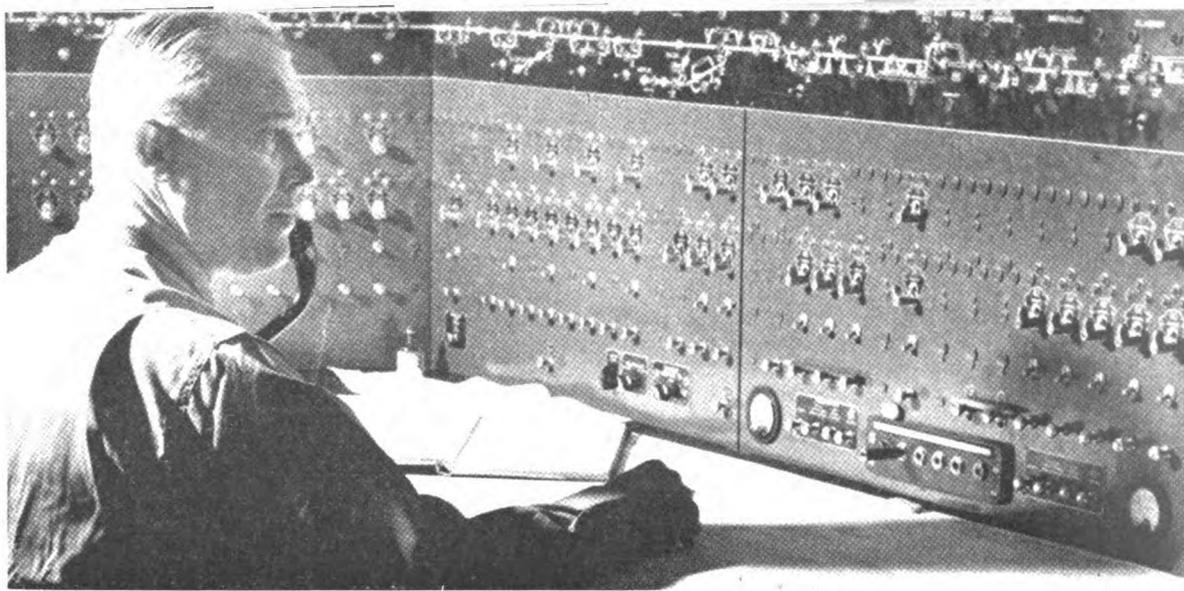


This machine controls the C.T.C. on the 111 miles of main lines on entire Pittsburgh & West Virginia route



## P. & W. V. Signals Entire Main Line

**Modified C.T.C. system includes spring switches and controlled signals to direct train movements over 111-mile railroad between Pittsburgh Junction, Ohio, and Connellsville, Pa.**

THE Pittsburgh & West Virginia has installed a modified C.T.C. system on 108 miles of single track and three miles of double track between Pittsburgh Junction, Ohio, and Connellsville, Pa. The control machine is located at division headquarters in Rook, Pa., midway in the territory, on the outskirts of Pittsburgh.

The 111-mile P. & W. V. is an important bridge line between the New York, Chicago & St. Louis and the Western Maryland, for fast freight service. In addition, it interchanges with several other roads between Pittsburgh Junction and Connellsville, originates coal traffic at a

number of mines along the line, and handles a considerable amount of traffic consigned to and from industries in the Pittsburgh area. The road operates no passenger trains.

### Through Hilly Country

A map of the P. & W. V., which traverses hilly country with numer-

ous curves, is shown in Fig. 1, single track being in service on the entire line, except for about four miles of double track in the vicinity of Rook, 55 miles east of Pittsburgh Junction. Maximum ascending grade is 1.4 per cent, compensated with curvature up to 10 deg., east from Rook to Pierce, about 16 miles; from Pierce to Connellsville, 1.0 per cent grade compensated, maximum 6-deg. curvature; and for a distance of 40 miles west from Rook to Pittsburgh Junction, ascending grades do not exceed 0.7 per cent, compensated, and maximum curvature is 3 deg.

