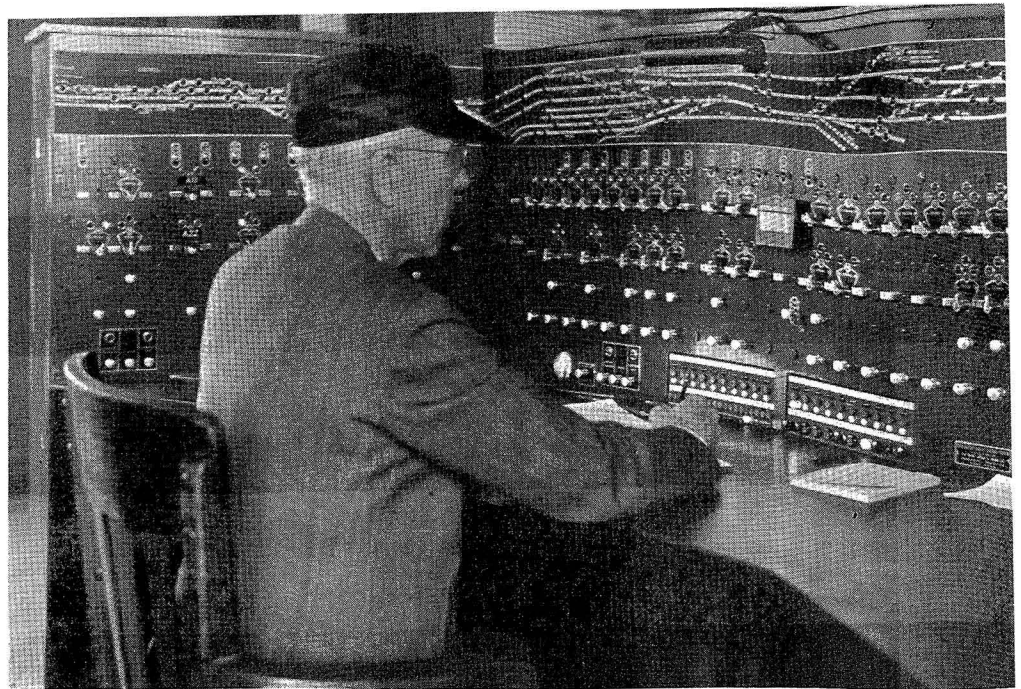


The miniature-lever machine at Columbia controls the interlocking at that point and also five remote-control layouts



