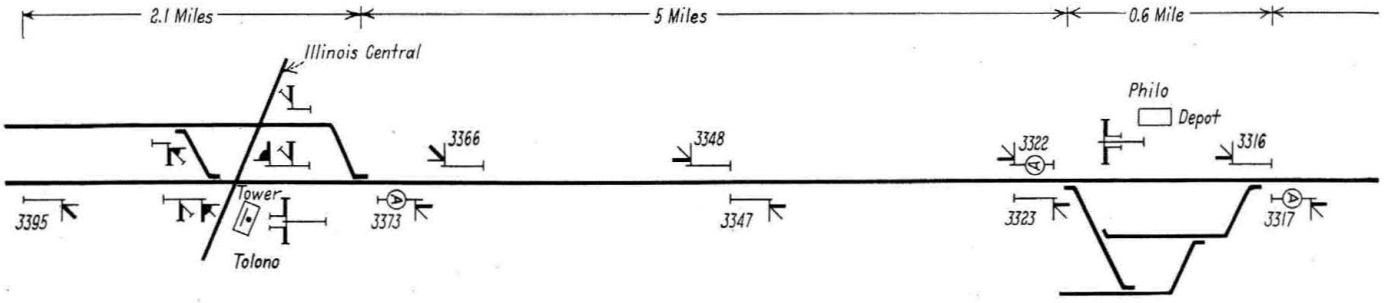
Automatics

Eastbound train No. 4, "Detroit Special," at the west end of Philo

THE Wabash has installed automatic block signaling on 34.1 miles of single track between Tolono, Ill., and Tilton, and Tilton, while between Ryan and Tilton a former second track was left as an auxiliary track. At Sidney, on the Decatur division, thus marking the completion of automatic block signaling on all single-track sections of principal main lines of this railroad. The newly signaled territory is on the main line between St. Louis, Mo., and Detroit, Mich., via Decatur, Ill. The line is double track from Decatur, 37.6 miles eastward to Tolono and single track from Tolono, 34.1 miles eastward to Tilton. As a part of the recent program, the territory between Catlin and Tilton, which was equipped with single-track signals, was changed by relocating the signals and installing A.P.B. single-track control circuits, the same as on the 30.2 miles of entirely new signaling on the territory between Tolono and Catlin. The new signaling was installed to increase the safety of train operation, and at the same time, to reduce delays of train movements to a minimum.



Character of Line and Traffic

Between Tolono and Tilton, 34.1 miles, passing tracks are located at Tolono, Philo, Sidney, Homer, Ryan and Tilton. The maximum ascending grade westbound averaging approximately 0.7 per cent, approaching Philo. The maximum ascending grade eastbound averages approximately 0.6 per cent, approaching Philo. The line between Tolono and Tilton is practically a tangent track for the exception of two minor curves, one of 0 deg. 30 min. between Philo and Sidney, approximately 9 miles east of Tolono, and another of 1 deg. 0 min. at Catlin, 3.9 miles west of Tilton. The rail in service in this territory is of 110-lb. stock, and the ballast is gravel. The speed limit for passenger trains on tangent track is 80 m.p.h., and for freight trains the limit is 50 m.p.h.

The daily traffic over this line includes two passenger, four red ball freight and one local freight trains eastbound, and two passenger, two red ball freight and one local freight trains westbound. In addition to these, extra trains are operated when required.

10.4 miles east of Tolono, the main line is joined by a branch, which extends north to Champaign, Ill., 11.7 miles from Sidney. Train order offices are located at Tolono, Philo, Sidney, Homer, Fairmount, Catlin and Tilton.

Two interlockings are in service within this territory between Tolono and Tilton. An interlocking at Tolono controls the necessary signals, interchange track switches, crossovers and end-of-double-track layout in the vicinity of a crossing with the Illinois Central. At Ryan, 24.7 miles east of Tolono, another interlocking controls the signals at a crossing with the Chicago & Eastern Illinois. The siding switch at this point is equipped with a spring mechanism. The new signaling that has been placed in service commences at signal 3395, 1.3 miles west of the Illinois Central crossing at Tolono, and extends eastward through and including Tolono and Ryan interlockings to signal 3033, 0.3 mile east of Tilton.

Generally speaking, the line between Tolono and Tilton traverses a reasonably rolling country, the maximum

New Signals

At the Tolono interlocking, wire and pipe-connected home signals as well as electric distant semaphore signals were replaced with searchlight signals at the same time as the new automatic searchlight signals were installed between Tolono and Tilton. Provisions were made also for additional home signal aspects at Ryan interlocking.

The signals are of the Union Switch & Signal Company's H-5 type with detachable mechanisms. Each unit is equipped with 250-ohm operating coils for operation on 10 volts d-c. The signal lamps are of the single-filament type, and are rated at 10 volts,

Installed on the Wabash

Modern signals and control circuits in service on 34.1 miles of single track

5 watts, or 11 volts, 11 watts where deflecting cover prisms are used. The signals are mounted on 5-in. masts, the center line of the lens being placed at 14 ft. 9 in. above the level of the rails. This arrangement places the signal lens in direct line with an engineman in a locomotive cab. The signals are painted with aluminum paint, except the signal backgrounds which are painted with black signal paint. Conforming with the practice of the Wabash, portable sectional concrete foundations are used for mounting the signals and instrument cases.

