CHAPTER IV.

NORMAL CLEAR CIRCUITS.

In all normal clear systems, the signal semaphores or disks are in the clear position at all times except when a train is in the block protected, or an otherwise dangerous condition exists. This implies that the clearing or retaining devices are normally in circuit with the power battery, and that their control is primarily effected with front relay contacts.

In Fig. 51 a diagram of one form of polarized system of normal clear signals is given. *C* is a two-arm semaphore signal, *E* being

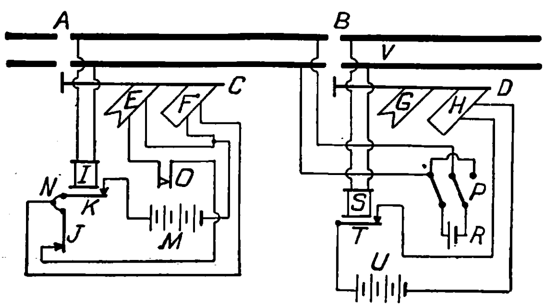


FIG. 51

the distant, and *F* the home blade. *F* indicates the condition of block *A–B*, to one end of which the polarized track relay, *I*, is connected, this relay deriving current of a given polarity from the track battery, *R*, at *B*. This circuit is through the rails of the track and the pole-changing switch, *P*, which is actuated mechanically (in the direction shown by the contacts) by the home blade, *H*, of signal *D*.

The distant blade, *G*, is not shown connected, to simplify the circuits; while the pole changer is omitted at *C* for the same reason. Relay *S* is connected across section *V*, in the block controlled by *H*, and derives current from a battery at the other end of this block, a polarity changer being also interposed.

Relay *S*, through the armature *T*, and a front contact, controls the flow of current from the signal battery *U*, to the home blade, so that when *S* is deënergized *T* falls, and by opening the circuit of *U*, causes *H* to move to the danger position.

If a train occupies the block between *A* and *B*, *R* will be short-circuited, thus deënergizing *I* and allowing the neutral armature, *K*, to drop, thereby open-circuiting the signal battery, *M*, and causing *F* to move to the danger position. *O* is a series switch open-circuited mechanically by the motion of *F*; hence *E*, deriving current from *M* through this switch, moves to the caution position.

The neutral armature, *K*, is connected to *J* by the jumper wire, *N*, *J* being the polarized armature of *I*, whose direction of motion, and consequently of contact, depends upon the polarity of the current which *I* receives. With *P* in the position shown, *J* will be in contact with its contact finger; but if *P* be reversed, *J* will be on open circuit. This latter condition will evidently occur if a train be in section *V*.

When the train passes out of the block of *H*, it moves to the clear position, by the action of relay, *S*, which restores current to this blade. This causes a shifting of the pole changer, which returns to the position shown in the diagram. The reversal of polarity causes *J* to move to its normal position, thus restoring *E* to the clear position.

Fig. 52 shows diagrammatically the arrangement of a block consisting of two insulated track sections, *A–B* and *B–C*; the home and distant semaphores being on separate posts. Such an arrangement is employed where the blocks are of considerable length, and wherever it is most desirable to locate the home and distant blades on independent posts, the distant semaphores being placed between the home signals.

Upon a train's entering the section, *A–B*, the armature, *H*, of track relay *G* falls, thus open-circuiting the main battery, *T*, and causing *D* to move to the danger position. When the train enters the section, *B–C*, the track relay *I* is short-circuited, thus allowing its armature, *J*, to fall, and, by open-circuiting track battery *M*, depriving section *A–B* of battery current. Thus *G* remains deënergized while *D* remains at the danger position.

The presence of the train in section *B–C* also allows the neutral armature, *K*, to fall, hence *E* moves to the caution position, being deprived of current from the main battery, *S*.

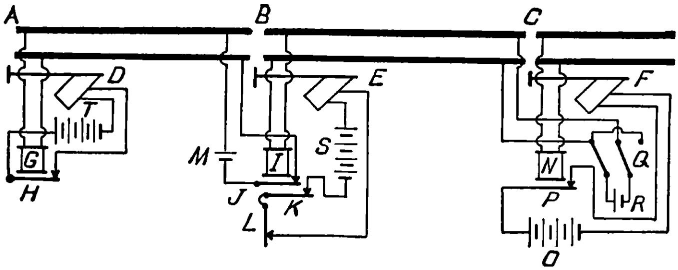


FIG. 52

The polarized armature, *L*, is not directly affected until the train has passed the insulating joints at *C*, when, by *N* being short-circuited, *P* falls, thus moving *F* to the caution position by open-circuiting the main battery, *O*. The motion of *F* throws the polarity reverser, *Q*, over, thereby reversing the polarity connections of *R* to the rails of section *B–C*, and causing *L* to move away from its contact, maintaining *E* in the caution position. This will continue until the train passes out of the section controlled by *F*, when *E* will return to clear.