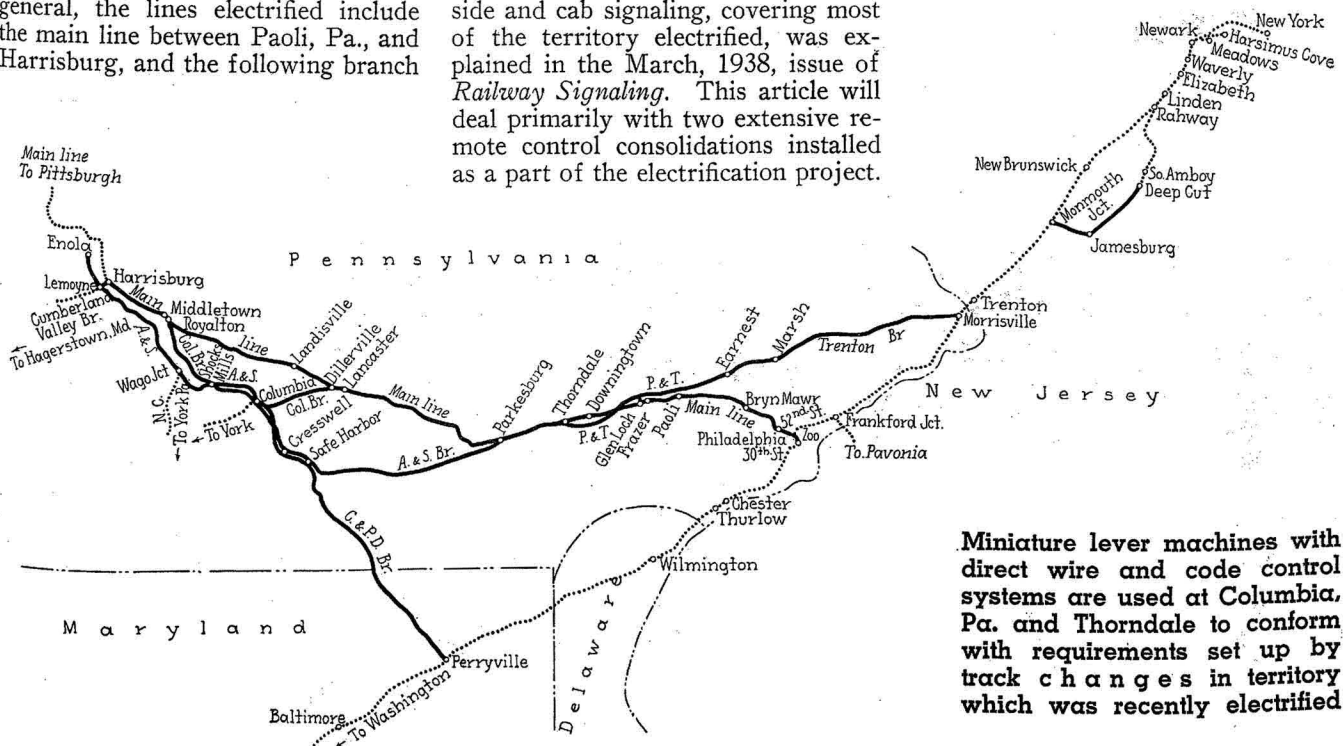
Interlocking Changes on the Pennsylvania

EARLY in 1938, the Pennsylvania completed the electrification of 315 road miles, involving 773 track miles, of lines in the territory between Philadelphia, Pa., Harrisburg, and Trenton, N.J., along with certain other branch lines necessary to obtain full benefit of electric traction. In general, the lines electrified include the main line between Paoli, Pa., and Harrisburg, and the following branch

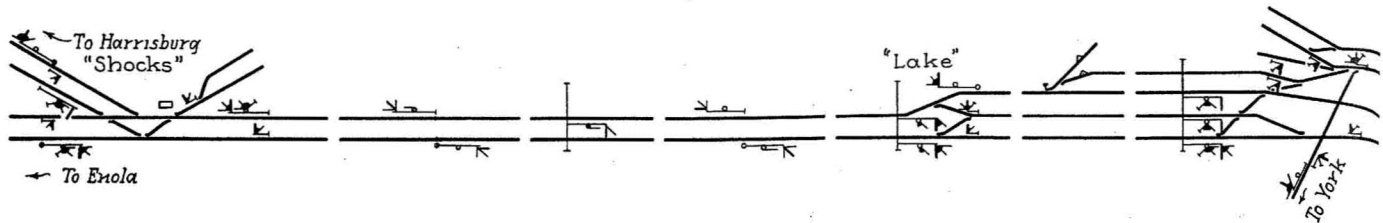
lines: Morrisville, N.J., to Thorndale, Pa.; Parkesburg, Pa., to Enola; Creswell, Pa., to Perryville, Md.; Lancaster, Pa., to Royaltown via Columbia; Monmouth Junction, N.J., to South Amboy via Jamesburg Junction; and South Philadelphia, Pa.

The installation of automatic way-side and cab signaling, covering most of the territory electrified, was explained in the March, 1938, issue of *Railway Signaling*. This article will deal primarily with two extensive remote control consolidations installed as a part of the electrification project.

