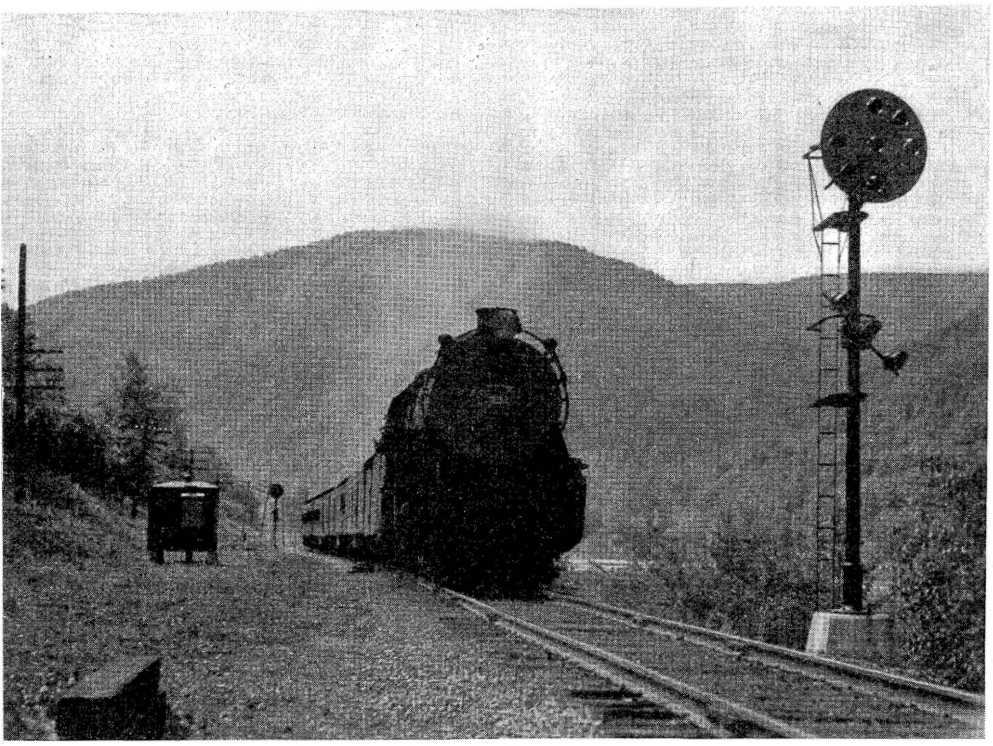
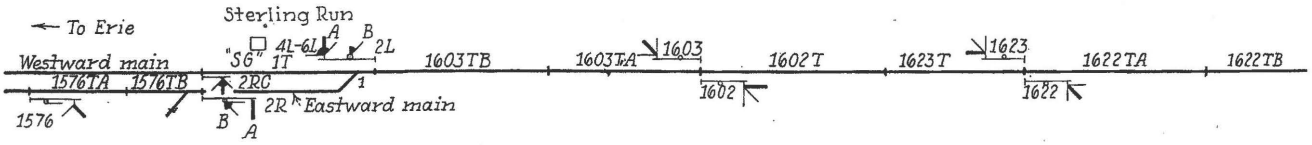


Westbound train entering single track at Huntley after accepting signal 8L.—Signal 8R in foreground.—Instrument house at left.

Ends of Double Track Controlled by C.T.C.



Pennsylvania expedites traffic over single-track section of double-track Renovo division — Automatic signals provided between end-of-double-track switches and between the control point and nearest remote station

THE PENNSYLVANIA has recently completed an installation of a Union time-code centralized traffic control system for the control of switches and signals at each end of 4.5 miles of single track, located between Huntley, Pa., and Sterling Run, within a double-track section of the Renovo division. Two end-of-double-track switches and 10 signals are controlled from an interlocking tower at Driftwood, Pa., 5 miles east of Huntley.

Prior to the installation of C.T.C., the double-track section from Driftwood to Huntley, and the single-track section from Huntley to Sterling Run were operated under manual block system rules. Block offices were located at Huntley and Sterling Run. The end-of-double-track switches were hand-thrown and the signals at these locations were power-operated semaphores controlled from the block offices.

The C.T.C. installation was placed in service on April 25, to eliminate congestion on the single-track section resulting from scheduled traffic of 10 passenger and 8 freight trains daily.

The Revised Layout

Revision of the layout included: The removal from service of the hand-thrown switches and power-operated semaphores at Huntley and Sterling Run; the removal of a westward block signal at Driftwood and an eastward distant signal 3,100 ft. west of Driftwood; the installation of two position-light, automatic signals between Driftwood and Huntley; the installation of an end-of-double-track switch, a position-light dwarf signal and two two-arm, interlocked, position-light high signals at Huntley (HY) controlled remotely by C.T.C. from Driftwood; the installation of two sets of single-track, position-light, automatic signal locations between Huntley and Sterling Run; the extending of the end of double track at Sterling Run 2,500 ft. eastward; and the installation of a power-operated end-of-double-track switch, a position-light dwarf signal and two two-arm position-light high signals at Sterling Run (SG) also remotely controlled by C.T.C. from Driftwood, and a position-light, two-arm, eastward distant signal for the eastward track at Sterling Run. The final layout is shown in the accompanying diagram.

