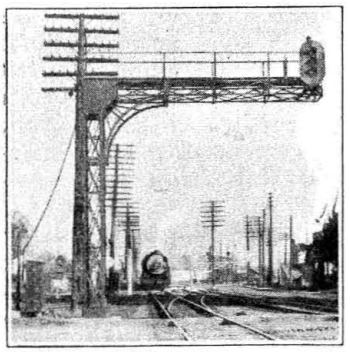


Cantilever bridge

Nickel Plate Installs 169 Miles of Color-light Automatics

A-C. floating system with primary cells for track at cut-sections —Unique polarized A. P. B. control

By J. H. Oppelt
Supervisor of Signals, New York, Chicago & St. Louis

THE New York, Chicago & St. Louis has completed the installation of automatic signals between Conneaut, Ohio, and Arcadia, a distance of 169 miles, of which 117 miles is double track and 52 miles is single track. A total of 272 Union Switch & Signal Company Style R-2 color-light signals are included in the installation.

At several points where semaphore signals had been previously installed and at one interlocking plant, the semaphores were replaced with color-lights. Color-light signals were in service at five plants and at three plants where the semaphores were comparatively new, they were continued in service. In addition to adapting the automatic circuits to nine interlocking plants, provision had to be made also at 56 highways for automatic protection, 47 flasher lights, 6 wig-wag and 3 bells being used.

A-c. Floating System for Power

Line wires are placed on the bottom arm of the existing Western Union line, the wire stringing work being done by Western Union forces. Power is transmitted at 440-volt, 60-cycle, single-phase on two No. 6 w.p. copper wires, attached to porcelain insulators on the two field pins. Control circuits are No. 10 w.p. copper attached to Western Union standard glass insulators. All wires are terminated on Ohio Brass Company dead-end strain insulators. Power is purchased from commercial power companies, the average distance between supply points being about 12 miles. At each point of supply a recording voltmeter is installed which provides a continuous record of the voltage. The voltage is stepped down from 440 to 110 through a Type-M transformer located on the crossarm so that no voltage higher than 110 is taken into the instrument case. Fused porcelain plug cut-outs are installed on the crossarm at each transformer.

The rails, which are all 90-lb. R. A. or 110-lb. R. E., are bonded partly with Armco wires and partly with Duplex Copperweld bonds. Continuous insulated joints are used throughout the installation. Kerite steel taped cable is used for all wire runs except shunt wires from rail to switch boxes where No. 9 Kerite

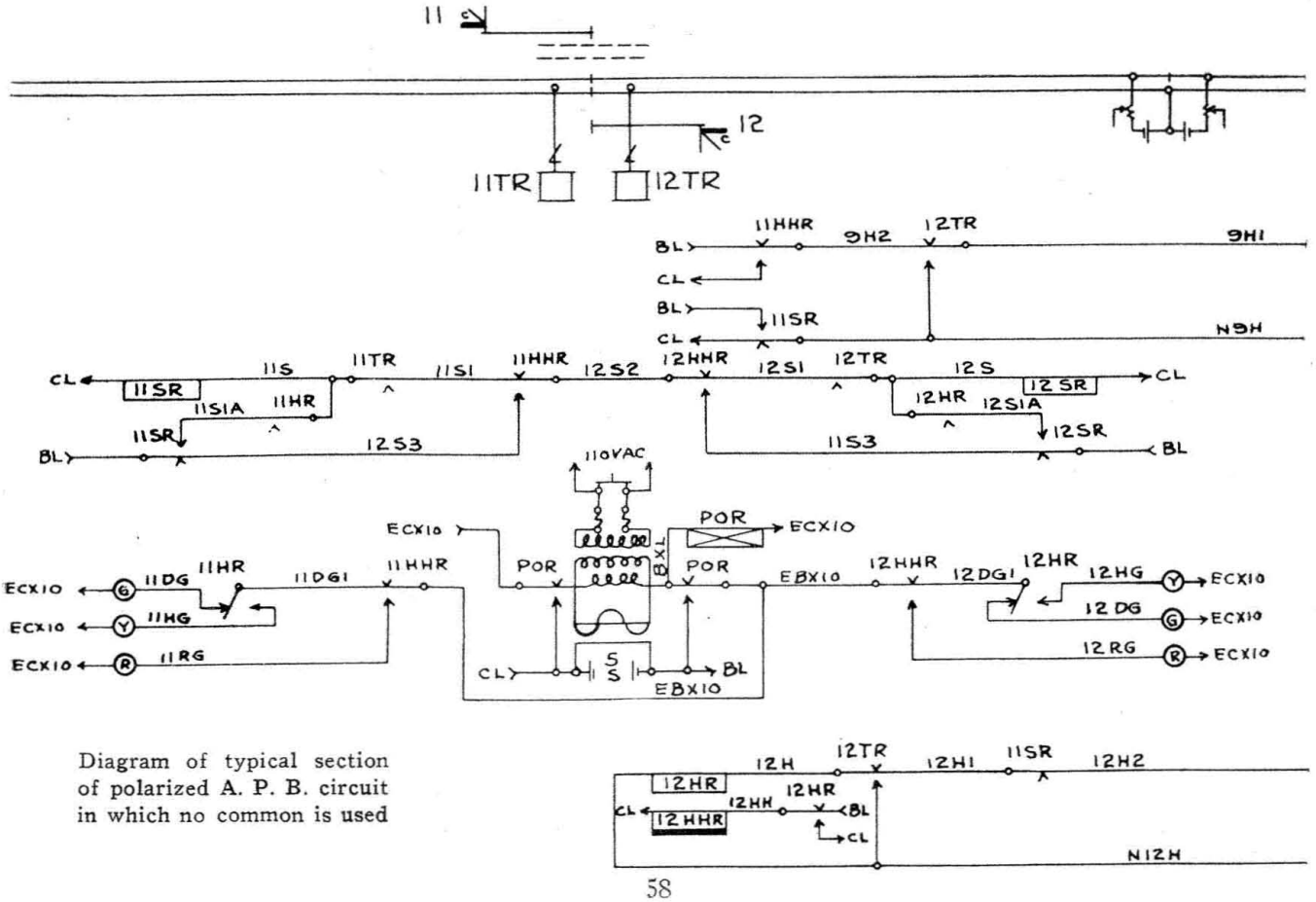
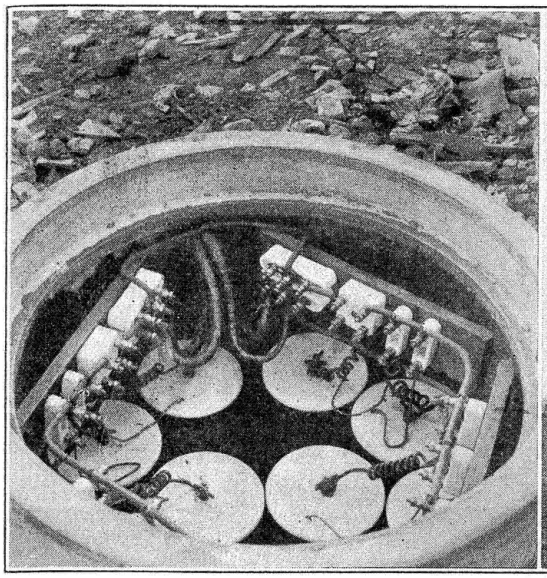
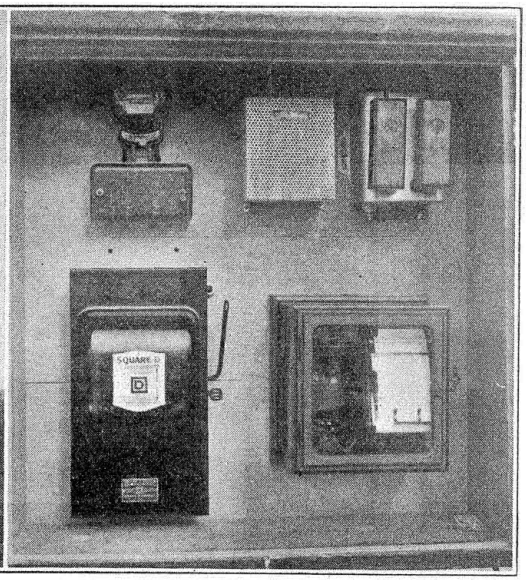