When surveying the lines to be electrified, consideration was given to changing certain track arrangements at outlying points to facilitate train movements. On the main line, between Coatesville, Pa., and Dale (junction of Trenton branch with



Miniature lever machines with direct wire and code control systems are used at Columbia, Pa. and Thorndale to conform with requirements set up by track changes in territory which was recently electrified



Track and signal plan of remote-control layouts between

main line), and on the A. & S. branch, between Shocks Mills and Creswell, certain hand-operated switches, together with new crossovers and turnouts, were made power-operated, to speed up operation and obtain maximum benefit with electric traction. Furthermore, to reduce delays, as well as to avoid intercommunicating be-

tween numerous interlocking towers, the controls for these switches and governing signals, as well as the controls for all other interlocked switches and signals within the areas specified, and in a number of cases trolley sectionalizing switches, were combined into and operated by central machines of the miniature-lever type. One machine, located at Thorndale, controls all functions between Coatesville and "Dale," and one located at Columbia, controls all functions between Shocks and Creswell, the old interlocking stations within these territories being abandoned.

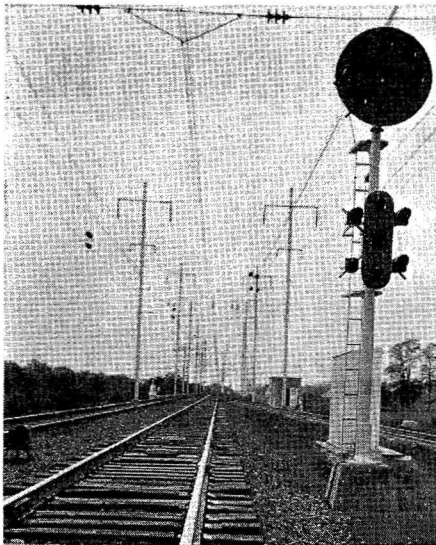
The Columbia Installation

Leaving Harrisburg, the freight tracks parallel the main line passenger tracks for approximately eight miles. At Royalton, these freight tracks connect with the Columbia Branch tracks which diverge southeastwardly along the east side of the Susquehanna river to Shocks Mills. At this point the A. & S. branch, after following the west side of the Susquehanna from Enola yard, crosses to the east side. From here to Columbia, previous to electrification, the two A. & S. tracks and the two Columbia Branch tracks ran parallel. At Columbia, two Columbia Branch tracks

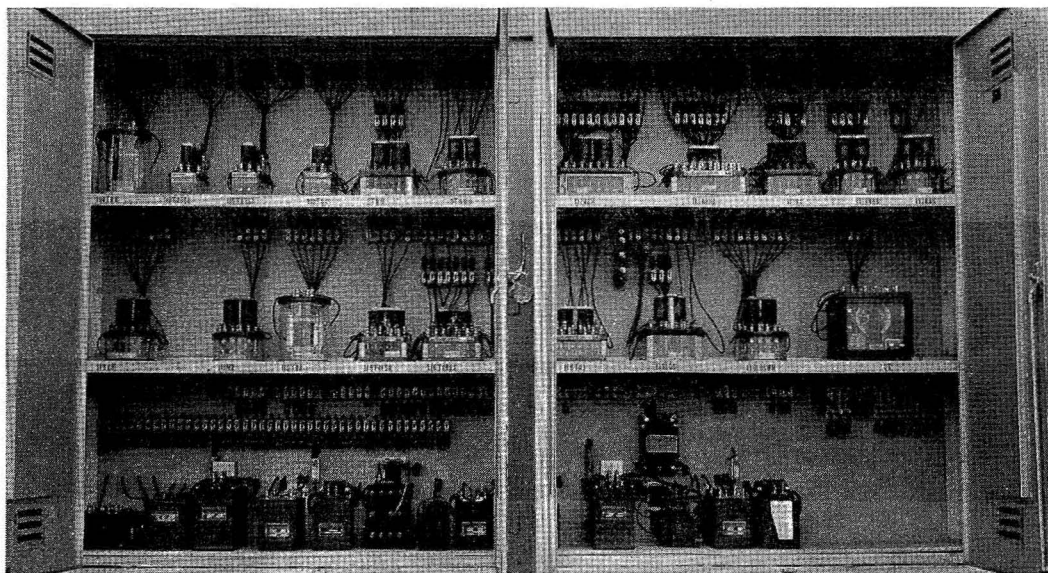
diverge northeastwardly to Diller-ville, the A. & S. tracks continuing along the east side of the Susquehanna to Creswell and then diverging through Shenks Ferry and Providence to Parkesburg. The Columbia and Port Deposit branch joining the A. & S. tracks at Creswell, follow the east side of Susquehanna to Perryville, Md.