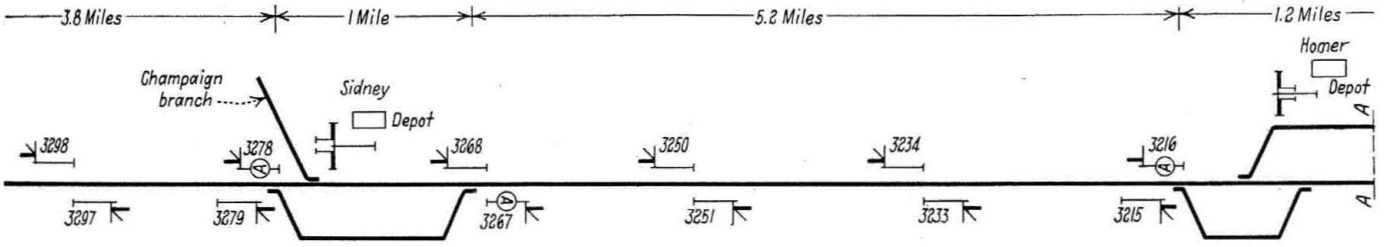
Each signal has one operative head which displays one of three colored aspects, red, yellow or green. Each station-leaving, head-block signal is an absolute automatic signal, and is so designated by the absence of a number plate and by the application of a special marker. This marker consists of a yellow enameled disk, 18 in. in diameter on which is mounted a Peerless raised letter "A" which is painted red and equipped with 7/8-in. red reflector buttons. This marker is mounted on the signal on the face of the mast, 5 ft. below the signal unit. The high home signals at interlockings are distinguished from all other signals by having more than one unit and further by the absence of both a special "A" marker and number plate. Automatic distant and permissive signals are distinguished from all others by the presence of an enameled black and white number plate, the signals being numbered to the nearest tenth of a mile.

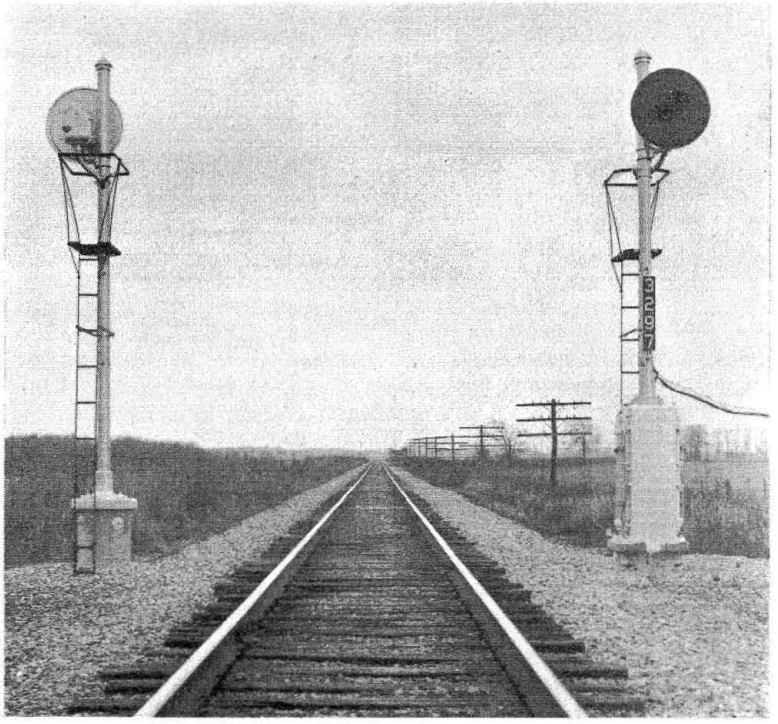
Successive Approach Aspects

At meeting points, the double caution overlap is used, for example, at Philo when the station-leaving signal 3322 is displaying the Stop aspect, the two successive signals in approach thereto, 3316 and 3298, display the Approach aspect. This control for the second signal is accomplished by making this signal repeat the Approach aspect of the first signal.

This feature is primarily provided to prevent trains, when approaching a meeting point, for example, at Philo, from receiving a Proceed aspect at signal 3298 and then a Stop aspect at signal 3316. Also, this feature in connection with the usual Stop aspect overlap at signals 3316 and 3323 into the track circuits in advance of signals 3322 and 3317, respectively, provides successive restrictive indications to take care of blocks at meeting points where the length of the passing track is not equal to the stopping distance. Except for these short blocks through some of the station layouts, all blocks are more than train stopping distance, and, therefore, the use of three-aspect signals is proper.

The intermediate signal locations are double locations with the exception of the single signal 3366 which is the westward distant signal for the Tolono interlocking. Where the dis-