### One Helper District

Traffic over the railroad, which consists roughly of 80 per cent merchandise and 20 per cent coal, includes an average of ten through freight trains daily, plus locals, mine runs and extras as required. These, for the most part, are handled by 2,000-h.p., double-unit diesel-electric locomotives, and the balance by mallet and mikado type steam locomotives. Some smaller-type steam locomotives are used on mine runs, locals and switching jobs. The busiest period on the railroad is usually between 4 p.m. and 8 p.m. Many car pick-ups from industries and on interchange movements with other

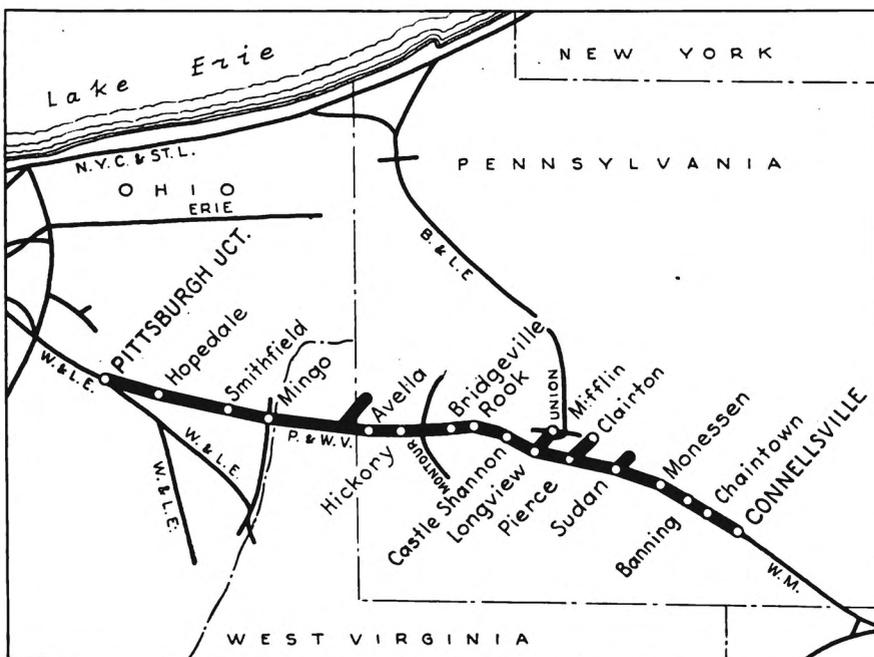
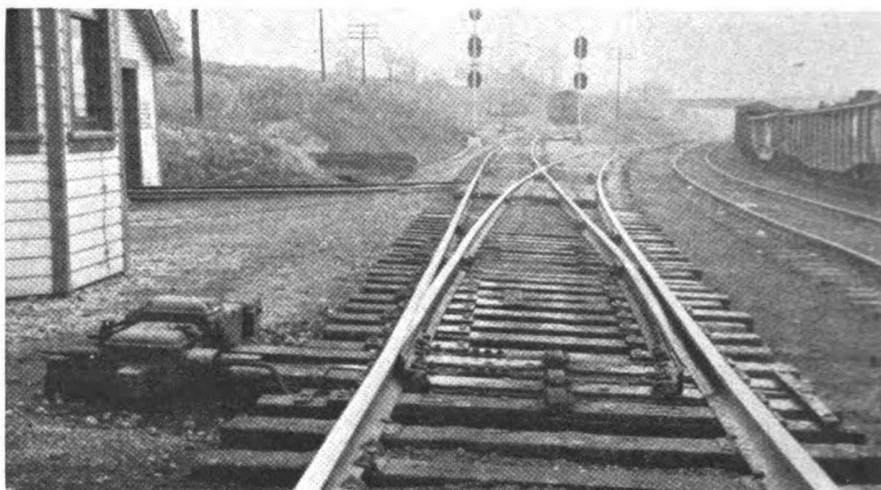


Fig. 1—Map of C.T.C. territory on P. & W. Va.

railroads are made between these hours. Interchange points with other railroads between Pittsburgh Junction and Connellsville are shown in Table 1.