Manual block rules are in effect east of Driftwood, DF, and west of Sterling Run, SG, block stations being located at Driftwood and at JN, approximately 9 miles west of SG. Signal 4L-6L at SG, remotely controlled by C.T.C. from DF, governs westward movements into manual block territory. Interlocking rules apply at DF, HY and SG. Automatic block system rules are in effect on double track between DF and HY, and on single track between HY and SG for following movements. Controlled manual block rules apply between HY and SG for opposing movements. At HY and SG, block signals govern the use of the blocks; their indications supersede time table superiority and take the place of train orders. Signals 8Lb and 8Lc at HY carry authority for movement on single track to signal 1623, and signals 2R carry authority for movement on single track to signal 1602. Telephones are provided in shelter boxes, connected with the block line, at HY on the north side of the westward main track, and at SG on the south side of the eastward main track. In emergency, the switches at HY and SG can be operated by hand after conferring with the operator at DF. Instructions for the manual operation of the switches are posted in the telephone shelter boxes. Trains stopped at HY or SG by stop signals, must immediately call DF for instructions.

Signal 1656 acts as eastward distant signal to Driftwood, signal 1655 serves as westward distant signal to Huntley, signal 1622 acts as eastward distant signal to Huntley, signal 1603 serves as westward distant signal to Sterling Run, and signal 1576 acts as eastward distant to Sterling Run.

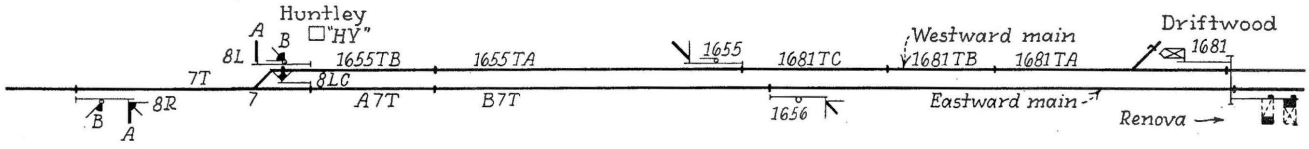
The Time-Code C.T.C. System

The Union time-code C.T.C. system is designed to control switch and signal functions of any type of track layout, being equally applicable to single track with widely separate functions or to multiple-track interlockings. It consists of special centralized traffic control equipment, operated in conjunction with standard track and signal apparatus.

A single series circuit of two wires extends from the controlling office to the most distant point of the controlled territory. By means of this line circuit, which is normally energized by a battery located at the office, the functions at any station may be selected and operated, and indications returned to the office reflecting the conditions at the remote points.

Operation of functions in the field is obtained by interrupting the line current and coding it on the time-element principle. A contact on a transmitting relay in the office is inserted in, and makes and breaks, the line circuit. Both open and closed line impulses are utilized. The impulses are numbered, beginning with the first break in the normally-energized line. A control code consists of 14 impulses, any one of which may be made long by proper control of the transmitting relay. At each of the field stations a special relay is operated by the line circuit, repeating the impulses put on the line to special decoding equipment. Slow-release relays are controlled by this code following relay. When all the impulses are short, these relays do not have time to release, but, if a particular impulse is long, a particular slow-acting relay releases, depending upon whether the impulse is odd or even numbered. In other words, a long odd numbered (line de-energized) impulse causes a particular slow-acting relay at each field station to drop, and a long even numbered (line energized) impulse causes a different slow-acting relay to drop. Register relays pick up in the field, depending upon the number of each long impulse. Thus, any one station may be selected by making particular impulses long, and certain functions at that station may be operated by making later impulses in the same code long.

The functions operated are controlled by relays connected to a stand-



Manual block signal 4L-6L at Sterling Run. After passing signals 1623 and 1603, train, upper left, will receive this signal to govern movement back into double track territory at Sterling Run.

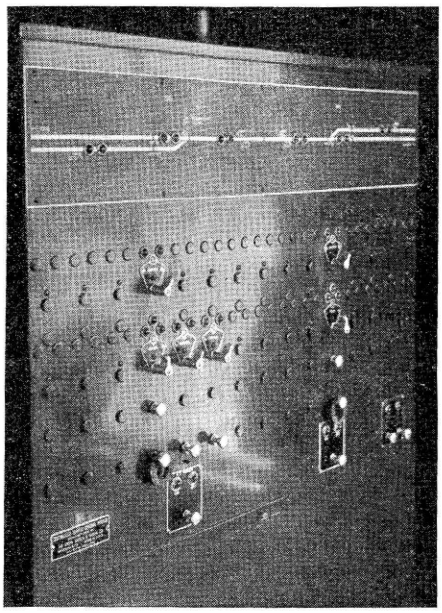
ard terminal board on the decoding equipment. All locking between the controlled functions, and all standard safety features, are accomplished by local wiring at each field station. Thus, the coding equipment is interchangeable, the different conditions present at each installation being taken care of by proper local circuits and proper connections to the C.T.C. apparatus.

Indications as to conditions in the field are obtained by automatically transforming the field station into a transmitter every time a function changes its position. By similar action to that of the office in sending, a field station may place an indication code on the line circuit, setting up receiving circuits in the office so that the information received is displayed on a panel board in front of the operator. The office receiving circuits are similar to those of a field station. An indication code consists of 16 impulses. The first part of this code selects the group of functions to be indicated and the latter part controls the lights, or other indicators, which show the condition of the functions in that group.

The Control Machine

The control machine for the C.T.C. system is located on the second floor of DF block station. This tower also houses a P-5 electro-mechanical machine with 6 mechanical levers and 12 electric levers controlling cross-overs and the leads to 2 yards and sidings at Driftwood. The C.T.C. machine is placed at the right of the electro-mechanical machine and consists of a 15-station control panel, 2.5 ft. wide and 54 in. high, equipped with 2 switch levers, 4 signal levers, 2 of which have "call-on" buttons, 4 code buttons, 2 power-off indicators with power-off bell cut-outs, and the usual indication and control code receiving and sending indicators, control code knock-down button, and "OS" bell cut-out. The code buttons control the sending feature of the machine and the control levers located directly above them. The switch and signal levers are provided with various colored indicators, the functions of which are explained later. A track diagram, showing the location of the switches and signals, including the automatic signals between HY and SG, is etched on a panel on the top front of the machine. Two normally de-energized red track indicators are provided for each track section between signal 8L and signal 2R and for the approach track sections between signals 1576 and 2R and between signals 1655 and 8L.

