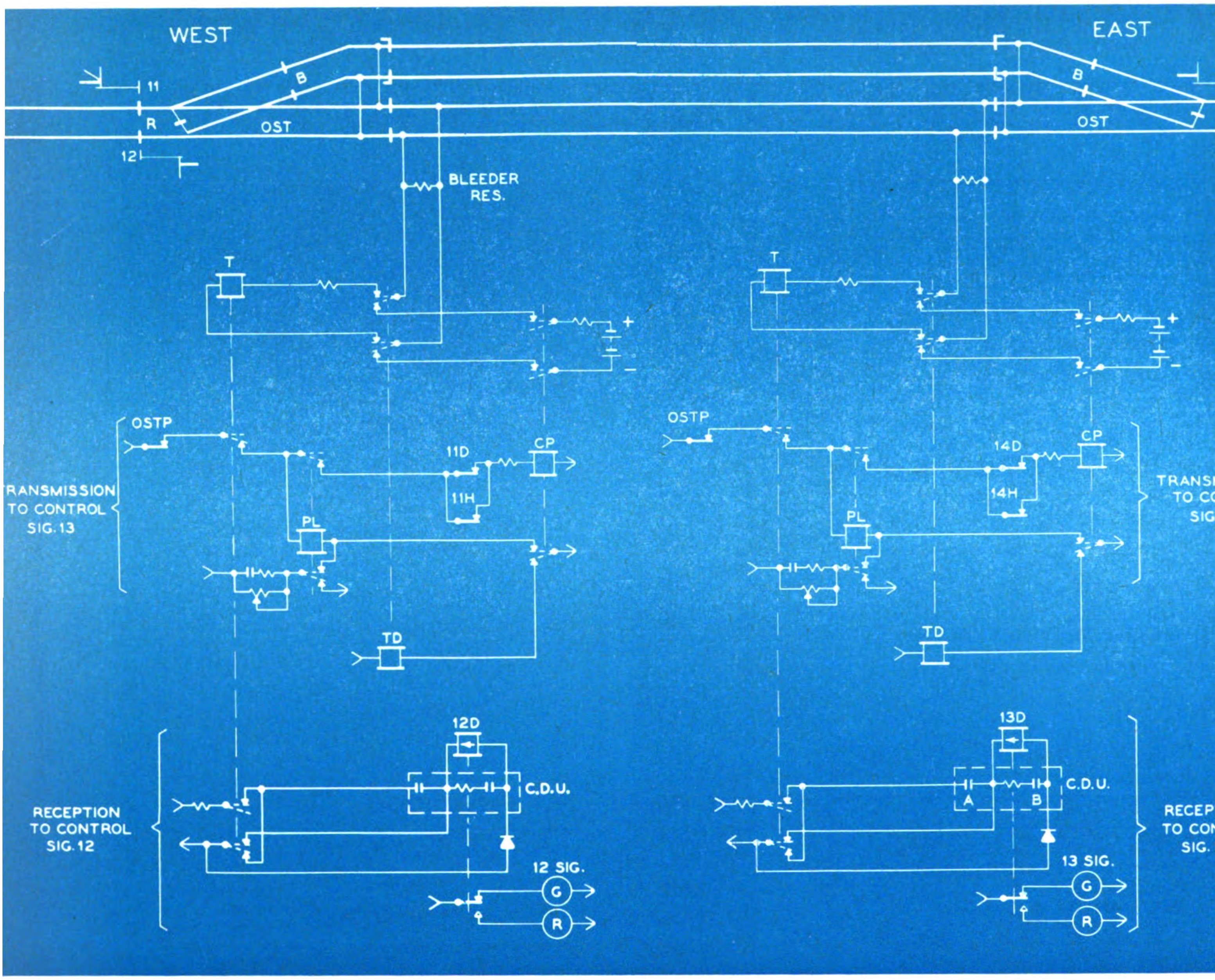


Fig. 4—Circuits for signaling at a typical siding

New Control System for Automatic Block

Uses Track Circuits Only

Slow codes, on the rails, first one direction and then the other, from siding to siding—are coordinated to accomplish controls without line wire circuits

