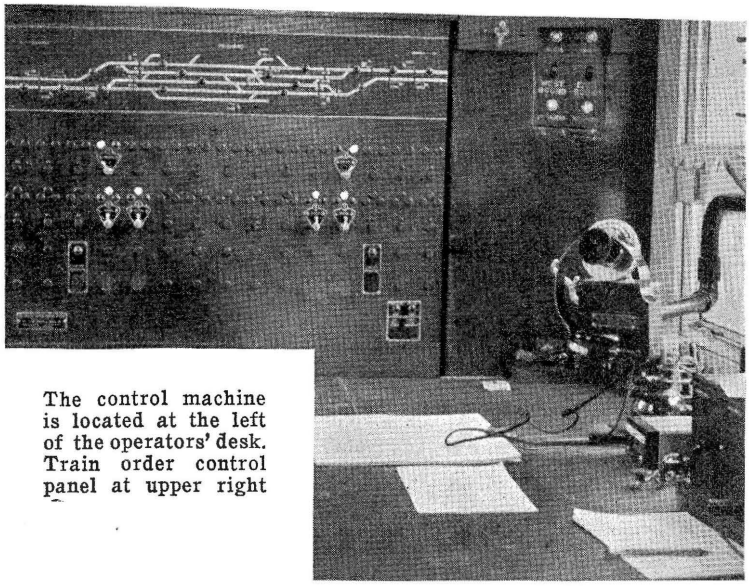
Norfolk & Western utilizes power switches, spring switches and controlled signals to speed up train movements at a four-track coaling station layout



The control machine is located at the left of the operators' desk. Train order control panel at upper right

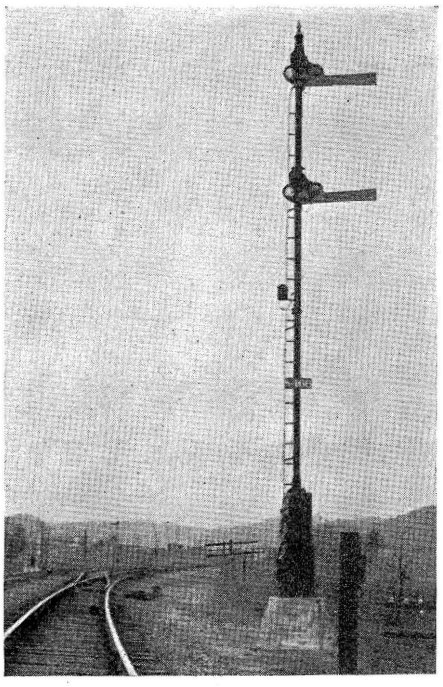
C.T.C. in Coaling-Station Territory

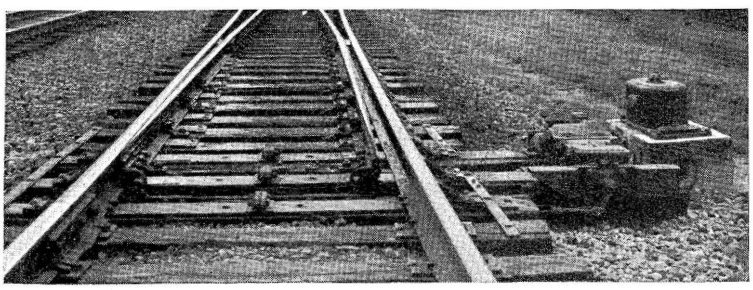
IN ORDER to expedite train movements when entering and leaving a four-track coaling and water station at Prichard, W. Va., the Norfolk & Western has installed power switch machines, spring switches and signals controlled by coding equipment from a C.T.C. machine in an office near the center of the layout. As indicated in the track and signal diagram, the coaling tipple spans the two main tracks, as well as an eastward and a westward passing track, both of which are located between the two main tracks, the entire layout between the outlying switches being more than three miles long. The four passing-track switches were formerly equipped with hand-throw stands, and were operated by trainmen. Automatic block signaling was in service, but, as the passing sidings were extended, a rearrangement was necessary. However, due to the length of the layout between switches, one set of automatic signals, S449 and S452, were allowed to remain as shown on the diagram.

