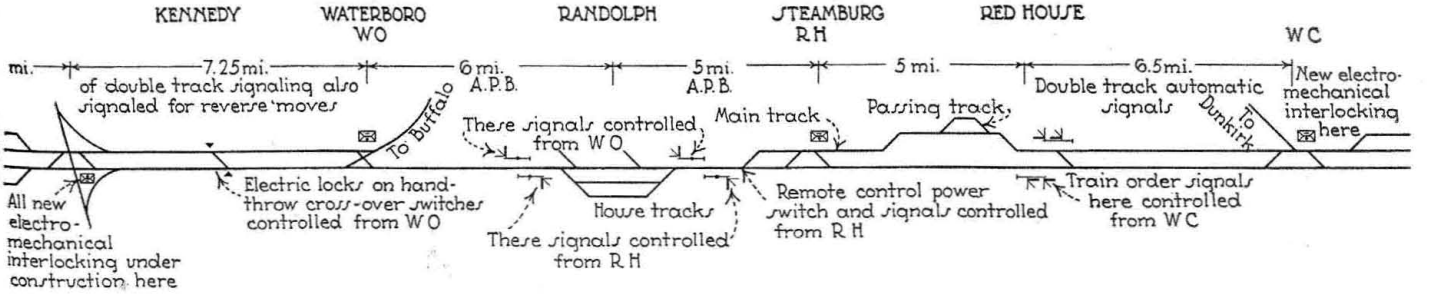
Details of Signal Construction

The automatic signals are the Union Style-R, color-light type, using a 10-volt, 18-watt lamp in each unit which is a-c. storage battery operated and an 8-volt, 10-watt lamp in each unit primary battery operated. The precast concrete foundations were furnished by the Massey Concrete Products Company. On the pole line side, the signal mast is mounted on a large case in which are housed the relays, rectifiers and batteries. These cases are 18 in. deep with a dividing partition, with a door on the track as well as the field side.

The cables from the line pole to the signal case are made up of No. 14 insulated copper wire, using a No. 8 galvanized iron or ¼ in. stranded messenger and Davidson cable strap ties. The cable wires are run down through a 1½-in. pipe in the top of the case, terminating on Raco lightning arresters mounted near the top of the case. The case wiring is made with No. 9 solid copper with 5/64-in. insulation taped and braided.

The ground consists of two one-inch steel rods 7-ft. long driven 2 ft. apart and connected by an Ohio Brass Company stranded ⅜-in. copper cable ground connector with clamps screwed on the rods and spot welded. The ground connection consisting of a No. 6 solid copper wire, is clamped to this cross cable and spot welded, and then runs up to the arresters in the case.

One cell of Edison Type B-6, 112.5 a.h. capacity, storage battery is provided for each track circuit. At each signal location a set of four cells of Exide Type-KXHS-9 storage battery of 100-a.h. capacity is provided for the operation of the line control circuits and the signal lights in case of a power interruption. Approach lighting of signals on double track is provided by the use of a DNL-3 relay in series with the signal control relay of the signal in the rear, while all signals on single track, as well as head block and interlocked signals, are continuously lighted.



and interlocking installation on the division

The storage batteries are charged by Union copper-oxide rectifiers, and a Union low-voltage transformer with a 110-volt primary is used to reduce the voltage for charging and to supply the signal lights normally. An enclosed-type double-pole switch, with plug-type fuses is mounted in the relay case and is connected in the 110-volt circuit to the low-voltage transformers. The 110-volt wires extend from this switch through the drop cable to the low-tension side of the 100-watt line

transformer mounted on the crossarm. This transformer is protected by G. E. compression type lighting arresters, and porcelain enclosed fused-plug cut-outs are connected in the leads to the 550-volt line circuit. The 550-volt power line circuit comprises two No. 8 copper wires with triple-braid weatherproof covering. These wires are carried on Corning Pyrex colored glass insulators (No. 662) on steel pins with wooden cobs. This circuit is located on the two pins on the field side of the signal crossarm. Power for the 550-volt feed line is purchased at various towns along the line, from 25 to 35 miles apart, no feed being more than 18 miles long. The line control circuits are No. 10 copper wire with triple-braid weatherproof covering and these wires are carried on glass insulators.

