CHAPTER XI.

UNION APPARATUS.

In Fig. 144 the track and motor connections embodied in the Union standard normal clear polarized rail-circuit scheme of operation are shown. The home signal, *H*, protects the block immediately behind it (not shown), the approaching train in

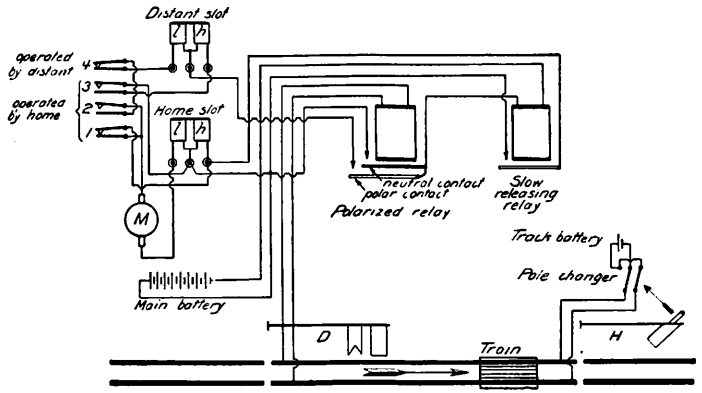

Fig. 144

the block preceding short-circuiting the track section and holding the signal at *D* at stop, in a manner now to be described. Excepting the track battery and pole changer at *H*, the entire arrangement of accessories and connections shown in the figure is at *D*. *H* has the same subsidiary devices, but their delineation would over-complicate the diagram.

The track battery at *H* is not connected directly to the track, a pole changer being introduced. The polarized relay is connected at the other end of the block (relay control being interposed where the blocks are of excessive length) and is affected

by three conditions: (1) the cessation or continuance of current, irrespective of its polarity; (2) the establishing of current of one polarity; and (3) establishing of current of the opposite polarity. Under certain conditions it would be apparent that the polar contact would still remain closed upon cessation of current, when the latter was in the proper direction. To provide against such a contingency, a supplemental break is introduced, as will be apparent later.

The polarized relay has two armatures, a neutral and a polar; the former being raised whenever current circulates around the coils; and the latter closing its contact when the current is in one direction and opening it when a reverse polarity is set up. The neutral contact controls the home semaphore, and the polar contact the distant semaphore in every case. When a train occupies the block (as is the case for the signal at *D*, or by reason of an open switch or similar cause), the polarized relay is de-energized; the home signal assuming the danger position, by the action of gravity. This movement to stop operates the pole changer, and thereby throws the distant signal in the rear to the caution position, through the action of the polar contact, distant slot, and gravity.

The reversal of polarity must evidently cause a momentary drop of the neutral armature, due to the instantaneous cessation of current through the magnet coils, followed immediately by a sweeping out of the residual flux. As the contact of this armature is in the home slot and motor circuits, it follows that the signal arm must move to danger. However, an intermediate slow-releasing relay contact is in series with the motor and home slot, the magnets of this relay being in series with the neutral armature contact and having a very high self-induction, being also provided with a copper tube for choking effect, so that before the self-induction current occasioned on breaking the circuit can neutralize itself (and consequently the residual flux cease) the circuit is again completed, and its magnetism fully restored; the home signal arm being thus unaffected.

The slot magnets are compound wound, having two separate windings, the inner of many turns and high resistance and the outer of few turns and low resistance. The high-resistance coils are connected in multiple with the main battery,

and the low-resistance coils in series with the motor; so that when a heavy current passes through the motor it must produce a corresponding increase in the magnetic effect upon the slot magnet armatures.

The sets of contacts, 1, 2, and 3, are indirectly operated by movement of the home semaphore; and 4 by the distant. Both 2 and 3 are normally closed (when the signal is at clear), while 1 is normally open (shown closed in the figure, since the signal is at stop). When the distant arm is at clear, 4 is opened; when at caution, closed, as in the diagram. The high-resistance home slot winding is connected across the battery through the contact of the slow-releasing relay; the same winding of the distant slot being in multiple with the battery, through the polar and neutral contacts of the polarized relay on one side, and through the home operated contacts 3 on the other side.

The motor is connected to the battery for the movement of the home blade through the low-resistance winding of the home slot, normally open contacts 1, and the slow-releasing relay armature; and for movement of the distant semaphore through the normally closed contacts 2, normally open contacts 4, low-resistance winding of the distant slot, and the polar and neutral contacts of the polarized relay.