The daily traffic on this line includes 8 passenger trains, 1 local freight train and about 24 through freights, 4 of which are high-ball scheduled merchandise trains. The remainder are coal trains, each including about 150 cars, which are loaded westbound and empty eastbound.

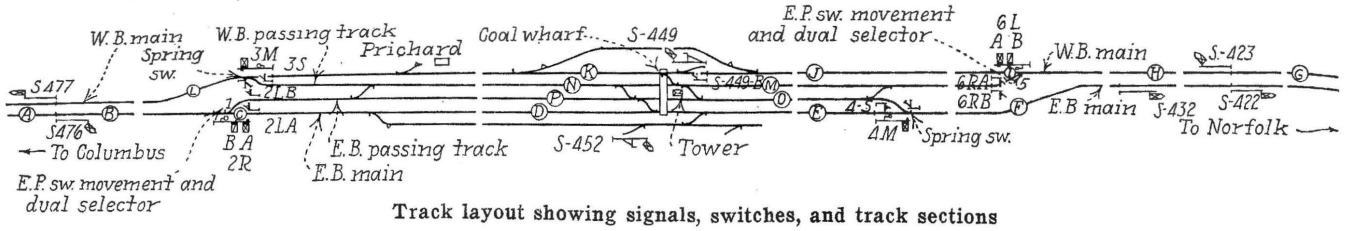
All trains except passenger and one high-ball freight take coal and water at Prichard. When passenger or merchandise freights are due, the coal trains are usually run into the passing tracks and the time lost in stopping these heavy trains to operate hand-thrown switches was causing excessive delays and congestion. An investigation led to the conclusion that this condition could be relieved by lengthening the passing tracks and providing operative switches and signals for directing train movement, the control of same being under an operator at a central point.

By this arrangement, train stops at the siding switches would be eliminated. Also trains ordinarily clearing for superior trains at other points, with a delay of 30 to 40 min., could be advanced to Prichard and cleared without any delay. When coal movement was heavy and coal trains and returning empties were under close





Controlled signal 2R and power switch No. 1 at west end of plant



Track layout showing signals, switches, and track sections

headway, the sidings were used for coaling and taking water when the main tracks were occupied.

As the operator has a line-up of train movements, and ample track indicators, this source of delay and congestion has also been eliminated. As many as six trains can be handled at Prichard at the same time.

Train movement through the sidings has been advanced about 30 min. due to elimination of 3 stops per train.

Signaling of the Track Layout

In order to provide a selection of routes, power switch machines were installed at the switch at the west end of the eastward siding and at the east end of the westward siding. As practically all of the movements out of the passing track are made in the normal direction of traffic, spring switch machines were used at the east end of the eastward siding and the west end of the westward siding.

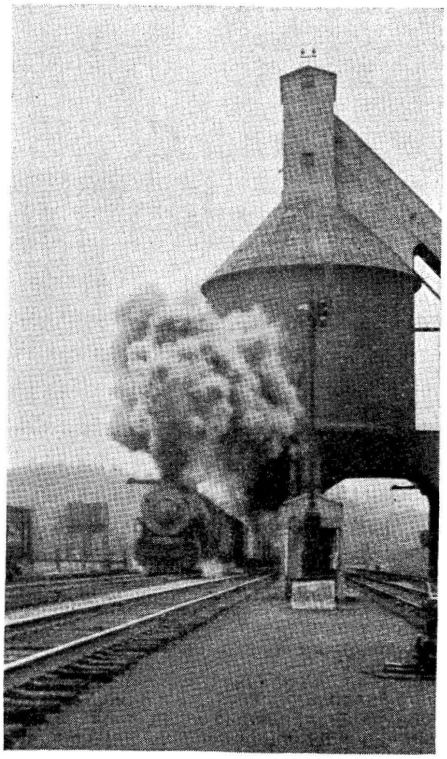
Automatic block signaling, arranged for single-direction, right-hand running on double track, has been in service throughout this territory for many years. According to N. & W. practice, such semaphore automatic block signals are equipped with pointed-end blades, and no marker light is used. When changing over to the new method of directing train movements in the Prichard area by signal indication, several of the existing semaphore automatic signals were converted to semi-automatic stick home signals, changes being made in the control circuits, arms being added as needed and square-end blades and markers being used. The new dwarf signals required are of the position-light type.