Diagram of typical section of polarized A. P. B. circuit in which no common is used



Primary battery for track at cut- sections only

Lower unit is grade signal



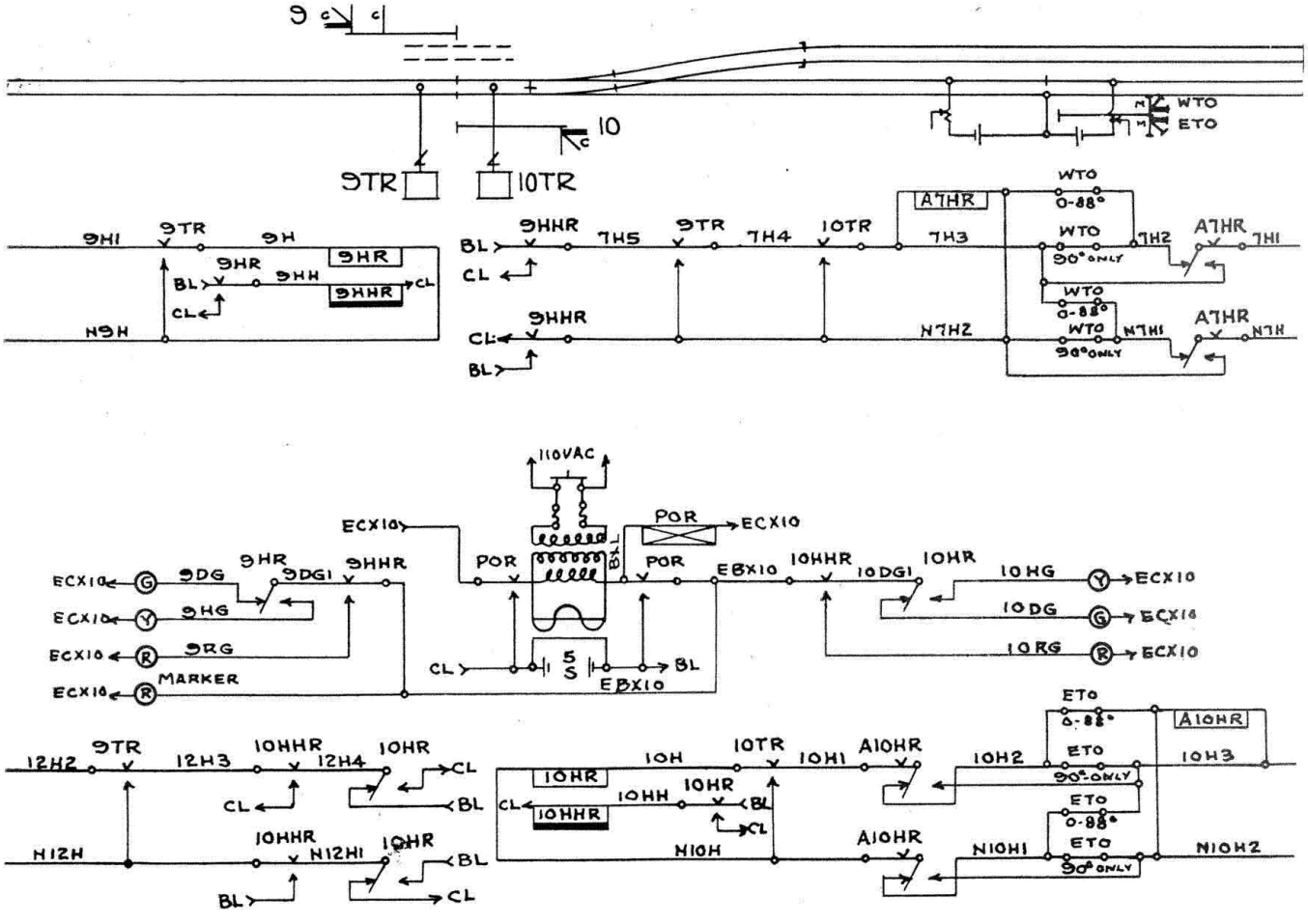
A-C. power feed with recording voltmeter

wire in trunking is used, the distance being too short to use cable profitably. Line drops from pole line to cable posts are made up of the required sizes of wire. Where signals are located on the side opposite the line, steel-taped cable is used from the pole line direct to the instrument case on the opposite or signal side of the track. Vertical rotary circuit controllers are used for shunting the track; and where line circuits are broken, Universal Type U-3 circuit controllers are used.