There is one helper district in the territory for steam locomotives only, namely, between Mingo and Hickory, about 19 miles. When these trains are helped, they are double headed. Trains hauled by the double-unit diesel locomotives do not require helper service, the tonnage rating of these locomotives (4,800) tons exceeding that of the mallet steam engine (4,415) tons. The principal mining areas along the P. & W. V. are located between Pittsburgh Junction and Avella. Westbound coal movements are assembled and weighed at Hopedale, then delivered to the W. & L. E. district of the Nickel Plate at Pittsburgh Junction, Ohio. Eastbound coal is assembled at Avella, where three crews are assigned to mine runs, then brought into Rook for delivery to industries in the Pittsburgh area and to the Western Maryland at Connellsville.

Prior to the installation of the new signaling, trains on the P. & W. V. were operated by timetable and train orders. Automatic block protection was in service for a short distance only on double track between Rook and West Belt Junction. During the day, there were only 13 open train order offices between Pittsburgh Junction and Connellsville, namely, Pittsburgh Junction, Smithfield, Mingo, Avella, Hickory, Bridgeville, Rook, West Liberty, Longview, Bruceton, Sudan, and



Power switch in C.T.C. territory

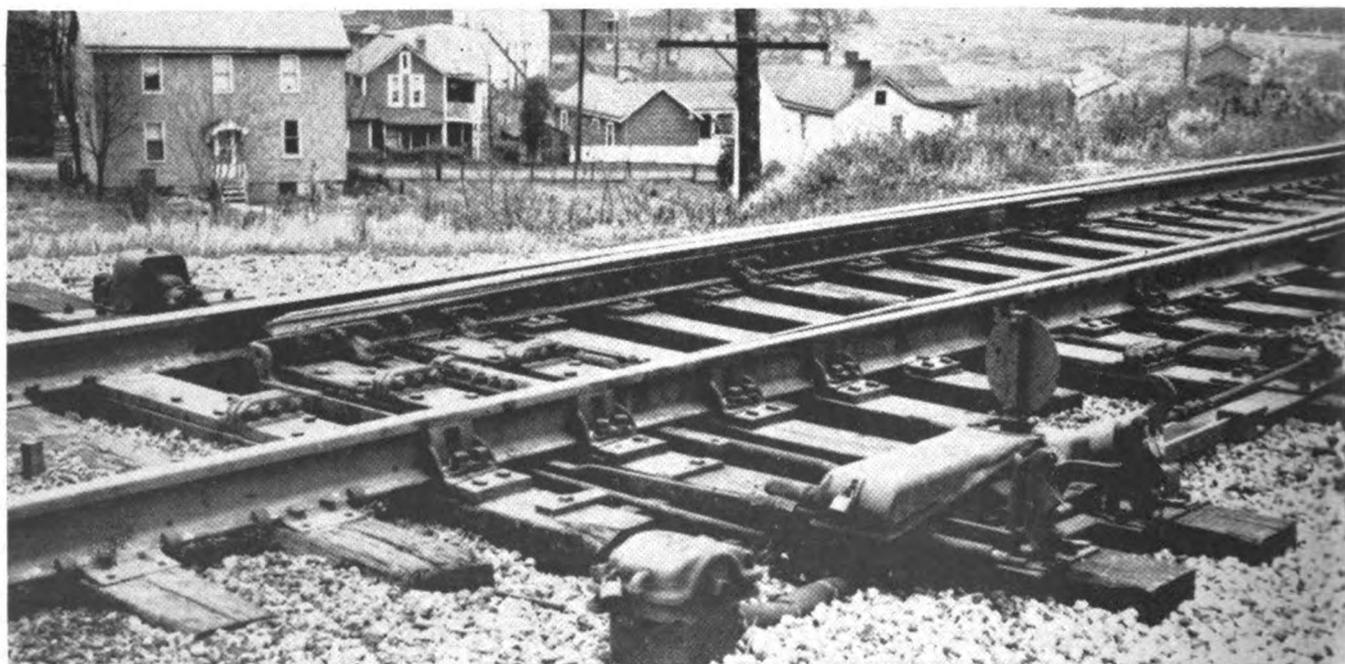
Monessen and Connellsville. At night, however, there was only one office open between Rook and Connellsville. Thus, if it became necessary to change orders or contact trains during these hours, delays in being able to do so were incurred which, in turn, would disrupt operations. The principal reasons for the C.T.C. installation, therefore were: (1) to overcome this problem; (2) to increase the safety of train movements, by providing track-occupancy and switch-position protection, especially in view of the nature of the terrain traversed by the road, and the many lead and siding switches on the main line and industrial areas; and (3) to increase railroad operating efficiency in general.

