CHAPTER X.

HALL APPARATUS.

THE enclosed disk signal has a number of meritorious features, among which are the protection of the moving parts against the weather, and the low energy required to operate the moving system. An electromagnet of comparatively small size operates the latter, the power required being insignificant (about 2.5 watts in ordinary cases). The external appearance of a post-type normal danger home and distant disk-signal, such as is used on the Lehigh Valley, is given in Fig. 129. *A* is the home banner, which consists of a red silk, cotton, or aluminum disk stretched on a ring having a diameter of about 18 inches; while *B* is the distant banner, which is of a green fabric. The inside back of the housing, *C*, is painted white, so that when the disks are in the upper position, the aperture in the case will show white. The case is usually painted black, so that the color of the opening may be seen for a considerable distance.

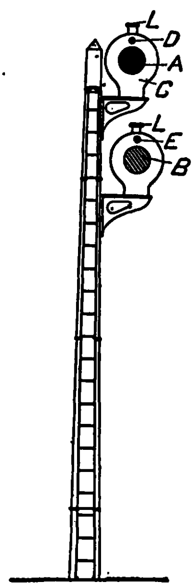

FIG. 129

Lamps *L* are placed in the rear of the apertures, *D* and *E*, before which spectacles of the same color as the disks pass, for night signaling. The tendency of gravity is to hold the disks in a position directly behind the glass-covered apertures, so that unless the magnets are energized, a color indication will be given to the engineer. Disk signals are purely color arrangements, in contradistinction to semaphore, or position and color signals. Where home or distant units on separate masts are used, the banjo is placed on top of, and centrally disposed with respect to the pole, which produces a more symmetrical combination.

Among the disadvantages of enclosed signals may be mentioned: the tendency of sleet or snow to obscure the disk, by covering the glass and thus giving a white effect; the direct reflection of the sun's rays in the engineman's eyes, preventing a clear view of the disk; and the liability of the glass spectacles falling out, due to their tendency to crack from the effects of the inertia of the moving system. Only the latter may be regarded as a dangerous feature, since all railroads require that a train stop when a signal is only partially or imperfectly displayed; which, while resulting in a certain loss of time, has not argued much against their introduction.

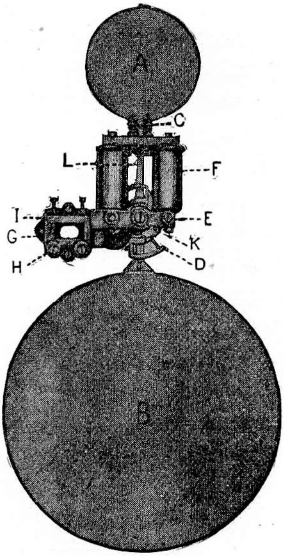

FIG. 130

Within the housing or banjo of the disk signal is placed the arrangement shown in Fig. 130, which constitutes the disk instrument. It consists of an electromagnet, *F*, whose armature, *D*, moves a member, *L*, to which the banner, *B*, of colored cloth for indications by day, and the disk, *A*, of colored glass for night indications, are fastened. *D* is pivoted at *K*, and its continuity of motion causes a greater flux to pass through the magnetic circuit by decreasing the sectional area of the air-gap. *F* is held in place by the brass piece *I–E*, this being secured in the iron base, *G*, by the eccentric washers, *H*, *G* being fastened to the inside of the banjo. The external circuit is connected to the binding posts, *C*. *A* and *B* move before clear glass apertures in the housing, a lamp being placed in the rear of *A*.

This type of signal mechanism is used extensively on the Lehigh Valley, Philadelphia and Reading, and Chicago and North Western. The disadvantage of the cloth banner is the rapidity with which the coloring matter fades in the penetrating sunlight which often strikes it in both summer and winter.

