G. W. HART.

SWITCH.

APPLICATION FILED JAN. 2, 1914. RENEWED JUNE 15, 1916.

1,244,085.

Patented Oct. 23, 1917.

2 SHEETS—SHEET 1.

Fig. 1.

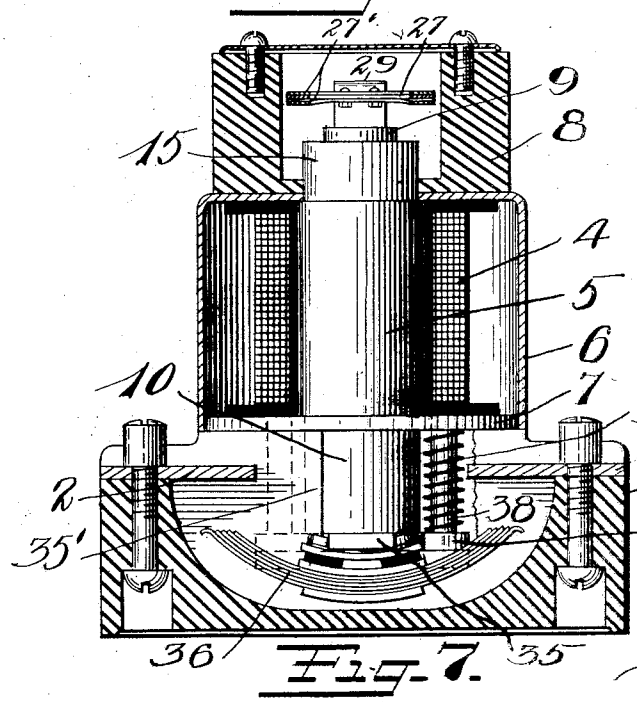


Fig. 7.

Fig. 8.

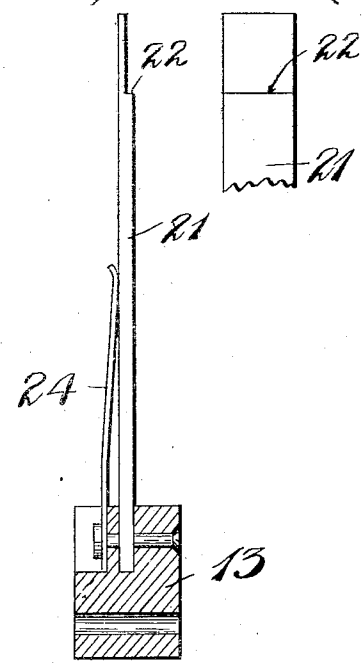
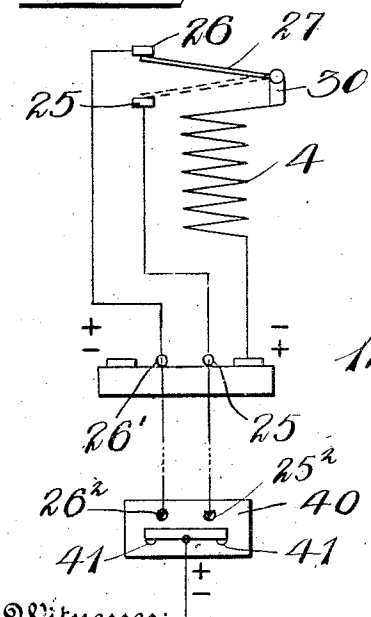
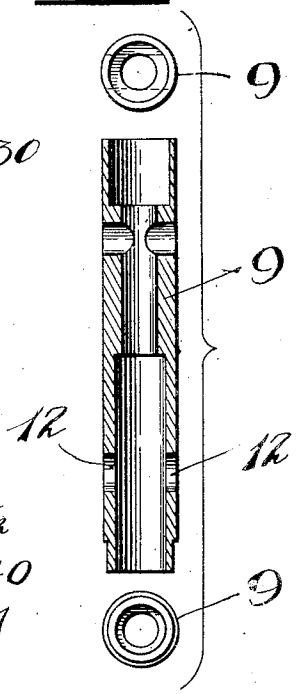


Fig. 9.





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2 SHEETS—SHEET 2.

Fig. 2.

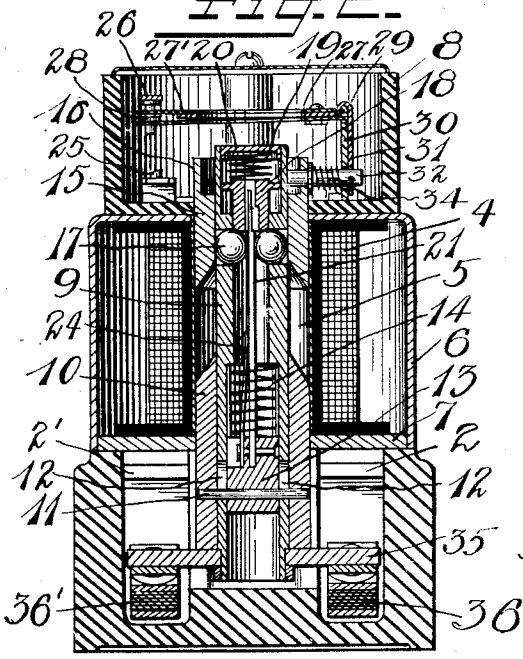


Fig. 3.