Previous to electrification, in the territory between Shocks Mills and Creswell, there was one 20-lever mechanical interlocking at Columbia, including several hand-operated crossovers and turnouts, and 7 electric levers controlling certain signals in Columbia; this machine also remotely operated a siding switch to the main track, with necessary governing signals, at a point now called "Lake," about 6,000 ft. west of Columbia.

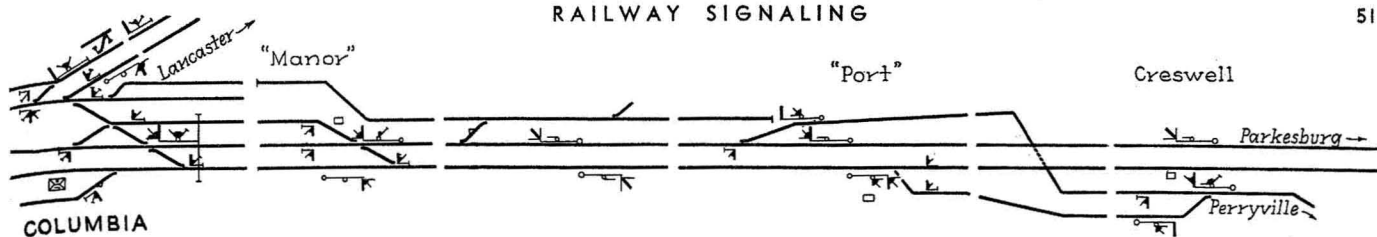
With the introduction of electric traction, which provides more rapid train movements, the electrification of all four tracks between "Shocks" and Columbia was not necessary. To avoid duplication of electric traction on the parallel lines, the Columbia Branch tracks at Shocks were shifted sufficiently to form a junction with the Atglen & Susquehanna tracks, and by adding two crossovers, provision was made for train movements in all directions. One track of the



Westward home signal at Shocks remote control layout



At the signal locations the instruments are housed in welded sheet-metal cases



Shocks and Creswell controlled from Columbia

Columbia branch, Shocks to Columbia, was abandoned, the remaining track, not electrified, was retained as a siding to serve numerous industries.

The former remote-controlled installation at Lake was amplified by adding two crossovers. These changes in track arrangement provide facilities for moving all Columbia Branch trains over the A. & S. tracks between Shocks and Columbia; in order to permit eastward movements of Columbia branch trains from Shocks to Columbia, while the normally eastward track is occupied, the westward track is signaled and operated for traffic in both directions, cab signals being in service for eastward movements, as well as for normally westward traffic.

The A. & S. branch and C. & P. D. branch tracks from Columbia eastward for about 7,000 ft. were relocated to provide a three-track railroad to "Manor" interlocking plant, where an interlocking consisting of one turnout and one crossover with necessary governing signals was installed. Just west of Creswell, at a point known as "Port," the single track of the C. & P.D. passes under the two A. & S. Branch tracks and then joins the westward A. & S. Branch track. The C. & P.D. Branch trains are operated over the A. & S. branch from Creswell to Manor. A new track was built at Port connecting the eastward A. & S. Branch track with the single-track C. & P.D. branch. The single track between Creswell and McCalls, on the C. & P.D. branch, is signalled for automatic block operation in both directions, including cab signals eastward and westward, occupancy of this section being controlled by traffic locking with the control points at Columbia and Midway. McCalls is remotely controlled from Midway.

