# CHAPTER XIII.

## ELECTRIC LOCKING.

An electric lock is a device, electrically controlled, which interposes a small latch or bar at a notch or recess in a movable or sliding piece, so that the latter cannot be given motion except under conditions governed by the lock. This moving piece obviously may be a semaphore, switch, or interlocking machine rod; in fact anything whose automatic control is desired.

Electric locking is sometimes introduced in mechanical levers, so that a signal operator cannot return to caution a clear distant that a train has just passed, then return the home to stop; permitting him thereafter to set up a false clear condition of a conflicting route by the mechanical unlocking that takes place. The lock circuit is through the rails of the section intervening between the home and distant signals, and in series with a battery and the lock magnets of the conflicting levers. The train may either complete the circuit directly or through the medium of a relay contact. Separate circuits may also be employed to lock the individual levers.

Electric locking, as a subsidiary function, is treated of in Chapter 5. It is scarcely possible to design a semi-automatic connection arrangement without the use of such locking; it forming the simplest scheme for controlling routes of any desired combination.

When a plate or rod connected to a lever has a notch or aperture into which a securely held but freely moving locking member drops, motion of the former can or cannot be effected, according to the position of the latter. Thus in Fig. 164, *D* is a rigid stationary plate having an aperture, *S*; *C* a movable plate connected to the lever to be locked; and *L* the armature of an electromagnet, *R*. If *A* be an unlocking controller, when it is moved in the direction of the arrow its contacts will be closed and a current pass from *B* through *R*, raising

*L* and unlocking *C*, and thereby rendering the lever free. Conflicting routes may thus be protected electrically.

A section of one form of switch lock is given in Fig. 165. Within a suitable housing, *H*, is placed an electromagnet, *A*, whose armature, *B*, carries a locking piece, F; the latter engaging

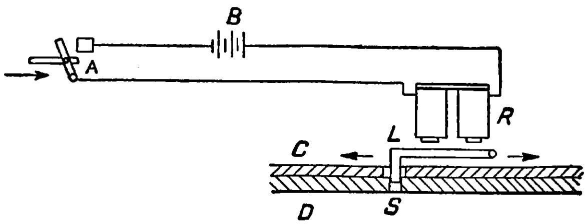


Fig. 164

with a slot or recess in a rod, E, connected mechanically with the switch point. Before the switch can be thrown, *E* must be free to move, which will not be the case if the armature is down, due to the locking which occurs by *F* falling into both a slot in the boss, *D*, and the rod slot. When current passes

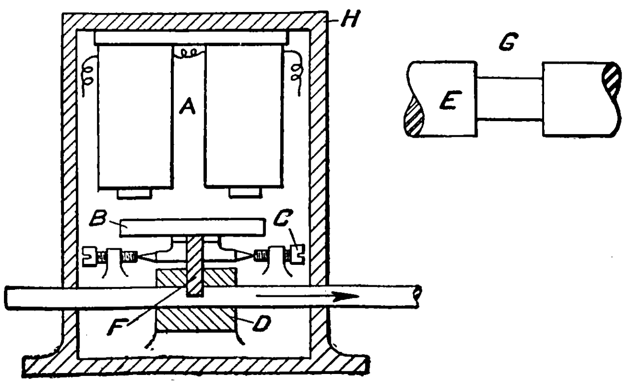


Fig. 165

around *A*, *B* will be raised and *E* free to move. At *G* another form of recess is shown, which has obvious advantages. *B* is carefully adjusted by means of the pivot screws, *C*.

Electric locks are most frequently used to regulate independently the function of the devices they are supplementary to.

As their application is varied, a large number of different types are in use. In Fig. 166 an electric lock applied to a mechanical interlocking machine is shown. The armature, *F*, of the electromagnet, *M*, carries a locking piece, *E*, which rests between the stationary lugs, *A*, and a recess in the piece at the rear of *D*, which is integral with the dog, *G*, of the locking bar, *C*; hence *C* cannot be moved unless *M* is energized. *B* is a banner which moves before an aperture in the housing, *H*, and is secured to the lock piece, *E*, serving as an indicator to the operator of the position of the lock bar.