Levers 1 and 7 control the end-of-double-track switches at SG and HY,



The control machine at Driftwood

respectively. The switch at SG is normally set for train movements from single track to the westward main track, while the switch at HY is normally set for movements from single track to the eastward main track. Two yellow indicators above each lever repeat the normal and reverse positions of each switch. The switches operate from normal to reverse position in approximately 16 seconds. When the home signals are restored to the stop position immediately before a switch lever is operated with the approach track section occupied, an automatic time release must complete its operation before the switch will operate. If dwarf signal 2R is restored, the time delay will function without the approach section being occupied.

Levers 2 and 8

Lever 2 governs signals 2L and 2R. These signals are normally at stop with the lever in the center and a red indicator above the lever, in the center, normally lighted. With the lever to the left, signal 2Lb is displayed in conjunction with signal 4-6 at stop for a westward movement over switch 1 reversed *only*. A yellow indicator over the lever to the left shows the operator when the signal is displayed. Throwing lever 2 to the right displays signal 2Rb for eastward moves from the eastward main track with switch 1 reverse, and signal 2Rc for eastward moves from the westward main track with switch 1 normal. A yellow light to the right and above lever 2 indicates, when illuminated, that one of these signals is displayed.

Lever 8 controls signals 8L and 8R, normally in the stop position, with the lever in center and a red indicator above the lever illuminated. With the lever to the left, signal 8Lb is displayed for westward movements on the westward main track with switch 7 reversed. With switch 7 normal, and lever 8 to the left, signal 8Lc will be displayed for westward movements off the eastward main track. Throwing lever 8 to the right displays signal 8Ra for eastward movements with switch 7 normal or 8Rb with 7 reverse. Yellow indicators, one on the right and one on the left, repeat the display of signals controlled.

"Call-on" buttons are provided below signal levers 2 and 8. The normal position of a "call-on" button is "in." With the button in the normal position and the signal lever positioned to clear the signal, the signal will operate as semi-automatic stick. When the button is pulled out and the signal lever is positioned to clear the signal, the signal will operate as semi-automatic non-stick, and the signal will display a stop-and-proceed aspect ("call-on") for closing in movements. Buttons must be pushed in and the code button operated to cancel the semi-automatic non-stick feature.

Levers 4 and 6

The control of block signal 4L-6L is arranged to enforce the complete sequence of lever operation for each train to insure that a clear signal can be displayed only as a result of proper manipulation. Levers 4 and 6 are normally to the right. Lever 4 controls the permissive block aspect for westward moves to the westward track into manual block teritory, and lever 6 controls the clear aspect of the same signal. Semi-automatic stick control is provided which causes signal 4L-6L to display a stop aspect as soon as a train enters track circuit 1T. An indication code is then transmitted, which causes the display of a red indication light to the right and above lever 4. Before the signal can again be cleared, levers 4 and 6 must be placed normal, the code button operated and a stop signal code transmitted to pick up relay 6NHS in the field. When signal 4L-6L is to be cleared for the next move, a permissive signal code must first be transmitted with levers 4 reverse and 6 normal and with switch 1 normal. Upon the completion of this code, a permissive signal aspect is displayed and an indication code is transmitted which lights a yellow lamp to the left and above lever 4 and also a yellow lamp to the right and above lever 6. The red light associated with lever 4 is extinguished at this time. The clear signal control code may now be transmitted by moving lever 6 to the left and operating the code but-

ton. Upon completion of this code, signal 4L-6L will display the clear aspect and an indication code will be transmitted which will light the green lamp associated with lever 6 and extinguish the yellow indication lamps. It should also be noted that a code can be transmitted at any time to set signal 4L-6L at stop by placing lever 4 or levers 4 and 6 normal and operating the code button, and that the signal aspect can be changed from clear to permissive by placing lever 6 normal and leaving lever 4 reverse and transmitting a control code.

Power-Off Indications

Two yellow and two red "On"-"Off" indicators and two cut-out buttons are provided in the lower portion of the panel for Huntley and Sterling Run power-off indications. With power-on at Huntley, a yellow "on" indicator is illuminated, while with power-off, a red "off" indicator is illuminated, and a bell rings continuously until cut out by operation of the cut-out push button. The power-off indication for Sterling Run operates in the same manner.

In the lower right corner of the panel, there is a yellow indicator which is illuminated when the machine is receiving a code, and another yellow indicator which is illuminated when the machine is sending a code, a control-code knock-down button which will cancel a code if operated before the code is sent, and an OS bell button which can be pulled out to cut out the operation of a bell which gives a signal as a train enters an OS section.

The control machine at Driftwood controls the position-light signals and two Union M-22 switch machines at the ends of double track at Huntley and Sterling Run over two copper No. 8 weatherproof line wires. One line coding storage unit, station 245, comprises the code receiving and transmitting equipment at Huntley, while one line coding storage unit and one field storage unit, stations 234 and 235, are used at Sterling Run. The field connections to these units are shown in Fig. A. Station 245 at Huntley controls and indicates No. 7 switch and No. 8 signals, and indicates eastward approach on the single track and occupancy of the interlocking track section at Huntley. Station 234 at Sterling Run controls and indicates No. 1 switch and No. 2 signals, and indicates the eastward approach and occupancy of the interlocking track section at Sterling Run. Station 235 at Sterling Run controls and indicates signals 4L and 6L, and indicates westward approach on the single track and power-off at Sterling Run. The power-off indications for Huntley and occupancy of the westbound approach to Huntley are carried in direct wire to the control machine at Driftwood.