A two-arm home signal was used at each of the two power-operated switches, namely signals No. 6L and No. 2R, these signals being used to direct trains to continue on the main track or, in case the switch is reversed, to enter the siding. To direct train movements in the trailing direction over these switches, position-light dwarf signals were installed, one for the main track and one for the siding, as, for example, signals 6RA and 6RB at switch 5.

As a means of protecting main line trailing movements over a spring switch, and also for use in directing a train on the main line to leave the Prichard layout, a high-semaphore signal is used at each spring switch, as, for example, signal No. 4M at the east end of the eastward passing track, the same purpose being served by signal 3M at the west end of the westward passing track. These signals are semi-automatic, and are equipped with square-end blades and stop and stay markers. In order to direct a train to pull out of a passing track through a spring switch, a dwarf signal was installed, such as signal 4S at the east end of the eastward passing track, and signal 3S at the west end of the westward siding. All of the signals explained above, as well as the two power-switch machines, are controlled by means of code circuits from a C.T.C. type control machine located in the operator's office near the coaling station.

Special Automatic Signals

Additional automatic signaling was also provided. As the westward passing track is long enough to hold two trains, a special automatic signal, signal No. S449B, a dwarf, was installed at a mid-point for this track, and is controlled by track circuits. Normally trains are operated right-hand running on the two main tracks, but as a precautionary measure serving as facing-point protection for the spring switches, and also as a means for trainmen on the rear of departing trains to check the correct operation of the spring switches, position light signals were installed, controlled by the position of the switch.



Westbound train order signal

One cause for delays in the past was that if a train approaching the coaling station, on either the main lines or passing tracks, did not pull up far enough for the rear end of the train to clear the passing track switch, then other trains would be prevented from using the switch. Getting information to this effect from the rear end to the engineman introduced delays. To correct this situation, a set of special indicators had been mounted, prior to the C.T.C. installation, on each side of the coal tipple, facing on-coming trains. Each of these indicators, consisting of a single unit, such as are used in making up position-light signals, with an amber glass, was retained in service. As a train approaches, the indicator for that track is lighted until the rear of the train clears its respective switch, at which time the lamp is extinguished. This control circuit is made when the track relay of the switch-detector circuit is down.

The two train-order signals are of the power-operated semaphore type, being located immediately in approach to the coal tipple and telegraph office. These are designated as train-order signals by a dove-tail blade and the flashing-light indications. The flashing effect is accomplished by a flasher-button inserted in the lamp socket, this small device including a thermal unit which opens and closes the circuit.

Switch Layout Construction

The two power switches, No. 1 and No. 5, are operated by Union Switch & Signal Company Model A-20 dual-selector electro-pneumatic switch mechanisms equipped with point-detectors and CP values. Air for each of the switches is supplied by an installation of duplicate 3½ cu. ft. per min. capacity each, Westinghouse Air Brake Company air compressors at

each switch. The compressors are driven by General Electric 110-volt, 60-cycle, a-c. motors, the units being supplied by the Union Switch & Signal Company, and housed in an 8-way instrument case. The air pressure is maintained between 55 and 70 lb. per sq. in., one compressor of a set cutting in at 55 lb. and cutting out at 70 lb., the other cutting in at 50 lb. and out at 60 lb. Air reservoir tanks of 7 cu. ft. capacity, together with alcohol drip-feed tanks, are housed in concrete boxes, placed on the ground.