THE FIRST HALF of this article, published in the May issue, explained the signal arrangements and basic principles of this system of controlling signals by track circuits only. The remainder of the article, including circuit diagrams and explanations, is as follows:

The simplified circuits in Fig. 4 are for a typical siding. Conditions are normal, that is, the switches are lined for a move on the main track, and the signals show the green aspect. Therefore, positive pulses are being dependently transmitted in both directions, and received to clear the two-position signals 12 and 13. Before describing the operation to clear signals 12 and 13, it may be convenient to list the relays involved, and their functions:

T—The track relay is a code-responsive VTB relay for reception of the pulses. It responds to coded energy from the track. It is equipped with either one or two armatures, depending on the code requirements. One armature responds to positive pulses and the other to negative.

TD—The transfer delay relay is a code-responsive relay which provides a time delay between the transmission of a pulse and the time the track relay is connected to the rails to receive a pulse. This delay allows the induced rail potential to dissipate through the track ballast and bleeder resistor before the track relay is connected to the rails, so it will not be improperly energized.

CP—The code pulse relay is a code-responsive VTB relay, which combines with the PL relay to generate the pulses, with polarity as determined by the position of the signal. It is equipped with either one or two armatures, depending on code requirements. When two armatures are used, one armature creates positive pulses and the other negative.

PL—The pulse length relay is a code-responsive relay used to determine the length of each pulse with the aid of the CP relay. It also determines the length of the off time between pulses with the aid of a condenser-resistor unit.

H and D—The home and distant signal control relays are biased-neutral relays. Although H relays are not shown, they are included here for future reference. These relays determine the aspect of the signal, H relay controlling it to yellow, and D relay controlling it to green.

OSTP—The OS track repeater relay repeats the position of the track relay in a detector track circuit, that is, it is normally picked up unless the detector track is occupied.

TRANSMISSION—The control of signal 13 depends upon the position of signal 11, which is clear. Therefore, pulses are being transmitted from the latter location at the west end of the siding. In this instance, the CP relay has a single armature since only pulses of one polarity need be transmitted to control a two-position signal, the stop position being absence of code.

The circuit to energize the CP relay at West is traced from positive energy through:

1. Front contact of OSTP relay, to check that the detector track is unoccupied.
2. Back contact of the track relay T to check that reception is not taking place. This contact also conditions the PL relay to be ready for transmission after a pulse has been received.
3. Back contact of the pulse length relay for reasons given below.
4. Front contacts of 11D and 11H relays in multiple, which determines that a pulse is to be transmitted.

The closing of the CP front contact picks up the PL relay, and at the same time releases the TD relay. This completes connections through TD back contacts to battery, thus applying positive energy to the rails. The pickup of PL removes energy from the CP relay. The TD releases quickly each time the CP picks up to transmit a pulse, then, when CP releases, TD slowly picks up to connect the track relay to the rails for reception.

Pulse Timing

The timing operation starts when the PL relay picks up. It is maintained in this position by the discharge of the condenser in a local circuit that includes a PL stick contact and a back contact of the track relay. Before the condenser charge is dissipated, the track relay receives a pulse and picks up. (This happens in dependent coding only. If the pulse were not received, the condenser charge would dissipate entirely and independent coding would commence.) The PL relay thereupon releases, allowing the condenser to recharge. The condenser and limiting resistor are in parallel with a relatively high resistance, which is adjusted to give the desired time constant.

The release of the PL relay again energizes the CP, which thereupon releases the TD and closes its own front contacts to apply energy to the rails. At the same time, the pickup of CP completes a circuit energizing the PL relay again.