The field storage control relays for signals are designated HS relays, viz.: 8LHS, 8RHS, 2LHS, etc. The switch control storage relays are designated WS relays, viz.: 7NWS, 1RWS, etc. The control relay for the "calling-on" aspect and for semi-automatic non-stick operation is designated CR. Repeating relays are designated M relays, viz.: 8RM, 7NM, etc. Time-element relays are designated TE, while SA is used to designate slow-acting relays. Approach relays are designated by the letter P or Q, viz.: 1PA, 2P, 1Q. Lock relays are designated KM, viz.: 8LKM, 2RKM.

Switch Controls

Referring to the connections to the field line coding storage unit 234 and field storage unit 245, when a reverse switch control code is transmitted to the field station, the stick circuit for relay NWS is broken through terminal 3, and relay RWS is picked up through the circuit from terminal 2 and remains stuck up through the circuit to terminal 3. Likewise, when a normal switch control code is received, the stick circuit for relay RWS through terminal 3 is broken, and relay NWS is picked up through the circuit from terminal 1, and sticks up through the circuit to terminal 3.

The switch control relays are polar relays, designated 1WR and 7WR respectively. Referring to the control for relay 7WR, polar selection is made over contacts on 7NWS and 7RWS switch storage control relays, and over contacts on the switch locking relay 7KM. As will be seen later, the switch must be faced up in one position or the other to display signal