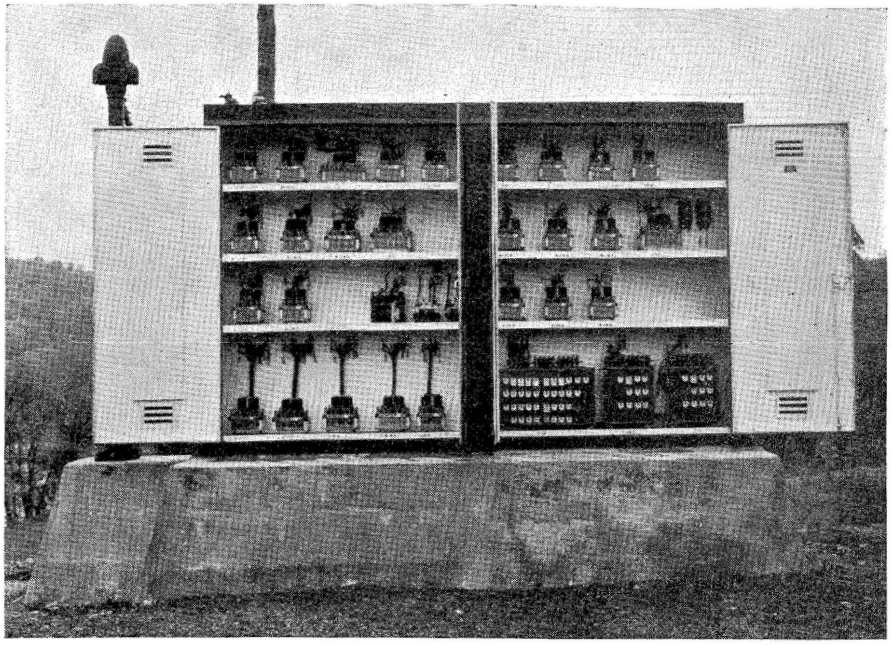
The switches at the leaving ends of the two sidings are equipped with Racor, "Three-in-One" stands, including springs, buffers, etc., for operation as spring switches, or for operation by hand lever in the ordinary manner.

Code Control System

A 15-station capacity control machine for the Union time-code system is located in a small, one-story frame telegraph office, approximately 6 ft. by 14 ft., near the coal tipple at the mid-point, between the eastward and westward passing tracks. The operator's desk is placed along one side of the building in front of a window, the entrance to the cabin being at one end. The control machine is placed flush with the end of the desk facing the doorway and at the left of the operator.

Two switch levers and four signal levers are provided on the machine, two separate amber lights being placed above the switch lever to indicate switch normal and switch reversed, respectively, when illuminated. Three lights are above each signal lever, a red indication being used for signals normal, an amber light for an L signal displayed, and an amber light for an R signal displayed. Two red low-air-pressure indicator lights are located in the lower portion of the panel, an indication being given and a bell being energized when the air pressure at either of the remote stations, supplied at those points by duplicate sets of air compressors, falls below 40 lb. per sq. in. Push-buttons are provided below each low-air pressure indicator to allow for cutting out of the bell by the operator.

The track layout and signal location is etched on the panel above the levers. Track occupancy is indicated by a normally non-illuminated red indicator light mounted on the panel in each track section. A single-stroke bell is provided in connection with all track sections, but can be made non-operative by the operator in all sections except A and G. Section A is the approach on the east main and G is the approach on the west main.



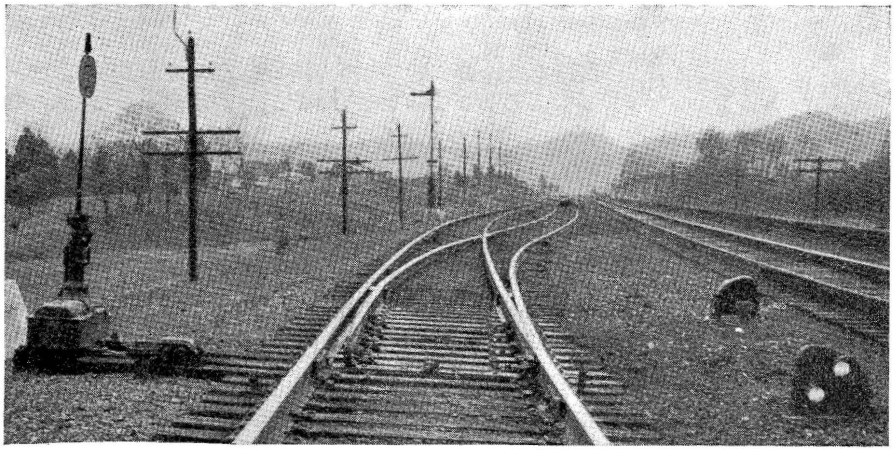
Instrument case housing the relays and code equipment at the west end

A panel is provided between the side of the C.T.C. machine and the wall, containing two toggle switches for the operation of the train-order signals. A white indicator lamp above each lever is lighted when the corresponding signal is clear, and a lamp below the lever is lighted when the signal is at stop.