Massey precast foundations are used for the ground signals, cable posts and instrument cases, a special foundation having been designed for the cases. Foundations for bracket posts and cantilever posts were poured in the field. The primary track battery is housed in Massey six-cell and ten-cell wells.

Special Arrangement of Light Units

In order to get the maximum separation between lights on two-unit signals, the top unit is arranged with red at the top, yellow in the center and green at the bottom. The lower unit has yellow at the top, green in the center and red at the bottom. Thus, with a maximum of eight feet between red lights, a



minimum of six feet is obtained between any combination of lights. The red unit on each signal is equipped with a white backlight which is hooded and gives both day and night indications. Passing trains may thus observe that the signal has assumed the stop position. It is also of value to track workers on single track, as it warns them of the presence of trains in the block.

Signals are continuously lighted with 10-volt, 18-watt lamps which are burned at slightly less than rated voltage. Each lamp unit is equipped with an adjustable resistance, so that the voltage for each lamp may be controlled separately.

Wooden Instrument Cases

The instrument cases are built of wood with a sheet metal top, false back and double doors. These cases are of sufficient size to hold all apparatus for a double signal location, and are painted gray inside, except the bottom shelf supporting the storage cells, which is painted with asphalt paint. The outside of all cases as well as signal poles and cable posts are painted black. The top shelf of the instrument case is used for relays, the middle shelf for any additional relays, power-off relay, transformers and rectifiers. The rectifiers are all of the electronic type recently developed by the Union Switch & Signal Company.

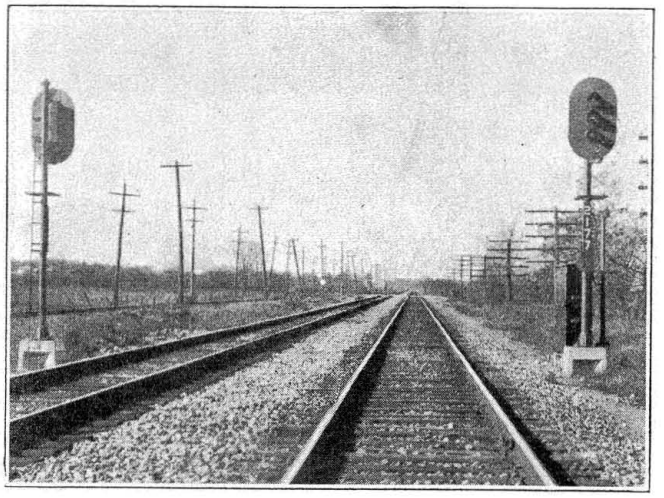
Relay cases were wired complete with all apparatus at headquarters and were loaded into box cars and unloaded and set upon foundations without disturbing the apparatus, by means of a special crane.

Neutral track circuits are used except through congested territory where the installation of line wire was not possible. In this territory, polar circuits are used. Through Fostoria, Ohio, in order to prevent foreign current interference, alternating current track circuits are provided.

The track battery feed at signal locations is obtained from one cell of Exide storage battery; where the battery feed is between signal locations, five cells of primary battery in multiple are used, both Edison and National Carbon primary batteries being used.