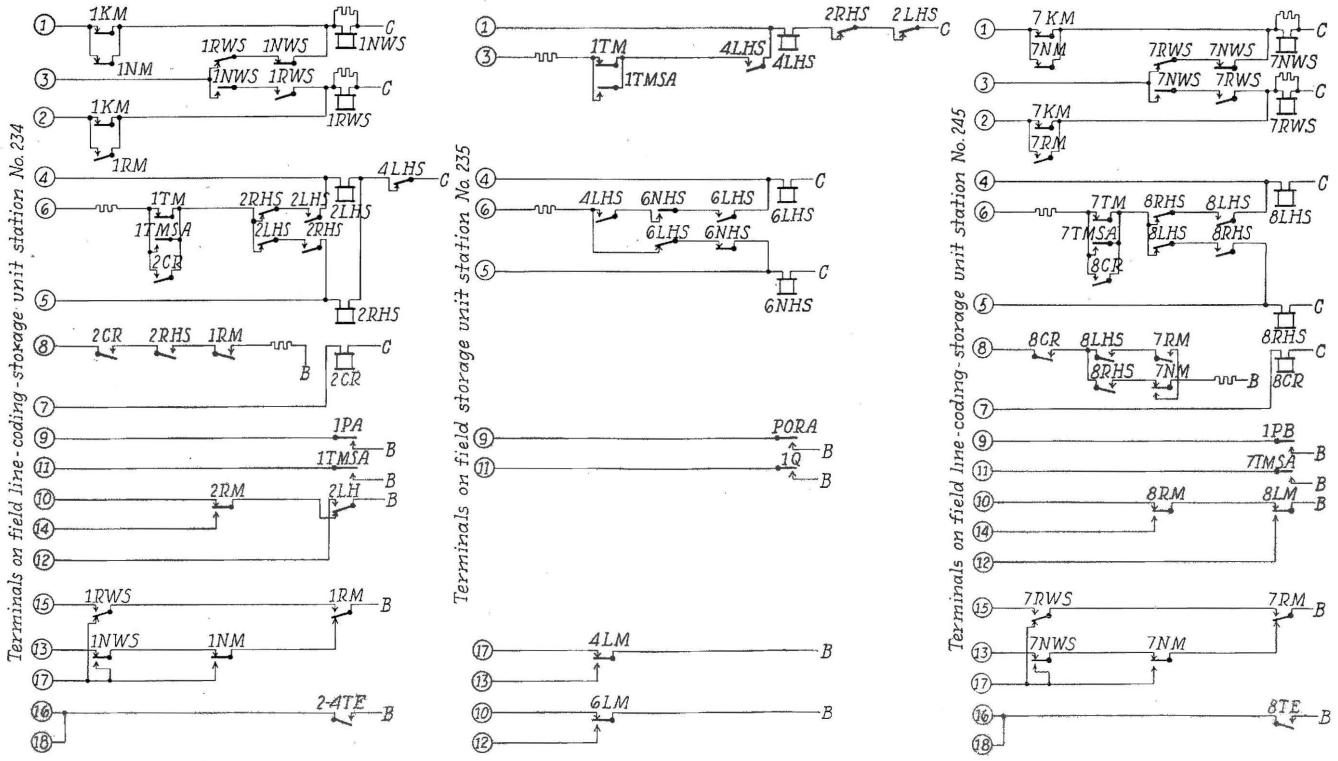


Figure A—Field connections to line coding and storage units

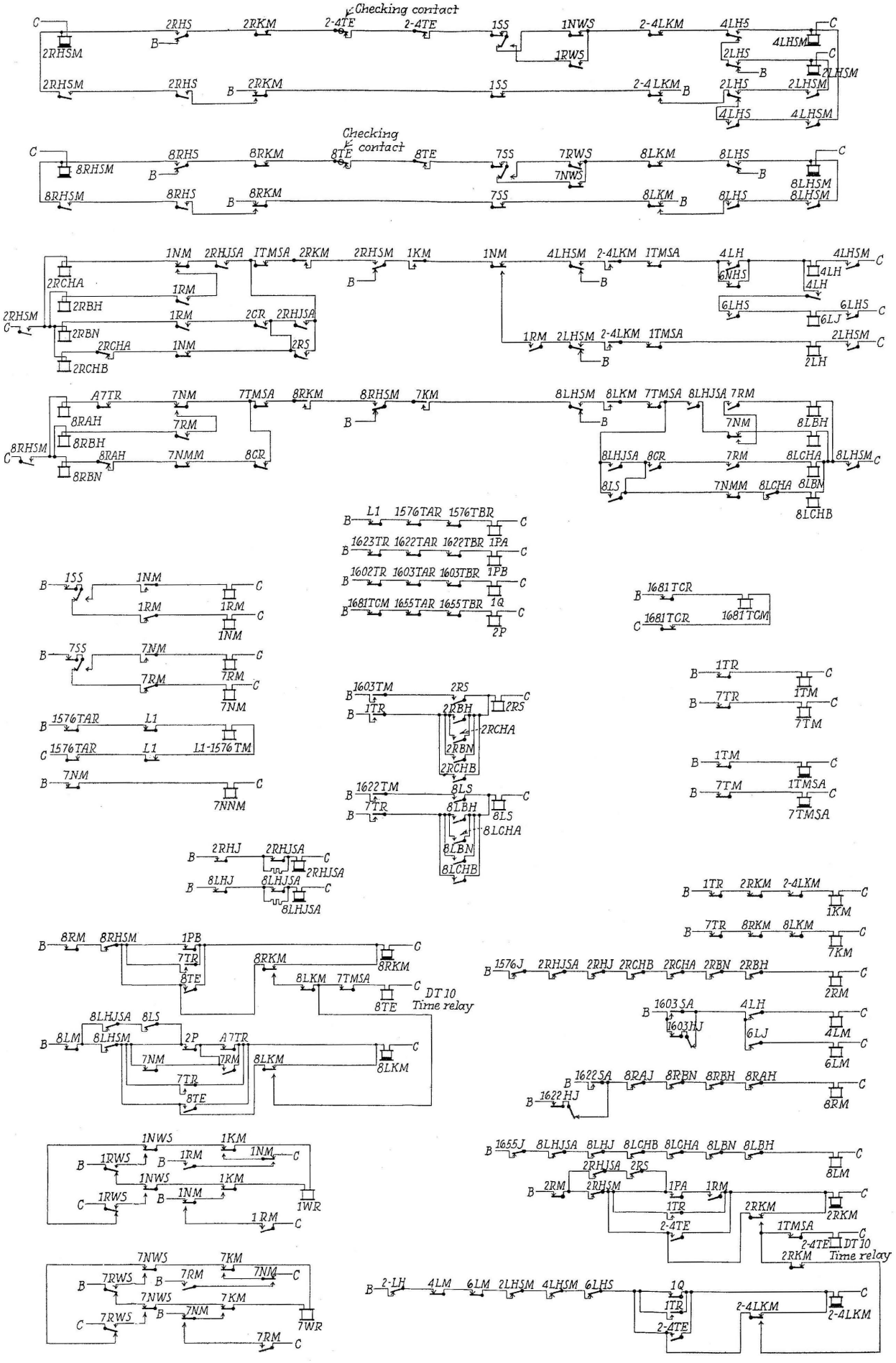


Figure B—Principal field circuits

8R or 8L governing movements over it. If either signals 8L or 8R are cleared, either relay 8RM or 8LM will be de-energized, breaking a front contact in the controls of either 8RKM or 8LKM. De-energization of either 8LKM or 8RKM also breaks a front contact in the controls of 7KM, which, when de-energized, connects a restoring circuit to relay 7WR, polar-selected through switch-position repeaters 7NM and 7RM.

Lock Relays

It will be noticed that locking of a switch is accomplished by disconnecting its control relay from the code circuits and connecting it to the proper restoring circuits. The switch lock relay 7KM is controlled over a front contact on 7TR and over a front contact on 8RKM and 8LKM. The front contact on 7TR provides section locking for switch 7, assuring that the lock relay 7KM will be de-energized with the interlocking (OS) track circuit occupied. The front contacts on 8LKM and 8RKM assure that approach, time and signal indication locking is effective on the switch. Contacts on these relays are also inserted in the controls of signals 8R and 8L to provide approach, time and signal indication locking for the signals.

Referring to the controls for relay 8RKM, signal indication locking, assuring that no aspect better than stop is displayed on the home signal and that the distant signal displays the proper aspect, is provided by a front contact of 8RM. Approach locking is provided by a front contact on relay 1PB, checking the approach track circuits to signal 8R unoccupied. This contact is cut around by a back contact on 7TR, the interlocking track circuit, allowing for the release of the approach, time and signal indication locking when a train passes the home signal. A front contact on 7TMSA relay, repeating relay 7TR is inserted in the home signal controls to put the signal to stop.

Assuming that 8R signal has been cleared, that the interlocking is unoccupied, that the approach is occupied, and that a control code has been sent from Driftwood putting signal 8R at stop, energization of 8RKM, with the subsequent release of the locking on switch 7 and signal 8R, is obtained only after time-element, type DT-10, relay 8TE has functioned. This relay is picked up when the control relay for signal 8R, 8RHSM, has dropped and when the signal aspect repeater 8RM has picked up. Since 8TE is used for both 8L and 8R, a front contact on 8LKM checks that the time-element relay is being operated for 8RKM. It also will be noted that a front contact of 7TMSA is inserted in the controls of 8TE to provide against unnecessary operation of the time-element relay.

Controls for Signals 2L, 2R, 8L, 8R

When an L signal control is received at stations 234 or 245, the LHS relay is picked up through the circuit from terminal 4 and remains stuck up through the circuit to terminal 6. Likewise, when an R signal control is received, the RHS relay is picked up through the circuit from terminal 5, and sticks up through the circuit to terminal 6. Referring to the stick circuits for relays 2LHS, 2RHS, 8LHS and 8RHS, it will be noted that these relays hold up until the stick circuit is de-energized by the dropping of the relay for the interlocking track section immediately in advance of the signal involved. Thus signals controlled over 2LHS, 2RHS, 8LHS and 8RHS are semi-automatic stick signals. It will also be noted that the CR relay, controlling the "call-on" aspect and semi-automatic non-stick operation, is controlled from terminal 7, and that the stick circuits for 2LHS, 2RHS, 8LHS and 8RHS are not broken if the proper CR relay is picked up. The function of this CR contact is to maintain the HS relays energized for semi-automatic non-stick operation of the home signals controlled.