An indicator, which is used at switches, towers, and interlocking points, and is usually in series with the indicator line-wire, is shown in Fig. 131. It is in reality a miniature modification of the disk signal mechanism, and consists of an armature, *C*, pivoted at *G*, to which is attached a small red disk or banner, *D*; this armature moving between the polar extensions, *B*, of an electromagnet, *A*. *D* is counterbalanced by an adjustable nut, *E*, so that the energy required to move the armature will be at a minimum. Insulated from but fastened to the magnetic yoke are the binding posts, *F*, to which the external circuit is connected. The moving system is of such design that the air-gap remains practically constant, while its sectional area continually increases

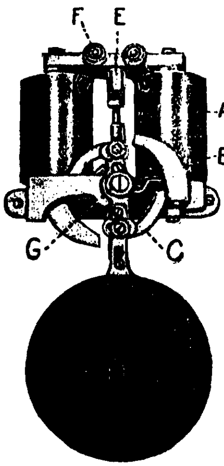

FIG. 131

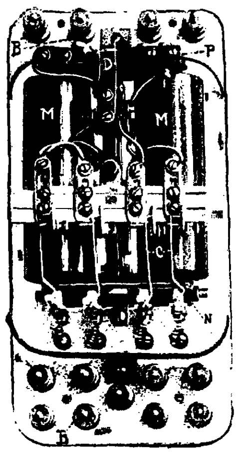

FIG. 132

with upward movement of the disk, the ampere-turns required being therefore very low. A slight amount of rust will prevent movement of the armature, hence the indicator is enclosed in a sealed housing having a glass aperture before which the banner moves.

One type of polarized relay is illustrated in Fig. 132. Upon a porcelain or slate base the magnet coils, *M*, with their cores and supports are mounted, with the armatures, *P* and *N*, the former polarized or permanently magnetic, the latter neutral. *D*, *D*, are the polar contacts; and *C*, *C*, the neutral front and back contacts, and fingers. Binding posts, *B* and *B'*, are for the external connection of these coils and contacts.

In Fig. 133 an interlocking relay is shown, in section and elevation. This in reality consists of two relays, whose armatures, A and A', are dependent upon one another. This is effected by the locking dogs, D, whose points, P, engage with the ends, E, on the armatures, by the action of the rollers, R. When current ceases to pass through the magnet coils, the armature falls (if not locked) and its roller forces over the dog, thereby preventing the other armature from dropping. Each

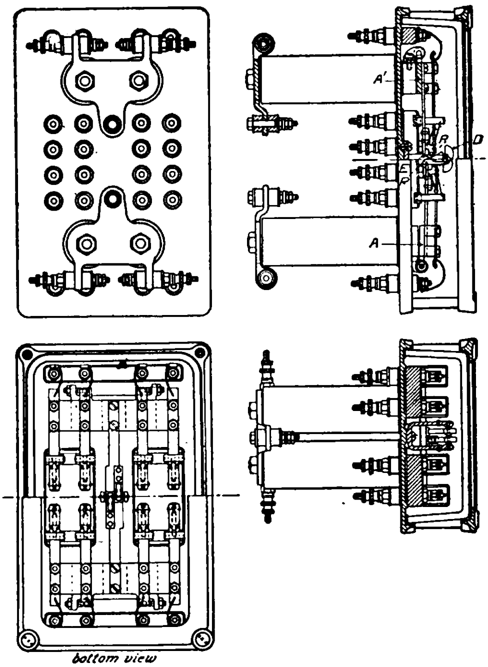

FIG. 133

relay has four sets of front and back contacts, the construction being similar in many respects to those herein described.

Fig. 134 shows a glass-enclosed, also a glass-mounted, neutral relay, with four front and four back contacts. Such relays are generally employed as track instruments, and are wound to a comparatively low resistance.

The principle of the type, D, structure is illustrated in Fig. 135. G is the main gear, which, driven by a motor, in turn produces the reciprocation necessary to clear the semaphore, through the lever, J. Both J and G have the shaft, A, as a center, J being loose thereon. M is the slot magnet, whose armature