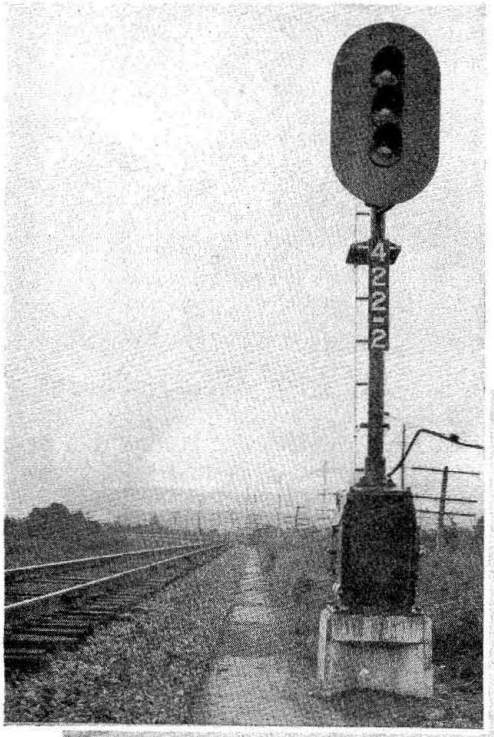
Parkway cable with a single No. 9 solid copper conductor is used for the connections from the relay cases to the rails. Raco bootleg outlets are used at the rail, the parkway conductor being joined to the stub end of the A. S. & W. rail connection by nine wraps and then soldered. This joint is pulled down in the riser pipe, and about two feet of slack cable is buried at the base of the riser. For the runs under the track for control circuits, etc., the parkway cable with No. 14 conductors is used. The parkway cable, except that used for track leads, has a covering of lead over the insulation followed by two turns of steel tape covered by jute, etc. A hole, 10-in. square, extends down through the center of the concrete signal foundation, and a 4-in. by 6-in. opening extends from this central duct through the foundation at various depths. The parkway cables are pulled in through these holes and up through the central duct into the signal case. This arrangement protects the cables and at the same time presents a neat appearance.

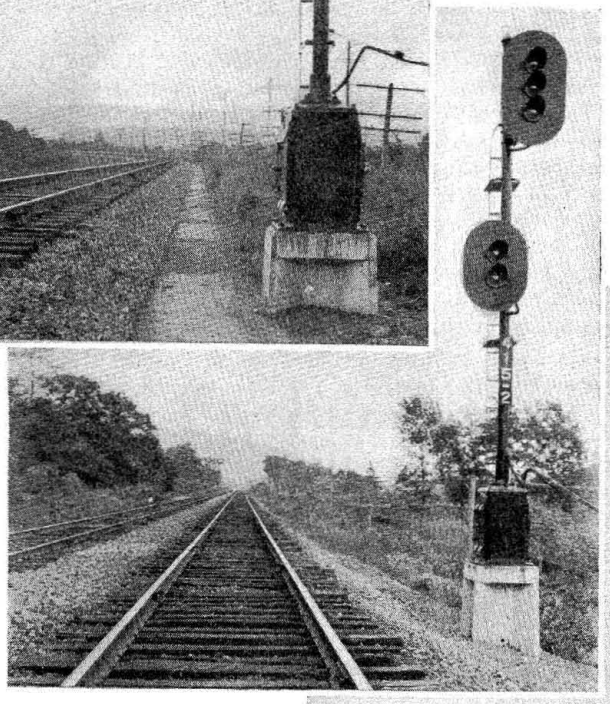
The rail joints are bonded with Ohio Brass Company gas-welded bonds. One thousand joints were bonded with the new stranded steel wire bonds and the remainder with the Weber type stranded copper bonds. Welded bonds were used also for all frogs, switches, etc. These welded bonds were all applied by the signal department forces of the Erie. With a crew of four welders, four helpers and a foreman, about 500 joints were bonded each working day.