Foresight was used in planning and installing the new signaling. Traffic operating conditions and the

limited initial appropriation did not justify power switches on all sidings, and while automatic block signaling could have been used to provide basic protection, the decision was made to install a signal indication system. Such a system eliminates train orders, increases operating efficiency and safety, beyond what could have been secured with automatic block. The new installation includes train operation by signal indication, and was designed to be amplified at any time by the installation of power switch machines and additional controlled or intermediate signals, as might be demanded by changes in traffic conditions.

#### Fifteen Passing Tracks

In some instances, sidings are a considerable distance apart. For example, between Connellsville and



Each spring switch layout includes a mechanical facing-point lock

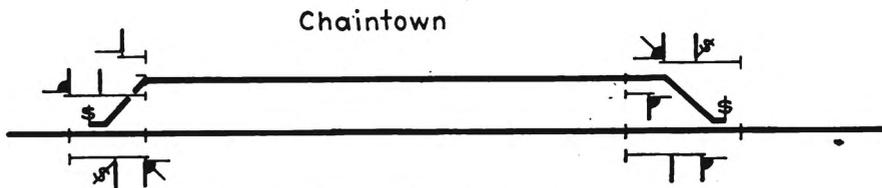


Fig. 2—Spring switch and signals at both ends

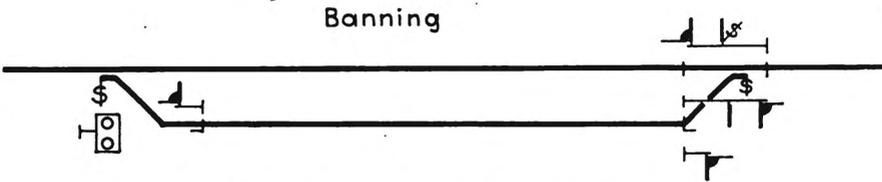


Fig. 3—Entering and leaving signals at only one end

Chaintown, the distance is approximately 8 miles. Since the approach signals are located 6,000 ft. from the home signal, there are no other signals between approach signals 16 and 61, a distance of approximately 5½ miles. Within this zone, the only major signal apparatus consists of track relay and battery cut sections, the two code wires and two signal control wires. This results in a highly economical arrangement which is entirely satisfactory for the traffic conditions existing on the Pittsburgh & West Virginia.

#### Spring Switches and Signals

The Pittsburgh Junction-Connellsville project includes 15 passing tracks, which now have No. 10 turnouts, good for 15 m.p.h. Of these, six are equipped with spring switches and controlled entering and leaving signals at both ends. These are at Smithfield, Mingo, Avella, Gladden, Castle Shannon

and Chaintown, as shown in Fig. 2. Seven sidings are equipped with spring switches at both ends, and controlled entering and leaving signals at one end only, and spring switch and controlled siding-leaving signals at the opposite ends. These are: Hopedale, Reed, Horning, Bruceton, Froman, Monessen and Banning, as shown in Fig. 3. The passing tracks at Hickory and Maple are equipped with spring switches at one end and power machines at the opposite ends, which will be discussed later. The Mifflin branch and the Clairton branch of the P. & W. V. leave the main line at Longview and Pierce, respectively, and these layouts are equipped with power switches and controlled signals. Passing tracks at Frick, Venice, Bridgeville, Woodrow, Rockdale, New Alexandria and Chandler were discontinued and made into storage tracks, the hand-thrown switches thereon being

equipped with electric switch locks, as were all other main-line hand-throw switches.

In this modified C.T.C. system, for the most part, no stick relays are provided in the signal control cir-

Table I—Interchange Points With Other Railroads Between Pittsburgh Junction, Ohio, and Connellsville, Pa., P.&W.V.