In order to facilitate train movements with as little delay as possible, and to permit traffic to be directed from a central location, the five remote plants, Shocks, Lake, Manor, Port and Creswell, together with the local layout at Columbia, were combined into and controlled from one machine located in a new tower at Columbia. This machine is of the miniature lever type, manufactured by the Union Switch & Signal Co. Inter-

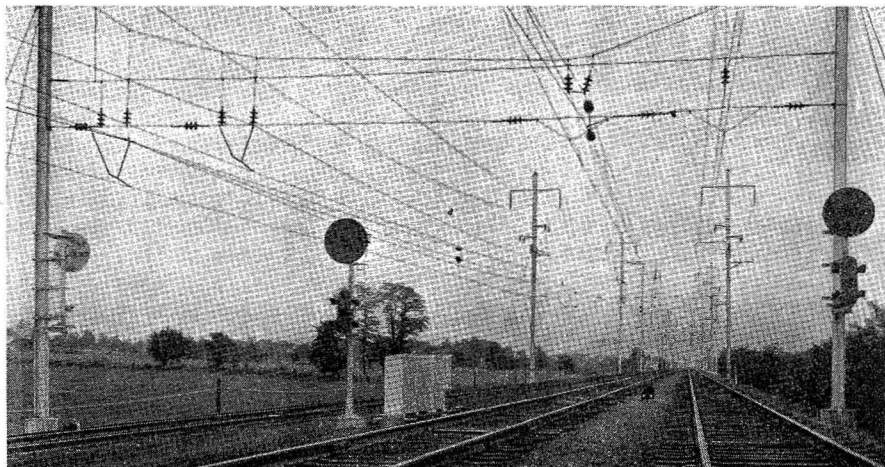
locked switches and signals in the vicinity of the control machine are operated by the direct-wire scheme, but the interlocked switches, governing signals, trolley sectionalizing switches, and other functions, at all the remote plants are controlled by the two-wire, time-code scheme of control.

All interlocked switches are operated by electro-pneumatic switch operating mechanisms and C.P. valves, except the turnout at Creswell, which

is a dual-control electric switch operating mechanism. All main-track switches are equipped with latch-out type point-detectors.

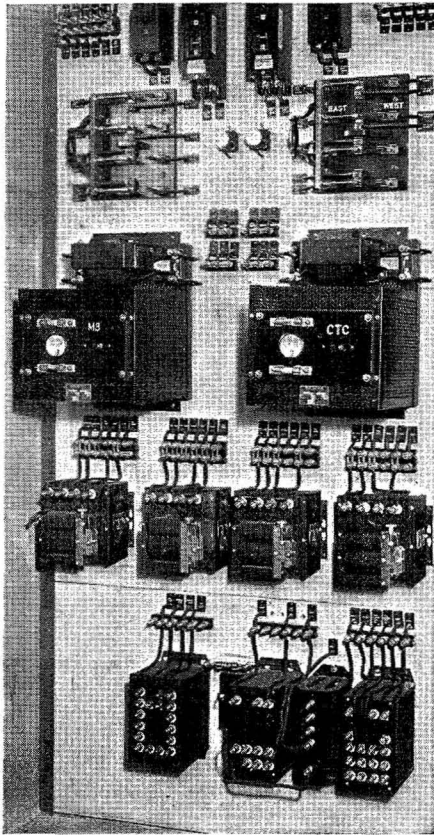
The Thorndale Installation

Prior to the electrification, there were located between Coatesville and a point about 3 miles west of Paoli, on the main line Philadelphia to Harrisburg, a 24-lever mechanical interlocking at Coatesville, a 23-lever electro-