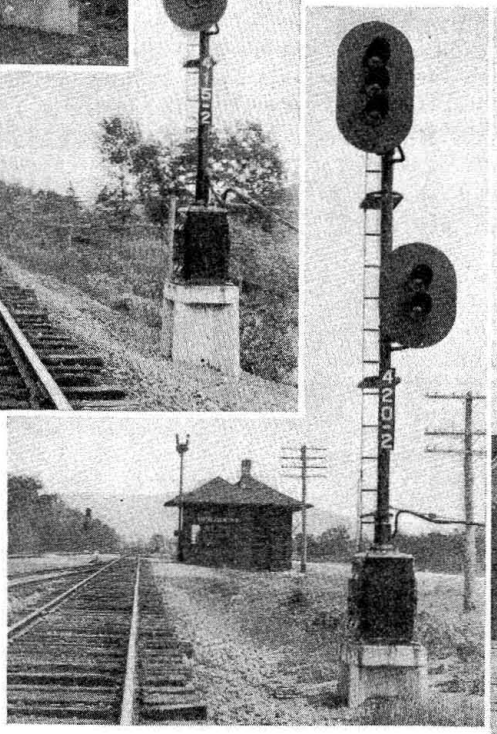
Features of Mechanical Plants

The new electro-mechanical interlocking at Salamanca, as well as the one under construction at Falconer, both include several interesting features, the switches and derails are operated mechanically by the levers in the mechanical machine, while the signals are operated electrically, being controlled by the electric levers in the Union Type-S-8 electro-mechanical unit mounted over the mechanical interlocking machine.