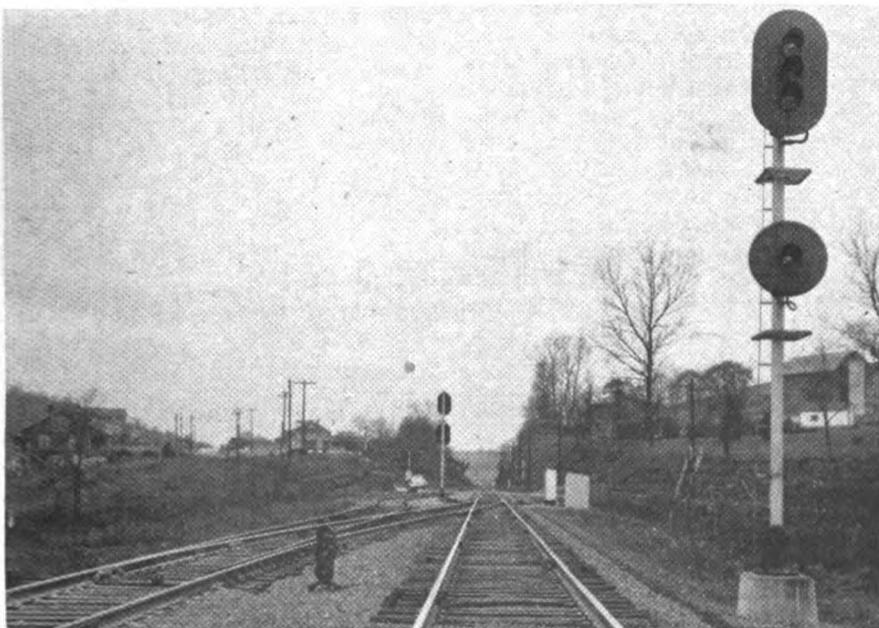
Railroad	Location
W.&L.E. dist.,	Pittsburgh Jct.
N.Y.C. & St.L.	& Mingo
N.Y.C.	Hopedale
Montour	George
P.R.R.	Bridgeville
P.&L.E.	W. E. Pittsburgh
Montour	Mifflin (on branch
Union	off at Longview)
Montour	Salida (on Mifflin br.
B.O.	off at Longview)
Union	Clairton (on branch
P.R.R.	off at Pierce
Donora Sou.	Sudan
Monessen	Monessen
Southwestern	
W. M.	Connellsville
P. Mck. & Y.	
P.&L.E.	

cuits for following train movements. Traffic being relatively light, trains are operated on a station-to-station block basis, such movements being authorized by a clear (green) signal aspect only. Appropriate approach signals, but not intermediates as such, are provided 6,000 ft. breaking distance in approach of all controlled signals.

#### Entering Sidings

When the dispatcher wishes a train to take siding, he controls the entering signal to display red-over-red-over-illuminated letter "S", which is authority for the train crew to throw the switch and enter the siding (the "S" is extinguished when the train passes the OS section), after which the switch is returned to normal. Otherwise, the actions of the train crew are similar to those in conventional C.T.C. systems with power-operated siding switches. When the dispatcher is ready to let the train depart from the siding, he clears the leave-siding signal, which is authority for the train to proceed and trail out on the main line through the spring switch.

At facing-point spring switch locations where there is no controlled entering signal to authorize train crews to throw the switch and enter a siding, there is a red and green spring switch signal, mounted at track level. This is an indicator independent of other signals, and is



Signals at the end of a siding



Train operation by signal indication

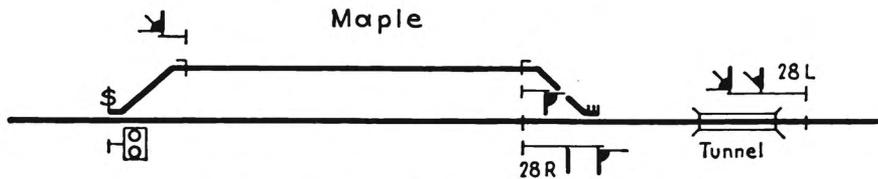


Fig. 4—Special signaling on account of the tunnel



Fig. 5—Signaling at the west end of Monessen including a slide detector fence with special control of signal 228

not controlled through the track or by line circuits. Green merely indicates that the spring switch is in its normal position, and red that the switch is open or reversed.