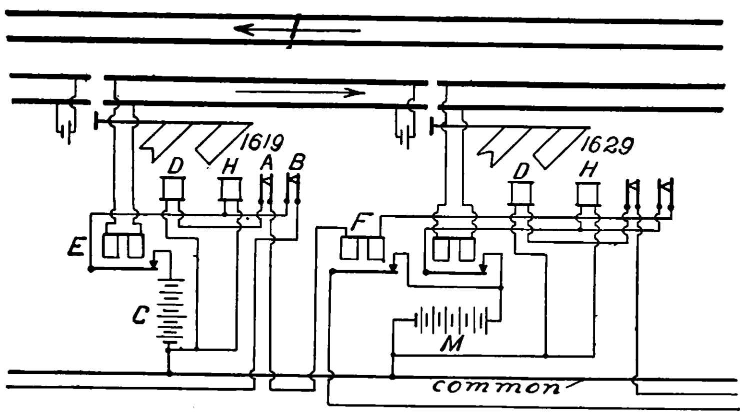


FIG. 53

The consecutive connections of home and distant normal clear signals for one side of a double-track line are shown in Figs. 53 and 54. At signal 1619, *D* operates the distant blade and *H* the home semaphore. In reality, these are motor-slot magnets, the motor itself being operated through an auxiliary circuit, which consideration, however, does not affect the fundamental connections. *A* and *B* are closed by the clearing of the home board, *A* being in series with the distant at 1619, and *B* in series with the distant at 1609 through the line wire. *H* is operated by current from the power battery, *C*, through the armature of track relay *E*. Hence, when the block of 1619 is occupied, *H* will be deprived of current, and *A* simultaneously opened, thus throwing both semaphores to the stop position.

The connections at 1629 are similar to the above, a series relay, *F*, being added, however, whose armature is raised when

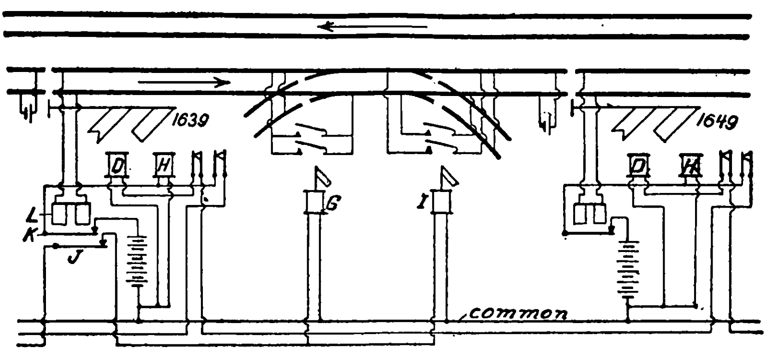


FIG. 54

current passes to the switch indicators, *G* and *I*, in Fig. 54, through the common and indicator line-wires, armature *J* at 1639, and battery *M*. The remaining circuits at 1639 and 1649 are practically identical with the preceding. In both diagrams a common line-wire is introduced. This is the usual practice with line-wire systems, one side of the main batteries and switch indicators being connected to it, thus economizing on the extra copper that would otherwise be required.

In Figs. 55 and 56, 2, 4, 6, and 8 are normal clear home and distant signals controlled through line wires and applied to one of the tracks of a double-track railroad. But one track relay is used in each block, the contacts, *C*, of these relays being in series with the home operating device. *B* is a distant contact in series with the circuit breaker, *E*, operated by the home semaphore and controlling therewith the distant blade of the preceding signal. Track circuit-control is introduced at *T*, Fig. 56, this arrangement being generally interposed in long blocks

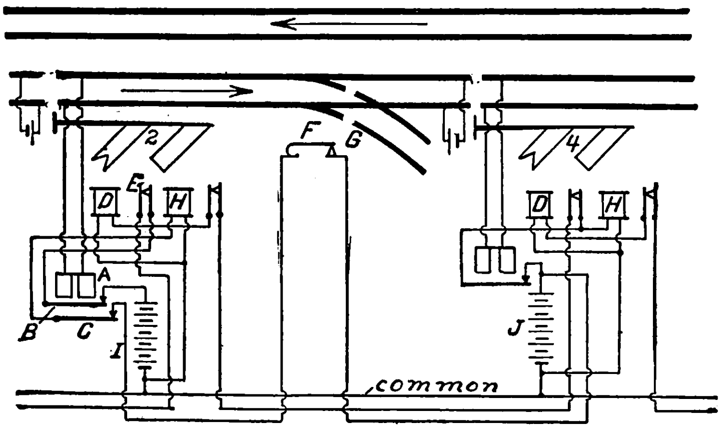


FIG. 55

having necessarily several sections. The front contact of the relay, *T*, is in series with the track battery, *M*, the back contact being in shunt with the latter. Hence, when *T* is energized,

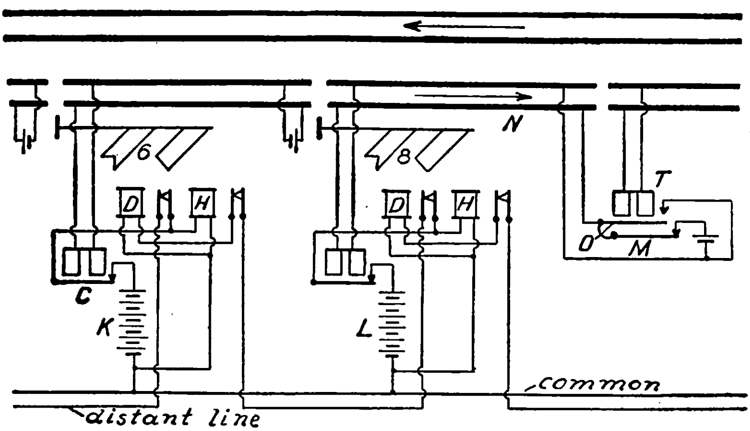


FIG. 56

M will be connected to and energize section *N*, while when *T* is deprived of current, the back contact will short-circuit the track at *N*, the front contact simultaneously open-circuiting *M*.

