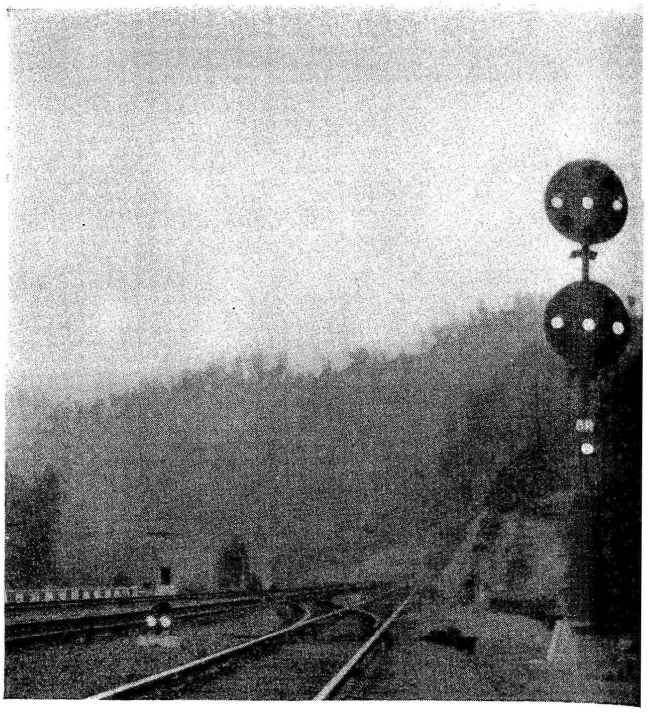
Traffic expedited on busy branch line handling coal traffic—Special relay connections used to secure low resistance at track cut sections



Centralized Traffic Control

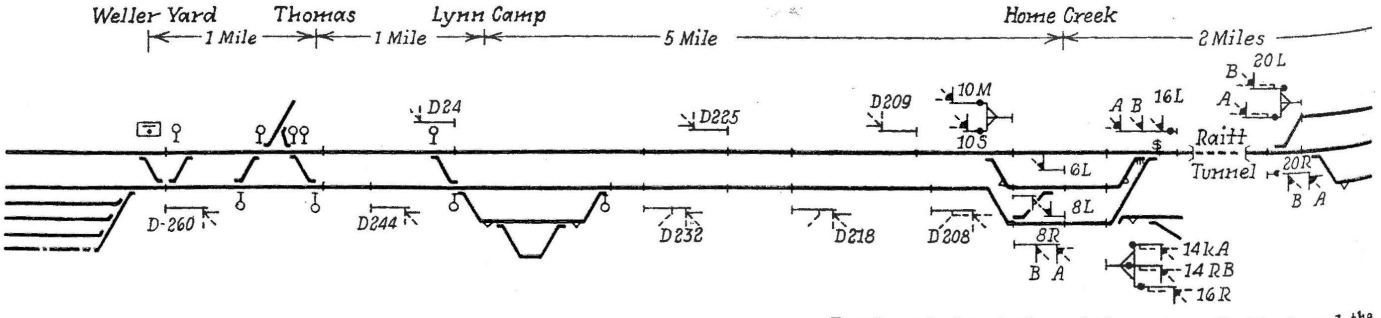
THE Norfolk & Western has installed automatic block signaling on seven miles of double track and nine miles of single track between Weller Yard, Va., and Luke, and the project includes centralized traffic control on the nine miles of single track and passing tracks between Home Creek, Va., and Luke. This installation is on the Buchanan Branch which extends eastward from a connection with the main line at Devon, W. Va.

Within recent years, several large coal mines were opened along this branch line. At present about 300 cars are being loaded daily and arrangements are under way to load as many as 600 cars daily. In anticipation of this traffic, the Norfolk & Western made extensive improvements on this line. As explained in an article in the January, 1939, issue of *Railway Signaling,* power switches and signals, controlled remotely from a machine in the Devon station, were installed to facilitate train movements between the main line and the Buchanan Branch at the Devon junction. At the east end of the branch, extensions were built to several new coal properties, the Weller Yard was enlarged, and seven miles of second track was constructed between Weller Yard and Home Creek, at the east end of Raitt tunnel. From Devon eastward, the grade ascends at about 0.3 per cent for 12 miles, then at about 1.8 per cent for five miles to Raitt tunnel. On the double-track line, the grade ascends westward at 1.7 per cent for about seven miles from Weller Yard to Raitt tunnel.