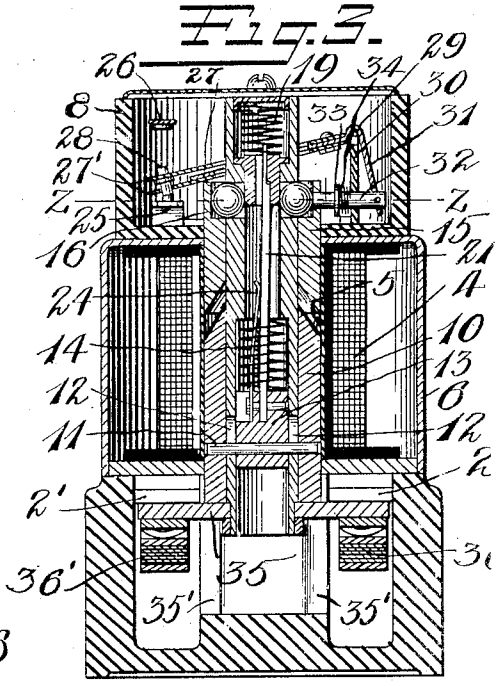


Fig. 4.

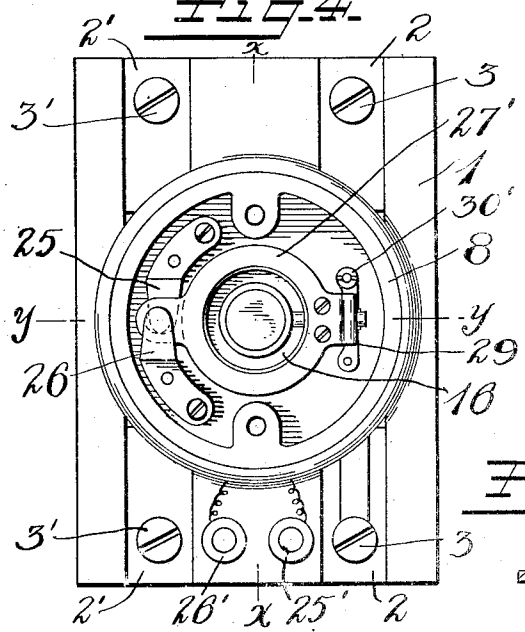


Fig. 5.

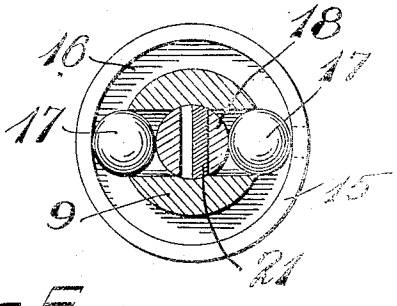
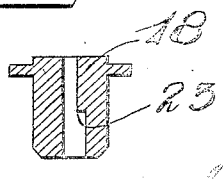


Fig. 6.



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UNITED STATES PATENT OFFICE.

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SWITCH.

1,244,085. Specification of Letters Patent. Patented Oct. 23, 1917.

Application filed January 2, 1914, Serial No. 809,877. Renewed June 15, 1916. Serial No. 103,909.

To all whom it may concern:

Be it known that I, GERALD W. HART, a citizen of the United States, residing at West Hartford, Hartford county, Connecticut, have invented certain new and useful Improvements in Switches, of which the following is a full, clear, and exact description.

My invention relates to improvements in electric switches, and has for its object to produce a single coil remote-controlled switch of the character just referred to, having two controlling circuits, one for opening and the other for closing the coil, and means for breaking each of said controlling circuits after the solenoid has been actuated to either fully close and lock the switch or release the lock. It further has for its object to provide a switch actuated by a single coil having locking means which control the auxiliary controlling circuits. It further has for its object to provide a remote-controlled switch of the plunger type having means for locking it closed and normally tending to move it to open position, said switch having a single operating coil, which when energized shall act to both close the switch if it is in open position and to release the lock so as to permit the switch to move under its normal tendency. The following is a description of an embodiment of my invention, reference being had to the accompanying drawings, in which

Figure 1 shows a partial section of the switch on the line *x—x* Fig. 4.

Fig. 2 is a transverse section on the line *y—y* with the switch in open position.

Fig. 3 shows a similar section with the switch in closed position.

Fig. 4 is a plan view with the cap plate removed.

Fig. 5 is an enlarged detail showing the locking means partially in section on the line *z—z* Fig. 3.