At the switch, *G*, a contact, *F*, is arranged, so that when the switch is open *H* will be deënergized and the home and distant blades at signal 2 thrown to stop. One side of each of the main batteries, *I*, *J*, *K*, and *L*, is connected to the common line-wire, as in the preceding case.

Figs. 57 to 62 show the standard normal clear overlap line-

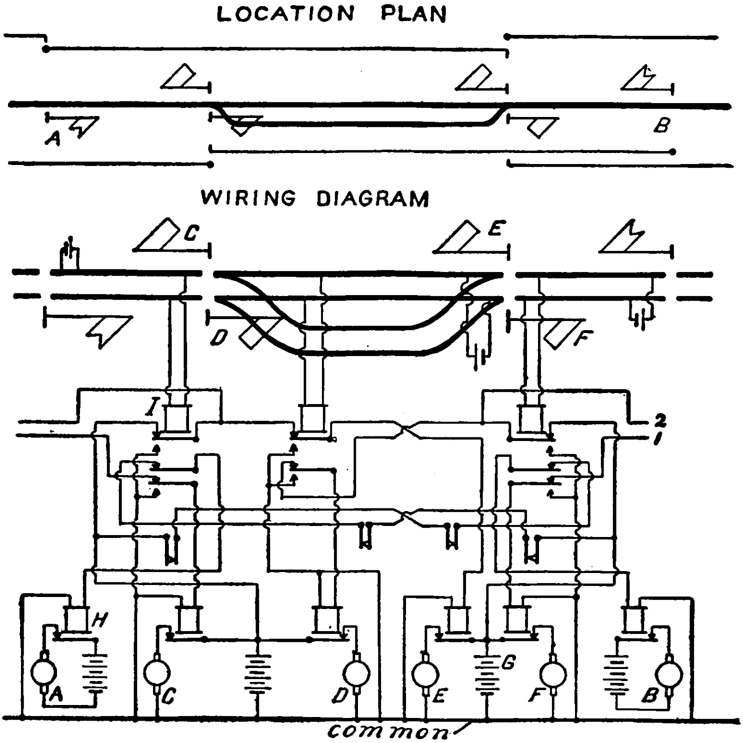


FIG. 57

wire circuits on single-track for east- and west-bound movements on the Southern Pacific.

In Fig. 57, *A* and *B* are distant signals indicating the track condition when approaching a station siding. The location plan shows the extent of the sections protected by the semaphores and the arrangement of the signals. Home signals, *C*, *D*, *E*, and *F*, are operated by the motors and accessories having corresponding letters. *A*, for example, is controlled through the armature of relay *H*, the latter being connected to main battery *G* through a front contact of track relay *I*, and the normally closed circuit breakers at *D* and *F*, by way of one of the distant line wires.

In Fig. 58 a similar arrangement is employed, a cut or relayed section being introduced. This changes the extent of the control of the home signal preceding *J* in the location plan, and

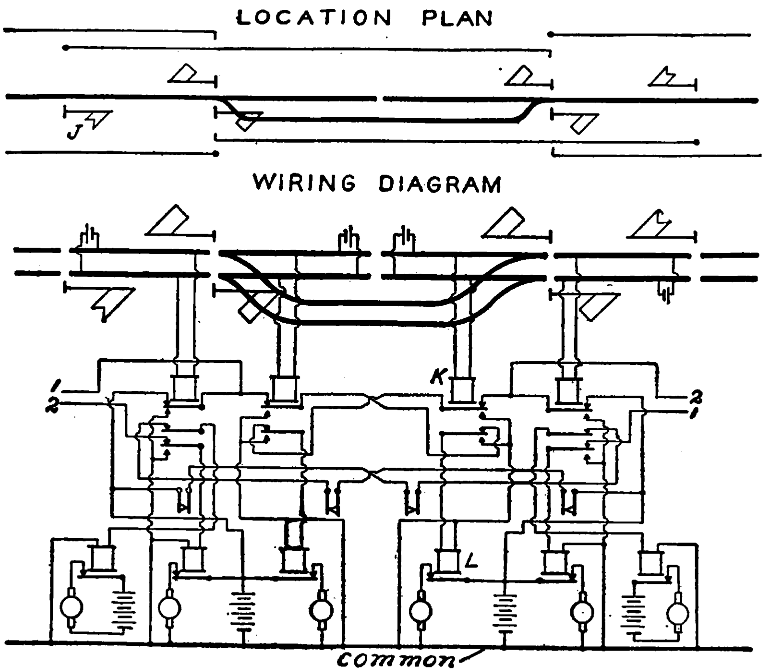


Fig. 58

interposes a track relay, *K*, having two front and two back contacts. The front points extend the function of the home line wires, the back points short-circuiting *L* and connecting one of the home lines to common.