#### Hold-Out Signals

At several mine and industrial area locations on the railroad, such as around West Middleton and Avella, where considerable switching takes place, and occasionally it is desirable to hold out main-line trains and yet let them advance as far as possible, there are hold-out signals under the control of the dispatcher. The double location west of West Middleton, has such signals. Similar signals are in service between Gladden and Bridgeville, West Liberty and Oak, Froman and Sudan, and between Monessen and Banning.

As mentioned previously, the siding at Maple is equipped with a power switch at one end and a

spring switch at the other end. There is a need for the power switch at the west end of Maple because of the tunnel at that point. In addition, eastward controlled signal 28L is located out of and at the west end of the tunnel. Thus, if signal 28L is at Stop upon the approach of a train, the trains will not be stopped in the tunnel. The power switch makes it unnecessary to stop a train in the tunnel when a train is to enter this siding.

#### Slide-Detector Aspect

Slide-detector fences are located in Black Rock cut west of Monessen. If these fences are actuated by falling objects in the cut, signal 228 is automatically controlled to display the Restricting aspect, Rule 290, red-over-yellow. Signal 24R also automatically assumes this aspect, when cleared by the dispatcher, indicating to approaching trains to

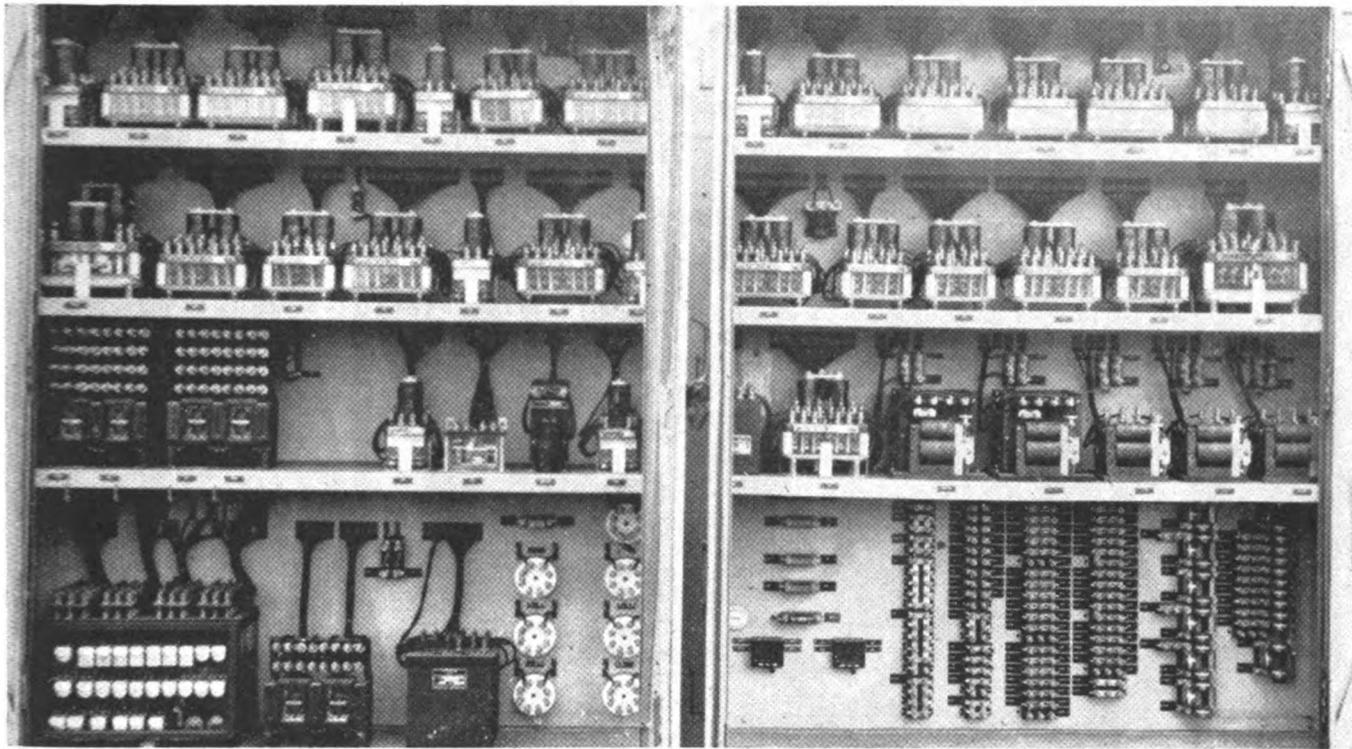
proceed at restricted speed. Upon actuation of the slide fences, an indication is also transmitted to the control machine at Rook, to cause the illumination of a red lamp. When this lamp is lighted, the dispatcher calls the maintainer and directs him to investigate the fences in Black Rock cut.