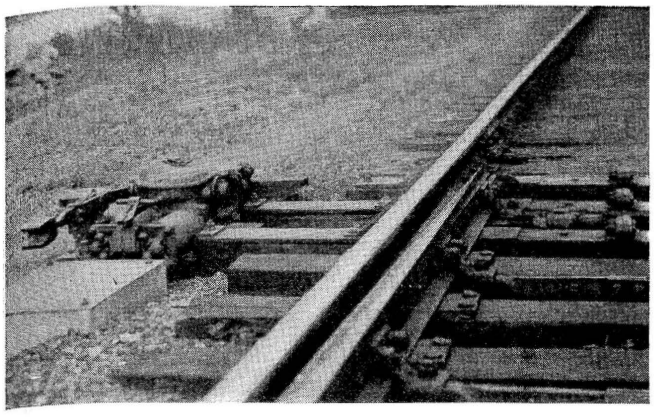
Operating Problems

During the late afternoon and early evening, the loaded coal cars are picked up from the mine tracks on the branches east of Weller Yard and are taken to this yard where they are assembled in trains. While pulling loaded cars from the mine tracks, empty cars must also be spotted ready for loading the next day. Likewise during the afternoon, a switch-run train operates between Weller and Luke, picking up loaded cars and setting out empties at the mines in the vicinity of Hurley, Raitt, Home Creek, and Lynn Camp. The loaded cars are set out at Luke, ready to be picked up by westbound trains. The loaded cars assembled at Weller Yard and the point mentioned above are all moved out during the night, and an equal number of empty cars must be returned during the latter part of the night or early forenoon.

The trains are operated between Weller Yard via Devon to Williamson, W. Va., which is 22.6 miles west of Devon on the main line. Some of the coal from the Buchanan Branch is for movement eastward, and these



Track and signal plan of the automatic block and the



Left—Signal 8R near the end of the passing track at the Home Creek layout
Above—Type-A20 electro-pneumatic switch machine with dual-control levers

Solves Problem

on the Norfolk & Western

cars are set out at Devon where they are picked up by main line eastbound trains. In addition to all the coal trains operated on the Buchanan Branch, a mixed train is operated in each direction daily, between Devon and Grundy, which is 10 miles east of Weller Yard. Although this train is scheduled, it runs off schedule as may be necessary to make switching moves and to get out of the way of through trains.

Thus the problem of operation on the Buchanan Branch is to direct the operation of the scheduled mixed train, the mine run, and through trains between Weller Yard and Devon, which are run as extras. On account of the impossibility of anticipating when trains will be ready to depart from certain points, the direction of train movements by train orders resulted in numerous train stops and delays, and the handling of passing track switches by hand-throw stands introduced additional delays. For these reasons, the centralized traffic control was installed so that all train movements between Home Creek and Luke, as well as certain other moves explained later, could be directed by signal indication without train orders.

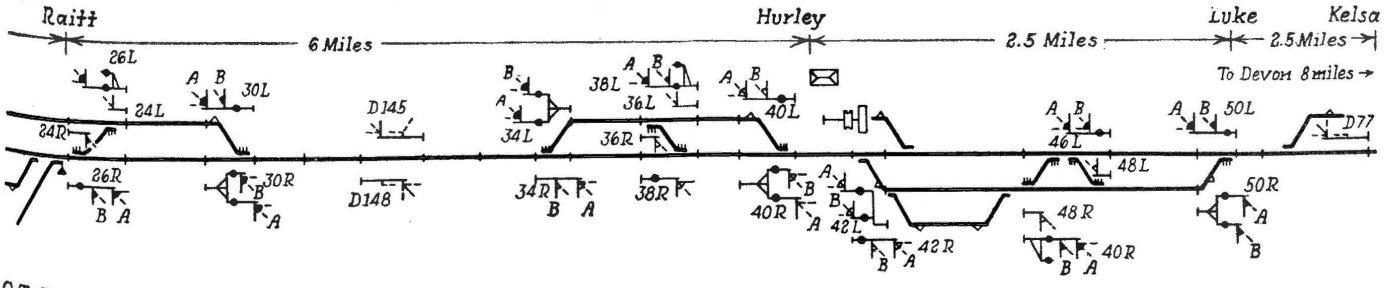
Under the new arrangement for directing train movements, the signals controlled by the C.T.C. system direct all train movements in either direction between the west end of Luke and the east end of Home Creek. Likewise a clear aspect on eastward signal 10M authorizes the train to proceed on the normal right-hand track from Home Creek toward Weller Yard. Westbound trains leaving Weller Yard carry train orders authorizing right-hand running to Home Creek and also orders authorizing movement from Luke to Devon, providing westward signal 50RA or 50RB is displaying a proceed aspect. Eastbound trains pick up orders at Devon for movement on the section from Devon to Luke.