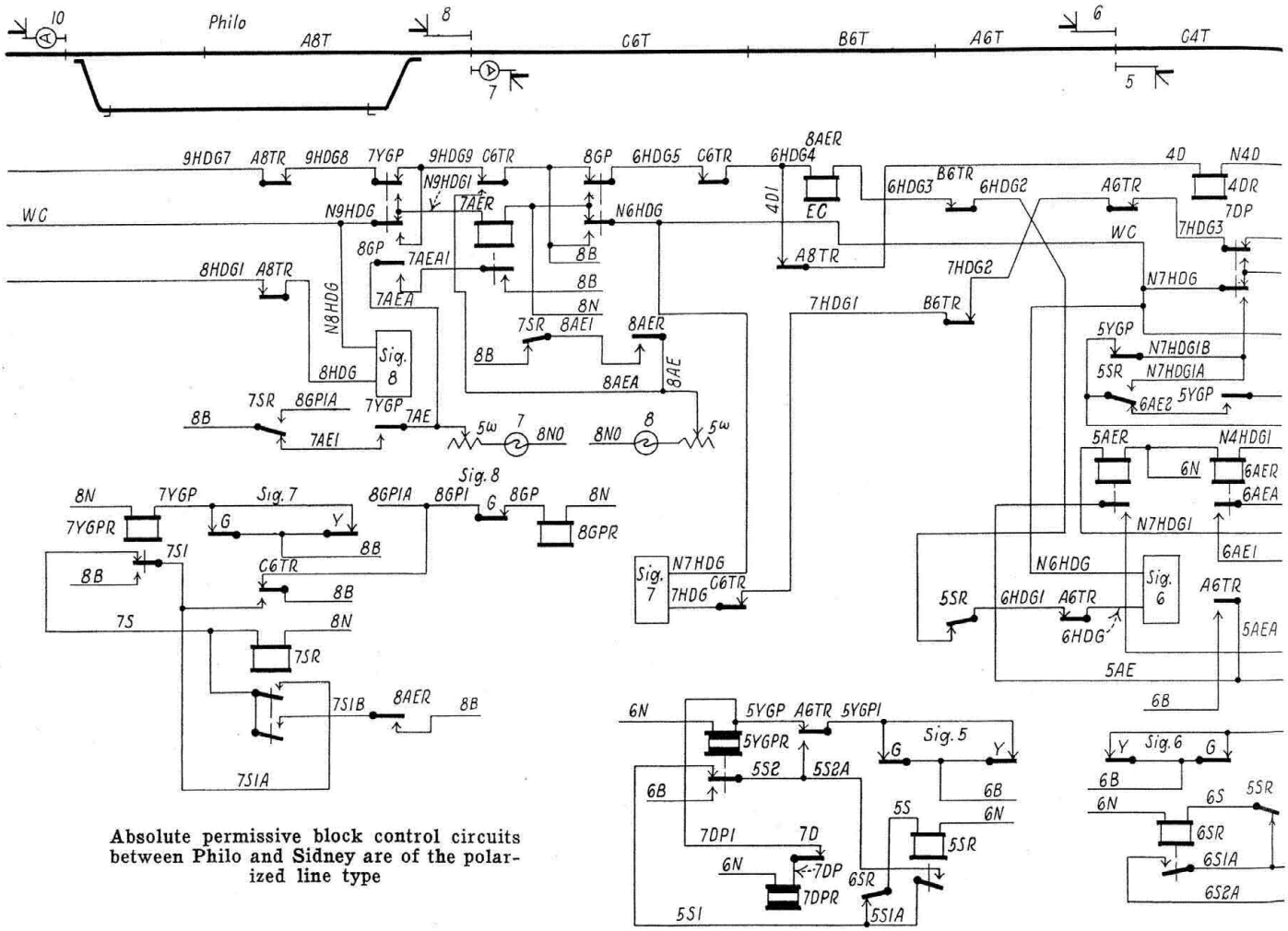




Double-intermediate automatic signal location 3298-3297, between Philo and Sidney. The signals are of the H-5 type with detachable mechanisms, and are approach lighted. Note portable sectional concrete foundations

tance between passing tracks is from 5 to 7 miles, two double locations are provided with a spacing of approximately 12,000 ft. between opposing intermediate signals.

The 3.8-mile distance between the passing tracks at Sidney and Philo was too short to use two sets of intermediate signals because the three automatic blocks would not each be equivalent to train stopping distance for use with three-aspect signals. Furthermore, the use of a single set of staggered intermediates would not solve the problem, nor would such an arrangement permit automatic blocks



Absolute permissive block control circuits between Philo and Sidney are of the polarized line type

Signal Control Circuits

The controls are arranged on the absolute permissive block system to provide absolute Stop aspects to prevent opposing trains from entering single track between two station layouts, and to provide permissive aspects for following trains. Each signal is controlled, to display three aspects, by a polarized line circuit which is connected to the 250-ohm coil of the searchlight signal mechanism. Absence of energy on this control circuit de-energizes the coil to set the spectacle in the red position. Polarity in one direction sets the spectacle in the yellow position, and reverse polarity sets it to the green position. Direct line control of the operating coil of the searchlight signal mechanism thus obviates the use of a local home relay.

The line circuit to the rear is polarized through two front and two back contacts in a 350-ohm, d-c. slow-pickup, slow-release DPR relay. This relay in turn is controlled by contacts in the signals which are closed when the spectacle is in either the yellow or green position. While a signal is changing from the yellow to the green position, the slow-release of the DPR relay prevents "flipping" of aspects of the signal in approach.

The accompanying circuit diagram has been simplified by using the figures

of equal lengths. By using a special control arrangement, only one set of intermediates was required, and these two signals are not staggered but form a double location, placed approximately midway between Sidney and Philo, thus providing blocks approximately 10,050 ft. long. The special feature is that the control of the Approach aspect of the station-leaving, head-block signal 4 at Sidney is overlapped to include track circuit A8T to the west of signal 7 at Philo, the length of this track circuit being about half the length of the station layout. Likewise the control of the Approach aspect of signal 7 at Philo is overlapped to include track circuit B2T at Sidney. With this arrangement, if two opposing trains occupy track circuits A8T and B2T, respectively, both trains would encounter the Approach aspect on signals 7 and 4, respectively, and be prepared to stop short of signals 5 and 6, therefore, the intermediate signals need not be staggered.