The condenser charge keeps the PL picked up in the time between the pulses, or the off time. The code pulses are made rather short in duration (a fraction of a second) whereas the time between successive pulses is about two seconds, which is much longer than the pulses themselves. The intermittent pickup and release of the CP relay is contniued as long as the detector track is unoccupied, reception is taking place at the proper time, and signal 11 is at either green or yellow.

How Decoding Is Done

At the east end of the siding, the pulses to control signal 13 are received by the track relay T, through front contacts of the TD relay. Each time the T relay picks up, it connects condenser A in the code detecting unit to energy and charges it. Each release of the T relay, between transmitted pulses, closes a circuit that permits the condenser to discharge through the winding of 13D relay.

The path of the current under both conditions, to keep the relay energized, is illustrated in Fig. 5. In the diagram at the left, the arrows show the direction of current flow when the track relay picks up. The 5000 mfd. condenser A is charged by a circuit through the connection between terminals 2 and 3. The previously charged condenser B, which

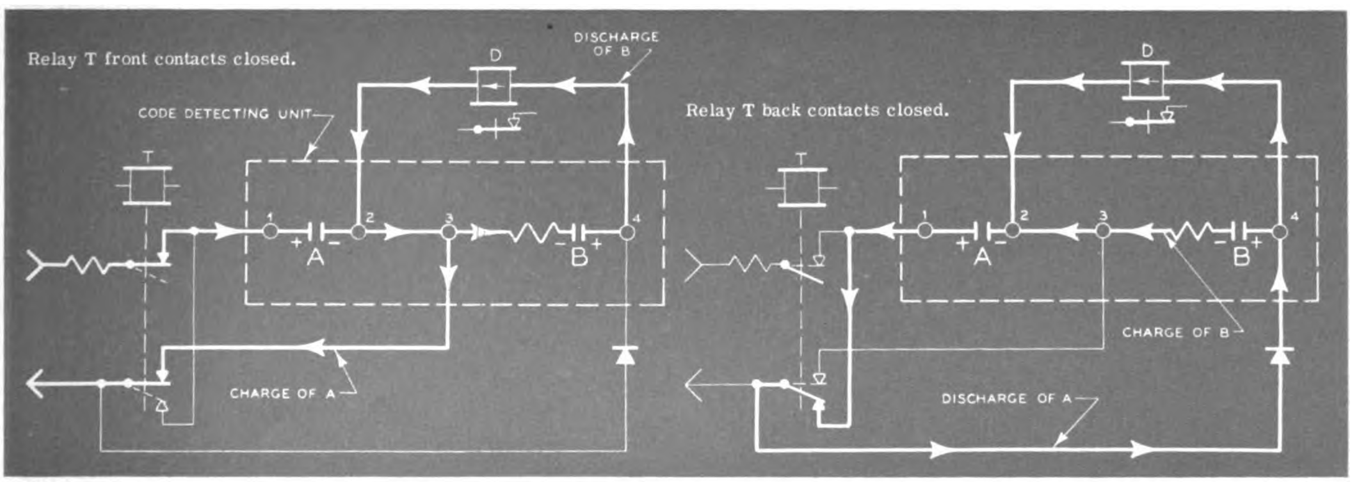


Fig. 5—Circuits for decoding operation

is 1000 mfd., is discharged through the relay winding and keeps the relay picked up during the time a pulse is received. The rectifier prevents condenser B from discharging through a front contact of T relay.

In the diagram at the right, the arrows show the direction of current flow in an interval between successive pulses when the T relay is released. Condenser A discharges through the relay winding, the polarity of current being such that the biased-neutral relay is energized to keep it picked up. A parallel circuit charges condenser B at the same time.

Thus, in the short interval when a pulse is received, the relay is energized by condenser B and in the longer interval between pulses, is energized by condenser A. If coding ceases, the condensers will not be charged and the relay will release. If steady energy is received inadvertently from the rails, the track relay will pick up and stay up. However, condenser A will not be permitted to discharge, and the relay will release when the charge of condenser B is dissipated. This provides protection against storage-battery effect in the track. The D and H signal control relays used in such decoding circuits are biased neutral as a precaution against possible breakdown of the condensers.