C.T.C. Control Machine

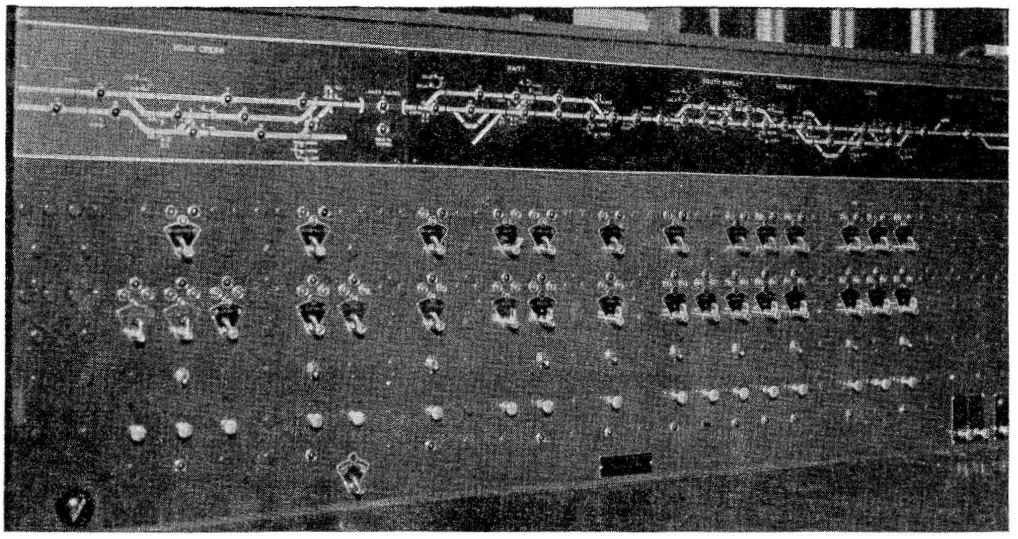
The signals for authorizing train movements in lieu of train orders, as well as the power switch machines, are controlled by a C.T.C. type machine with non-interlocked miniature levers and a complete system of indications, this machine being located in the telegraph office at the west end of Weller Yard. This machine has 17 levers for controlling signals and 12 levers for controlling switches or crossovers, as well as one lever for controlling an electric switch lock.

The small toggle type levers, on the control machine below the switch levers, are for the control of the maintainer's call lamps and whistles at the corresponding field locations.

In order to afford protection for motor cars passing through or men working in Raitt tunnel, all signals governing movement through it can be locked in stop position by means of a special lever on the C.T.C. machine and two push buttons, one located at each end of the tunnel, which operate a locking circuit. The employee desiring protection advises the operator by a telephone located adjacent to either push button, and holds this button "in" until an indicator light is illuminated, which will occur only if the operator sends out a special code while the button is being held "in." This locks the above mentioned signals in the stop position, and also illuminates an indica-



C.T.C. territory between Kelsa and Weller Yard



The centralized traffic control machine is located in the office at the Weller Yard