Function of the HSM Relays

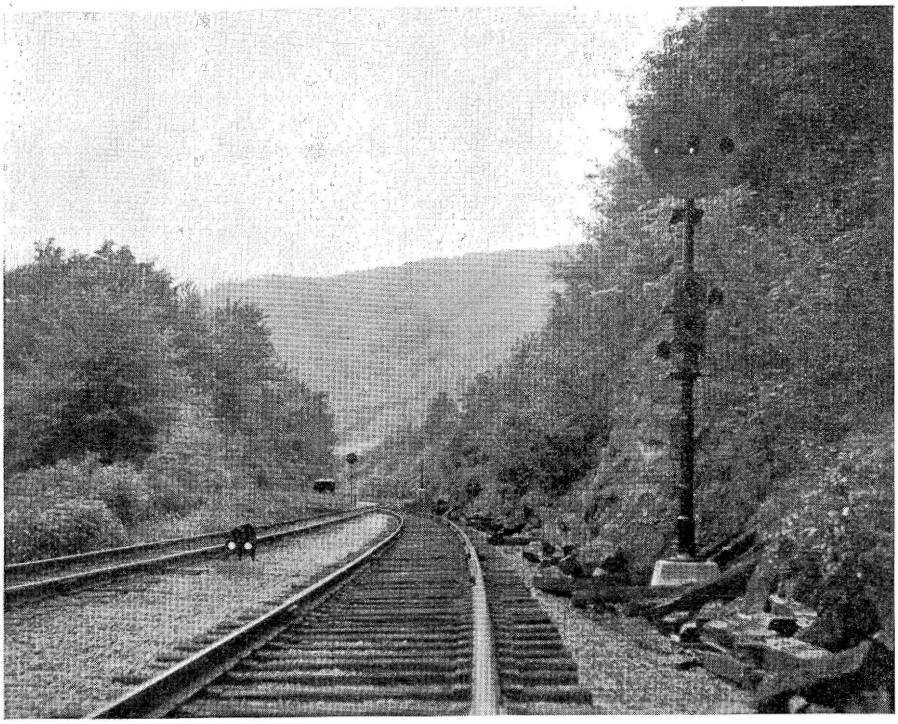
Referring to Fig. B, the controls include the usual HS relays, such as 2LHS, 8RHS, etc., and, in addition, include HSM relays. These HSM relays each have a pick up circuit which includes all switch storage relays, NWS and RWS, and switch repeating, SS, relays in the route, which insures that all switches have functioned before a signal can clear and each HSM relay has a stick circuit which includes all switch repeating, SS, relays in the route and requires that all switches remain in their proper position to hold the signal displayed. For example: To clear signal 8R, code is sent to pick up relay 8RHS; the pick up circuit for relay 8RHSM is then from battery through a back contact on 8LHS, checking that opposing signals 8L may not be displayed, through a front contact on 8LKM, which checks that opposing signals 8L are at stop, through a front contact on 7RWS and a reverse polar and neutral front contact on 7SS or through a front contact on 7NWS and a polar normal and neutral front contact on 7SS (depending on the position to which the switch has been coded), checking that the position of the switch storage relay agrees with the position of the switch, through a back contact and a checking contact on approach time release relay 8TE, which assures that the time relay is full normal, through a front contact on 8RKM, which, when opened, makes the approach, time and signal indication locking effective, and through a front contact on 8RHS, checking that 8R is the signal for which a control code has been sent.

Battery is then fed to the control relays for signal 8R over a back contact on relay 8LHSM, checking that the opposing signal 8L cannot be cleared, over a back contact on 7KM, checking that the switch is locked, over a front contact on 8RHSM, over a back contact on 8RKM, checking that the approach, time and signal indication locking on signal 8R has become effective, and over a front contact on 7TMSA repeating the interlocking track circuit unoccupied. At this point the circuit divides to select signal 8RAH or 8RBH, in accordance with the position of switch 7, as indicated by relays 7NM and 7RM, or to select the marker light control relay 8RBN. If a top arm aspect is to be displayed, through contacts on 8RAH energized, A7TR, controlled by the track sections on the eastward main track must be energized and switch 7 must be normal. The caution-slow-speed aspect on the lower arm, controlled by 8RBH, is displayed only when switch 7 is reverse. The control relay for the marker light, 8RBN, used with the top arm at stop as a "call-on," stop-and-proceed aspect, is only energized when 8RAH is de-energized, checking the top arm at stop, when switch 7 is normal, 7NMM, and when the CR relay has been picked up by a control code.

Direction Selection

Direction selection of the stop-and-proceed ("call-on") signals to the single track between Huntley and Sterling Run is obtained by normally de-energized stick relays 8LS and 2RS. Relay 8LS is picked up by a train accepting an indication on signals 8L and shunting interlocking track section 7T, and is held up as long as the train is on the track circuit between signals 8L and automatic signal 1623 by a back contact on track section repeater 1622TM. Relay 2RS is controlled similarly for a movement in the opposite direction past signals 2R.

The lock-out and the directional selection for the APB feature on the single track between Huntley and



Above — Signals 2Ra-b and 2Rc at Sterling Run. Below—Partial view of interior of instrument house at Huntley

Sterling Run is obtained by the dropping of the 8LKM relay when signals 8L are displayed for movement to the single track and by the dropping of 2RKM relay in the case of the 2R signals.