Two-unit approach signals are in use as distant sig-





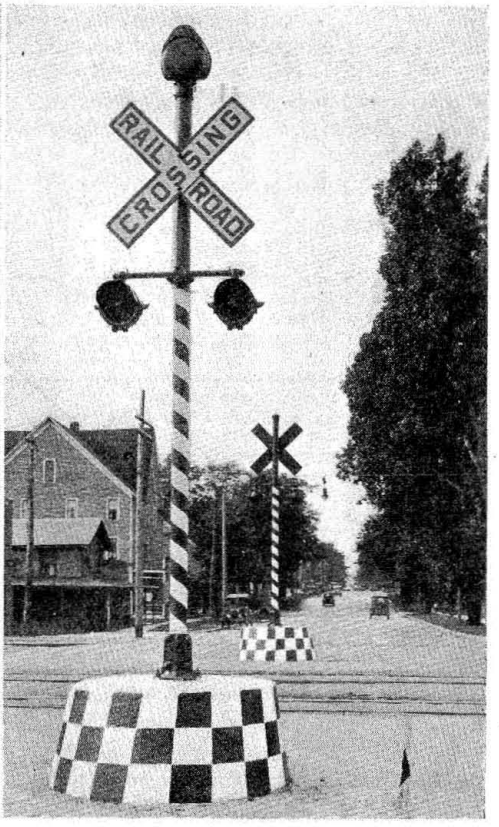


The Three Types of Signals

Top—Automatic signal

Middle—Approach signal for interlocking

Bottom—Train order signal

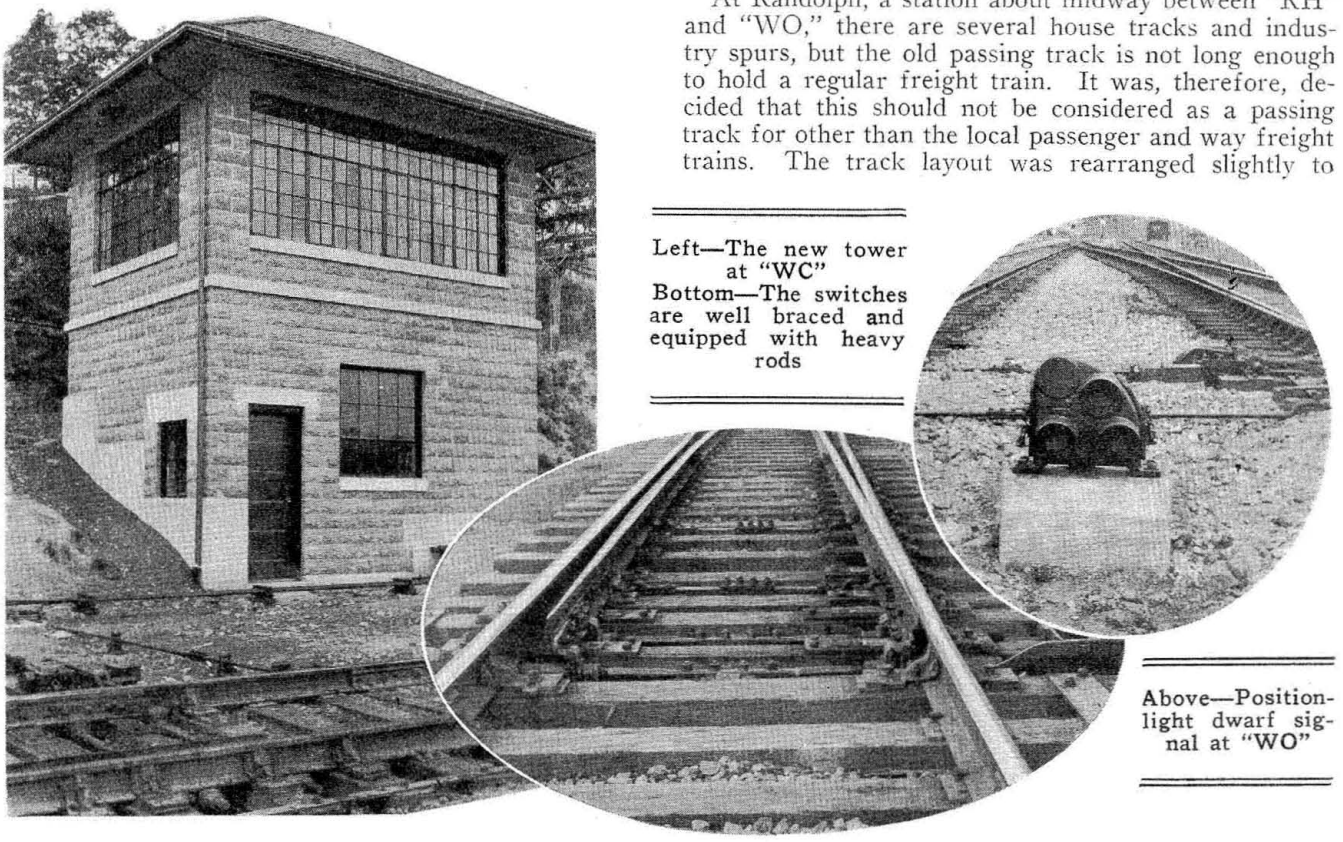


Right—Flasher-light highway crossing signal located in center of street

nals approaching three-unit interlocking home signals. The lower unit is staggered to the left and the indications are in accordance with the Standard Code Rules 281, 282 and 285, i.e.:

Green over Red—Clear signal.
Indication—Proceed.
Yellow over Green—Approach—medium signal.
Indication—Approach next signal at not exceeding medium speed.
Yellow over Red—Approach signal.
Indication—Prepare to stop at next signal.
Train exceeding medium speed must at once reduce to that speed.

Union Style-ML forced-drop electric locks are used on mechanical levers circuits being provided for complete approach, route, and detector locking. An illuminated track diagram is mounted over the machine. The relays are mounted in a sheet metal cabinet in the lower floor of the tower and a wire chase, made of asbestos transite board, carries the wires from the case up to the machine.