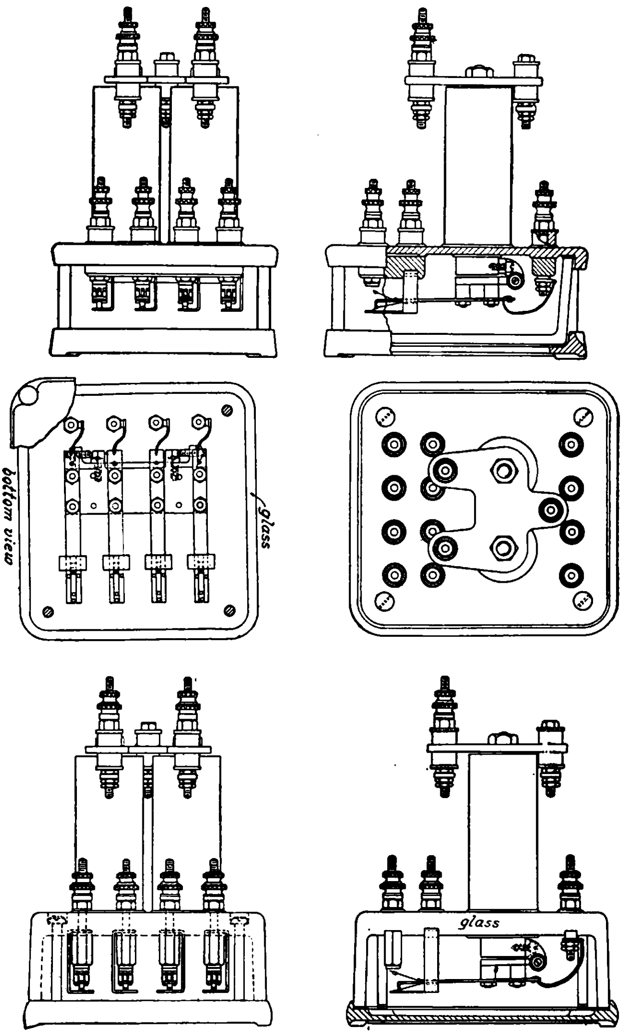

FIG. 134

is secured on and gives motion to the pivoted bar, F. H is a pivot bearing for the end of the rod, B, and R is a roller stud on the same. D is a trigger-shaped piece fastened to G, which engages with the end, E. If M be deënergized, and G rotated in the direction of the arrow by the motor, when D strikes E, R will force F up, and cause D to pass E, thus imparting no motion to J or the semaphore, a stop, S, preventing F from being thrown too far. If M be energized, G evidently, by a converse reasoning, will cause J to move in the direction of

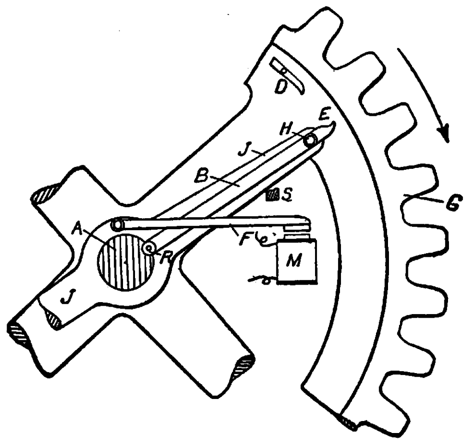

FIG. 135

the gear, and clear the semaphore. The requisite changes in interconnection and disengagement are also effected by the moving system, but these need not be entered into.

A type, F, motor mechanism for a double semaphore structure is shown in Fig. 136, and is similar in mechanical design to the electro-gas arrangement. Two independent sets of mechanism are used, but only one will be described. The motor, 15, frame 5, dashpot pistons, and clutch magnets are supported by the iron base, 8, as are also the side frames, 6 and 7, which act as housings for the gear shafts, 36 and 37, and retain the clutch levers, 11 and 12 (which are hidden from view). Rigidly secured to the dashpot cylinder, 29, is the thrust rod, 13, the dashpot pistons being mounted on pedestals within the frame and on the base, 8. This thrust rod is guided by the cylinder, 29, the upper end of 13 passing through a bearing in frame 5. The semaphore, connected to 24 by a link, is held at clear by a latch engaging with a lug on the clearing lever, 22. The thrust rod, 13, carries the latch support, 96, which in turn carries clearing lever

22, thrust piece 100, and a latch engaging with the lug on 1, to hold the semaphore at clear. 100 carries a V-shaped latch, 33, which engages with the lug on the clearing lever, 22, the clearing operation being indirectly performed by the train of motor-driven gears, 3.