3, 4, 5, 6, etc., as signal numbers rather than the actual four digit numbers of the signals. The operating coil of signal 4 is normally energized by a line circuit starting with 6B at signal 6 and feeding through a front contact of distant repeater relay 4DPR, wire 4HDG3, a front contact of track relay C4TR, wire 4HDG2, a front contact of track relay B4TR, wire 4HDG1, a front contact of track relay A4TR and wire 4HDG to the coil of the mechanism. From the other side of the coil, wire N4HDG extends to common wire WC-EC. At signal location 6, this common wire

N4HDG extends through a front contact of relay 4DP, on wire N4HDG1, through the coils of approach lighting relay 6AER and to 6N which is the negative side of battery 6B. As long as the circuit is thus energized, signal 4 displays the green aspect.

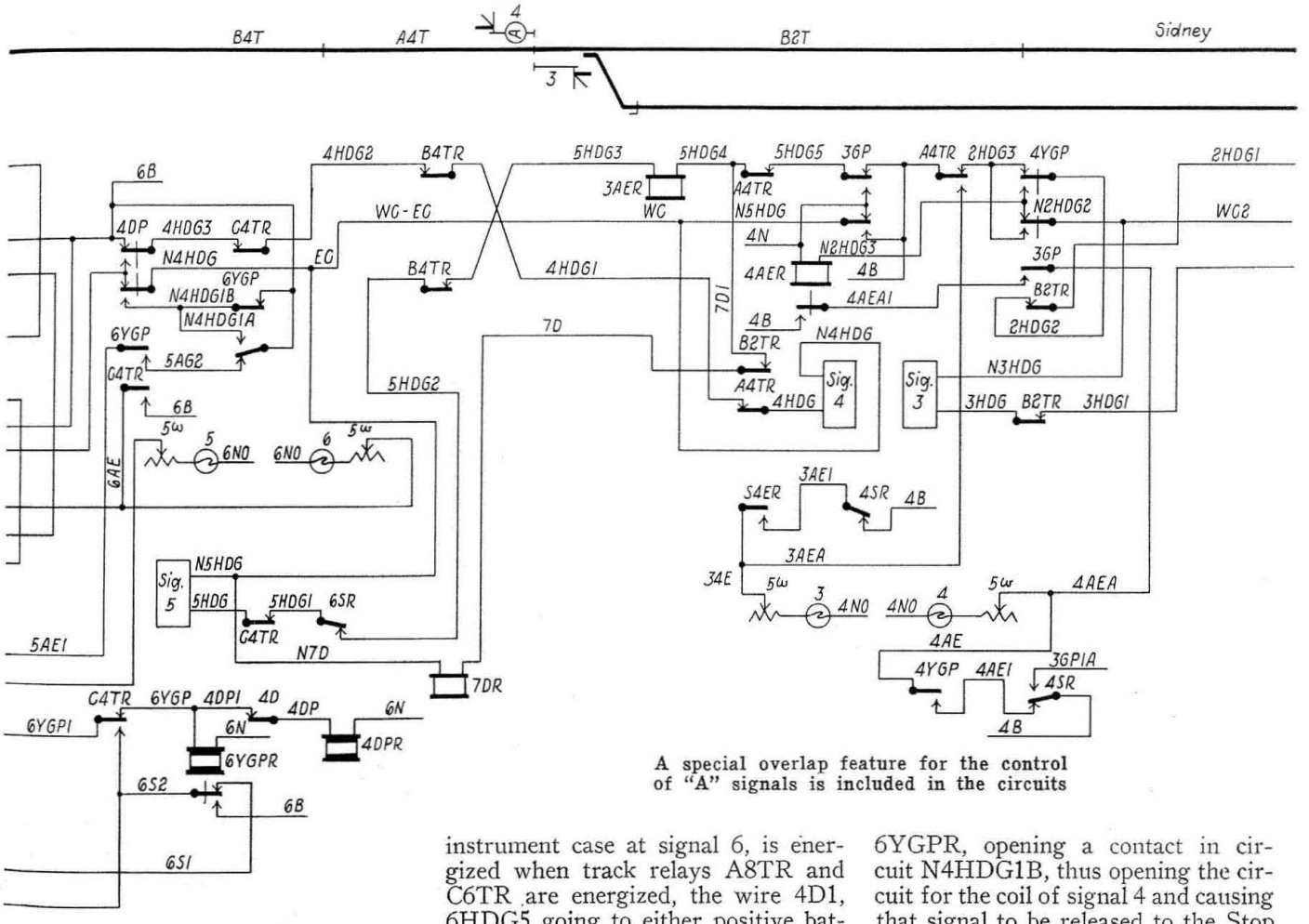
When relay 4DPR at signal location 6 is de-energized, the circuit 4HDG on wire 4HDG3 is connected through a back contact to wire N4HDG1, through the coils of relay 6AER and to negative battery 6N. Likewise, when relay 4DPR is released, the other side of the coil for signal 4 on wire WC-EC and N4HDG is connected through a back contact of relay 4DPR, wire N4HDG1B, a front contact of relay 6YGPR which is energized when signal 6 is in either the yellow or green position, and then to positive battery 6B. The polarity on the coil of signal 4 is, therefore, reversed, and the spectacle is thrown to the opposite side to cause the yellow aspect to be displayed.