In Fig. 59 overlaps are introduced at the west end of a station siding, and a distant signal at the east end. The distant control-line, *M*, is in series with the home-circuit controllers, *N* and *O*, current being derived from the main local battery, *P*, an independent local battery, *Q*, operating the mechanism. It will be noted that the negative sides of the main batteries are connected to the common. This precludes the possibility of dissimilar polarity, and the consequent wasteful discharge on confusion of the circuit wires.

The converse of the above appears in Fig. 60, a distant signal being placed at the west end (in this book, the east is always at the right and the west at the left hand side, as will occur when

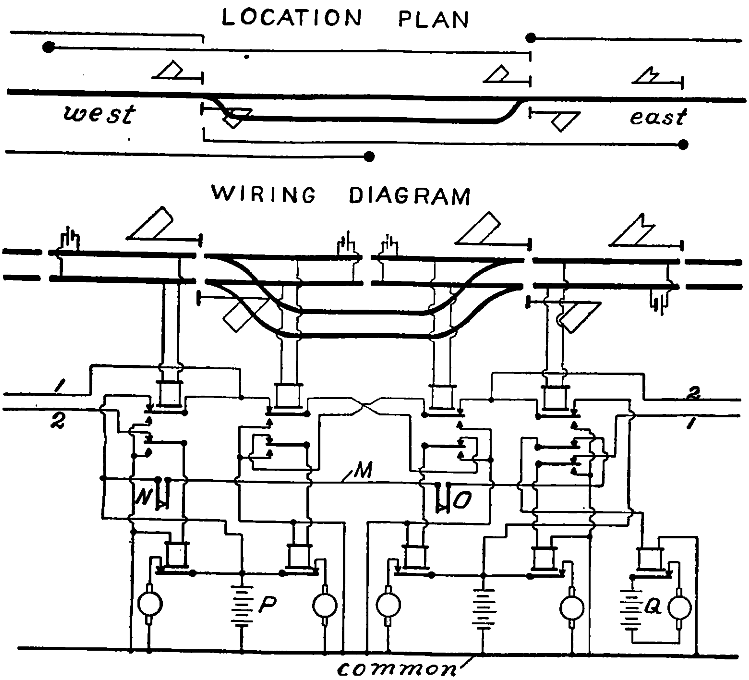


FIG. 59

the reader is facing north), and overlap at the east end. The independent working circuit is at *R* in this case, relay *S* having three front and two back points, the latter connecting to common. The front points clear the signals for one direction of train movement, and the back points are for the opposite sense, also completing these same control circuits.

Figs. 61 and 62 show the circuit arrangements between stations, with overlap. In the former, home signal *T* is controlled through line 1, and *U* through line 2. The working circuit, V, of the former is independent, that of the latter being connected to the common, as are all the track-relay back points. In Fig. 62 a relayed section only is shown, the line wires being simply broken at the relay contacts, a location diagram being unnecessary in this case. As before, the back contacts are connected to common, and close the preparatory control functions.

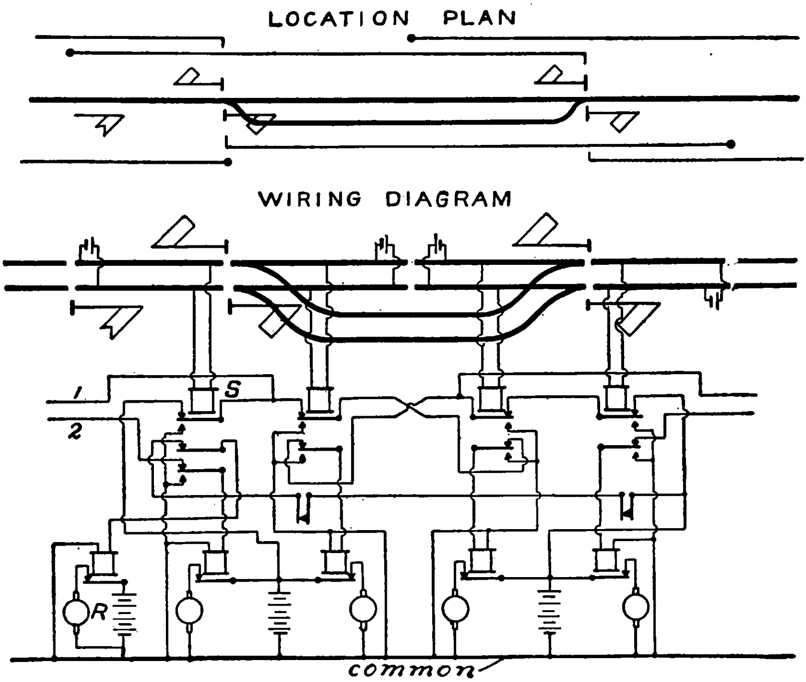


FIG. 60

Figs. 63 to 66 show normal clear motor-circuits and signal arrangements on the Missouri Pacific, the mile posts and signals being numbered from the terminal at St. Louis. Home and distant semaphores are placed on separate masts and controlled through line wires. The motor connections only are represented, but of course slot magnets are in parallel with the main batteries, the motors not being in circuit except when clearing takes place.