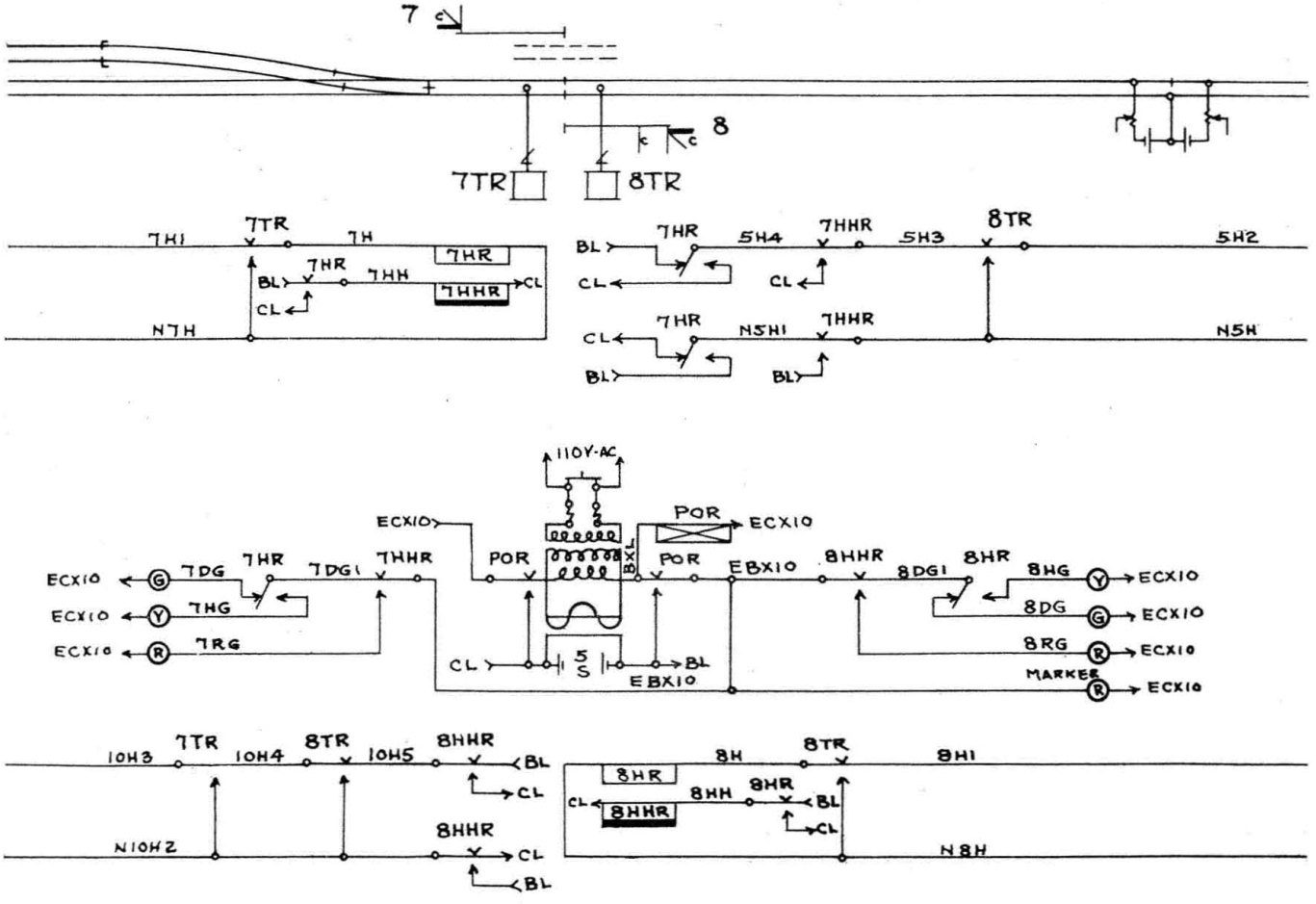
Polarized A. P. B. Control Circuits

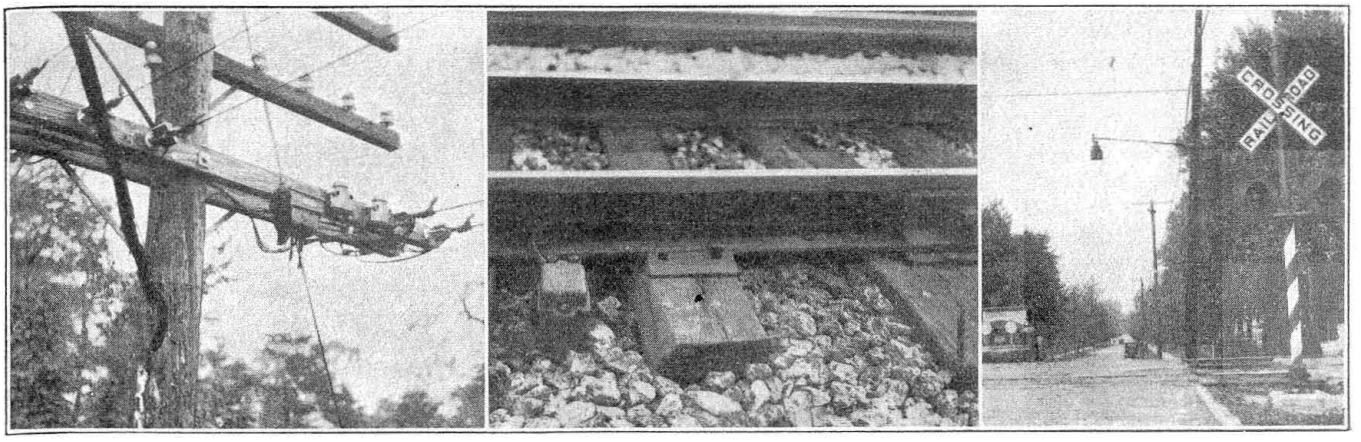
On single track, a modified A. P. B. circuit designed by the railroad's engineers is used. The polarized A. P. B. circuits, as installed, make the use of



Typical location on double track

a common wire unnecessary, thus reducing the possibility of trouble from grounds to a minimum. There is also a considerable saving in line wire due to the fact that four wires only are necessary between signals at opposite ends of sidings. An explanation of the circuits follows (refer to circuit plan):