Distant Repeater Relay

In view of the fact that contacts of relay 4DPR play an important part in the control of signal 4, the control of relay 4DPR should be studied. As shown in the diagram, the right terminal of relay 4DPR is connected to the negative battery 6N. From the left terminal, wire 4DP extends through a front contact of relay 4DR, on wire 4DP1 and wire 6YGP through a front contact of track relay C4TR wire 6YGP1 through a parallel circuit that is closed when signal 6 is in either the yellow or green position and to positive battery 6B. Therefore, relay 4DPR is energized when signal 6 is either yellow or green, track circuit C4T unoccupied and relay 4DR energized. Relay 4DR, located in the instrument case at signal 6, is energized when track relays A8TR and C6TR are energized, the wire 4D1, 6HDG5 going to either positive battery 8B or negative battery 8N, depending on whether relay 8GPR is up or down. As relay 4DR is a neutral, it is energized by either polarity. The slow-release characteristics of relay 4DPR prevent "flipping" of the aspects of signal 4 when signal 6 passes through the red position when changing from the yellow to the green position when a westbound train is passing through this territory.

With respect to the special overlap of the Approach aspect of signal 4 to include track circuit A8T at Philo, with track relay A8T down, relay 4DR is down and relay 4DPR is down, and relay 6YGPR is up. Therefore, signal 4 displays the Approach aspect as previously explained. If track circuit A8T is not occupied, signal 4 normally displays the Clear aspect because relays 4DPR and 6YGPR are up.

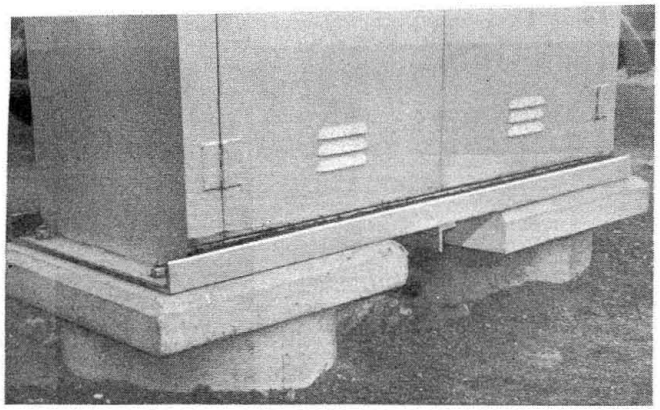
Signal 4 displays the red aspect if any of the track circuits A4T, B4T or C4T is occupied because a front contact of the relays for each of these track circuits is included in the control circuit 4HDG. For opposing train movements, signal 4 displays the red aspect as soon as an eastbound train passes signal 7 and enters track circuit C6T, thus placing signal 6 in the Stop position which releases relay 6YGPR, opening a contact in circuit N4HDG1B, thus opening the circuit for the coil of signal 4 and causing that signal to be released to the Stop position. The absolute Stop aspect, to prevent opposing trains from entering single track between passing tracks, is thus effected.



A special overlap feature for the control of "A" signals is included in the circuits

Operation for Following Moves

For an operation involving westbound following trains, signal 4 changes from the red to the yellow position as soon as the rear of the leading train passes signal 6, this feature being accomplished by the stick relay 6SR. When the leading train is occupying track circuit C4T, signal 6 is in the green or yellow position, therefore, positive battery 6B feeds through yellow or green contacts in



Portable sectional concrete foundations are used throughout the new installation for mounting the signal masts and instrument cases, conforming with the standard construction practice

signal 6, wire 6YGP1, back contact in track relay C4TR, wire 6S2, front contact in relay 6YGPR, wire 6S1, back contact in stick relay 5SR to the coil of relay 6SR and to negative battery 6N. After relay 6SR is up, a stick circuit feeds through a back contact of 5SR, wire 6S1A, front contact of 6SR, wire 6S2A, wire 6S2, a back contact of 6YGPR to positive battery 6B. Relay 6SR remains energized as long as signal 6 is in the red position, i.e., until the westbound train passes signal 8. In the meantime, relay 4DPR is down, 6YGPR is down, and the connection to complete the line circuit for signal 4 is from wire N4HDG, back contact of 4DPR, wire N4HDG1A, front contact 6SR to positive battery 6B, thus causing the Approach aspect to be displayed on signal 4 with a westbound train between signals 6 and 7.

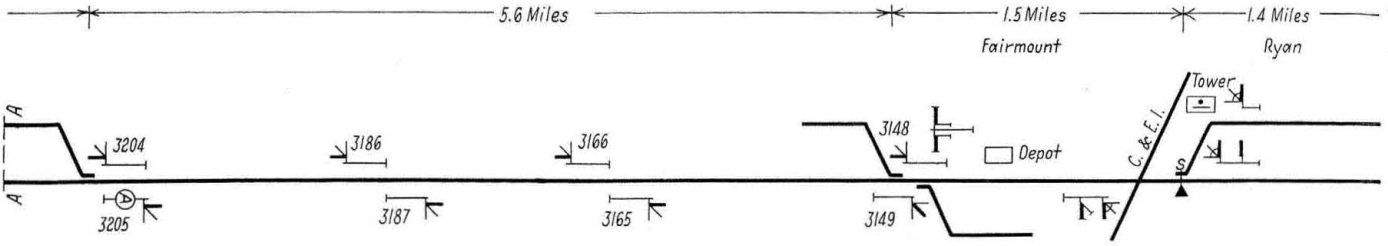
The slow-release characteristic of relay 6YGPR permits pickup of 6SR. The slow-pickup characteristic of 6YGPR prevents relay from picking up under a light train movement through the block when passing over insulated joints and prevent "flips" on the signal approaching thereto.