Above—Position-light signals were used throughout. View shows eastward home signals at Shocks. Below—The switches are operated by electro-pneumatic machines equipped with lock rods and also point detectors





Code-line switches, rectifiers and transformers on panel in the Columbia tower

pneumatic interlocking at Thorndale, an 11-lever interlocking at "Caln" (the machine being located in Thorndale tower), a 23-lever electro-pneumatic interlocking at Downingtown, two hand-operated turnouts and one hand-operated crossover at what is now "Glen," and a hand-operated crossover and two hand-operated turnouts at what is now "Dale." Glen is the junction of the Trenton branch with the main line, and Dale is the junction of the Philadelphia & Thorndale branch with the Trenton branch. The Philadelphia & Thorndale branch joins the main line at Thorndale. Between Caln and Thorndale interlockings, the Thorndale coaling station and yard with many tracks served the necessities of steam operation.

The advent of electrification required several major track changes in this territory. The tracks in Thorndale yard were completely rearranged, providing two yard running tracks

for through freight service, and east and west ladder tracks for pick-up and set-off service. The through freight electric service, as well as additional shifting at both ends of the yard, made necessary certain track changes in Thorndale interlocking, and a major rearrangement of switches at Caln.

The old standard four-track interlocking at Downingtown was located on a curve, and as the new arrangement of switches at Thorndale and Caln permitted crossover movements formerly made at Downingtown and Coatesville, the entire interlocking at Coatesville was abandoned, and by installing three new crossovers on tangent track just east of Downingtown, the old interlocking plant at Downingtown was abandoned.

To obtain full benefit from electric operation, the former hand-operated switches at Glen and Dale, including a slight rearrangement of tracks at Dale, were interlocked, and, to improve the efficiency of train movements, reduce delays to a minimum, and cut down maintenance and operating costs, the control of interlocked switches, signals, trolley sectionalizing switches, electric switch locks, and all other interlocked functions at Coatesville, Caln, Thorn, Downs, Glen and Dale are combined into and operated from one central machine, located in new tower at Thorndale.

In order that reverse movements may be made on No. 1 Track, between Caln and first eastward signal west of Coatesville, without train orders, this signal is operated as a holding signal, so that eastward trains may continue to this point, instead of being held several miles west at Park, while movements are being made at Coatesville industrial sidings.

The Control Machines

The control machine is of the miniature-lever type similar to the machine at Columbia; all interlocked switches, signals and other functions in the vicinity of Thorndale are controlled by the direct-wire scheme, all functions at Coatesville, Caln, Downs, Glen and Dale are controlled by the two-wire time-code system, similar to the control of the remote plants in the

Columbia area, explained previously.

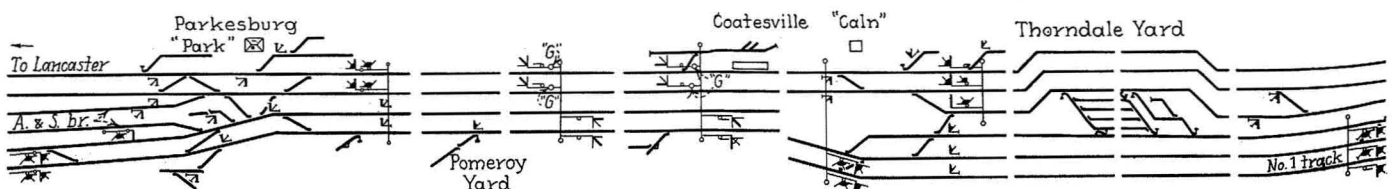
The central control machine towers, switch-operating mechanisms, signals and details of construction throughout the Thorndale consolidation are practically identical with the installation in the Columbia area. The following data and explanation will, therefore, apply generally to both the Columbia and Thorndale installations.

The control machine is of the miniature-lever type, similar in construction and detail of working parts to machines included in centralized traffic control systems, relays serving to check the numerous routes in lieu of the older scheme of mechanical locking. The machine is constructed in three sections, a middle section 5 ft. long, with a 30-in. section attached at each end, placed at an angle for better observation and manipulation, and an operator's table built as part of the machine extending its entire length.