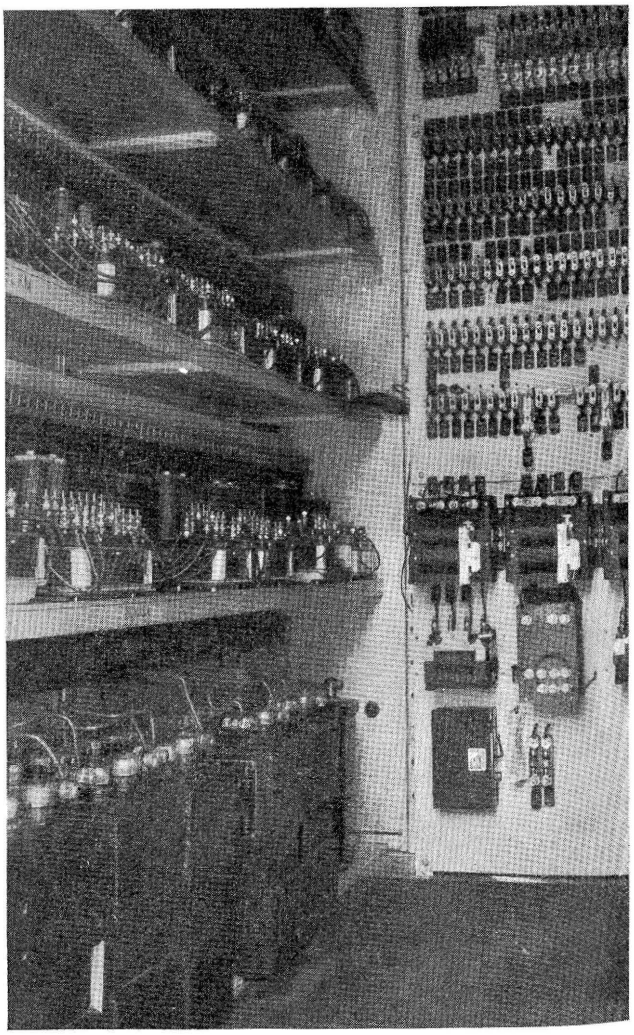
Semi-Automatic Non-Stick and "Call-On" Features

As mentioned previously, the stick circuits for 2RHS, 8LHS and 8RHS remain closed and these relays remain energized when the respective CR relays have been coded, even though a train passes the home signal and shunts the interlocking track section. Energization of the stick circuit for 8RHSM depends upon the position of 8RHS, 8RKM, 7SS and 8LKM. Once 8RHSM has been picked up, 8RKM will be down. Relay 7SS will remain picked up since the switch is locked by 7KM. Relay 8LKM will be held up over 8LM up and 8LHSM down, and stick contact 8LKM. Thus 8RHSM will remain picked up, and signal 8R will operate as a semi-automatic, non-stick signal after the train has left 7T track circuit. In the controls for 8RBN it will be noticed that the marker light is given when the top arm is at stop, as indicated by 8RAH being down, and only when the route is lined up for a movement to the eastward main track. De-energization of the CR relay, and removal of the semi-automatic, non-stick and "call-on" features, is accomplished by pushing in the "call-on" button on the control machine and re-coding the field equipment. The "call-on" and semi-automatic non-stick features are not provided for signal 4-6-2L.

In the controls of 8LBN, relays 8LS or 8LHJSA must be picked up before this relay is energized. These contacts are used to insure that the track between SG and HY is not occupied by an opposing train. In the controls for 8LKM, back contacts on 8LHJSA and 8LS in series cut around the back contact on 8LHSM. These contacts are used to prevent unnecessary delay which might be occasioned by dropping 8LKM at a time when signal 8L cannot be displayed.

Controls for Signals 4 and 6

Again referring to Fig. A, it will be seen that the control storage relay for signal 4L is controlled through the circuit from terminal 1 of station 235, that it is picked up only when 2RHS and 2LHS relays are de-energized, insuring that no code has been sent for signal 2R or 2L, and that the stick circuit for relay 4LHS extends through a front contact on 1TM in multiple with a back contact on 1TMSA to terminal 3. The front contact on 1TM opens before the back



contact on 1TMSA closes, de-energizing stick control storage relay 4LHS, establishing the stick feature for signal 4L. The stick feature for all signals is established in a like manner.