The movable contacts of the circuit controller, 21, are operated

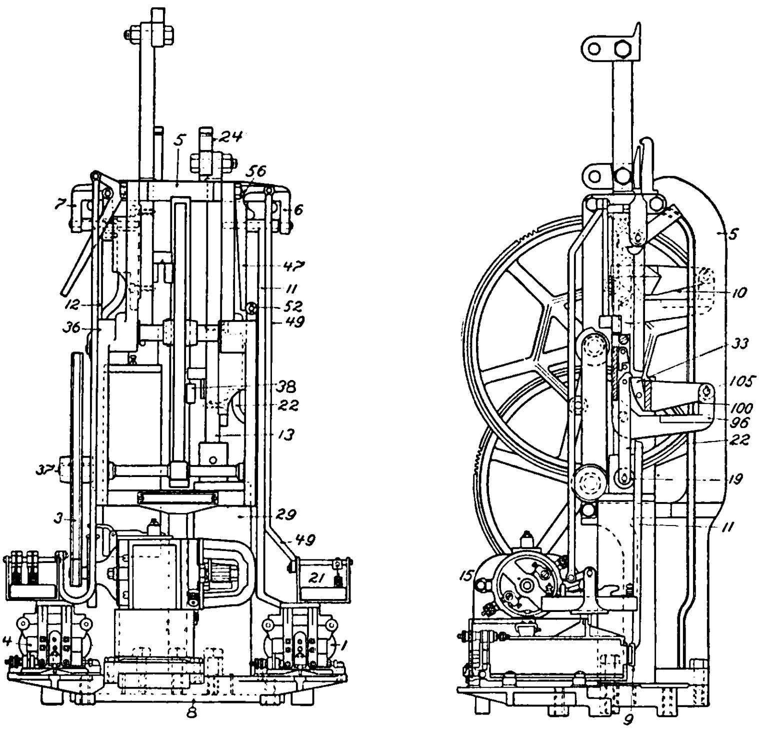

Fig. 136

by the control rod, 49, and escapement lever, 47; the latter is thrown by the latch support roller, 52. The front armatures of the clutch magnets, 1 (one magnet being on each side), control the parallel contacts of the motor circuit, while the back armatures are secured to the clutch levers, 11, thus keeping the latter under the control of the magnets. When the home blade is at stop, the controller contacts for the series motor, 15, are closed, and the distant clutch magnets are on open circuit, so that the latter cannot be cleared before the home is fully at clear. The motor circuit is closed directly the home clutch magnet is energized, by the front contacts, 4; while simultaneously the rear armature, 9, is attracted, thus preventing the clutch lever, 11, from moving when the stud roller exerts its pressure. The motor now drives the gears and brings 38 under 100, forcing it up. As 11 is securely held by 9, 22 cannot swing back; hence the thrust rod and all its appurtenances are carried to the clear position, in moving to which roller, 19, pivoted in 22, rolls against 11. The final portion of this movement to clear brings roller 52 against the short link of escapement, 47, rocking it about 56, so that rod 49 operates the circuit controller and opens the motor circuit, at the same time closing that of the distant. The home is held at clear by the action of the lug on 11, which engages with a latch on 96, releasing the downward pressure on the stud roller, and allowing the distant to be cleared by the motor. A stud roller similar to 38 is on the opposite side of the gear and displaced 180° from 38; for clearing the other blade, a similar structure to 96–100–52–, etc., is employed.

After having been cleared, 38 moves beneath 100, the signal circuit being broken as soon as the clutch magnet is energized, as before. The motor circuit is opened by the front armature, and the rear armature allows 11 to swing back sufficiently to permit the retaining latch to disengage and cause the return to danger by gravity, this movement being dampened by the dashpot, 29. As soon as this movement begins, the circuit controllers, 21, are reversed, and should the motor inadvertently become on closed circuit the gears will merely revolve uselessly, since 38; cannot clear the semaphores unless clutch magnets, 1, are energized. Should the clutch magnets become deënergized with the blades partly at clear, 22 would swing back, since latch 33 is permitted to pass the clearing lever lug, thereby throwing the semaphore to danger, as 100 swings on its pivot 105 to the normal position after the stud roller has moved beneath it.

A double electromechanical slot is shown in elevation and section in Fig. 137. The dashpot shells, *D*, are secured to the rods, *R*, which are interposed in the semaphore links. When *B* is forced upward by the operator's lever, *L* will tend to swing outward on its pivot. If the enclosed coil magnet, *M*, be energized, its armature, *A*, will hold *C* at the inner position, so that *L* cannot move, and motion of *B* is transmitted to *R*. If, however, *M* be deënergized, roller *O* throws *C* over, in opposition