Independent Coding

The description thus far has dealt with dependent coding, that is, the track relay must pick up and release the PL relay so the condenser may be charged for the next transmission, which will start when the track relay releases. However, if a pulse is not received in the predetermined length of time, independent transmission takes place.

Referring to Fig. 4, assume an eastbound train occupies the OST detector track at the west end of the siding. The OSTP relay releases and prevents further operation of the CP relay. Hence transmission stops. At the other end of the track circuit, at the east end of the siding, the track relay T remains released, so the pulse length relay PL is held picked up until the condenser charge is dissipated. Its release closes the pickup circuit for the CP relay. The transmission operation proceeds as described before, except that the track relay is inoperative and the discharge time of the condenser determines when the next pulse is to be transmitted.

At the west end of the siding, when the rear of the eastbound train leaves the detector track circuit, the OSTP relay picks up and allows signal 11 to clear. Thus the pickup circuit of the CP is again established, and pulses are independently transmitted eastward up to the rear of the train.

When traffic conditions return to normal, transmission at both ends is quickly brought into step for dependent coding. To facilitate this, the rate of independent coding at one end is different from the rate at the other end, for example, 33 pulses per minute as compared to 29 pulses per minute. The faster rate has an opportunity to be received at the other end and return the system to dependent coding.

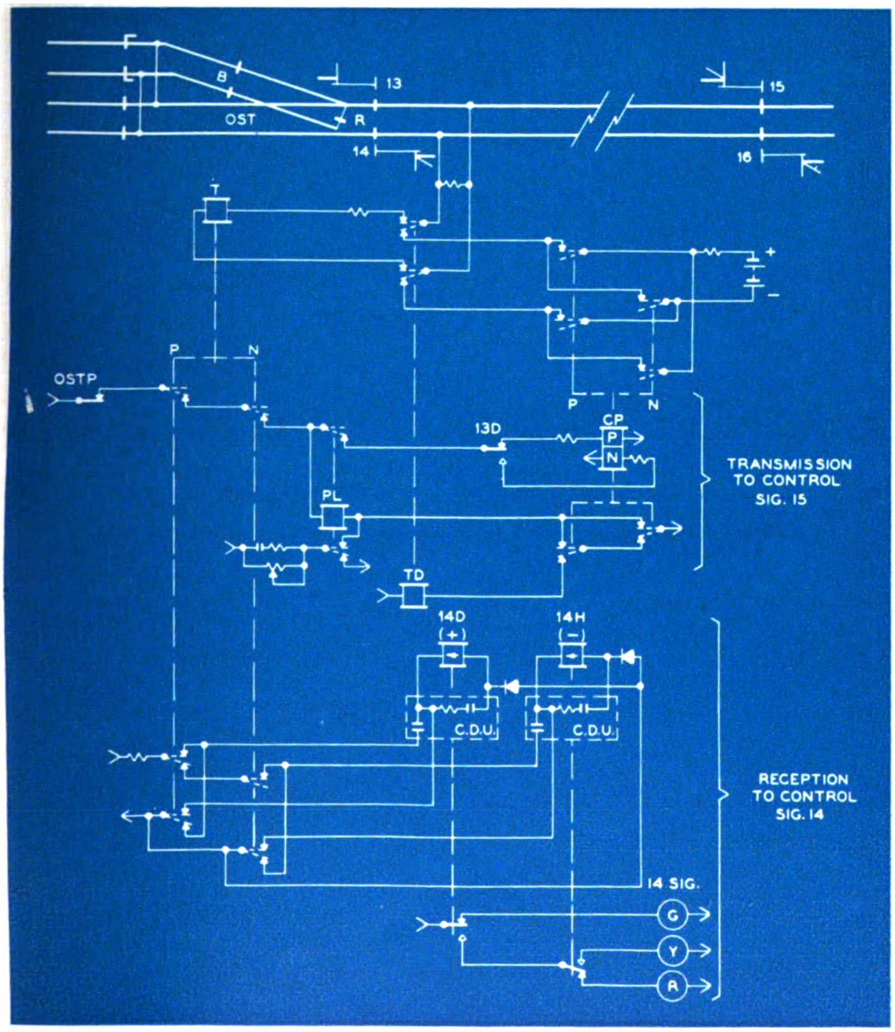


Fig. 6—Circuits to control three-position signal

Control of 3-Position Signals

The circuits in Fig. 6 are a continuation of those for the siding. They show how both positive and negative pulses are transmitted and received to control three-position signals. For example, information about signal 13 is transmitted eastward to control intermediate signal 15, and signal 14 is controlled by information transmitted west concerning signal 16. In this case, the CP relay and the track relay have double armatures, one responding to positive pulses and the other to negative. Otherwise the operation is much the same as described previously.

In transmission to control signal 15, the circuit to energize the CP is the same as before except that closing the front contact of signal control relay 13D will operate the positive armature of CP relay, and the release of 13D operates the negative armature. Therefore, when 13 signal is green, a positive pulse is transmitted to control 15 signal to green, and when 13 is red, a negative pulse is transmitted to control 15 to yellow. Occupancy of the detector track circuit will, of course, release OSTP relay, place all opposing signals at stop, and start independent coding as shown in Diagram C, Fig. 2. (See May issue.)

In the decoding operation to control signal 14, the position of signal 16 determines whether a positive or negative pulse will be received, and therefore which armature of the track relay will operate. If the pulses are positive, signal control relay 14D picks up and remains up in the same manner described previously, and signal 14 will be green. If negative, 14H relay is energized, and signal 14 is yellow.

Fig. 7 shows the circuits for a double intermediate signal location. In addition to the relays discussed so far, others are required for direction control purposes:

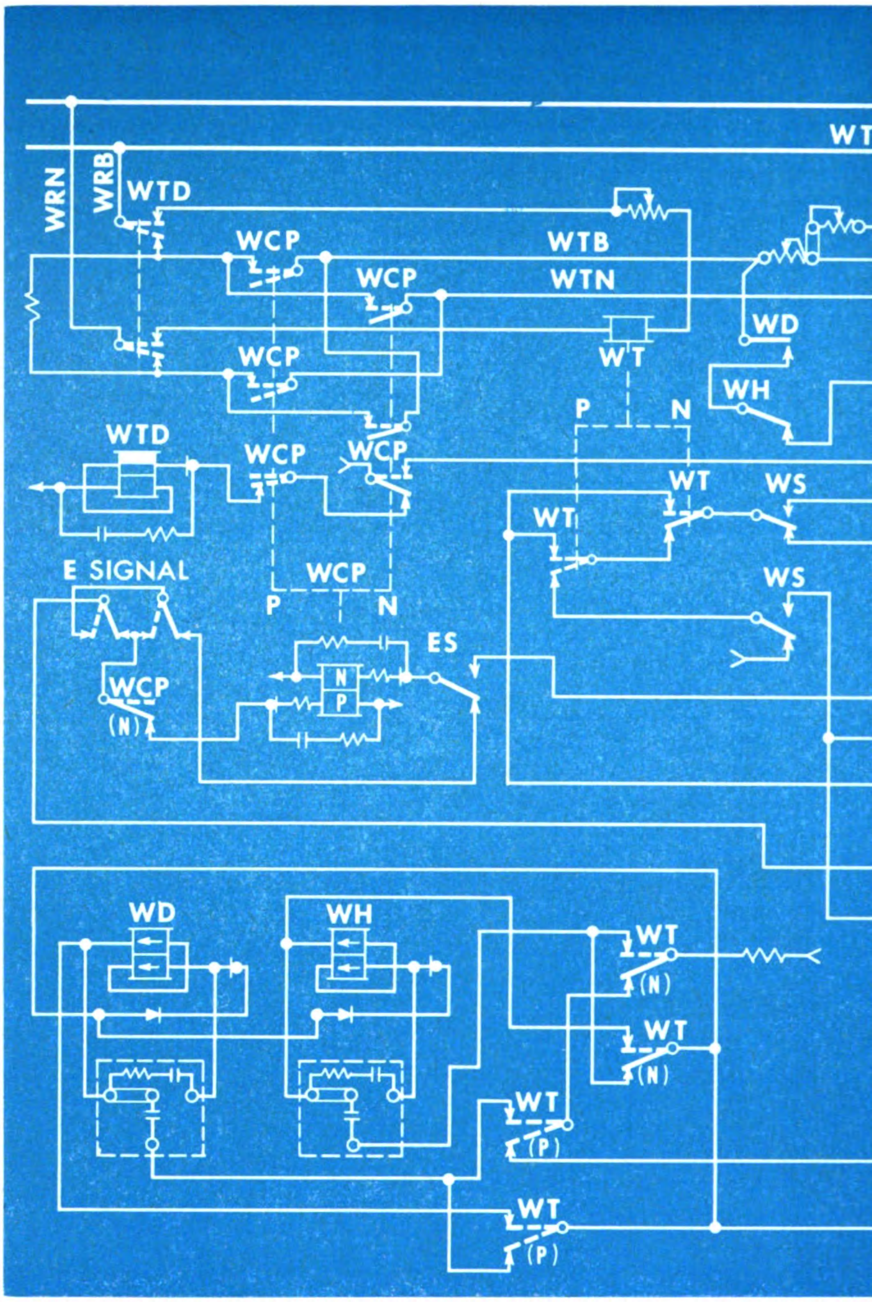
A—The series approach relay is a code-responsive VTB relay which repeats the code when a train is approaching, and thereby picks up the proper directional stick relay. This relay has two windings, one for each direction.

WS or ES—The stick relays are neutral directional relays. Such a relay is picked up by A relay on the approach of a train. In picking up, the proper stick relay records the direction of a train passing an intermediate signal location.

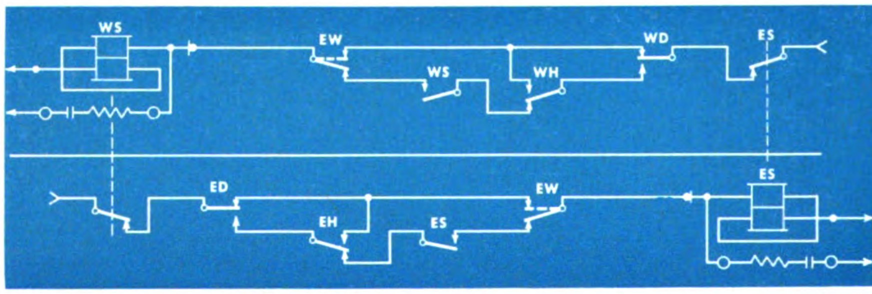
With the signals clear as shown, positive pulses are being transmitted dependently. A pulse received by the track relay WT, for example, applies energy to the ECP relay, so that the pulse is repeated into the adjacent track circuit. The reception of a negative pulse will usually result in transmission of a positive pulse. The pulse is always passed on, but its character may be changed, since this depends upon the position of the signal. The ECP pickup circuit to relay the pulse is taken through back contacts of the ET to check that reception is not taking place, through back contacts of directional stick relays ES and WS to check that there is no traffic, and through the positive front contact of WT to positive coil of ECP. This operation is a simple repeat of the pulse received; there is no pulse timing involved in dependent coding. In like manner, the reception of a pulse by ET will cause WCP to transmit through a circuit similar to that described.