The dispatcher's office and control machine on this project are located at division headquarters in the yard office at Rook. The machine is

#### Lists of Sidings

Stations	Miles from Connellsville
Connellsville	
Frick	0.9
Chaintown	7.8
Banning	16.0
Alto	19.5
Monessen	21.0
Speer	23.5
Maple	27.8
Sudan	30.1
Froman	35.7
Pierce	39.8
Bruceton	42.7
Horning	44.2
Longview	45.9
Castle Shannon	47.7
Fair Haven	49.4
Oak	50.4
West Liberty	51.7
West Belt Jct.	52.8
Kelley	53.9
Rook	56.1
Bridgeville	60.5
Gladden	63.6
Venice	68.0
George	69.3
Acheson	70.5
Hickory	73.0
Woodrow	76.5
Rea	78.5
W. Middletown	80.4
Avella	82.3
Penowa	85.5
Virginia	86.3
Rockdale	89.7
Wellsburg	90.7
Mingo	91.7
N. Alexandria	95.7
Smithfield	99.8
Chandler	102.7
Reed	105.0
Wayco	106.1
Hopedaletrf.	107.0
Hopedale	108.6
Pittsburgh Jct.	111.2

a 12-ft. unit with a 7-ft. center panel and a 2½-ft. wing at each end, and includes a conventional arrangement of levers, indications lamps, track diagram and a 57-pen graphic recorder, 47 pens of which are in service. Indication lamps on this machine are white for track occupancy; red for OS sections, signals normal and slide-detector indica-



Large sheet-metal case includes relay, code equipment, rectifiers and arresters

tions; yellow for siding occupancy and switches reversed; and green for switches normal and signals cleared right or left. Power-off indications are blue.

#### Code Line in Two Sections

The code line between Pittsburgh Junction and Connellsville is split at Rook with filters between the two sections for communications purposes. This circuit is on two No. 9 AWG 40 percent conductivity, Copperweld, weatherproof wires on the railroad's pole along the right of way.

Power is furnished to each signal and power switch location at 460 volts a.c. on two No. 9 AWG solid copper, weatherproof wires on the pole line, 5 cells of lead storage battery, rated at 120 a.h. being provided at these locations for standby. Where power is available, each track circuit, all of which are the conventional d.c. type, is fed by 1 cell of lead storage battery, rated at 60 a.h. At isolated spots, to which the power line does not extend, the

track circuits are fed by 3 cells of 1,000-a.h. caustic soda primary battery in multiple. The main battery at the control office in Rook consists of 8 cells of 200-a.h. lead storage battery.

The track on this railroad consists of 115-lb. rail with prepared-slag ballast, the rails being bonded with rail-head type bonds. All line and track circuits are protected with Westinghouse R.V.S. type arresters. The new signals on the project are the Styles R-2 ground and N-2

dwarf color-light type; the power switch machines, Style M-22A; Spring switches, style S-21; and the electric switch locks, Style SL-6A.

This signaling was planned in collaboration with the Pittsburgh & West Virginia by the Union Switch & Signal Company, which furnished the major items of equipment for the project. The construction work was done by the Union Switch & Signal Construction Company. Wire and cable for the installation was furnished by the Kerite Company.

This arrangement of high signals at the junction are in the C.T.C.