At home signal 142, a circuit controller is introduced, which closes the track relay upon itself when the switch is thrown,

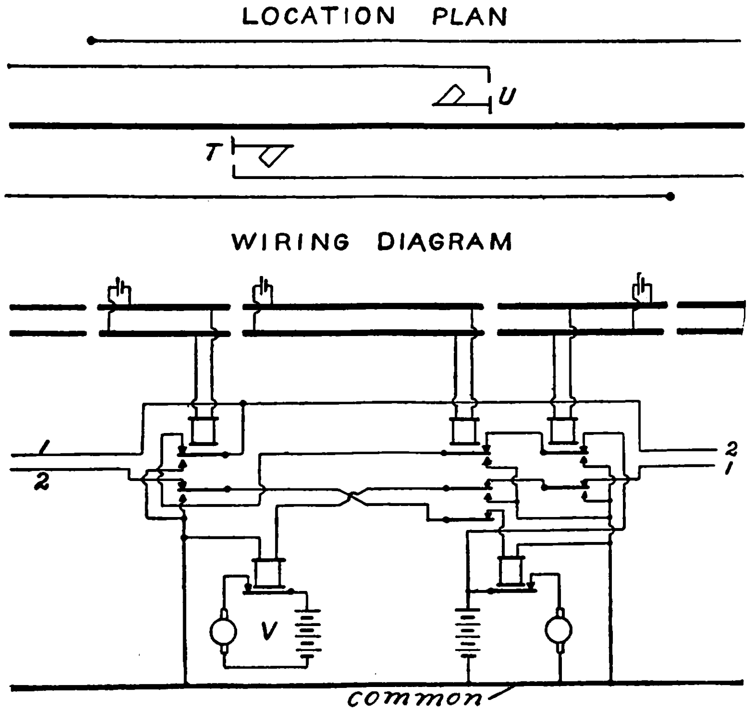


Fig. 61

and connects the relay to the track when the switch is returned. In the semaphore's stop position, also, a circuit breaker in series

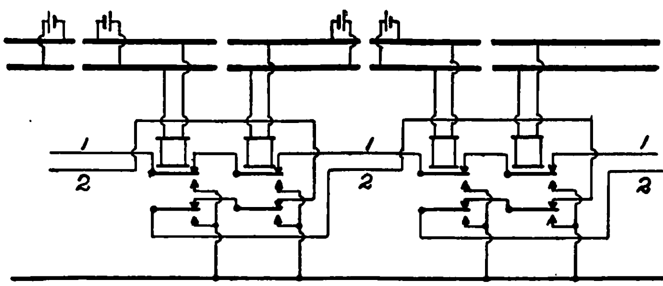
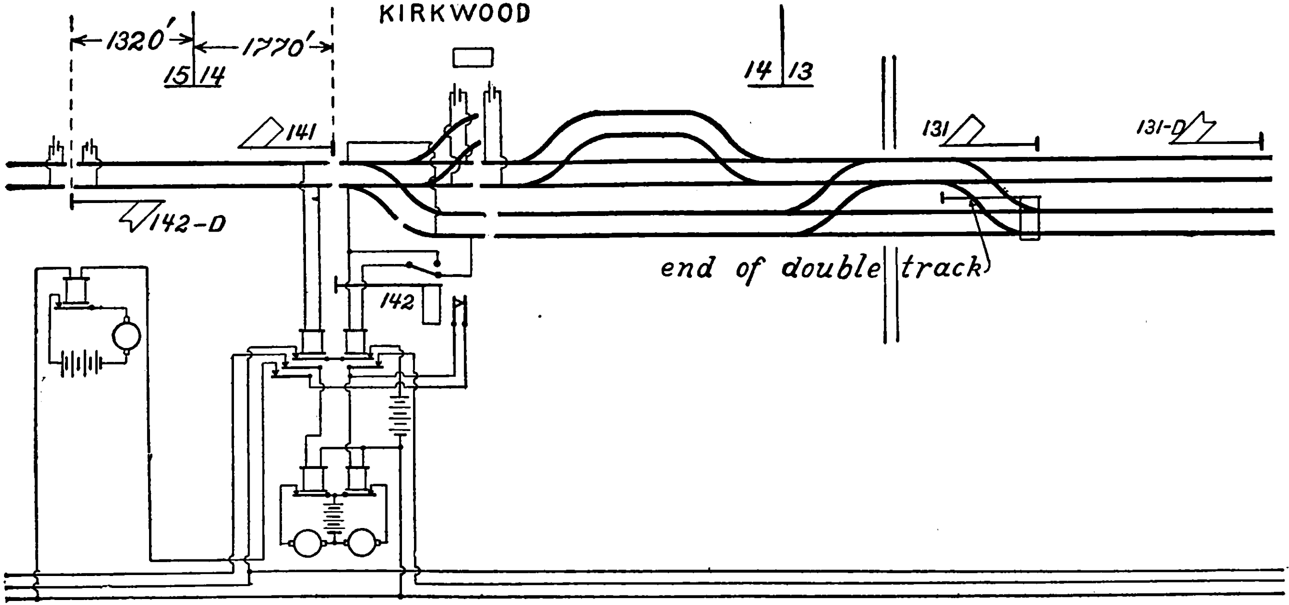


Fig. 62

with the motor at the distant signal, 142-*D*, is closed, clearing the latter by energizing the motor relay.