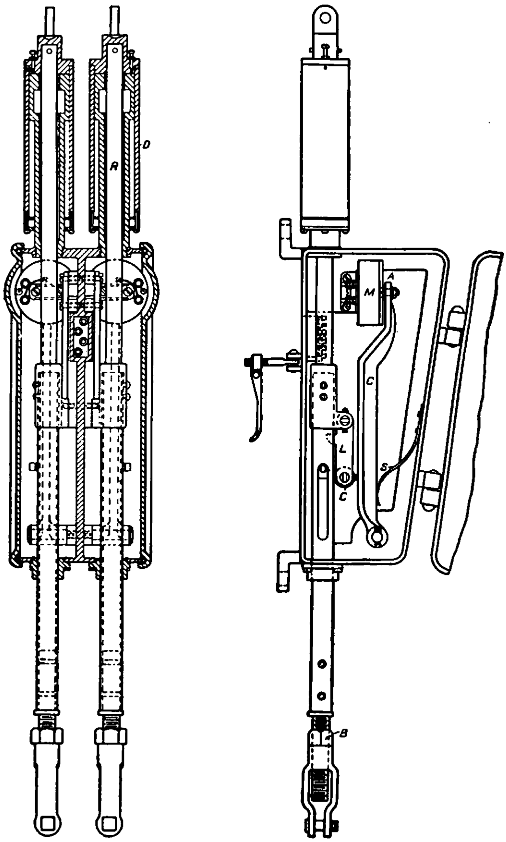

FIG. 137

to the spring *S*, and *B* moves upward without throwing the semaphore.

In Fig. 138, which illustrates a combined tower indicator and bell, *S* is a miniature semaphore showing the condition of a track section or signal, which is thrown by the armature, *A*, of the magnet, *M*, through the bell crank, *L*. When *S* moves to danger, the clapper *C*, on the semaphore rock-shaft strikes a gong, *G*, thus warning the signal operator. The armature also carries front and back contacts *T* for introduction in the circuits of the tower.

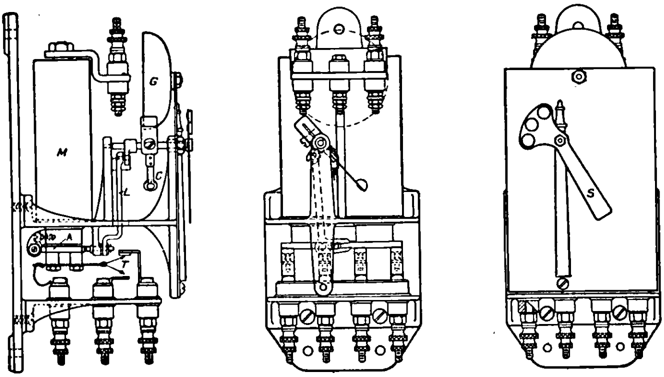

FIG. 138

Fig. 139 outlines a switch instrument which does not close the circuit contacts (on a normal danger network) until the rail point has reached its fully normal position. These contacts, *C*, are actuated by the links, *L*, arranged about the rock shaft, *R*. When the sector, *S*, is moved in the direction of the arrow, the

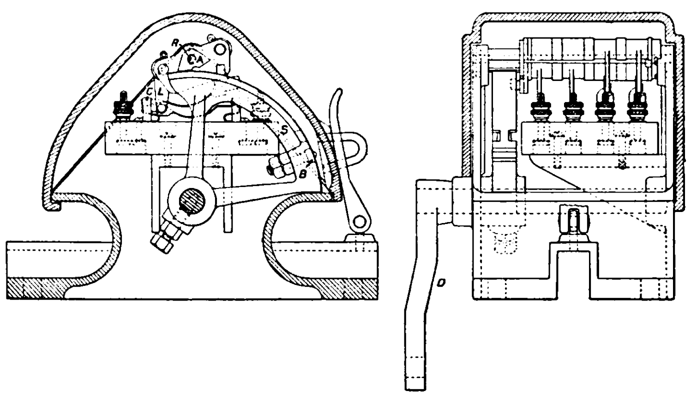

FIG. 139

steel block, *B*, engages with the piece, *A*, and thus opens the contacts. The switch link is fastened to *D*.