Left—The new tower at "WC"
Bottom—The switches are well braced and equipped with heavy rods

Above—Position-light dwarf signal at "WO"

Switches Well Braced

The switches are well braced with Ramapo Ajax type adjustable rail braces installed on the outside of the rail on the head-block tie and on the first tie ahead of and back of this tie and on the inside of the rail on the first tie ahead of the head-block tie. The Wharton O'Brien type adjustable rods are used for the head and front rods. Adjustable type lock rods are used on all switches. The rocker shaft lead-out is bolted to steel beams set in concrete. The up and down connections in the tower are 1½-in. pipes. The tower is constructed of concrete blocks, and large casement-type windows afford plenty of light and a view of the tracks on the three sides.

The high signals are the color-light type and the dwarfs are the position-light type. The wires from the tower to the switches and signals are distributed in parkway cable and Raco cast-iron parkway outlet boxes are used to terminate the parkway conductors at the ground line. From this box, wires are carried to the switch circuit controllers in flexible conduit.

The nine miles of single track from the end of double track at "RH" to "WO" is the neck of the bottle for this division and handles 12 scheduled passenger trains and as high as 25 freight trains daily. The problem was to expedite train movements in this territory, and this was partially accomplished by the use of a remote-control power switch machine at the end of double track at "RH," together with a system of signals to direct train movements so as to eliminate train orders. The power switch at the end of double track, together with the surrounding signals, are under the control of the towerman at "RH."

Control for Special Signaling "RH" to "WO"

At Randolph, a station about midway between "RH" and "WO," there are several house tracks and industry spurs, but the old passing track is not long enough to hold a regular freight train. It was, therefore, decided that this should not be considered as a passing track for other than the local passenger and way freight trains. The track layout was rearranged slightly to bring all the switches within the station limits, and a set of absolute signals were located at each end of the layout. The towerman at "RH" controls the eastbound signal at Randolph to bring trains toward him, and likewise the towerman at "WO" controls the westbound signal to bring trains toward him. These men co-operate in the operation to give trains the proper signals to make through movements betwen "RH" and "WO" on signal indication. Telephones are provided at each absolute signal so that the conductor can call the dispatcher if necessary.

When the local freight has switching to do at Randolph, the conductor gets permission from the dispatcher to occupy the main line up to the time when certain trains may be expected to pass. This signaling system has worked out satisfactorily; the through trains are getting over this nine-mile section without stops or delays.

Old Mechanical Plants Rebuilt

The mechanical interlocking plants at Niobe and "WO" were completely overhauled, some semaphore signals being replaced with light signals and Type-S-8

electric units were added for the remote-control and check-locking levers, complete electric locking with all new wiring being installed. The wires from the tower are run under the track in parkway cable to a large junction box on the opposite side of the tracks, from which point the wires are run in cable made up of separate No. 14 insulated conductors carried on a 3/8-in. stranded messenger, supported from reinforced concrete cable posts, set not less than 9 ft. from the nearest rail. The posts are 11 ft. long, set 3½ ft. in the ground, so as to bring the cable about 7 ft. above the level of the rail. Davidson metal cable straps are used to form the cables and support them from the messenger. All insulated wires and cables are Okonite.

At each plant a new storage battery of 4 cells of Exide Type-EMG 9 of 112-a.h. capacity was installed for the lock circuits and the emergency supply for the signals, which normally feed off the a-c. supply. The battery in each plant is on a-c. floating charge.

Either-Direction System for Double Track

On the 8 miles of double track from Waterboro "WO," to Falconer "DV," the automatic signaling is installed for right-hand running with blocks about two miles long. Superimposed on this signaling is an arrangement of starting signals controlled by check locking between the two towers, such that trains can be directed in either direction on either track. For right-hand running, the automatic signals permit closer spacing of trains, but for a left-hand movement, which will not be used except for run-around movements, the block extends all the way from one tower to the other, except that approach signals are provided for the reverse home signals. On account of the fact that reverse running is regular practice on this section, electric locks are provided on the crossover switches at Kennedy, an intermedite station, these locks being controlled remotely from "WO" tower.