A partial elevation and section of one type of such a signal mechanism for semaphores is shown in Fig. 145. The motor, 17, through its armature shaft, 39, drives the large gear, 21, whose pinion, 22, engages with the sprocket-carrying, gear 20. The home semaphore is connected to the rod, 7, pivoted at 33, and the distant to 8; the former being at clear. Motion is imparted to these rods by the movable members, 37, which rock about a shaft, 32. These members carry the slot magnets 9 and 34, to which connection is made through flexible cable, to the binding posts, 36. The armatures, 40, of these magnets, through the latch ends, 31, engage with the train of links, 30, 25, 29, and 28, so that when 34 is energized under specific conditions, the cam piece, 28, is immovable.

To the ends of the arms, 37, are pivoted two links, 6 and 10. The former operates the plunger, 4, of a dashpot, the shell, 3, of which is held in the mechanism frame. The relative retardation is varied by the screw, 2, which governs the discharge of

the entrained air through the orifice, 1. These dashpots prevent spasmodic movements of the mechanism when returning to the stop position by gravity. Link 10 operates a current reverser or pole changer, the essential parts of which are the sets of contact springs, 14 and 13, with the scraping pieces, 12. Connection to the track circuit is effected through the binding posts, 11, 15, and 42.

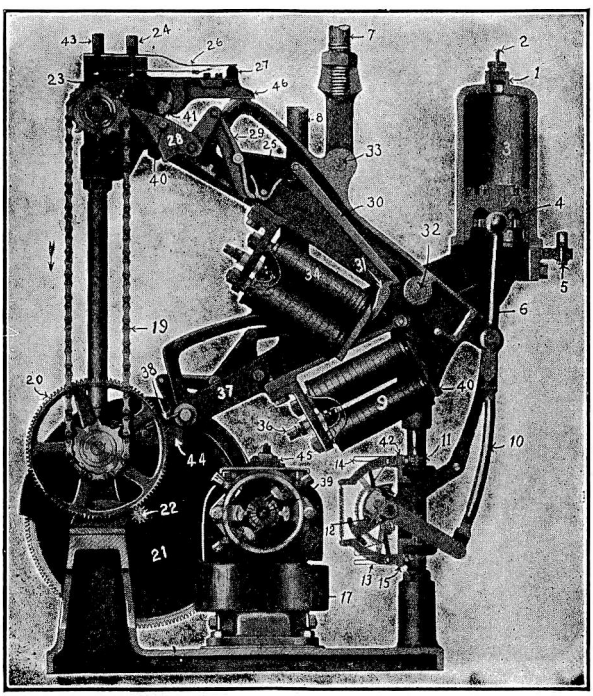

FIG. 145

As only the home blade is at the clear position, the distant block must be occupied or dangerous. If it be supposed to be again clear, 9 will be energized simultaneously with the passing of the current through the motor. As the motor gains speed, the chain starts to move, and as 44 is held rigid by the interposed links and the spring, 38, 37 will be carried upward by the action of the roller engaging with 44. When it reaches its extreme upward position, a stud opposes gravity through

the latch, 41, latching taking place when 40 passes the hook. At the same time, the motor circuit is opened at contact springs, 26, by the insulated strip, 27, through the pivoted piece, 46, which 37 strikes, since 43 and 24 are in series with the motor. The brake, 45, is applied when the current through the motor ceases, thus bringing the armature to an almost immediate stop. The electrical connections have been described in connection with the preceding figure, the external and interconnections being made at the posts, 5.

In Fig. 146 the arrangement, which is frequently used to clear the signal arm, is isolated. The motor drives the chain, *J*, in the direction of the arrows. This causes a roller, *R*, to strike the pivoted member, *E*, which is connected to the links, *F* and *G*. The semaphore rod is pivoted at *A*, and the whole

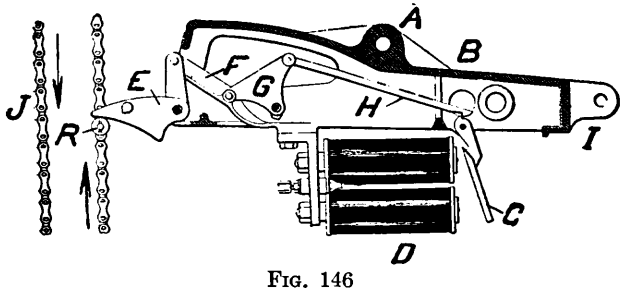

FIG. 146

structure at *B*, the dashpot plunger and polarity changer being operated from end *I*. If the slot magnet, *D*, be energized, armature *C*, through its hook end, will prevent *H* from moving when *E* is struck, through the action of *F* and *G*. Hence *R* raises *E* and the entire arm about *B* as a center, thus clearing the semaphore in opposition to gravity. If *D* is not energized, this cannot occur; and if it be de-energized when the blade is at clear, the release of *H* will cause it to fall to stop.