A standard switch indicator is shown in Fig. 140, the miniature semaphore being moved in a somewhat similar manner to that shown in Fig. 138. Front and back contacts are also provided, a push button, P, being introduced in series with the magnet winding, and in shunt with the front "stick" contact. With

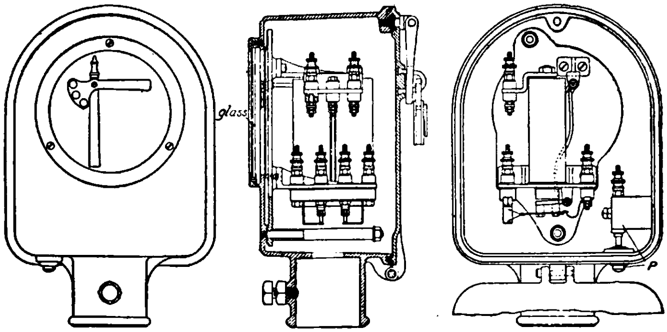

FIG. 140

this device, a trainman, by pressing the button, may ascertain the condition of the two preceding blocks, the semaphore being normally in the danger position.

In Fig. 141 the standard wireless connections for single-track

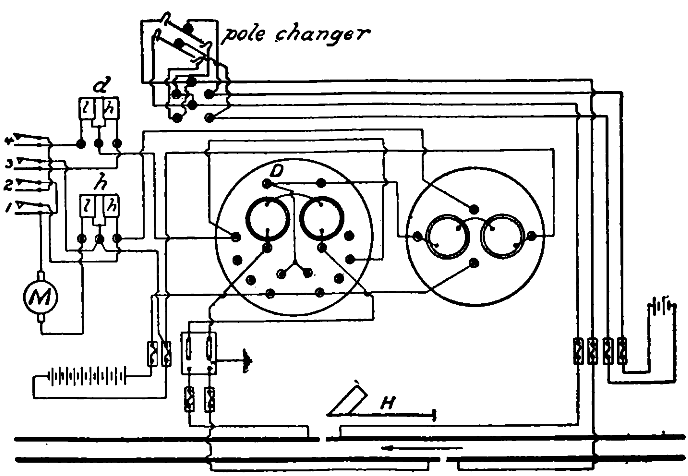

FIG. 141

one-way movements with overlap appear. The motor, M, is in series with the front-contact of a slow-releasing relay in series with the track relay, D, front contact, the contacts, 1, 2, 3, 4 being operated simultaneously by movement of H.

In Fig. 142 the wireless connections of a normal clear home and distant signal, *S*, for one of the tracks of a double-track road, and a polarized relay, *P*, are shown. The scheme of interconnection is an elaboration of that already given in Fig. 70, utilizing a compound slot, *h*, in series with the motor for the home blade and a simple wound slow-releasing slot, *d*, for the distant. This is the usual practice, as the home is cleared first, and the effect

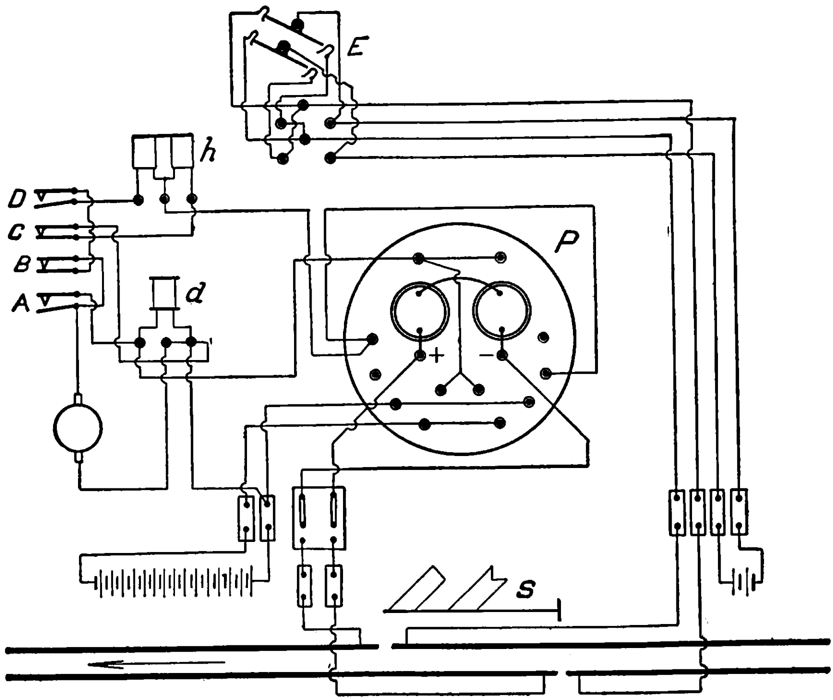

FIG. 142

of drop in potential is not so manifest in the case of the distant slot. *E* is a polarity reverser, for the control of the preceding distant.