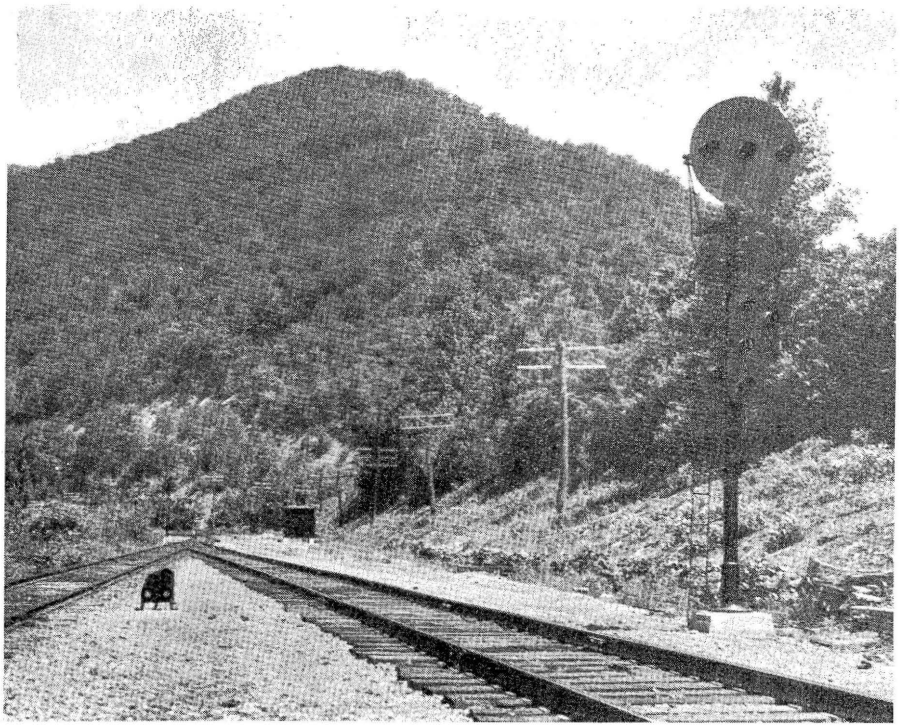
Relay 6LHS is controlled through terminal 4, while relay 6NHS is controlled through terminal 5. Both 6LHS and 6NHS are stuck up by circuits connected to terminal 6. Relay 4LHS is the control storage relay for the permissive block aspect on signal 4L-6L, relay 6LHS is the control storage relay for the clear block aspect, and relay 6NHS is the control storage relay to insure that lever 6 is returned to the normal position each time before a proceed aspect can be displayed. The stick circuit for 6LHS requires that 4LHS be picked up and that 6NHS be de-energized. Likewise, the stick circuit for 6NHS requires that 6LHS be de-energized. In Fig. B, relay 6LJ, which controls the clear block aspect, is controlled over a front contact on 4LH, thus requiring that the permissive control relay be operated from the control office before the clear block aspect may be displayed.

Construction Features

The centralized traffic control system, position-light signals, Style M-22 dual selector switch machines, relays, and housings for this installation were supplied by the Union Switch & Signal Company. DN-11 neutral relays, DP-14 and DP-17 polar relays, DT-10 time-element relays were used. The track relays were equipped with 4-ohm coils, while all line relays were 1,000-ohm relays, with the exception of the slow-acting relays with 500-ohm coils, the DP-17 switch-repeating relays, with 300-ohm local coils and 400-ohm operating coils, and the DP-10 relays, which were wound for 12 volts.

Power for the installation is obtained commercially at 110 volts at DF, HY and SG, and is arranged so that SG may feed HY or HY may feed SG. The machine battery is composed of 8 Gould 80-a.h. cells, while the code line is fed from 12 Exide BTMH-2 cells floated on an RT-21 rectifier. These batteries are located in the basement of the tower at Driftwood. The switch machine batteries, located in the C.T.C. housings, consist of 12 Gould Kathenode 120-a.h. cells. The field control circuits at each of the remote locations are fed from 6 Gould 120-a.h. cells floated on RT-10 rectifiers.

Track circuits are fed from Gould 80-a.h. storage cells floating on RT-10 rectifiers, while Gould 120-a.h. storage cells floating on RT-21 rectifiers are used for emergency signal lighting. Style ANL-30 power transfer relays were provided.



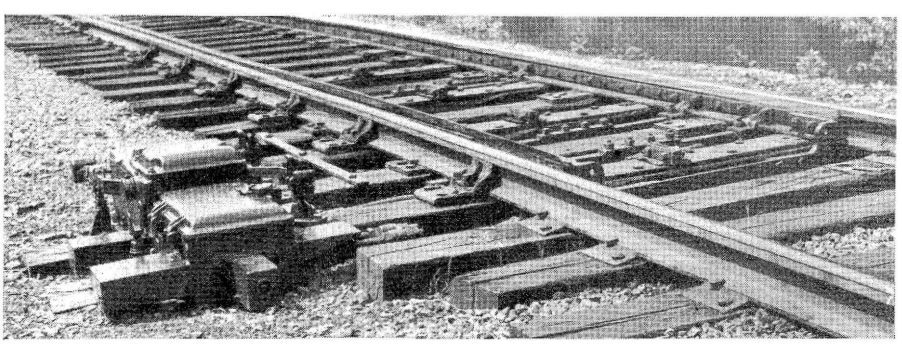
Signals 8La-b and 8Lc at Huntley

The track was bonded with 36-in. stranded plug type bonds and the track leads are in Hazard single-conductor No. 9 parkway, with inside connected outlets.

The code line circuit was run in two No. 8 copper weatherproof line wires, while the 110-volt line is in two No. 10 copper weatherproof line wires. Approximately 1,000 six-pin crossarms were replaced by ten-pin arms to carry the new line wires. The distant signal control wires are No. 9 hard-drawn copper line wires. General Cable Company parkway cable was used between instrument cases, instrument houses, and the pole line, either 7- or 9-conductor being installed. Relay leads are No. 16 flexible insulated wire, while jumpers are No. 16 solid insulated wire.

At the automatic locations, sheet-steel instrument cases were used with the relays supported on sponge rubber. In the C.T.C. houses, the relays rest on rubber matting. Raco six-in-a-unit Bakelite terminal blocks and asbestos terminal boards were provided. The batteries were placed in the lower portion of the instrument cases and houses.

The installation of this equipment was made under the supervision of E. B. Pry, superintendent of telegraph and signals, and G. C. Felton, supervisor of telegraph and signals. A total of 32 men were engaged in making the installation, under the direction of W. H. McSparrin, foreman, and T. R. Woolslayer, assistant foreman. Headquarters were established at Driftwood. Fourteen men were utilized in a line-wire gang to replace the 6-pin crossarms with 10-pin arms, string line wire, and do the necessary guying. Six men were assigned to digging trenches and laying parkway cable. A gang of 12 men built forms, mixed the concrete, poured the foundations and set up and wired the instrument cases. The job was placed in service on April 25.



Style M-22 switch machines are used to operate end-of-double-track switches