Electric locking is sometimes applied as an intermediary to

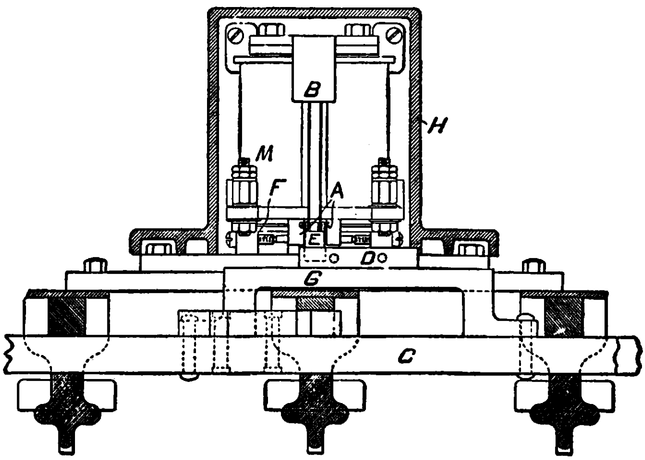


FIG. 166

derails or switches, so that the cleared home signal (mechanical) of an approaching train renders effective this locking, the release being arranged to act subsequently, providing the train has entered an unlocking track section and the home signal has been thrown to the stop position: the latter having to occur prior to the passing out of the train from the releasing section. This leads to the consideration of electric releases (although mechanical releases have been more extensively applied).

Electric releases are adjuncts which allow of a temporary manipulation of interlocked devices by the introduction of a supplementary or compensating feature; so that the interlocking machine can be set normal under specific conditions. This release must be returned to its normal state (and consequently the electric locking made effective) before any routes can be set up for approaching trains.

In Fig. 167, *B* is a battery in series with which is connected a stick relay, *R*, and the normally open contact-springs, *C*; and whose armature contact is in series with the normally open contacts, *K*. *N* is a nut which moves along the threaded rod, *A*, when the crank, *H*, is revolved. When *N* is moved upward, the contacts, *K*, are closed, but *B* discharges no current as the armature of *R* is down. When *N* strikes *C*, the latter are closed, thus allowing a current to pass through *R*. *M* is a circuit controller operated by throwing the lever to which it is attached, while *T* is a locking relay in series with the contacts, *K*, and energized when they are closed. To require the return of *N* to the normal position, both *C* and *K* must be opened, as the battery will have two multiple paths for the current, the first through the front contact of the locking relay, its coils, the circuit controller, and lock; the second through the contacts, *K*, the armature of *R*, the coils of *R*, and the circuit controller, the lock, *T*, being thus shunted, and consequently deënergized. When *K*–*K* are opened, however, this will not occur, and the locked functions will be released.

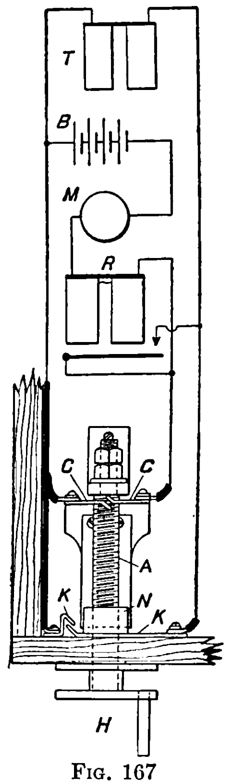

Fig. 167

This release arrangement is placed at some distance from the operator, so that some time will be taken to reach it, and this, in addition to that required in moving *N* up and down suffices to give the requisite time before the signal can be cleared for the changed route, assuring greater safety thereby.

Fig. 168 is a section of the sector block and lock employed in the Coleman arrangement. Within the housing, which is fastened to the frame of the interlocking machine, is the sector block, *S*, which is moved about a center by the link, *C*, fastened to the lever, *D*, secured to the square shaft, *G*. *D* is connected to the unlocking segment, so that whenever the operator raises the latch preparatory to throwing the lever, it will describe an arc. Within the case is an electromagnet whose armature extension, *B*, drops into a slot, *P*, in the sector, a coinciding slot being also in the case. Hence, when the electromagnet is deënergized, *B* will fall into the slot and securely lock *S*. *B* also carries a banner through the projecting rod, *H*, which passes before an aperture, *A*, in the case, and indicates to the operator the position of *B*.