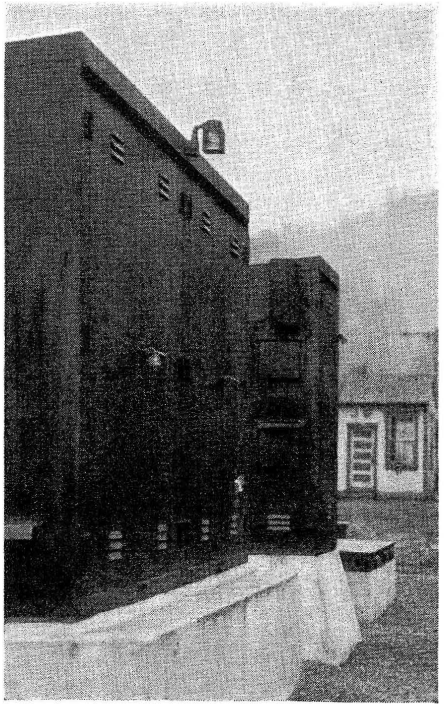
tor light on the machine. The signals cannot be cleared by the operator until the push button is again held in while a clearing code is sent out, which releases the locking and extinguishes the indicator lights both in the field and on the machine. Thus definite action must be made simultaneously by two men, both to set up and to release this locking circuit. The field action of the combination may be set up at one end of the tunnel and released at the other, or set up and released at the same location.

The illuminated track diagram includes lamps to indicate train occupancy of all the main line as well as the passing tracks in C.T.C. territory. Within the limits of the passing tracks, separate lamps indicate track occupancy of sections of the main line and siding between switches and crossovers. With these indications, the operator is informed of the location of each and every train at all times. Light-type indicators, working in conjunction with a bell, are provided on the control panel to give warning in case the air pressure at any of the electro-pneumatic power switch layouts is reduced below 45 lb.

Position Light Signals

The signals on this installation are of the position-light type, and standard aspects are used. Each semi-automatic signal controlled by the C.T.C. system and used for authorizing train movement is designated by a position-light marker mounted on the mast 6 ft. below the position-light head. A signal such as 34R has two position-light heads, the top head governing train movement on the straight through route and the bottom head, on the diverging route. Several signals, such as D148, are equipped with a vertical row of lights below the top head and when illuminated, in conjunction with diagonal position of top lights, indicate that the signal in advance is in the caution position or that the bottom indication of that signal is set for a diverging movement. It was necessary to install this approach indication as the views of the signals are comparatively short due to numerous curves and high mountains, and it would be impractical to secure efficient train operation without their use. Standard position-light grade indications are installed as needed to prevent unnecessary stops of tonnage trains.

As part of the signaling system, position-light type switch indicators are located at main-line, hand-operated switches. Normally two lamps in a diagonal row are lighted in such an indicator, but if a train is approaching within the limits of three automatic blocks, including the one in which the indicator is located, the indicator displays two lamps in a horizontal row.



Maintainer's call lamp on case

Switch Operation

The end-of-double-track switch at Home Creek is operated by a Pettibone-Mulliken Company spring switch mechanism with a Union Switch & Signal Company mechanical facing-point lock and dual-control mechanism. The passing tracks and crossover switches are operated by Union Type A-20 electro-pneumatic switch machines equipped for dual-control. When a selector lever is operated, the air supply to the switch machine is cut off, the valve control circuits are opened, and a code is sent to the office indicating an open switch and an occupied track circuit. Each selector lever is locked with a standard padlock to prevent unauthorized operation, and the hand-throw lever is, of course, padlocked.

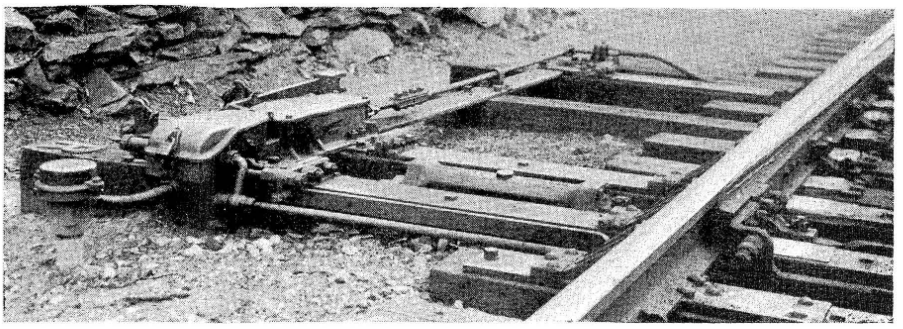
Each switch is equipped with lock rods, and a point-detector which is set to operate if the switch point is open more than 3/16 in. Each layout is equipped with three ¾ in. by 7 in. insulated gage plates, and two of these plates extend and are bolted to the switch machine to prevent lost motion. Adjustable rail braces are used on the ties which are equipped with gage plates.