KIRKWOOD
1320'
1770'
15
14
14
13
141
142-D
131
131-D
142
end of double track

Fig. 63

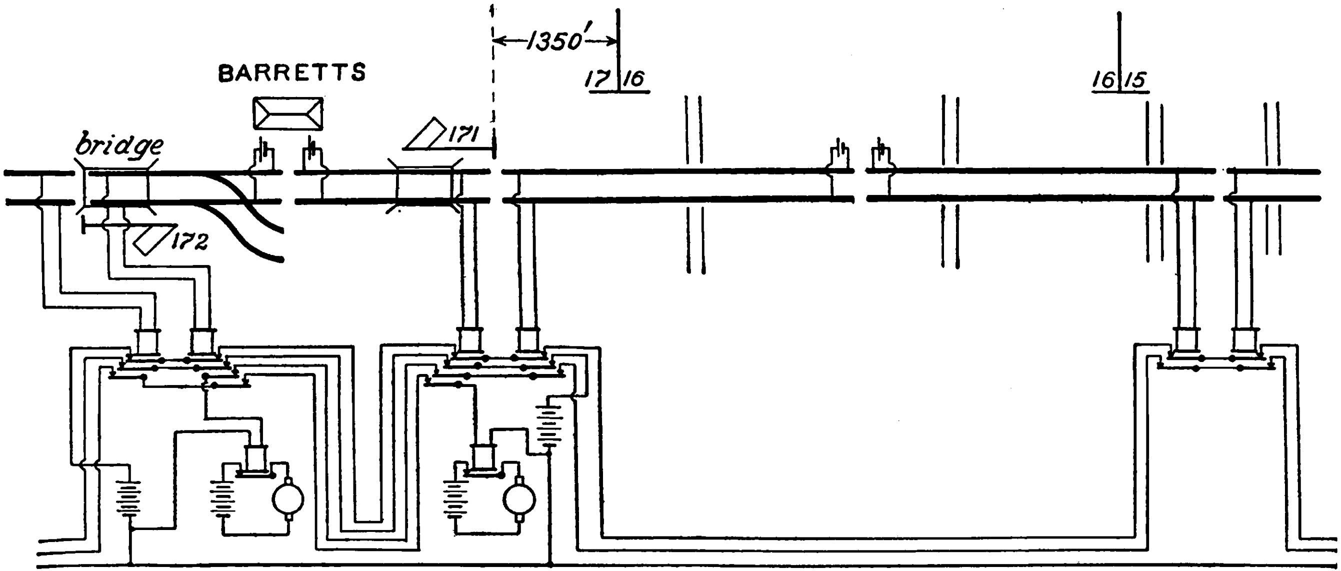


Fig. 64

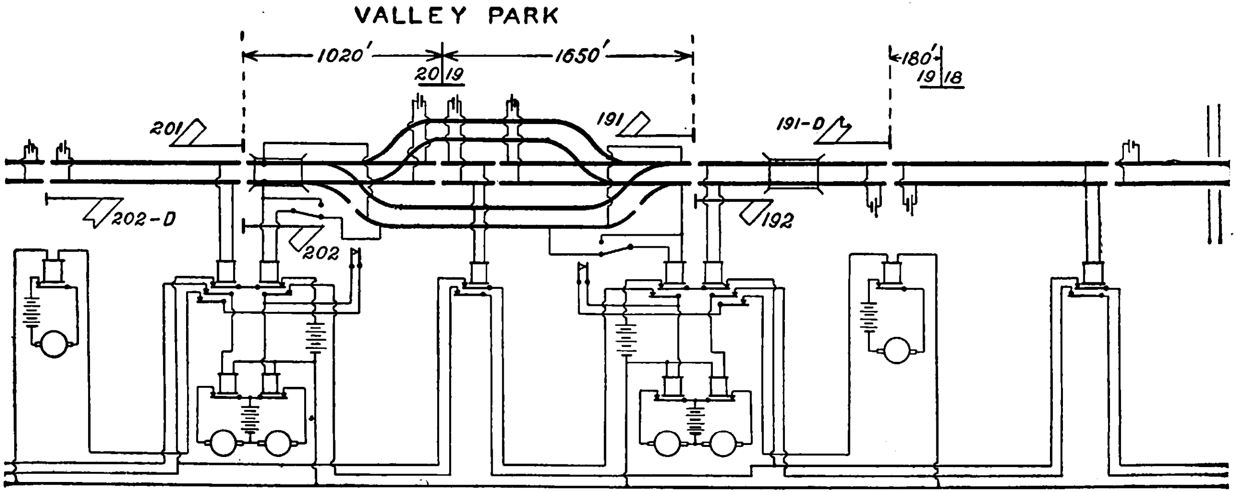


Fig. 65

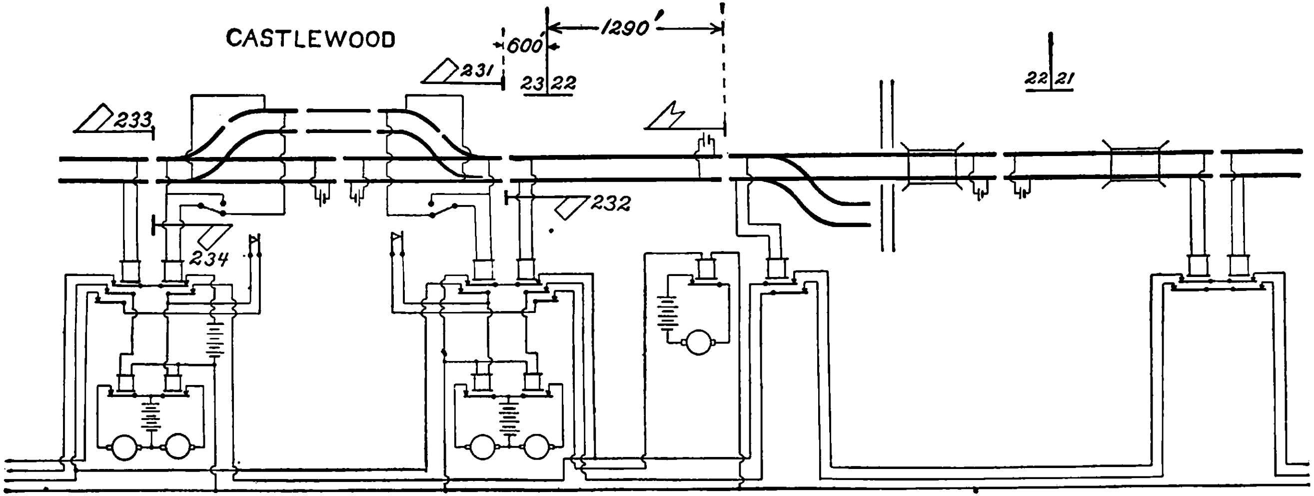


FIG. 66

The track relays at 172 and 171 have four sets of contacts each, three of these being for the line wires; thus constituting simultaneous quadruple breaks (one for each track section) in these lines, which pass to preceding and succeeding signals. At Valley Park two sidings appear, for train movement in both directions. Signals 191 and 202 each have a circuit controller and breaker, which control the track relay and section and the distant signal of each respectively. At Castlewood a single siding is introduced, the signal and connection arrangements being similar to the preceding. It will be noted that the motor batteries are not connected to the common line, since they are part of independent local working-circuits. The lengths of the various sections may be approximated from the mile posts.

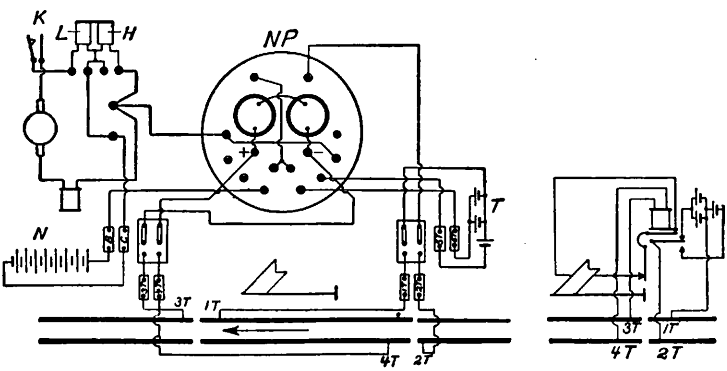


FIG. 67

The wiring for a one-arm distant in an overlap system is shown in Fig. 67,—the diagrammatic scheme of connection being represented at *A*, *NP* is a neutral and polarized relay (commonly termed simply a polarized relay). The circuit controller, *K*, operated by