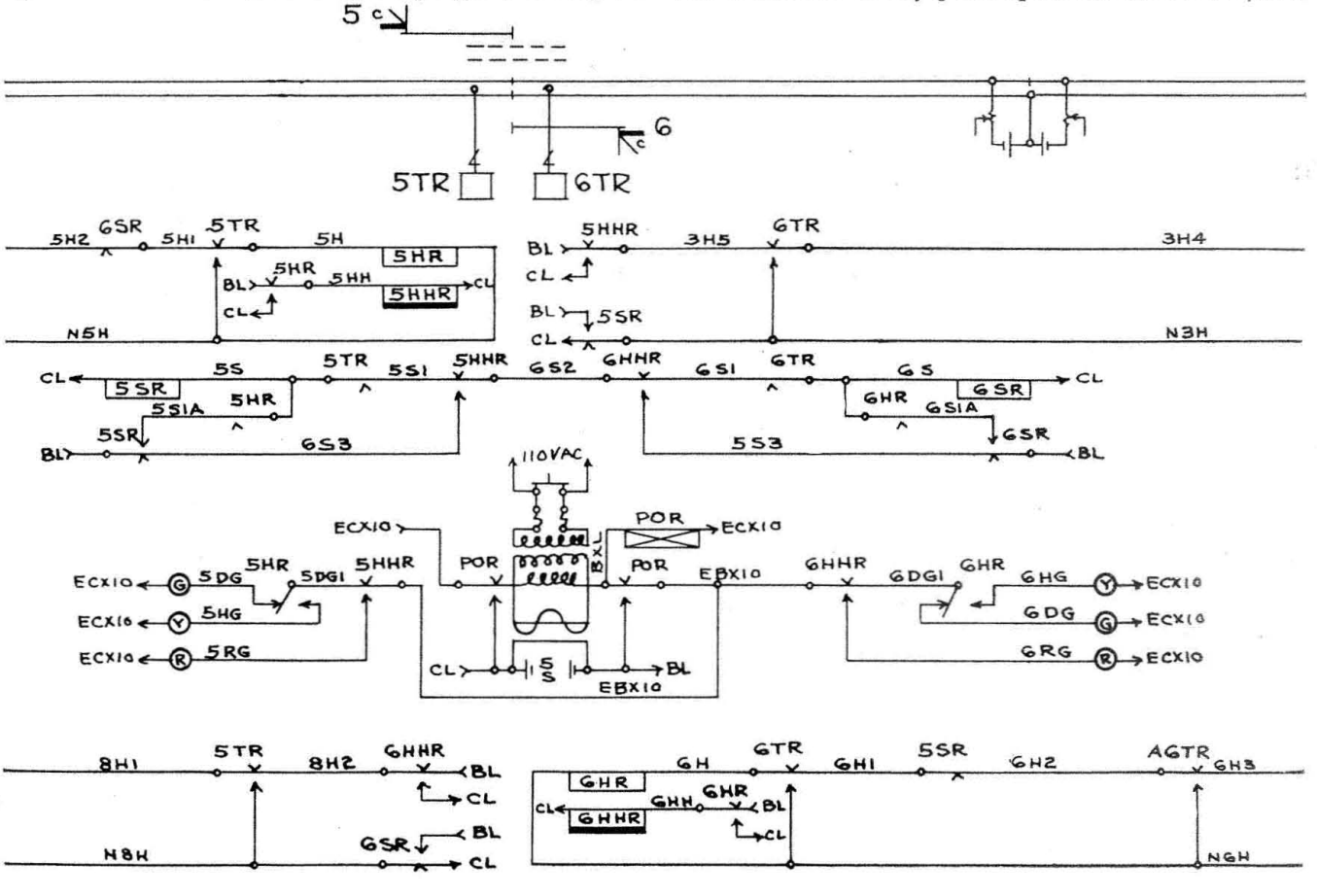


Transformer on crossarm | Raco parkway outlet | Flashlight crossing signal

A westbound train standing east of signal 1 will of course have signal 2 at "stop." This will mean that *2 HHR* is de-energized and will send current in the reverse direction, through the coils of *4 HR*. The reversal of *4 HR* causes signal 4 to show a yellow or caution indication. As the train moves west past signal 1, it will drop *1 TR*, thus opening the control of *1 HR*. As *1 HR* controls *1 HHR* it also will drop, causing signal 1 to indicate "stop." *1 TR* also opens *4 HR*, then *4 HR* opens *4 HHR*, *4 HHR* opens *6 HR*, *6 HR* opens *6 HHR*; *6 HHR* opens *8 HR*, and *8 HR* opens *8 HHR*. Signals 4, 6 and 8 then show red or "stop" indications. *8 HHR* dropping will reverse the current through *10 HR*, causing it to reverse its polar contacts and signal 10 to show a yellow or "caution" indication. *10 HR* in reversing will cause *12 HR* to receive reversed current and signal *12* to show a yellow or "caution" indication. As signal *8* has a red marker which is always lighted, there are at this time two red lights which make *8* an absolute stop signal, holding all eastbound trains from entering the block already occupied by the westbound train.

As the westbound train proceeds into circuit *A1T* it holds signal *1* at block by keeping *1 HR* open and keeps all eastbound signals at block by keeping *4 HR* open. As the train proceeds by signal 3 it will drop *3 TR*, opening *3 HR*, and as the train is still on circuit *A1T*, it will close the pick-up circuit for *3 SR* before *3 HHR* (which is slow-acting) opens. As *3 HHR* opens, it will cause signal *3* to assume the "stop" position.

Relay *3 SR* in picking up connects *N1H* to positive battery, and *3 HHR* dropping connects *1H3* to negative battery. This completes the circuit for *1 HR* as soon as the rear end of the train has proceeded far enough west so that it is clear of circuits *1T* and *3T*. Under the effect of this reversed power battery, *1 HR*, will pick up and reverse its polar points. *1 HR*, in picking up, closes the circuit for *1 HHR*. With *1 HR* reversed and *1 HHR* picked up, signal 1 will show a caution indication. Relay *3 SR* opens the control of *4 HR*



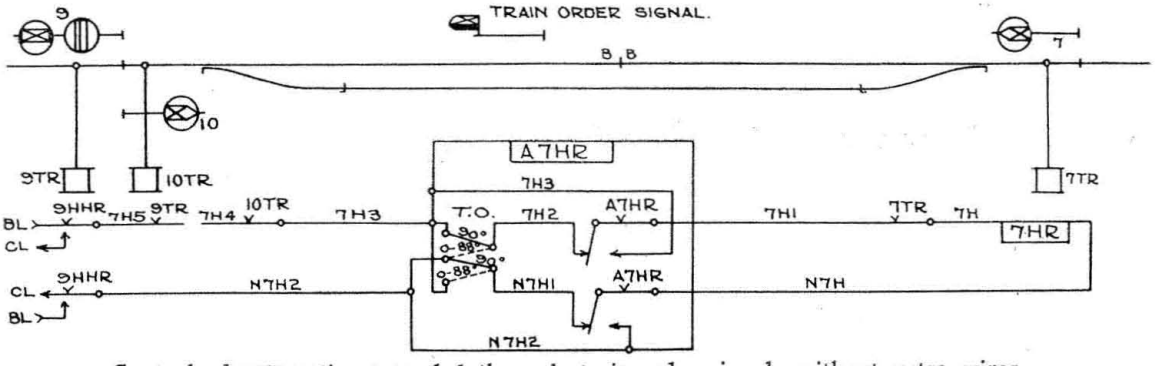
so that even though *3 TR* picks up and closes *3 TPR*, signal *4* will not clear, as there would then be a possibility of opposing trains passing signal 1 and signal 4 at the same instant.

As the train proceeds through circuits *A6T* and *6T*, it holds the control of *3 HR* open and also helps to keep signal *6* at stop. Of course signal *6* would remain at stop anyway, because *6 HHR* is still down on this westbound move. As the train passes signal *5* it shunts *5 TR*, opens *5 HR* control and closes *5 SR* before *5 HHR*, which is slow-acting, gets a chance to open. As *5 HHR* drops it places signal *5* to stop. *5 HHR* connects *3H5* to *CL* and *5 SR* connects *N3H* to *BL* as soon as the train clears *6 TR*. *3 HR* will receive reversed battery and will pick-up and reverse its polar contacts. This will allow signal *3* to display a caution indication when *3 HHR* picks up.