The stick relay 6SR will not pick up during the passage of an eastbound train, because, in this instance, signal 6 would be in the red position and relay 6YGPR would be down when an eastbound train enters track circuit C4T, and, in addition, 5SR energized would keep 6SR from picking. Thus the pick-up circuit for 6SR would be open at the front contact in 6YGPR.

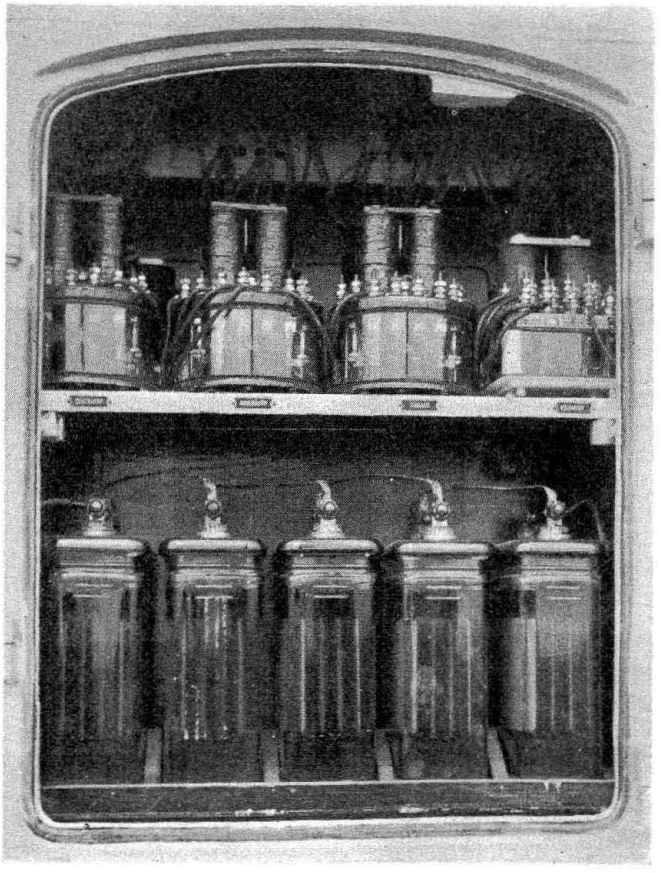
Another feature of these circuits is that as a westbound train holds up stick relay 6SR while in the block between signals 6 and 8, and the control circuit for the coil of signal 5 includes a back contact in relay 6SR, a westbound train, if it is stopped between signals 6 and 7, cannot get a green or a yellow aspect on signal 5 to make a back-up move, because the control of that signal is open at a back contact in relay 6SR.

Successive Approach Control

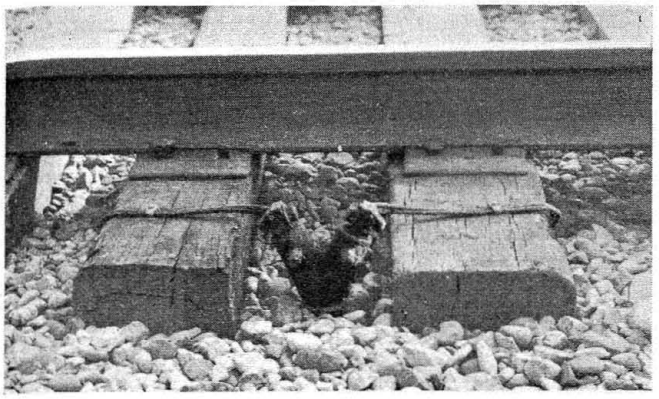
As mentioned previously, the block between signals 8 and 10 is only 0.6 mile long, which is not enough for train stopping distance, and, therefore, when signal 10 displays the red aspect, signals 8 and 6 both display the yellow aspect. Also signal 8 is overlapped one track circuit section in advance of signal 10 to make the length of the Stop aspect longer than stopping distance. The special control of the yellow position of signal 6 is accomplished by controlling relay 8GPR through a contact closed when signal 8 is in the green position only. When signal 8 is in the yellow position, relay 8GPR is de-energized, and, therefore, the line control circuit 6HDG is poled



Track and signal layout between Tolono and Tilton



Field side of the base-of-mast instrument case of intermediate distant signal to Tolono, 3366, showing the storage battery, the track repeater, the stick and the track relays



Forked-end bootleg outlets with stranded track connections with ⅜-in. plugs are used for connections to the rails

to cause signal 6 to be in the yellow position.

The electric lamps in the automatic signals are normally extinguished, and are lighted by approach control circuits. With certain exceptions, the lamps are lighted only for trains which are approaching the signal, rather than receding from the signal, this result being accomplished by extending the lamp circuits through contacts in the stick relays and in the signals or signal-repeater relays of the signal on the other side of the track.