Fig. 142*a* shows the standard connections for a normal clear home and distant disk-signal on one of the tracks of a double-track road, *H* being the home banjo. This arrangement is an extension of the home banjo-circuit given in the preceding chapter, a polarized relay being used, as in the latter case.

T has two components, which are connected in series. When one of the neutral armatures comes in contact with the back contact point (by short-circuiting of the track) but one cell is connected to the latter. *N* operates both blades, being under rather heavy discharge when the low-resistance winding is in circuit and the disk being cleared, and under slight demand when at clear. The insulating joints are not shown opposite,

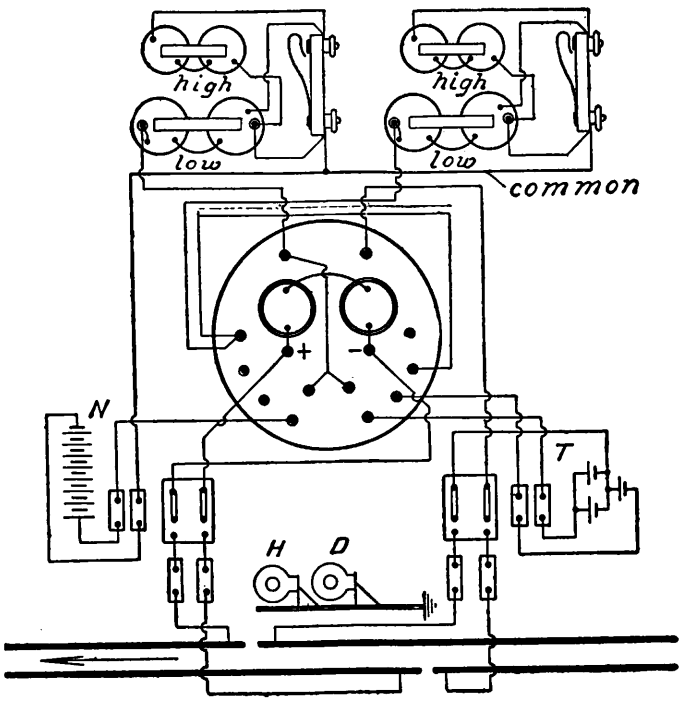

FIG. 142*a*

as in practice they are staggered, in common with the ordinary joints.

Figs. 143 and 143*a* are consecutive circuits showing the Hewett line-wire scheme of normal danger operation, with a normally open track-circuit, the track relays being normally closed for switch indicator control. At signal 522, the track element is connected in series with the opposed or differential relays or windings *A* and *B* (having a common armature), but in this case

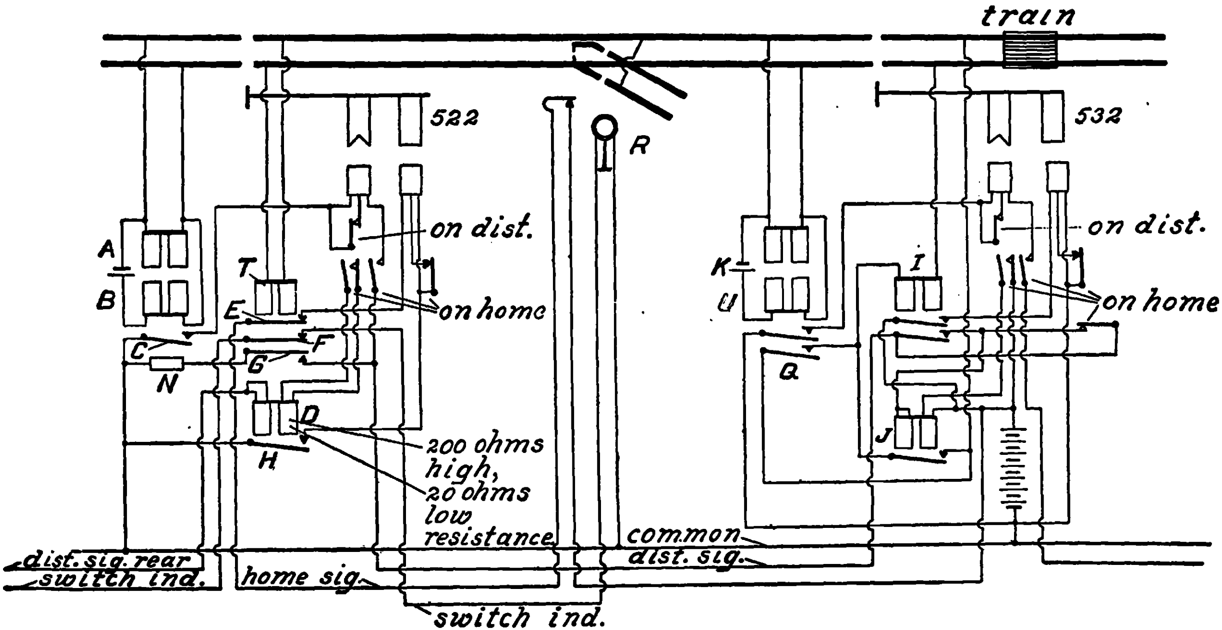
train
522
532
R
A
B
T
E
F
C
G
N
D
H
on dist.
on home
200 ohms high,
20 ohms low resistance
K
U
I
Q
J
on dist.
on home
dist. sig. rear
switch ind.
home sig.
common
dist. sig.
switch ind.