The Union standard disk mechanism is illustrated in Fig. 147. It consists of an aluminum disk or colored banner, *D*, carrying a lens at its center; and suspended upon a rod, which passes through the pivoted armature, *A*, of the electromagnet, *M*. The moving system is counterweighted at *W*, the electromagnet being held within a box fastened to the rear of the narrow case, a front view of which is shown at *C*. A hinged

lamp is placed in the rear of *C* for night signaling, the rays of this lamp passing through a lens at the center of the disk. The rear of the aperture, *P*, before which the banner moves, is painted white, so that when the latter is raised a clear indication is given, the lower end only being visible, the clear lens before the lamp being also seen at the center of *P*. An opening is provided so that repairs and connections can be readily made.

In Fig. 148 a slow releasing relay is shown, *A* being the armature, *B* the back contact prong, and *F* the front contact. The magnets are wound to such a resistance that a high self-induction results at the current strength normally passing

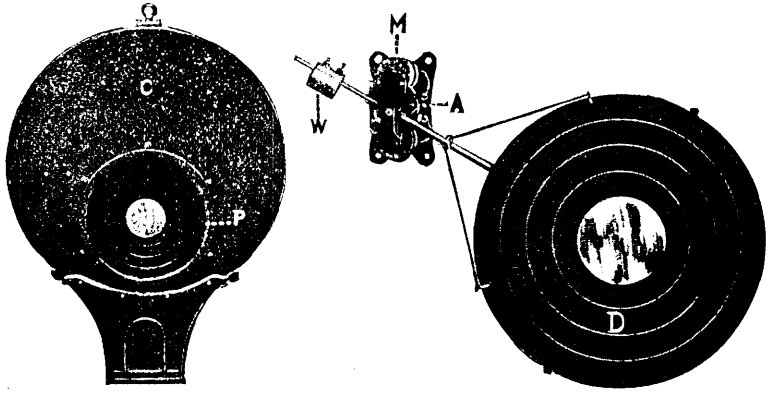

FIG. 147

through the coils. The magnetic circuit is long and of generous sectional area, the pole tips presenting a large surface to the armature. A soft copper sleeve is slipped over each core before the winding is put on. The eddy currents set up momentarily in the sleeve when any change in exciting current occurs, oppose any change in flux, and thus tend to retain the magnetism. These factors, combined with a short lift, small air gap, large percentage of residual magnetism, and high working flux density (much greater than is actually required for the mechanical work done) produce a slow release of the armature when the energizing current is interrupted. Such a relay is used in connection with the polarized wireless system, when slow-releasing slots are not employed, to prevent open-circuiting

of the home slot circuit when a momentary reversal of polarity occurs at the polarized relay.

Fig. 149 illustrates a vertical rotary switch-circuit controller in section. This instrument is intended to short-circuit the track relay at a track switch when the latter is open, or to short-circuit the signal relay. When the switch is closed, the contacts are open, so that the electrical conditions of the section are not interfered with. The arrangement consists of the dust and waterproof cast iron housing, *A*, provided with a