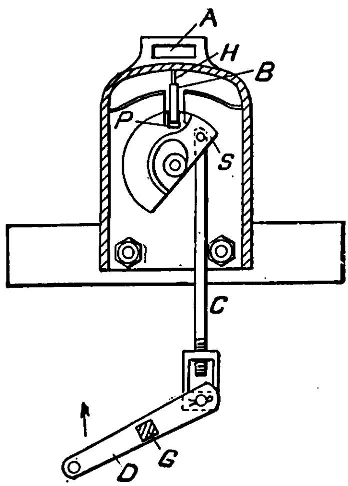

FIG. 168

By providing a circuit controller connected to a battery circuit in which a locking electromagnet is included, it is evident that a distant signal's movement may be employed to govern the movement of an interlocked lever. In Fig. 169 we have an interlocking magnet, *B*, applied to the lever, *A*, in such a manner

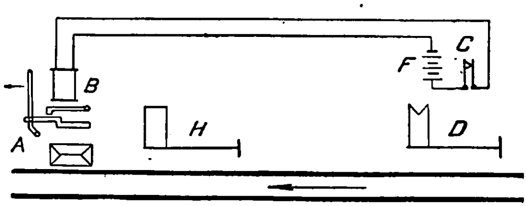

FIG. 169

that when its armature is down, motion of *A* in the reverse direction cannot be effected. When the interlocked lever has been thrown to its normal position, and the distant signal arm fails to assume the caution position, since the contacts at the controller, *C*, are open, it is not possible to throw the lever of the home signal, *H*, to its full normal position. Hence such a route, and all other conflicting routes, are successfully locked until *D* has been cleared, thus raising the armature of *B* by the current from *F*. This provision is sometimes required to preclude the possibility of *D*'s not working properly with its lever. Such an arrangement does not interfere with keeping both home and distant signals in their proper relation, or their normal indications, providing the levers are manipulated in proper sequence.

Fig. 170 combines the simple interlocking of the lever of the above case with an indicator and magnetic controller, the signals being in the clear position. *C* is in the latter position, due to its electromagnet being deënergized, a condition occurring when *B* is open. Thus *C* operates in unison with the distant signal, and if *B* is closed, will be in the caution position. The movement of the armature of *C*, beside setting the miniature signal,

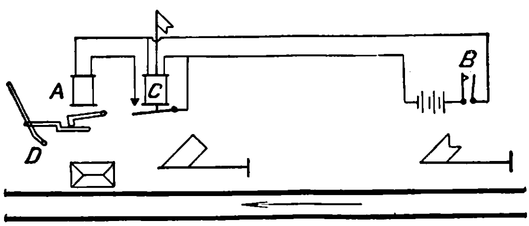


FIG. 170

connects the electric lock, *A*, in shunt with its magnet, thus energizing the former and releasing the lever. This release is usually effected on the latch of the lever which must be loose before the latter can be moved over its quadrant. Not only is less energy required to move the locking member in this case, but the liability to stick is also much less. The purpose of the above arrangement is to set the signals in their normal position, and still require that the distant signal be at caution before a route can be altered.

A circuit arrangement for the switch lock of an outlying switch controlled from the signal cabin is shown in Fig. 171. The operator's hand switch, *C*, is a two-point arrangement, the left-hand contact of which is connected to the relay, *D*, and in series with the contact, *G*, at the switch, *B*. *S* is a mechanically operated home signal having the circuit controller or commutator, *F*, the latter being in series with the switch-lock magnet and relay, *H*, so that when *S* is cleared *H* is deënergized, and consequently locks *B*. *H* also has an armature and contacts, *I*, while *M* is a push-button, or switch, at *B*; *L* is a bell, connected to one side of the main battery, the latter being also connected to the common line-wire.

If a freight train at the siding, *B*, desires to move to the main line, the conductor presses the button, *M*, which causes *L* to ring in the cabin. If the operator can allow the switch to be thrown open, he moves the hand switch lever to the right-hand contact. If *F* be closed, a current will pass from the main battery over the common line-wire to *H*, *F*, *E*, and *C*, thus energizing *H* and releasing the lock. A train cannot now pass in the direction of the arrow, since the semaphore at *S* is at danger.

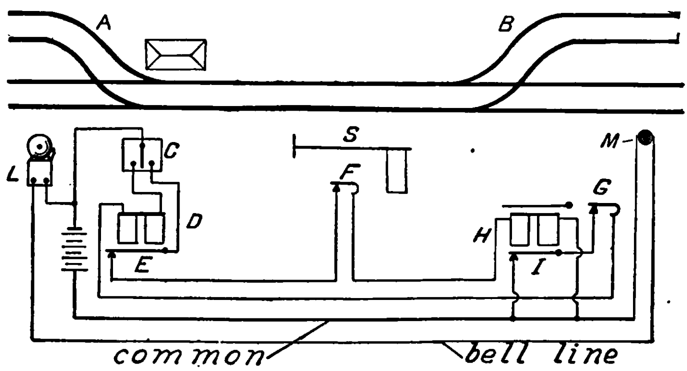


FIG. 171

Also, if the lock, *D*, were energized, its armature, *E*, would be raised, thus opening the circuit and preventing *H* from being energized. The train could not proceed from *B* if *S* were at clear, as *F* would be opened.