Compressed Air Supply

The compressed air for the operation of the switch machines at each layout is supplied by duplicate sets of compressors, rated at 3.25 cu. ft. per minute and driven by 110-volt ¾ h.p., a-c. motors. The compressors are controlled automatically, the one

in normal operation being set to cut in at 55 lb. and cut out at 70 lb., while the auxiliary compressor cuts in at 45 lb. and out at 60 lb. A hand-operated switch is provided to interchange the compressors from normal to auxiliary service for a period of one month, so that the wear will be uniform.

An electric switch lock, controlled by the C.T.C. machine, is provided on switch 23 at Raitt. This switch leads to a mine track on which an entire train is pulled when making switching moves. Before re-entering the main line a member of the train crew must telephone the operator to tell him that the train is ready to move and then the operator releases the lock if he is ready for the movement to be made. On sidings where cars are held for certain periods, Hayes derails are pipe connected to and operated by the respective switch machines.



Spring switch with mechanical facing-point lock

Pole Line and Power Supply

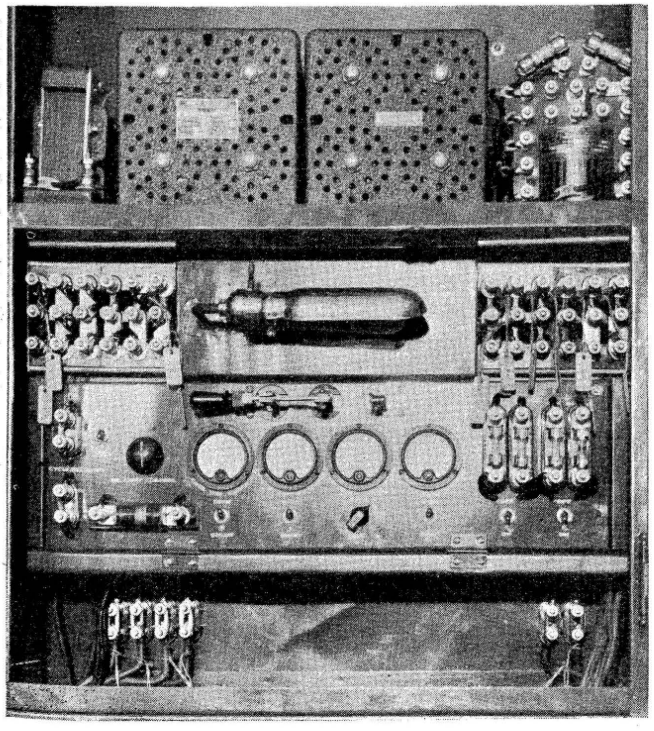
A new pole line was constructed to carry the signal line and the a-c. power distribution line. Class 3 southern pine poles, treated full length with creosote sufficient to penetrate to the heart wood were used. The poles are of various lengths depending on the lay of the land, but the average is about 35-ft., and the poles are spaced about 130-ft., i.e., 40 to the mile. The three-phase 4400-volt, 60-cycle power distribution circuit is carried on three No. 4 bare solid hard-drawn copper wires, two wires being on the short crossarm and the third on the pin on the top of the pole. A ground conductor, consisting of a strand of three No. 10 Copperweld wires, is carried on an angle iron galvanized bracket which places this wire 1½-ft. above and 12-in. to one side of the top of the high voltage wire. This ground wire is connected to ground at every eighth pole and also at all signal locations, Copperweld ground rods ½-in. by 8-ft. being used. All low voltage circuits are No. 10 bare Copperweld wire except the line code circuit which is No. 6 bare solid copper wire.