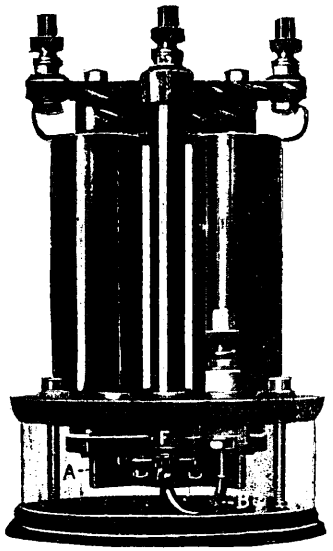

FIG. 148

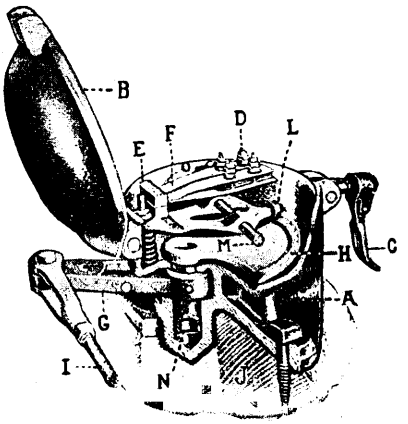

FIG. 149

hinged cover, *B*, which is held securely in place when closed by a lock and clasp, *C*. Fastened to an insulating strip are the phosphor-bronze platinum-tipped strips, *F*, with the binding nuts, *D*, for connection to the external circuits. The housing is fastened to the long tie, *J*, by lag screws, adjacent to the switch-point rail. It is connected to the latter by the rod, *I*, which imparts motion to the crank, *G*, fastened to the cam piece, *H*, the pivot being the shaft, *N*. Riding on the inclined flat lip, *H*, is a small roller, *L*, fastened to a cast iron rocking piece pivoted to the shaft, *M*, *L* being pressed against *H* by the action of the spring, *O*.

Closing the switch will, through the rod, *I*, produce a movement of the rotary cam piece and thus throw the roller, *L*, upward, which compresses the spring, *O*, and moves the lower insulating strip downward, allowing the contact strips, *F*, to separate, thus breaking the circuit. With *G* in the position shown in the figure, the switch is open, the contact strips thus short-circuiting the track. The purpose of the rotary cam is to absorb the motion given to *G* by every car wheel which passes over the switch-point rail, and prevent its being communicated to the contact strips. In Fig. 150 the mode of application of such a box to a switch is shown. *K* is the switch-point rail, which is connected to the box crank by the rod, *I*.

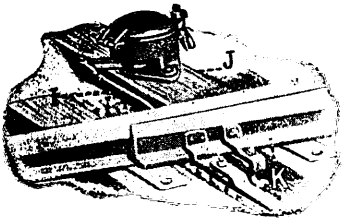

FIG. 150

In Fig. 151 a duplex rotary circuit-controller is illustrated.

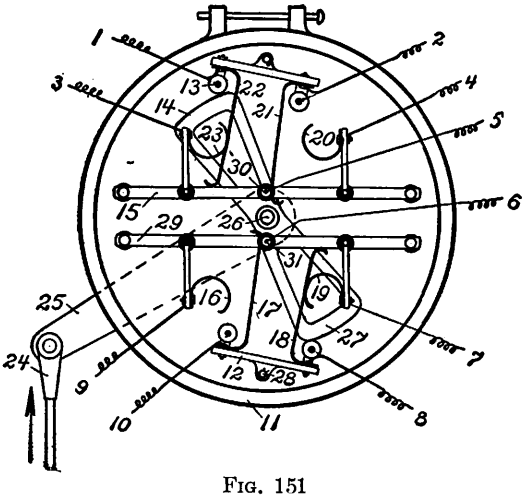

FIG. 151

This arrangement is intended to control from one to four separate circuits; or it may be employed to reverse the polarity or connections of two independent circuits. It is frequently employed in place of the switch circuit-controller above described. The instrument consists (Fig. 151*a*) of two operating cams, *V*,

whose outer edges bear against rollers arranged on pivoted bars, the latter carrying contact springs and connectors, *X*.

Within the weatherproof cast iron housing, 11 (this being merely a connection plan), are two cams, 14 and 27, arranged to move about a pivot, 26. These cams are secured to the crank, 25, operated by the switch, semaphore, or interlocking machine rod, 24. The outer edges of the cams bear against small rollers, 13, secured to the rocking members, 12, pivoted at 28. These rocking members carry the insulated contact springs, 21, 22, 17, and 18.

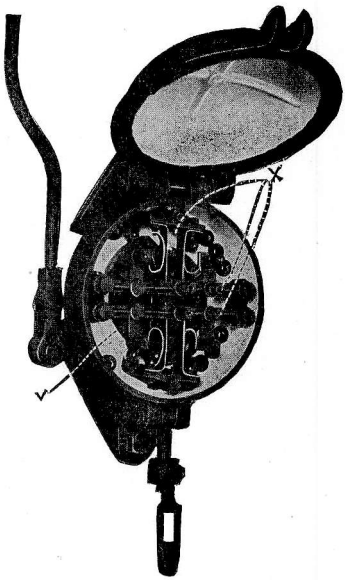

FIG. 151*a*

The stationary pieces, 15 and 29, also carry insulated contact spring strips, 16, 19, 20, and 23, which are in or out of contact with the movable strips according to the position of the cams, and consequently the position of 24. Connecting posts, 30 and 31, to which the wires, 5 and 6 pass, are insulated and stationary, and have a projection beneath which obstructs the motion of the movable contact springs. In the position of the cams shown, 21 is in contact with 30, and 31 with 17.