Highway Crossing Protection

The automatic highway crossing protection on this division was brought up to date to meet the needs of present highway traffic. New flashing-light crossing signals were installed at 17 crossings, 5 of which are for single—and 12 for two (or more)—track lines. Existing wig-wag and flashing-light signals at four crossings were rewired and connected for operation from storage battery on a-c. floating charge.

Perhaps the most interesting installation of crossing signals on this division is at Cambridge Springs, Penna., where five streets cross the tracks at an angle. These signals are controlled manually. To meet the desires of the local city authorities, the crossing watchman not only controls the signals, but also flags the crossing during the day time, which requires him to occupy the ground or lower floor of the tower during this period, and at night he stays in the upper floor of the tower. This required that duplicate sets of annunciators, control switches, etc., be provided in the tower. All of the automatic crossing signal layouts are arranged to operate for trains approaching in either direction on either track.

Train Order Signals a Special Feature

As a means of completing the system of operating trains by signal indication without written train orders, the Erie uses telephone train order signals remotely controlled at passing tracks and at important main track crossovers located at intermediate points between open offices. For example, the set of train order signals located at Red House is controlled from "RH" Tower, the set at Lakewood is controlled from Jamestown, and the sets at Cambridge Springs and Mill Village are controlled from Cambridge Springs. These train order signals consist of a two- or three-unit color-light signal attached to a pole below the upper automatic unit and staggered to the right. The top arm is a regular automatic signal controlled by the track circuits ahead, and, when the train order signal is operated to display any other than the green indication, is causes this top unit to display the red indication, which also sets the signal in approach to yellow (as a caution indication).

The control for the telephone train order signal is affected with a two-wire polarized circuit, the home control line relay for the upper automatic unit being controlled through a normally closed front and normal polar contact of the train order polar relay. With battery in one direction, the train order line circuit causes "Green" to be displayed in the train order unit. With battery in the reverse direction, the train order line circuit causes "Yellow" to be displayed in the train order unit. With no battery on the line "Red" is displayed in the train order unit. With either "Yellow" or "Red" displayed, the home relay of the automatic drops and causes the top or automatic unit to display its most restrictive indication.

Principal Items of Signaling Equipment

127	One-unit ground signals
35	Two-unit ground signals
6	Three-unit ground signals
1	Three-unit cantilever signal bridge
4	One-unit cantilever signal bridges
2	Bracket signals
8	Dwarf signals
45	Highway crossing signals
31	Four-way relay cases
36	Two-way relay cases
163	Eight-way relay cases
11	Twelve-way relay cases
60	U-4 switch circuit controllers
188	Rotary switch circuit controllers
6	Switch movements at remote-control layouts

Unique Aspects for Train Order Signal

The aspects and indications of the train order signal are as follows:

Red Light (Indication): Stop on main track and report for instructions. It is forbidden to use a crossover at any point where a telephone train order signal is located without permission.

Yellow Light (Indication): Take siding, and when clear of main track report for instructions. Passenger trains will report before pulling in siding.

Green Light (Indication): Proceed regardless of following superior trains unless otherwise ordered.

It is forbidden to accept the proceed indication if there is any known cause that will prevent making usual running time. When a train accepts the proceed indication and for any cause is unable to make usual running time, the train must be protected as prescribed by the rules.

Construction Program

The signaling equipment was furnished and installed under contract by the Union Switch & Signal Company. However, the Erie forces handled certian parts of the work, such as bonding, track insulation, and the placing of the concrete signal foundations. The Western Union forces did the pole line work, adding the new crossarm and stringing the line wires, as well as building the 12.5 miles of new pole line on the freight line between Niobe and Columbus Junction.