All indication lights in the control cabin are normally fed with a-c. However, in case of a power outage, a Union ANL-40 power-off relay cuts them over to a battery so that the operator may remain informed as to the positions of the functions controlled.

The cabin equipment is located in a Union steel relay case, with shelves having two doors with glass windows. A.A.R. terminals are used. In circuits where tests are frequently made, EZ testing terminals are installed. A control panel for cutting out either the east end stations or the west end stations is located on the upper wall at one end of the cabin. Since, in case of trouble, the maintainer usually reports to the operator at the cabin, this location of the sectionalizing switches is quite advantageous in releasing the operative portion of the machine while repairs are being made.

One line-coding storage unit and two storage units are located at each of the two remote points, giving a total of six stations. The east end stations are 234, 235 and 236. The track-occupancy indications for sections G and H are handled by station 234. The control and indication of switch No. 5 and signals 6L and 6R, and the track occupancy indications of sections J and I are handled by station 235. The control and indication of signals 4S and 4M, the low-air-pressure indication for the east end station, and the track occupancy indication for section F, are handled by station 236. The west end sta-



Spring switch layout at west end showing spring switch indicator

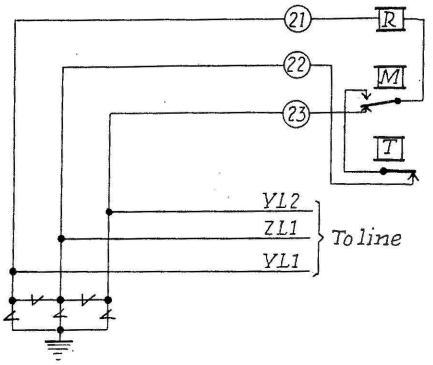
tions are 245, 246 and 247. Station 245 handles the track-occupancy indication of sections A and B. Station 246 handles the control and indication of switch No. 1 and signals 2L and 2R, and the track-occupancy indications of sections C and D. Station 247 handles the control and indication of signals 3S and 3M, the low-air-pressure indication for the west end station, and the track-occupancy indications of section L.

Since the control station is located at the center, it was necessary to use three line wires to the east end to prevent the east and west end stations transmitting code simultaneously. However, the usual two wires were run to the west end. The method of connecting the transmitter, line repeater, and master relay to the line at each of the remote stations is shown in the accompanying diagram. The C.T.C. line circuits are operated at 20 volts, supplied by 10 cells of Exide BTMH storage battery floated on an RT-11 rectifier at the control point. No. 6 AWG bare solid copper wire is used to carry the code line, being mounted on No. 42 glass insulators on a pole line paralleling the tracks on the north side. At the mid-point the code line is brought from the pole line under the tracks to the control cabin in Kerite No. 6 AWG solid copper mummy finish underground cable. The code operating equipment circuits are fed at 16 volts by 8 cells of EMGS-5 battery floated on an RT-42 rectifier.

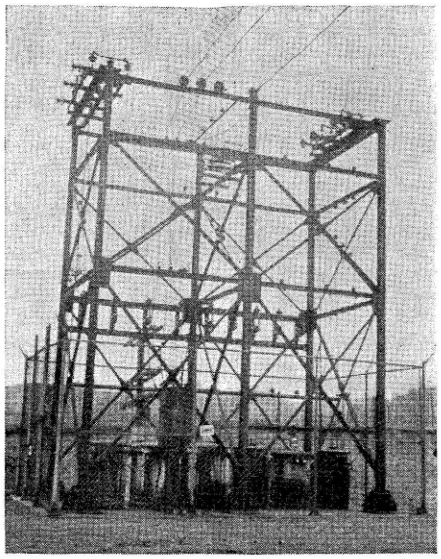
Other Construction Features

The semaphore signals on this installation are the Style-S, operating on 10 volts d-c. The semaphores are electrically lighted, using 12-16 volt, 21 c.p. bulbs in Everett projectors. The operating battery at each signal consists of 5 cells of either EMGS-5 or DMGO-5 on floating charge through an RT-10 rectifier.