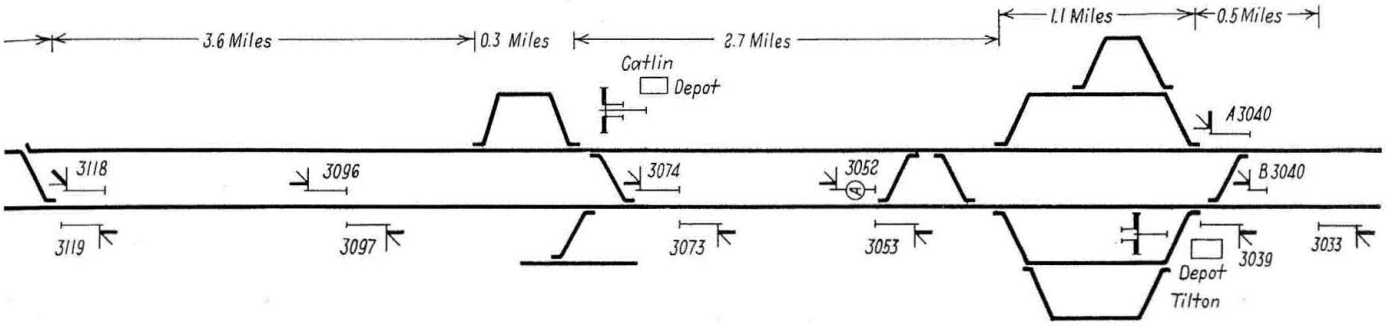
Approach Lighting Circuits

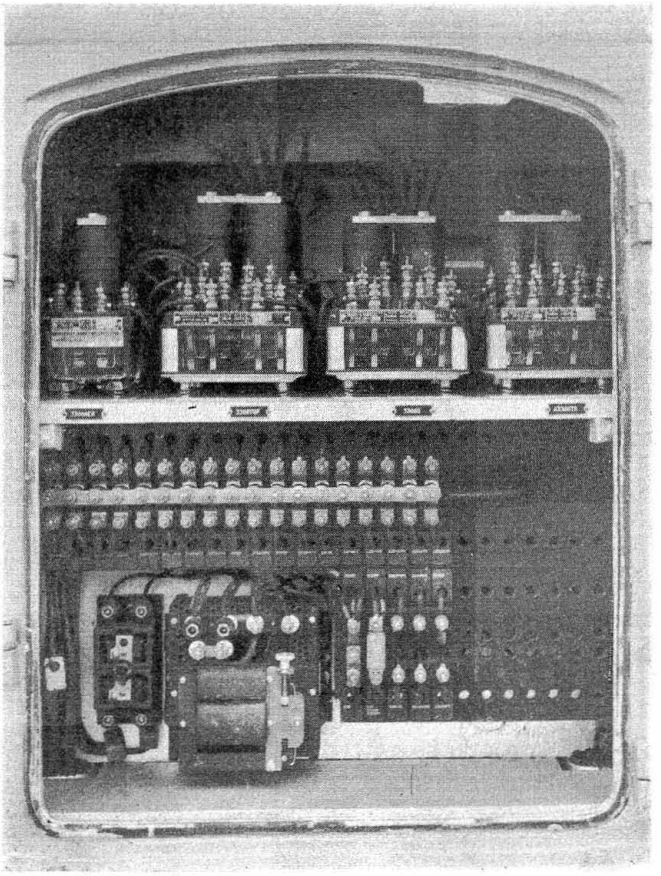
Each signal is lighted during the time a train is occupying any part of the automatic block in approach to that signal. The approach lighting control includes a 60-ohm relay in series with the line circuit for the signal in the rear, this AER relay being de-energized when any track circuit in the block is occupied, and the lamp circuit is completed through back contacts of the AER relay.

Certain variations from block-to-block approach lighting are in effect. For example, the lamp in an absolute station-leaving, head-block signal is lighted to display the red aspect as soon as an opposing train passes the opposing station-leaving, head-block signal at the next station, this feature being provided as information to operators and other employees concerning the approach of trains. In this case, signal 4, for example, would be in the red position and the lamp is lighted by a circuit feeding positive battery 4B through a back contact of relay 4SR, then released, through a back contact of relay 4YGPR, then released, and to the lamp.

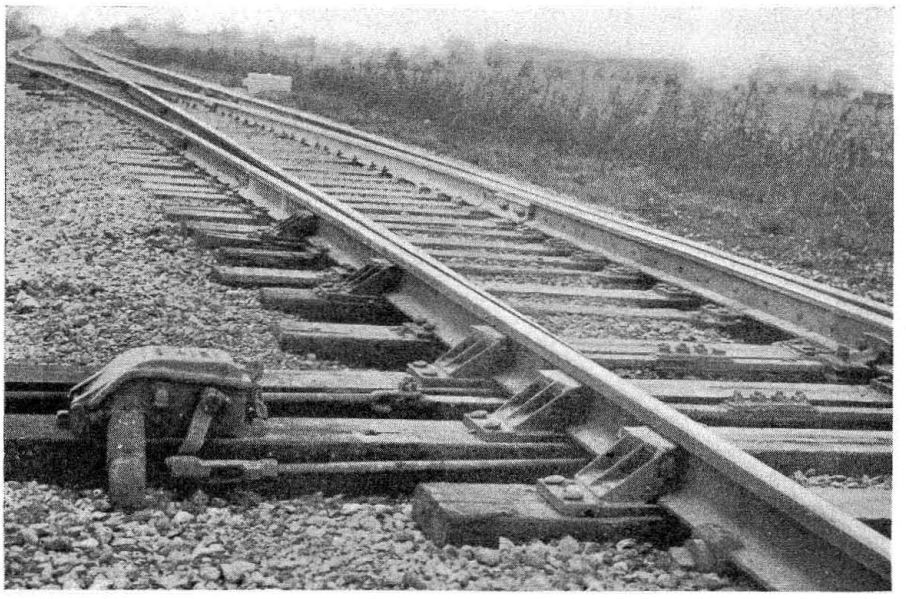
When the rear of a train passes a signal for the opposing direction and is occupying the first track circuit in the receding direction, the lamp in the signal is lighted. This result is accomplished by feeding battery to the lamp directly through a back contact of the track relay. For example, the lamp for signal 5 is fed battery through a back contact of track relay A6TR for track circuit A6T.