Track Diagram and Levers

A track diagram located immediately above the operating levers and extending across the length of machine, includes all interlocked switches, signals, trolley-sectionalizing switches, indication lights for track circuits and traffic direction, and lights indicating trolley de-energization, all operating functions being numbered for ready reference. Indication lights functioning in conjunction with switches and signals are located on a panel as usual, immediately above the controlling lever involved. Lights are provided on the front plate for all remote-controlled plants, indicating low air pressure and power-off; and also push buttons are provided for operating an emergency whistle at each remote plant.

The Columbia machine includes 29 levers for switches and electric switch locks, 27 levers for signals, 2 levers for traffic, 2 levers for trolley-sectionalizing, 5 low-air pressure indication lights, 6 power-off indication lamps, 6 push buttons for emergency horns, 29 toggle switches for trolley de-energized indication lights on track diagram, and 2 ammeters for registering the current discharge. The Thorndale machine includes 28 levers for



Track and signal plan of remote-control layouts between

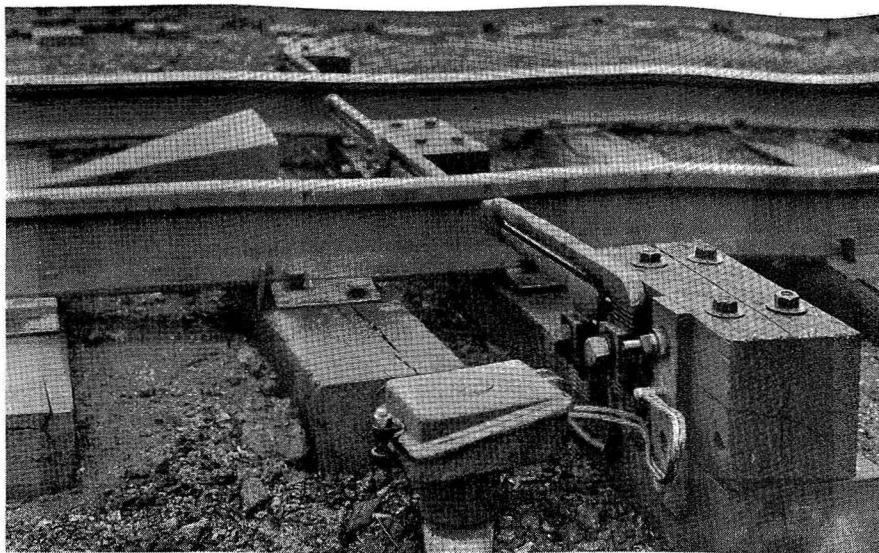
switches and electric switch locks, 24 levers for signals, 13 levers for trolley sectionalizing, 1 lever for dragging equipment detector, 5 low-pressure indication lights, 5 power-off indication lamps, 5 push buttons for emergency horns, 45 toggle switches for trolley de-energized indication lights on track diagram, and 2 ammeters for registering the current discharge.

The line code system for both Columbia and Thorndale is divided into two circuits, one east and one west from the control machine, the normally operating circuit being included with other line wires in the signal aerial cable, with an emergency pair in the telegraph and telephone cable, which may be used as desired.

A particular feature at both Columbia and Thorndale is that the telephone 10-line concentration unit and 20-key patching unit are located in the front panel of the machine, with the face of the unit flush with the face of the machine panel, immediately in front of the operator.

The machines, with the necessary batteries, rectifiers, transformers, and instrument racks, are housed in two-story brick buildings located at Columbia on the south side of the A. & S. tracks, and at Thorndale on the north side of the main line tracks.