The track circuits are of the d-c. type, each fed by one EMGS-7 cell floated on an RT-10 rectifier. Some of the track circuits are polarized and



Code line connections at east end



Sub-station located at the coal dock

the remainder are neutral, using either DN-11 or DP-21, 4-ohm relays.

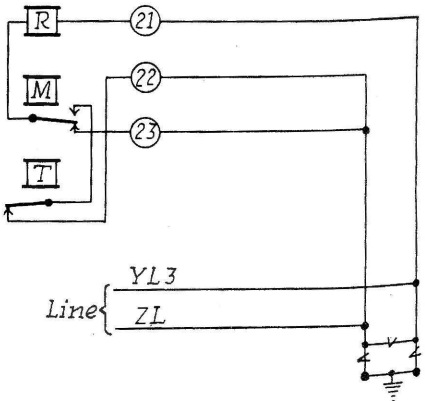
All hand-throw switches and crossovers are equipped with shunt boxes and double track-shunting connections. The crossovers between the main tracks and sidings are pipe-connected and bolt-locked. All fouling protection is run double. The rail is 131-lb. rail with continuous 4-hole insulated joints. Track connections are No. 9 AWG single-conductor stranded mummy finish underground cable, with Raco bootleg outlets and Keystone 13-strand connectors. Lavar 36-in., 3-strand bonds are used for bonding the passing tracks, while head-of-the-rail ribbon plug type Raco bonds are used on the main tracks.

Union 4-, 6- and 8-contact DN-11 relays of 1,000- or 750-ohm resistance are used on the line. Time-element relays are of the DT-10 type, while the slow-release relays are DN-11, 400-ohm relays. Union sheet-steel instrument cases, 7 ft. high, 9 ft. 8 in. long and 16 in. deep, house the apparatus at the remote stations, while the battery is housed in concrete battery boxes, with tin covered wood covers, placed on top of the ground. At the spring switch locations, the relays are housed in an 8-way instrument case, and, at the automatic signal locations, in the lower section of the Style-S signal cases. No. 16 flexible, rubber and braid covered, 19-strand Kerite wire is used for jumpers. Signal circuits are carried between locations on No. 10 AWG bare Copperweld line wire mounted on No. 42 glass insulators on the pole line or in No. 14 AWG solid copper, mummy finish, underground cable. Terminal pole boxes are used at signal locations, the low-voltage circuits being broken through Raco Everett turret-type lightning arresters.

Power Supply

Power for the installation is obtained from a commercial source at Kenova, 13 miles west of Prichard, at 13,200-volts, 60-cycles, 3-phase. This line is No. 4 AWG bare copper wire on brown porcelain insulators, feeding the intermediate automatic signal locations and the west end remote station at Prichard, terminating at an outdoor transformer sub-station at the mid-point of the remote control installation, where it provides power for the operation of the coal-handling facilities and feeds a 4,400-volt, 60-cycle, 3-phase signal power line running east 34 miles to Crum, W. Va. The power feed for the east end remote station is taken from this 4,400-volt line, which is No. 4 AWG bare solid copper wire on brown porcelain insulators. A static wire is provided in conjunction with the power lines, consisting of a No. 5 AWG three-strand Copperweld wire. Air-gap switches are installed in the power line every five miles, and both the 13,200- and 4,400-volt lines are transposed at intervals of five miles. At the west end remote station, a General Electric 5 K. V. A. single-phase, 13,200-110-volt transformer is provided, being connected across one phase of the 13,200-volt line. Three 13,200-4,400-volt, 37½ K. V. A. single-phase transformers are used at the mid-point sub-station, the single-phase transformers being connected in delta. At the east end remote station a General Electric ¾ K. V. A. 4,400-110-volt, single-phase transformer is connected across one phase of the 3-phase, 4,400-volt line. Where necessary, the 110-volt line is run for short distances in No. 10 bare Copperweld line wire on No. 42 glass insulators.

This installation was planned and installed by signal forces of the Norfolk & Western, the major items of signal apparatus being of Union manufacture.



Code line connections at west end