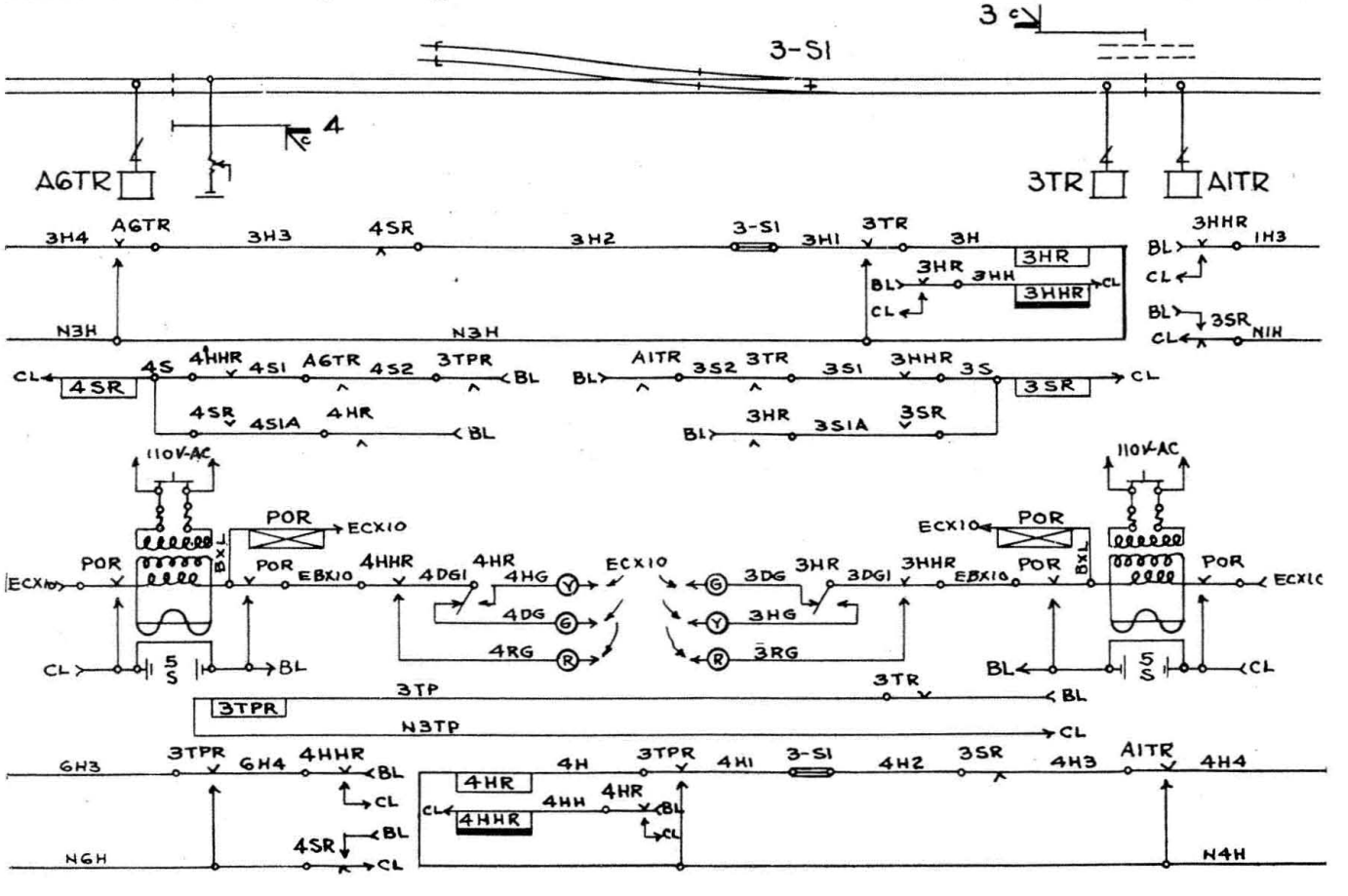
3 HR in picking up releases *3 SR*. With *3 SR* down and *3 HHR* up, *1 HR* will receive battery through its coils in the normal direction which will energize the green light on signal *1*, allowing it to indicate proceed. *1 HHR*, being slow-acting, will not drop during the reversal of *1 HR* and will prevent signal *1* from blinking red when changing from yellow to green. *3 SR* in dropping connects the battery to *4 HR* in the normal direction. *4 HR* will pick up *4 HHR*, giving a green or "proceed" indication to signal *4*. *4 HHR* will connect *6H4* to *BL*, but as *5 SR* is picked up it will be impossible for *6 HR* to pick up.

As the train proceeds through *5T* and *8T* circuits, it will hold signal *5* at block by keeping *5 HR* down and will open *8 HR* helping to keep signal *8* at block but, as mentioned before, this eastbound signal cannot clear anyway, because *6 HHR* is down and *6 SR* is not picked up. As the train passes the cut-section west of signal *5* and shunts *8 TR*, it puts signal *10* to block by opening *10 HR* control, which in turn opens *10 HHR*. The latter in dropping cuts *10 HR* out of the control of *12 HR* and keeps reversed battery on *12 HR*, holding signal *12* at caution.