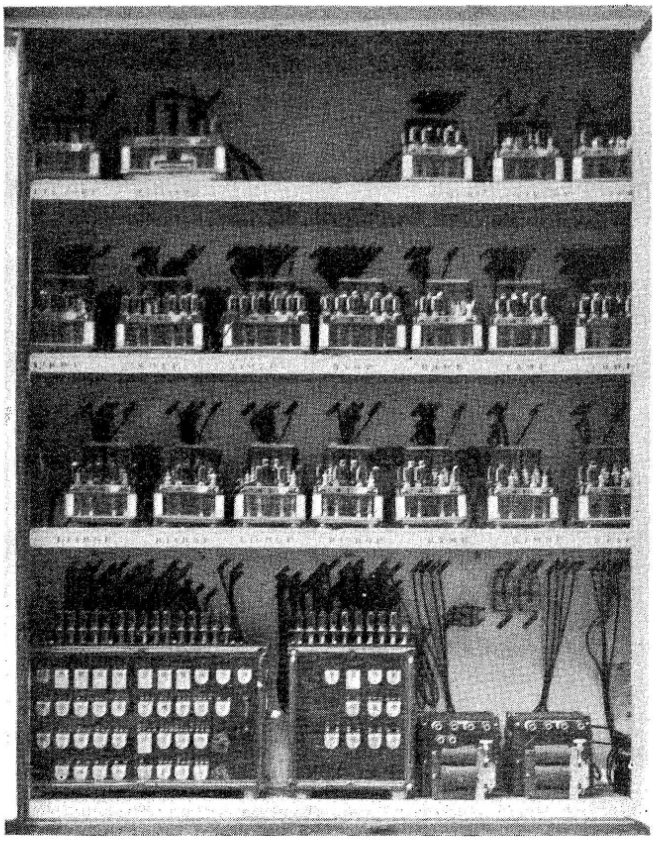
At each signal location a General Electric Company, Spiracor type single-phase transformer, rated at ¾ kva, reduces the voltage from 4400 to 110, to feed the low-voltage transformers, rectifiers, etc. Pellet-oxide type arresters and fused cut-out boxes are mounted on the crossarm with the line transformer.

The signal line control circuits are protected by Raco low-voltage turret type arresters, which are mounted in a cast-iron box attached to the pole just below the bottom crossarm. The drops from these arrester boxes to the cases are in manufactured aerial cable attached to Copperweld messenger wire with Raco cable straps.

A set of five cells of Exide EMGS-7 battery on floating charge from an RT-42 rectifier feeds the line control circuits and serves as standby. Each track circuit is fed by one cell of the same type of battery which is charged by an RT-10 rectifier. Rail joints are bonded with Raco rail-head plug-type bonds.

The insulated wires and cables on this installation are of Kerite manufacture. Underground cables are made up with non-metallic mummy





Above—Power equipment in control station
Right—Instrument case at field location

type outer protection. Connection from the cases to the rail are underground cable with No. 9 flexible conductor using Raco metal bootleg risers.

Code Line Battery

The controls of the signals and switches, as well as the various indicators, are handled by a two-wire time code system. The office coding and storage units are located in the sheet-metal case of the control machine. The 80-volt code line battery consists of 37 cells of Exide type BTMHP3 battery, and the 16-volt local battery of 8 cells EMGS-7.

The code line and local batteries are on floating charge through an RT-42 and on RT-81 rectifier respectively. The rectifiers, arresters, switches, meters, etc., associated with the code line circuit are mounted in a sheet-metal cabinet in the office, as shown in one of the illustrations.

At the field locations, the code equipment, as well as the relays, are located in large-sized, sheet-metal cases, which are 2-ft. from front to rear, 5-ft. 7-in. high and 9-ft. 8-in. long. Two sets of double doors open at the front, and removable panels at the rear give access to the wiring space behind the terminal boards. All incoming wires, as well as wires from terminal posts on instruments, are terminated on Raco bakelite base terminals mounted in the lower shelf of the left-hand section of the case. A 110-volt a-c. outlet plug is provided in each case so that the maintainer can plug in an extension cord and lamp when working at night.

From the terminals, each wire passes back through an individual hole in the terminal board, then up in the wiring space and out through another hole and direct to its post on an instrument. An identification tag on each wire is held against the terminal board by a small screw.