Should a train desire to proceed from the siding, *A*, to the main line, the reverse operations occur, the hand switch lever being moved to the left-hand contact. A current then passes through *D*, raising its armature and releasing the switch lock. *C* must now be closed and *H* deënergized, so that the armature, *I*, will close the circuit. This cannot occur if the switch at *B* is open, or *H* is energized. *D*, however, may control a signal, so that a train movement on the main track can be allowed only when it is energized; that is, *C* must be in the left-hand position.

In Fig. 172 a control circuit, such as is used in connection with a train staff on a single-track line with sidings, is shown. The main line is connected to a siding by the switch, 1. From the block tower, 9, the home signals, 2 and 22, are operated, 11 being a circuit breaker operated by the semaphore of 2, while 17 is operated by the insertion of a train staff; and when the latter is closed, relay 19 is energized.

The removal of the staff opens this circuit, but the relay remains energized, since a current flows through it by reason of the armature, 18, of the 4-ohm track-relay, 23, being up. This also closes the slot circuit, causing a current to pass through

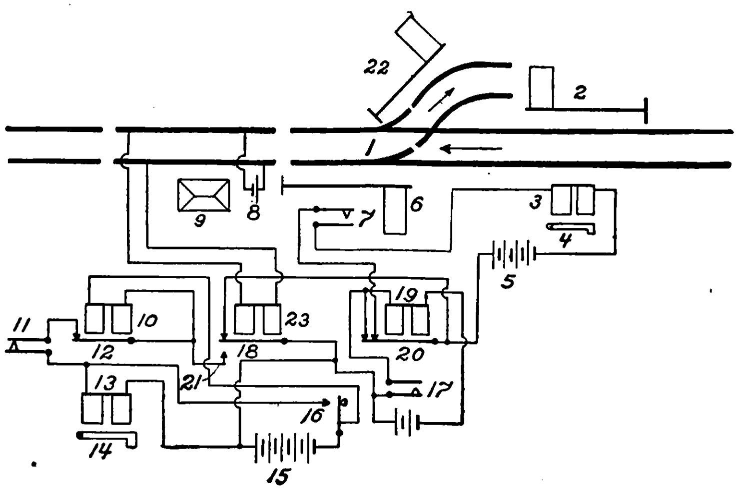


FIG. 172

the coils of a slot or lock magnet, 3, whose armature, 4, controls the movement of the main line signal, 2, which must be cleared in order to allow a train to proceed in the direction of the arrow. When 22 has been cleared, which will occur when the switch, 1, has been opened, a staff is inserted and therefore the circuit closer, 7, operated.

When this signal is cleared, the circuit through the lock magnet, 13, is broken at 11, which allows the locking function, 14, to fall, the latter locking the switch rod in place. The switch cannot therefore be opened until a train has passed over the insulated section to which the 4-ohm relay is connected. The engineman of a train passing into the protected section removes the staff at 7, thus opening this circuit and causing 2 to pass to the danger position. The track being short-circuited, the 5-ohm relay, 19, is deënergized, and the 9-ohm relay, 10, energized. After the entire train has passed over the track section across which a difference of potential is maintained by the battery, 8, the 4-ohm relay is again active, which allows the switch to be thrown to its normal position.

The signal, 6, may be a distant signal, or one showing the condition of the main line for trains taking the siding. 15 and 5 are slot batteries, and the armature, 18, has a lower contact, 21, which is in series with 12 and 10. 16 is a hand switch provided to unlock 13 through battery 15, in case it becomes necessary to move a train in one direction before another can proceed to that point.

Detector bars may sometimes be replaced by short insulated track sections introduced at the switch to be governed, electric locking being also provided. In electrical power interlocking, special track relays having contacts capable of carrying and breaking heavy currents are necessary. These have non-fusing carbon contacts of great area, a wide break being interposed when the relay operates, in some cases requiring also a magnetic blow-out. The locking-circuits are usually independent of the power circuits control in such cases; but their application need not be entered into here.