The second floor provides space for



Dragging-equipment detectors were installed as a part of the project

the operating machine, telephone test panels, and trolley-sectionalizing panel board. The ground floor is utilized for all signal and telephone instruments, the relays, transformers, rectifiers, coders, batteries and numerous other instruments being supported in instrument racks constructed of pressed steel and pieces, shelves and angle frame, with $\frac{1}{2}$ -in. asbestos board covering the entire back of the racks for attaching wire terminals. The racks were shipped knocked down, the sections being assembled and bolted together in place. Bakelite based wire terminals for all relay leads, with fibre tags to designate each wire, are secured to the asbestos back. Incoming cables and wires are terminated on a separate terminal board, No. 16 fire-proof insulated wire was installed throughout the network of circuit combinations, all wiring in rear of racks being run through insulated bridle rings.

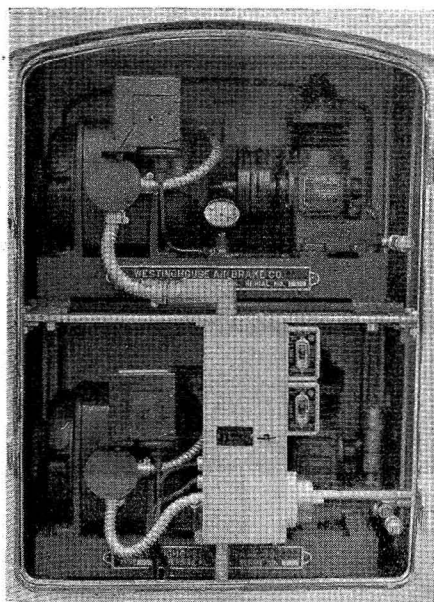
In the basement of the new towers are located, at Columbia, two 17.5-cu. ft. compressors, and at Thorndale two 20-cu. ft. compressors, serving the local switches. At the remote

plants, duplicate 3.25-cu. ft. unit compressors are installed, these being operated automatically by 220-volt, 100-cycle current. One compressor of each unit is adjusted to start at a lower pressure than the other so that both will not come on the line at the same time. At the remote control points, concrete houses are installed for housing the numerous instruments of each central instrument location.

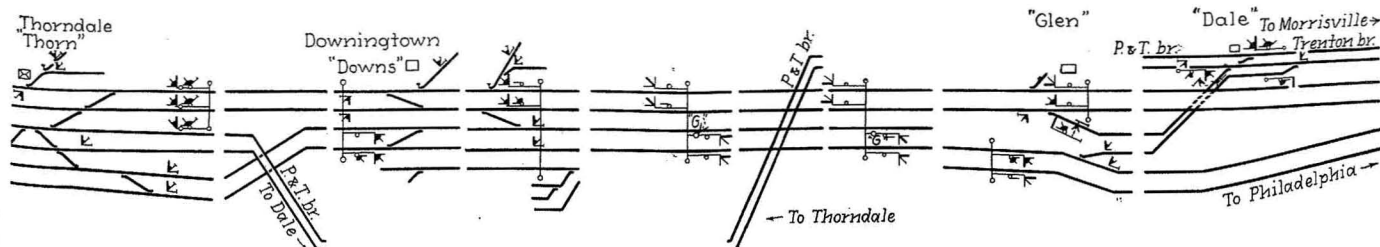
Dragging Equipment Detectors

Generally, throughout the electrified territory dragging equipment detectors were installed in approach to interlockings. As shown in the illustration, a cast-iron member is supported near each rail, with a circuit run through these members in series. When anything dragging on a train strikes a member, it is broken, thus opening the circuit to a relay; this relay in turn controls the wayside and cab signals. The train is brought to a stop in the regular way but must not proceed without examination for broken parts, or upon permission of proper authority.

The remote control installation explained in this article was installed by forces of the Pennsylvania, the major items of signaling materials being furnished by the Union Switch & Signal Company.



At outlying layout the electro-pneumatic switch machines are supplied from small-sized air compressors



Parkessburg and Dale, controlled from Thorndale