the semaphore, is in series with the motor and low-resistance (or compounding) winding, *L*, of the slot magnet. The high resistance winding, *H*, is connected to *N* and the front armature contacts, normally holding the signal blade at clear. The track battery, *T*, is divided into two parts, which are in series and have a common junction, 1*T*. When one of the neutral front contacts is closed, two cells in multiple are connected across the track, of a certain polarity; and when the back contact is closed, but one cell, of opposite polarity.

In Fig. 68 the connections of a normal clear home semaphore, with a separate distant in the rear, appear. The use of a slow releasing relay admits of an ordinary slot magnet, *S*, having as usual a compound winding. The track relay, *R*, has four ohms resistance, and is of the ordinary neutral type. *T* is connected to the block preceding the home signal through the polarity reverser, *P*. The armature and front point of the slow releasing relay are in series with the motor and low-resistance winding of the slot, this relay being connected across the main battery, *Q*, through the front points and armature of *R*. *N* is a circuit

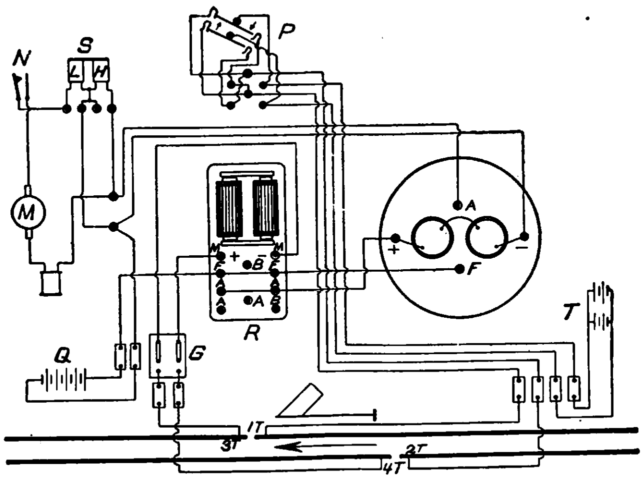


FIG. 68

breaker in series with the motor, and breaks the continuity of the working circuit when the semaphore is at full clear.