This feature is provided so that a train, which has been stopped, will have a red aspect to prevent it from making a back-up move. Except for this special feature, the signal would be dark. As soon as the rear of the westbound train clears track circuit A6T, the A6TR relay is picked up, and then the feed for the lamp in signal 5 extends through a back contact of 5AER, then closed, on wire 5AE1, through a back contact of 6YGPR, then closed, and to a back contact in relay 6SR which is then open because this relay is energized. Therefore, the lamp in signal 5 is extinguished as soon as the rear of a westbound train clears track circuit A6T. On the other hand, for an eastbound train passing





Track side of base-of-mast instrument case of intermediate distant signal to Tolono, showing approach lighting, yellow green repeater, stick and track relays. Lightning arresters, terminals, cut-out switch and rectifier are also shown here



Typical hand-throw switch layout in the newly signaled territory, showing bracing and switch circuit controller

signal 7, relay 5AER would be released, relays 6YGPR and 6SR would be down, and, therefore, the lamp in signal 5 would be lighted for the eastbound train.

Power Supply

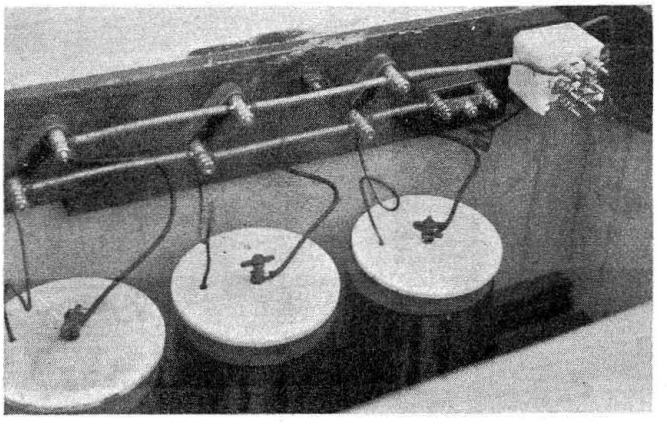
At each signal location, connections to the 220-volt, 60-cycle, a-c. line wires extend in cable to the instrument case, where they terminate in a Raco enclosed fused cut-out or disconnect switch, provided with a 3-amp. fuse on each side of the circuit. From this cut-out switch, the 220-volt circuit feeds an RT-21 transformer-rectifier for charging storage batteries. At some locations it also feeds a W10 type transformer with a DN-22P power transfer relay to switch the lamp feed to the battery in case of an a-c. power outage. A set of five cells of Exide lead storage battery is used at each signal, the KXHS-7 type being used at intermediate automatic signals, and the DMGO-7 at the head-block locations on account of the heavier normal discharge at these signals.

Each track circuit, the maximum length of which is approximately 4,000 ft., is fed by three cells of Columbia No. 572 primary battery, connected in multiple with a 2.5-ohm Raco adjustable limiting resistance in series.

Construction

The line control wires as well as the power supply wires are strung on a separate 10-ft. signal crossarm installed as the bottom arm on the existing pole line. No double arming is required because of the use of Ohio Brass breakarms at line-break locations. The line control circuits are on double-braid, weatherproof No. 10 Copperweld, 40 per cent conductivity wire. Two double-braid weatherproof No. 8 solid copper wires are used for the 220-volt a-c. power distribution circuit. These two wires are on the two end pins of the crossarm on the track side of the pole line, and are transposed every mile in order to reduce inductive interference with the communication circuits directly overhead.

The 220-volt distribution circuit is not continuous throughout the installation, but is sectionalized and fed at seven points within the territory, namely, Tolono, Philo, Sidney, Homer, Fairmount, Catlin and Tilton.



Each track circuit is fed by three cells of primary battery in multiple, with an adjustable limiting resistance located in series with the circuit

The 220-volt line extends in each direction from such a station for four to five miles, ending at a signal location. From that point on to the end of the next feed, no 220-volt circuit is provided, thus saving considerable first cost and additional maintenance expenses. At each signal location this line is protected by lightning arresters, mounted on the crossarm. The ground rods are ½ in. by 8 ft. Copperweld with ground wire clamps.

The runs from the instrument cases to the rail connections are in No. 9 single conductor cable having a non-metallic armor finish, and forked-end Hanlon & Wilson bootleg outlets, and stranded track connections extending to ⅜-in. plugs in the rails. The control circuits from the case to the signal on the opposite side of the track are in a five-conductor No. 12 cable having a mummy finish with no metal therein. The lighting circuit is in a two-conductor No. 9 cable, which also is run under the track and up in the mast of the opposite signal from the case. From the instrument cases to the line connections, open wires are suspended on a stranded messenger in metal cable rings, No. 14 and No. 12 wires being used for control and the 220-volt circuits, respectively. The multiple conductor underground cables on this installation are of Kerite manufacture.

Switch Circuit Controllers

Each of the main line switches in this territory is provided with a U-5 switch circuit controller equipped with a return spring device so arranged that if the controlled connecting rod becomes disconnected, the spring will operate the controller, thus resulting in signals displaying the most restrictive aspect.

The signal and instrument cases for this installation were wired in the Wabash signal shop. This signaling was planned and installed by the signal department forces of the Wabash under the direction of G. A. Rodger, signal engineer. The major items of signaling equipment were supplied by the Union Switch & Signal Company.