The westbound train in passing signal *7* shunts *7 TR*, opening the control of *7 HR*—*7 HR* opens *7 HHR*—*7 HHR* in dropping, causes signal *7* to show stop—*7 HHR* connects *5 HR* to negative battery and *N5H* to positive battery, thus allowing *5 HR* to pick up as soon as the train clears *8 TR*. *5 HR*, in picking up,



Control of automatics extended through train-order signals without extra wires



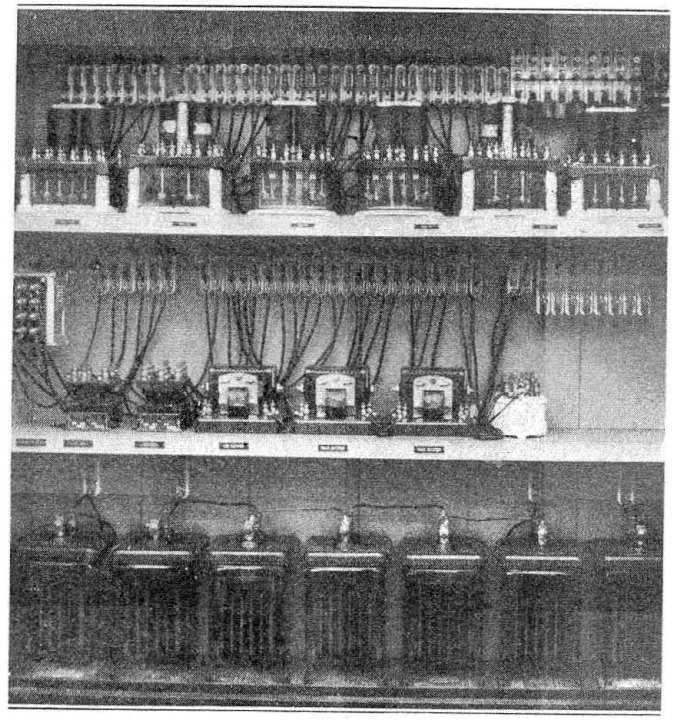
picks up *5 HHR* and also releases *5 SR*. This puts normal battery on *3 HR*, allowing its polar contacts to swing normal and light the green light on signal *3*. *5 SR* in dropping, puts normal battery on *6 HR*, the latter picks up *6 HHR*, which allows signal *6* to show green or proceed, *6 HHR* picking up also puts normal battery on *8 HR*, which picks up *8 HHR* and clears signal *8*. Relay *7 TR* also keeps *10 HR* open and signal *10* at block.

As the train proceeds to *10T* circuit, *10 TR* is shunted and keeps signals *7* and *10* at block. As the train passes signal *9* it shunts *9 TR*, causing signal *9* and the opposing signals to the next passing track to show "stop," as described when the train passed signal *1*. As *7 HR* control is carried past absolute signal *9*, so that two opposing trains cannot pass signals *7* and *10* at the same instant under caution indications, signal *7* will remain at block until the rear end of the westbound train has cleared *9T* circuit.

In leaving *9T* and entering *12T* the train shunts *12 TR*, keeping signal *9* and all opposing signals to the next siding at block. *9 TR*, in picking up (with *9 HHR* still down) puts reversed battery on *7 HR*. *7 HR*, in picking up reversed, picks up *7 HHR*, causing signal *7* to show a yellow or caution indication. Relay *7 HR* reversed and *7 HHR* picked up, keep *5 HR* reversed and hold signal *5* at caution.

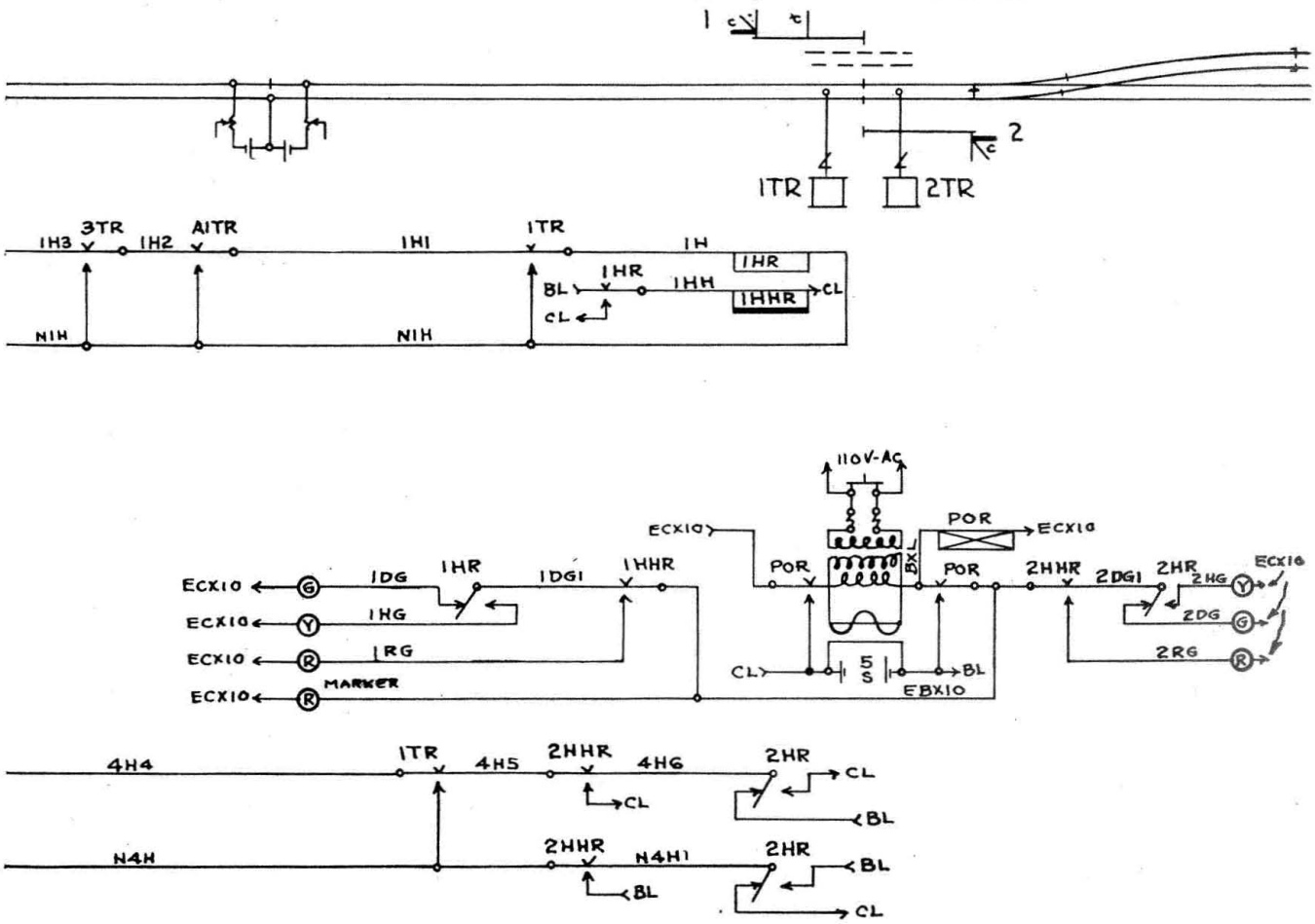
As the train passes signal *11* it puts this signal red and picks up *11 SR*. This causes signal *9* to show caution as soon as the rear end of the westbound train has cleared *12T*. In clearing signal *9* to the caution indication, *9 HR* picks up, in turn picking up *9 HHR* and putting normal battery on *7 HR*. This in turn causes signal *7* to show a green light and puts normal battery on *5 HR*, causing signal *5* to show green.