The relay and signal connections for a single-track normal clear two-arm home and distant arrangement are shown in Fig. 69. The polarity reverser, *R*, operated by the home signal, is connected to the track and track battery, *T*, thus controlling section *S* of the preceding distant semaphore circuit. The armature and front contacts, *A* and *F*, of the slow releasing relay, *K*, are in series with the home slot, *HS*, and motor, and connected to the latter through the contact springs, *A*, which, with *B* and *C*, are operated by the home blade. *D* is operated by the distant, and with *A* is normally open. Plate *G*, at the fuse and arrester blocks, is connected to ground. The neutral and polarized track-relay has two front and two back contacts, the diagrammatic circuit-arrangement being as shown in Fig. 51.

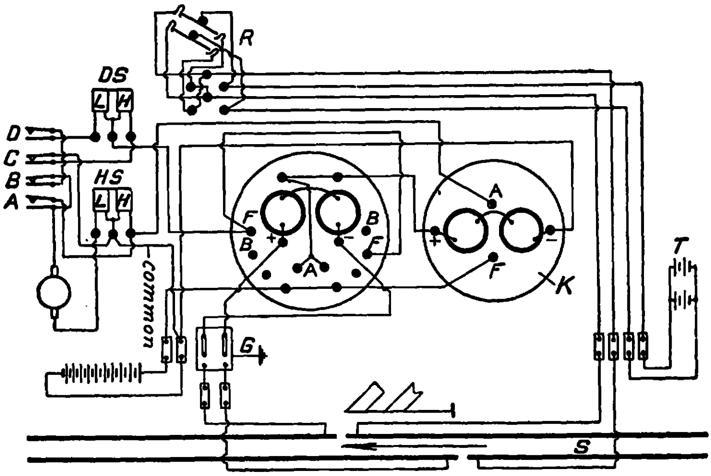


FIG. 69

A standard circuit arrangement for a normal clear wireless single-arm home signal is shown in Fig. 70. A slow releasing

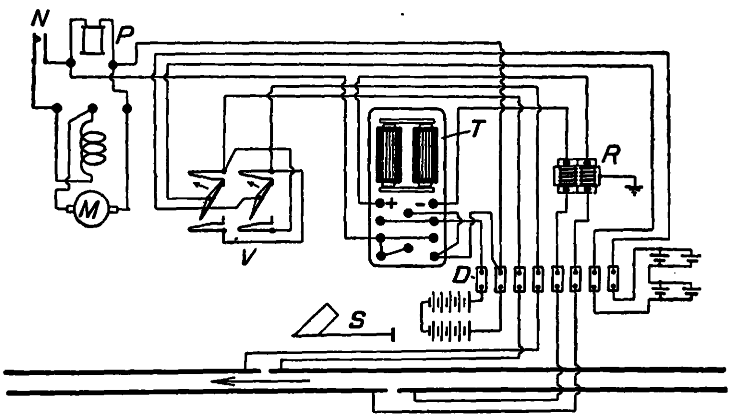


FIG. 70

slot, *P*, which eliminates a separate slow releasing relay, is connected to the common wire and the armature of the four-ohm track-relay, *T*, being in shunt with the motor, *M*. The latter is in series with N and operates when the latter is closed, which is the case whenever the semaphore, S, is not at full clear. The polarity reverser, V, governs the distant of S through the polarized relay. In series with the magnets of T are the lightning arresters, R, the plate beneath which being connected to ground. The main binding posts and fuse strips are shown at D, to which all incoming and outgoing wires are connected.

A normal clear-wiring diagram for a one-arm home semaphore with overlaps is shown in Fig. 71. The slow releasing

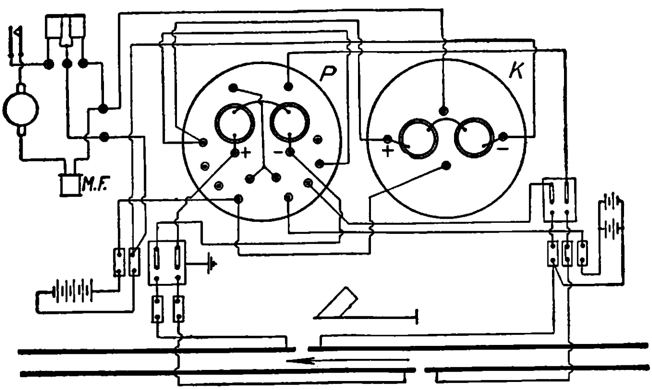


FIG. 71

relay, K, is connected as already described, but a polarity reverser is not used. Instead, the polarized relay, P, has an additional neutral back-contact and armature, which short-circuits the track upon its deënergization. In the upper or working position this armature connects the battery to the track section protected by the preceding semaphore. The scheme of connection used will be rendered clearer by the inspection of the small diagram at 71a.

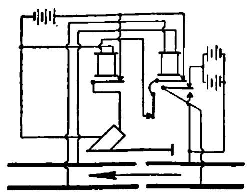


FIG. 71a