When a train enters the block between sidings, the tumbledown feature of Trakode simultaneously places all opposing signals in the block at stop. Assume an eastbound train enters the block in which the intermediate signals W and E are located and signal W therefore goes to stop. The release of the WD relays will cause all signals to become lighted. Nothing happens now until the train is close enough to the location so the shunt current becomes large enough to start the approach relay coding. The initial pickup of the A relay energizes the directional stick relay ES, which is then held picked up as the A (E) contact operates, because of the condenser-resistor shunt making it slow-release. This ES pickup circuit checks that the opposing directional stick WS is released.

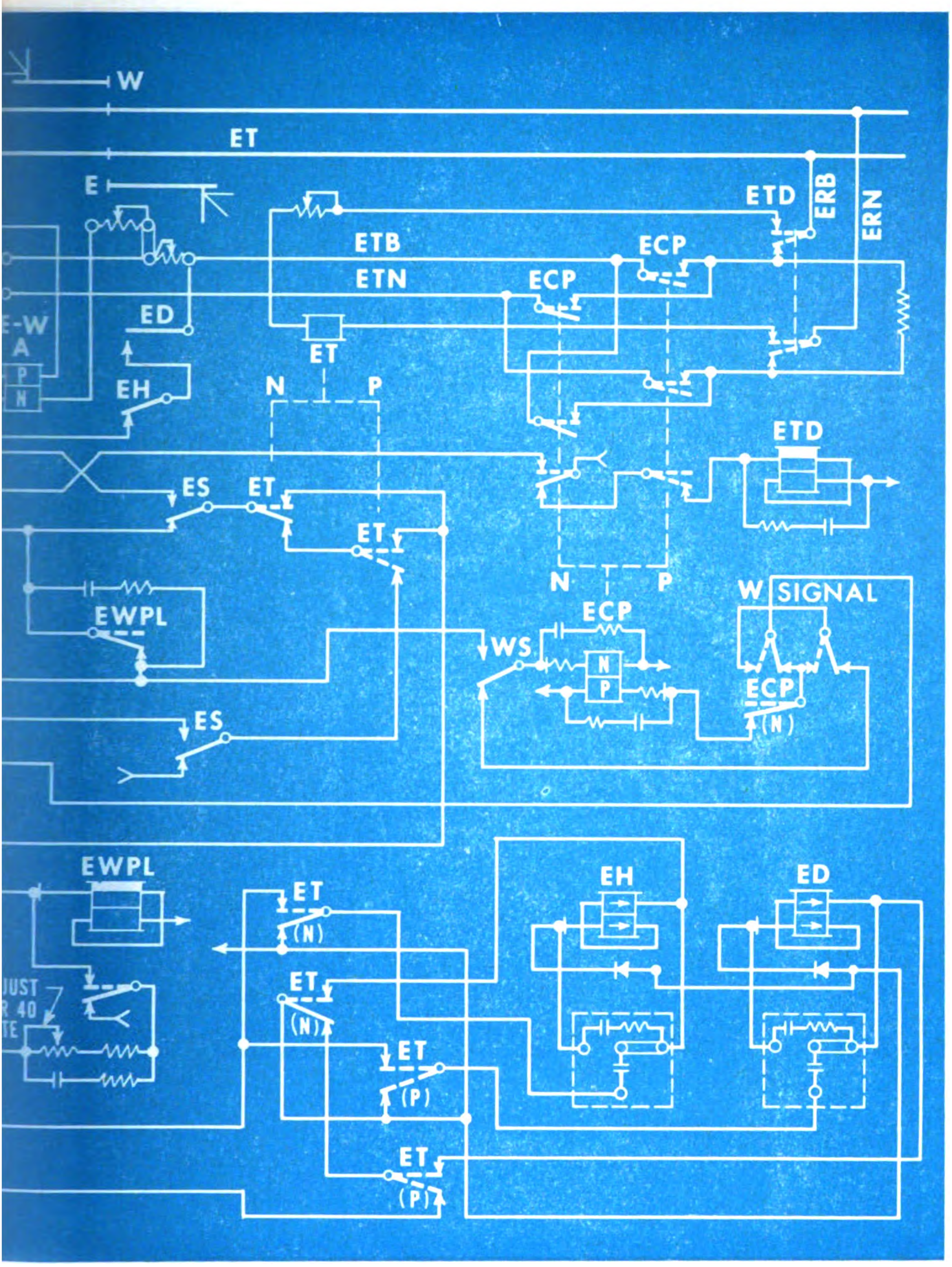
As the train passes the intermediate location, the signal control relay ED releases placing signal E at stop. This establishes a stick cir