Maintainer's Call Lamp

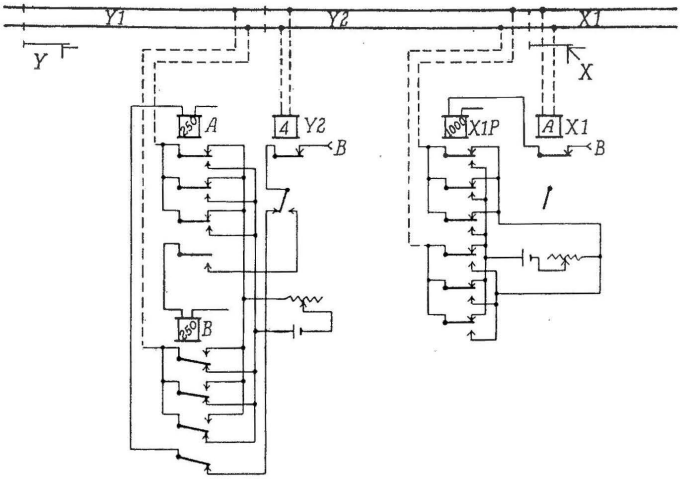
A maintainer's call lamp, consisting of a white fresnel lens, 3-in. in diameter and 3-in. high, is mounted on the front of the case and above the doors. When the operator wants to call a maintainer at a certain location, the corresponding toggle switch on the panel is thrown, and a control code for that location is sent out. This causes the maintainer's lamp to be lighted and also to blow a blast on the pneumatic whistle. The lamp remains lighted until an extinguishing code is sent out. A telephone, connected to the operator's line is located in the vicinity of each group of signals or switches, for use of the maintainer as well as members of train crews.

Polar Track Circuits

The automatic block signals on the double track are controlled by polarized track circuits to display three aspects. In order to minimize the contact resistance and thus insure proper operation of these polar circuits, a special arrangement of relays was used to permit contacts to be used in multiple. At signal X a 1000-ohm relay X1P is controlled through a front contact of track relay X1 in the block for Signal X. The X1P relay has six contact fingers with front and back points connected as shown to polarize the feed to track circuit Y2, and thus control the 4-ohm polar track relay Y2. This Y2 relay is a model DP-21 which has two normal and two reverse polar contacts which were not considered to be enough to handle the polar track circuits, and, therefore, two 250-ohm neutral relays A and B were connected as shown.

When a train is traveling from signal Y to signal X, the control relay for signal Y will be de-energized by direct track circuit control, while track circuit Y1 is occupied. While track circuit Y2 is occupied, relay Y2 is de-energized, and, therefore, both special relays A and B are de-energized, thus disconnecting battery from track circuit Y1 and also shorting the track circuit. When the train clears track circuit Y2, but is occupying block X1, then relay X1P is de-energized causing positive battery to be fed to the lower rail and negative battery to the top rail of track circuit Y2. This energizes track relay Y2 with the polar contact thrown to the right, which causes relay B to be energized with relay A de-energized. This connection feeds positive battery to the top rail and negative battery to the bottom rail of track circuit Y1. This causes the approach aspect to be displayed at signal Y.

When the train passes out of Block X and track relay X1 is energized, relay X1P is picked up, which reverses the polarity on track circuit Y2. This causes the polar contact in track relay Y2 to move to the left position which causes relay B to be de-energized and relay A to be picked up. This operation reverses the polarity of the feed to track circuit Y1, thus reversing the polar contacts in the relay which controls signal Y and causes the clear aspect to be displayed.



Circuits to secure low contact resistance

Both front and back contacts in the relays X1P, A and B, are silver to silver impregnated, and experience since the installation has been in service indicates that the resistance of three of these contacts in multiple is sufficiently low to insure reliable polarized track circuit control.

Considering the scheme from the safety standpoint it will be noted that if either relay A or B fails to pick up when it should that a short will remain on track circuit Y1. Both of the relays A and B cannot be energized at the same time because the control of each is made through a back contact of the other.

Construction by Railroad Forces

This installation was planned by the N. & W. signal department engineers with the cooperation and assistance of the Union Switch & Signal Company engineering staff. The major items of signaling equipment were furnished by the U. S. & S. Co., and all field work was done by the N. & W. signal department construction force.