FIG. 143

no energization results, so contact C is open. When A (which is in shunt with the track) is short-circuited by a train or otherwise

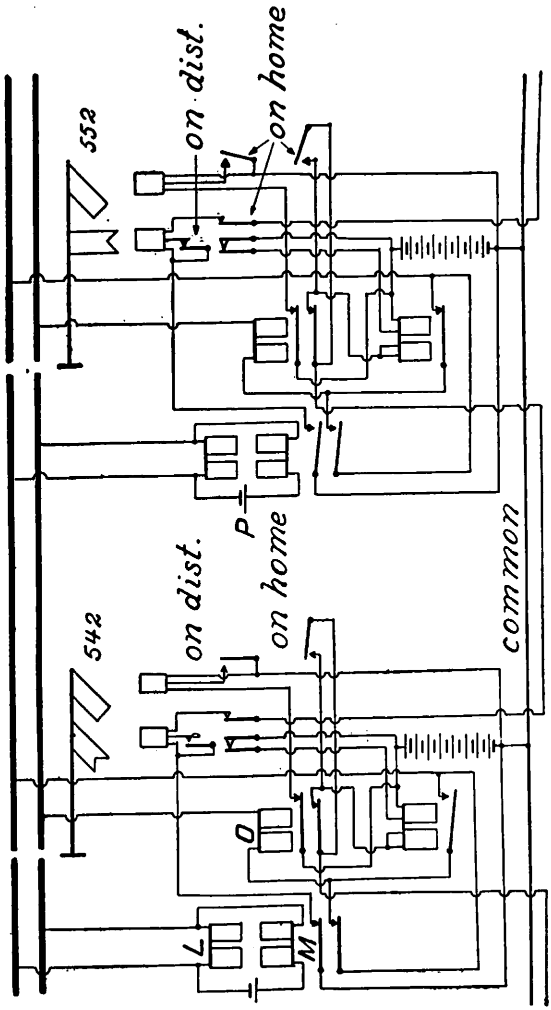

FIG. 143a

B is fully energized, and consequently, C is raised; T receives current from K, and is in series with a differential winding, U.

At 532, a train appears in the home block, which short-circuits the upper winding, L, and fully energizes M; thus raising both contact points, and clearing 542. The 4-ohm relay, *O*, is also energized (by the closing of the lower contact of *M*) from *P*. The home mechanism, when cleared, closes two contacts and opens one; when moving to stop, the reverse; *D* is a relay having two connections of its windings: one of 200 ohms, the high resistance, and the other of 20 ohms, this being effected by a shunting contact operated by the home mechanism. Also, when either the home or distant clears, short-circuiting contacts are operated, which throw into circuit the high-resistance slot or retaining coil, which maintains the clear position of the semaphores, with insignificant current consumption.

When the armature contact, *Q*, is closed, *I* is connected to the track; and, if energized, the local home will clear, and subsequently, the distant. At 522, *N* is a resistance in series with the distant signal line through *G*, which is the cause of a supplemental energization of *J*, having a subsidiary control over *I*. The indicator, *R*, is connected to the indicator line and common, and is in series with *F*. The home semaphore at 522 is controlled by *E*, and at 532 by a front contact of *I*.