To show the use of the arrangement as a reverser of polarity, suppose that a track battery is connected to 1 and 2, one track rail being connected to 3 and 4. If the other rail is connected to 5, it is evident that the polarity of the track circuit is reversed at every consecutive movement of 24; which may be secured to the home semaphore of a signal on the wireless or polarized track-circuit system. By connecting one side of one circuit to 1 and 3, and the other side to 7 and 8, we have double-pole simultaneous control of two circuits. Numerous such combinations will occur to the signalman.

Fig. 152 shows a polarized indicator mechanism, such as

is used at a siding or crossover, or to indicate the state of two or more distant devices having suitable battery connections. When applied at a siding switch, it apprises the brakeman of an approaching train, and the movement of the home signal governing the section in which the switch is located. When used in conjunction with a slotted mechanical signal, it may similarly indicate the approach of a train, and the clearing or return of the semaphore.

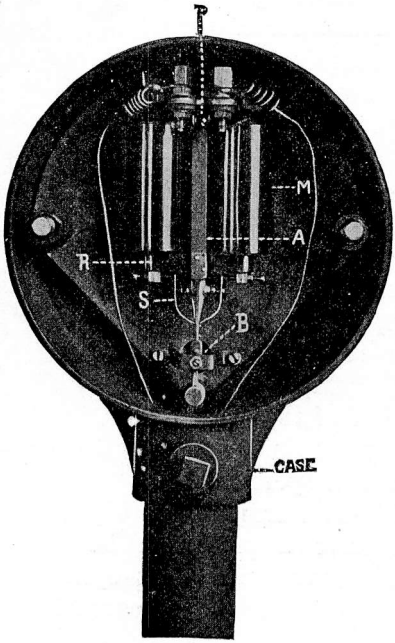

FIG. 152

It consists of an electromagnet, *M*, whose permanently magnetized armature, *A*, is held centrally in a state of static equilibrium by the adjustable springs, *S*, between the pole pieces, *R*. This armature is pivoted at *P*, and engages at its lower end with a rocking member, *B*, the latter giving motion to a pointer (not shown) which has three positions of rest, according to the direction of the current or its continuity. The mechanism is enclosed in a cast iron box, placed at the top of an upright located near the switch.

Fig. 153 shows a front and side elevation of a multiple unit semaphore indicator, with the binding posts and armature contacts. This type has three front contacts, 1, 2, and 3, also two back contacts, 4 and 5. The electromagnet, 8, through the armature, 11, operates a shaft, 7, which is secured to a miniature semaphore moving before the face glass, 9. Interconnection and connection to external circuits is effected at the binding posts, 10. These instruments are mounted in a moisture-proof

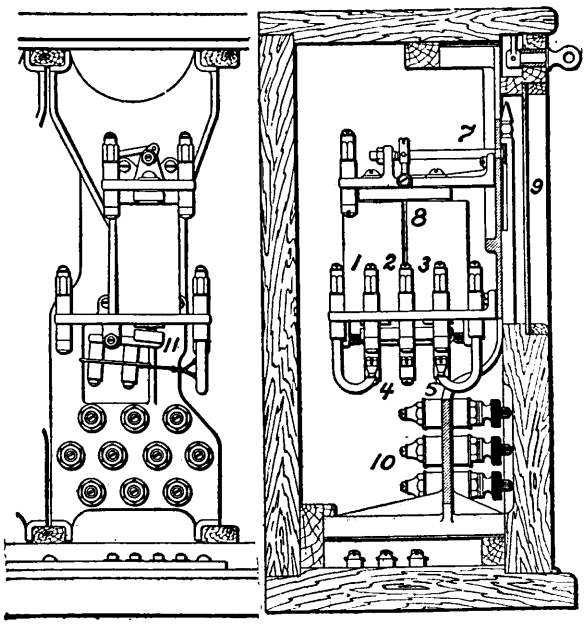

FIG. 153

housing in gangs or banks, and find application in train sheds, signal towers, and stations. Frequently single-stroke and vibrating bells supplement these devices, giving an audible announcement of the semaphore movement. A common bell for each bank may be used, but it is better practice to employ individual bells.