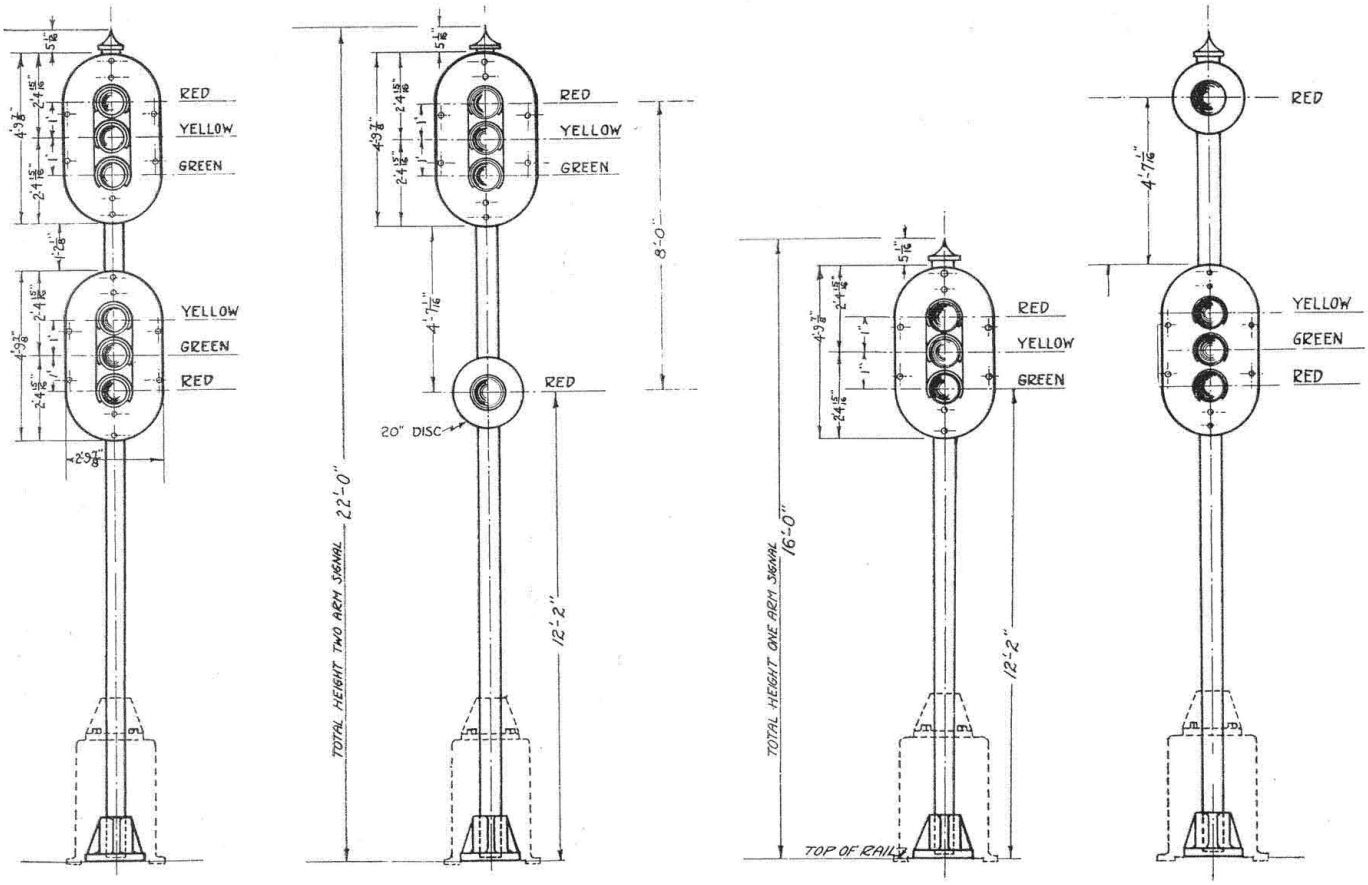
The control of the automatic signals is cut through



Interior of typical case

the mechanical train order signals and in order to accomplish this feature successfully a unique circuit was designed. The circuit at the train order signal is used to cause the automatic signals in the rear to show that some restricting signal is displayed ahead. The polarized relay is so controlled that, if either the train order signal is in a restricting position or signal *9* is at stop, signal *7* will indicate caution.





Diagrams showing arrangement of color-light units to secure maximum spacing between red lights

The additional polarized relay *A7 HR* is installed at the train order signal, which in the event that *9 HHR* changes the polarity of the circuit, relay *A7 HR* will reverse and eliminate the pole-changer at the train order signal from the circuit and allow the reversed current to pass through in such a way that *7 HR* will reverse. If *9 HR* remains in the normal position and the pole changing device at the train order signal is reversed, relay *A7 HR* will remain normal, but *7 HR* will reverse. In either case a train would receive a "caution" indication at signal *7*.

The Union Switch & Signal Company furnished and installed all signal materials under the direction of J. T. Mallanny, field engineer. The railroad company furnished in place all foundations and all track insulation. H. M. Osinski, signal inspector, was in direct charge of all the signal construction work for the New York, Chicago & St. Louis.

Signal department officers of the Louisville & Nashville at a recent supervisors' conference