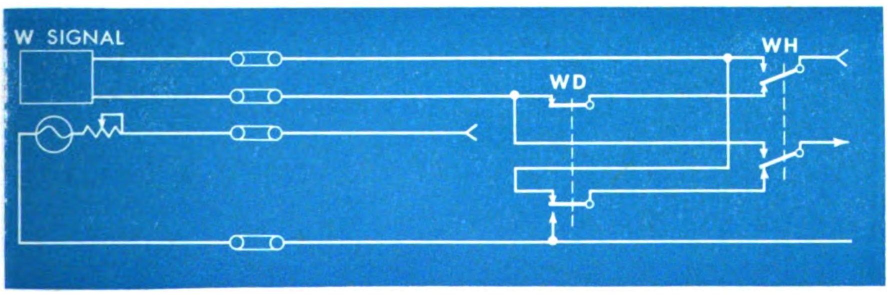
Left half Fig. 7—Circuits at intermediate signal
The two rail connections WRN and WRB are at the signal



Stick relay circuits at intermediate



Right half Fig. 7—Circuits at intermediate signal
The two rail connections ERB and ERN are at the signal



Typical local circuit for signal

cuit for the ES relay, through back contacts of the ED and EH relays. When the train is past the location, the WCP transmits negative pulses west to place the signal in the rear at yellow for a following move. With the ES picked up, a circuit is completed to energize the negative coil of WCP relay. This can be traced from positive energy through contact of WS released, through back contact of WT, to check that reception is not taking place, through back contact of PL relay, through a front contact of ES and through the WCP negative coil to negative energy.

At the same time that WCP is energized to apply the negative pulse to the rails, parallel paths of the circuit pick up the pulse length relay PL immediately after charging the condenser associated with it. The pick-up of PL opens the circuit to end the pulse and permits the condenser to discharge through the PL winding, holding it energized a predetermined length of time. When the charge is dissipated, PL relay releases and the WCP negative coil is again energized. The independent coding continues until the train clears the track circuit to the east of the location.

With the train out of this block, negative pulses will be transmitted west to control signal E to yellow, and positive pulses to control the next following signal to green. Track relay ET responds to the negative pulses by operating the N contacts. These pulses are decoded in the usual manner, described previously, so that signal control relay EH is picked up and stays up as long as coding continues. Thus signal E is placed at yellow. Reception of the negative pulses also energizes the positive winding of the WCP relay, thereby transmitting positive pulses westward to control the next signal to green. When relay EH picks up to control E signal to yellow, the stick circuit of the ES relay is opened and this relay returns to its normal released position.

Repeating Cut Section

Where signals are spaced so far apart that the distance between them is greater than the practical operating length of Trakode, it is necessary to introduce one or more code-repeating cut sections between the signals. Two track relays having double armatures are used at each cut section. Pulses are received by one track relay on condition that the other is not receiving pulses from the opposite direction. The relay receiving the pulse then operates its positive or negative armature in response to the polarity of the pulse, and in so doing, applies the same battery polarity to the rails in the adjacent track circuit.

This signaling was planned and installed by signal forces of the Texas & Pacific, under the direction of J. L. Weatherby, signal engineer, the major items of signal equipment being furnished by the General Railway Signal Company.