Fig. 154 illustrates a neutral type disk indicator, which is applied where it is desired that two indications be given, as, for example, to indicate the condition of a given block, whether occupied or clear. It consists of a metal disk, *D* (usually red),

which is actuated by the armature of the electromagnet, *M*, the latter being in series with a track-relay armature contact. *D* is fastened upon the vertical shaft, *S*, which is fastened by a link and stud, *P*, to an extension, *E*, of the armature. When *M* is energized, *E* moves outward a trifle, thus permitting *P* to swing around, and present the edge of the disk to the observer. *B* is of non-magnetic material, the armature being partly enclosed by it.

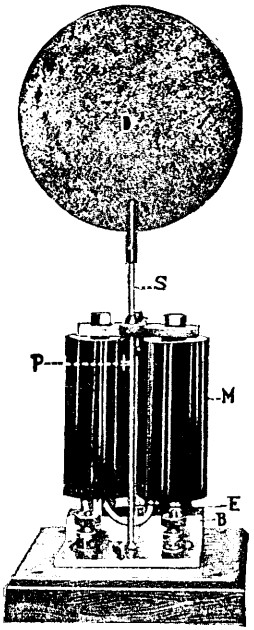

FIG. 154

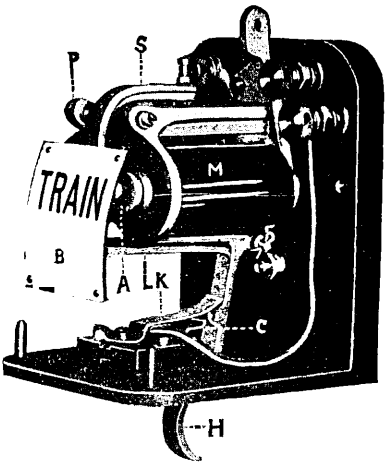

FIG. 155

To apprise a tower attendant of the presence of a train in a certain block, or indicate the approach of a train to a signal, a drop annunciator is used. This consists, as shown in Fig. 155, of a banner, *B*, with the desired inscription on its face, which moves before a glass-covered aperture in the housing (shown removed). This banner is affixed to a pivoted casting, *L*, which is provided with a handle or finger, *H*, and is held in its upward position by a trip upon the piece, *S*, pivoted at *P*, whose position and movement are adjustable. To the latter, the armature, *A*, of the electromagnet, *M*, is fastened. When a current passes

through *M*, *B* is released in an obvious manner, and is restored by means of the handle, *H*. An auxiliary circuit for audible announcement of the movement of *B* is sometimes made use of, and consists of a battery and bell in series with the contacts, *K*–*C*, the latter being closed when *L* is in its lower position.

Drop annunciators are used in connection with crossing circuits (see Fig. 31) to announce approaching trains, and at interlocking towers to avoid delays caused by switching engines drilling within yard limits. Delays to through passenger trains by long, slow-moving freight trains, which receive a signal prior to the former, are prevented by its use, so that the operator can first give the passenger train the right of way.

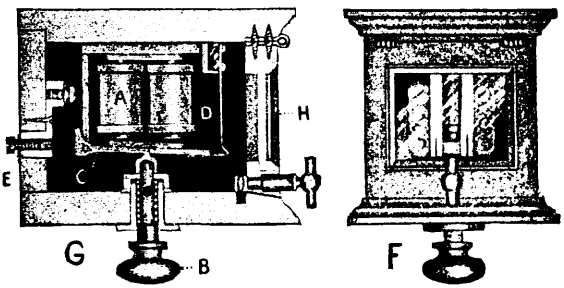

FIG. 156

One form of circuit controller, the application of which was considered in Fig. 77, is illustrated in Fig. 156, *G* being a part section and elevation, and *F* a front view. The electromagnet, *A*, enclosed in a box having a glass door, *H*, is in series with the armature contacts, *D*–*C*, connection to external circuits being afforded by the lugs, *E*. When the knob, *B*, is raised, these contacts are closed, hence a current passes around *A* (providing the external circuit is otherwise complete) thus raising the armature, *C*, and maintaining the energization of *A*. Should the external circuit be opened, *C* will fall, and *A* will be deënergized, until *C* is again raised by the operator, irrespective of the condition of the external circuit.