Fig. 6 shows an enlarged section detail of the movable abutment.

Fig. 7 shows details of the movable plunger.

Fig. 8 shows an end view and partial front view of the releaser.

Fig. 9 shows a diagram of circuits.

Referring more particularly to the drawings, 1 is a switch base of insulating material carrying the main contacts 2—2 and 2′—2′ secured thereto and provided with binding posts 3—3′. Mounted upon the base is a solenoid 4 within which is a stationary tube 5, preferably of brass. Surrounding the solenoid is a casing 6 of iron or other magnetic material closed at its bottom by a plate 7 of similar material so as to inclose the solenoid and furnish a ready magnetic path for the magnetic lines of force therethrough. To the top of the casing 6 is secured a cup-shaped member 8 having an insulated inner surface. In the present instance this cup-shaped member 8 is composed of insulating material such as porcelain or fiber. Within the brass tube 5 is a member 9 capable of moving in both directions. This movable member is made of non-magnetic material such as brass. Surrounding the lower end of the movable member or plunger 9 is an armature 10 of magnetic material, which is connected to the member 9 so as to have lost motion relatively thereto. This connection is formed by a pin 11 passing through elongated slots 12 formed in the member 9. The member 9 in the form shown is tubular and within it is located a metal block 13, which is rigidly connected to the armature 10 by the pin 11, so that the two move together and each have lost motion relatively to the member 9. A spring 14 bearing against an internal shoulder in the member 9 tends to depress the parts 10 and 13 so as to keep the pin 11 in the bottom of the slots 12. Within the upper part of the tube 5 and fixed so as to be stationary relatively thereto is a magnetic core 15, constituting a stationary magnetic core for the solenoid adapted to strengthen the action of the same upon the movable armature 10. This core is provided with a recess 16, the lower surface of which forms a seat or stationary abutment for the locking balls 17, which are located in diametrically opposite holes in the upper portion of the member 9. Coacting with these locking balls is a movable abutment 18, which in the device shown is carried by the member 9, being movable relatively thereto and being acted upon by a spring 19, whose upper end engages a closure 20 carried by the upper end of the member 9. The spring 19 presses the movable abutment downward and when the switch is in unlocked position, tends to force the locking balls 17 outward, so that when the solenoid 4 is energized so as to raise the armature 10 and the member 9 sufficiently to

bring the balls 17 above the abutment formed by the bottom of the recess 16, the balls will be forced outward by the movable abutment into the position shown in Fig. 3 and lock the member 9 in raised position.

21 is a releaser, the same being a strip of metal somewhat loosely mounted on the block 13. This releaser 21 has a shoulder 22 (Fig. 8) which is adapted to engage with a shoulder 23 (Fig. 6) formed on the movable abutment. A leaf spring 24 mounted on the block 13 and bearing against one side of the releaser 21 tends to move the upper end thereof sidewise, so that the shoulder 22 will lie in the path of the shoulder 23. When the member 9 is in depressed position, the right hand ball 17 engages the right hand side of the member 21 and moves it so that its shoulder 22 is held out of the path of the shoulder 23 of the movable abutment. The other detent ball 17 engages the opposite side of the releaser 22, and the two balls thus positively define the position of the releaser when the switch is unlocked. When the switch is locked, the balls 17 being moved outward by the action of the movable abutment 18 will free the releaser 21, so that it is at liberty, so far as they are concerned, to move so as to bring the shoulder 22 into the path of the shoulder 23. When the switch is locked and the solenoid is deënergized, the parts assume the position shown in Fig. 3, with the shoulder 22 directly under the shoulder 23. When the armature is again raised, the shoulder 22 engages the shoulder 23 and lifts the movable abutment 18 so as to permit the balls 17 to withdraw from the stationary abutment formed by the recess 15, whereupon the plunger 9 falls, the parts assuming the position shown in Fig. 2.

The solenoid 4, as will hereafter be explained, is controlled by two auxiliary circuits, and it is desirable to have means for breaking either of those circuits as soon as it has served its purpose. In order to secure the breaking of these circuits, I provide stationary contacts 25—26, the first of which is included in the auxiliary circuit for releasing the detent and the other of which is included in the auxiliary circuit for closing the switch.

Coacting with these two contacts is an oscillating contact arm 27 carrying two leaf springs 27′ between which is a contact member 28. The arm 27 is pivoted at 29 to a metallic upright 30 secured to the bottom of the member 8 and has a depending arm 31, which is pivoted to a sliding bar 32 of insulating material, whose inner end passes through an opening in the side wall of the recess 16, so as to lie in the path of one of the balls 17. This bar is provided with a shoulder 33, against which acts a spring 34 tending to keep the bar in its inner position, and consequently to keep the contact arm 27 and contact member 28 in raised position, as shown in Fig. 2, so that the contact 28 is in engagement with the stationary contact 26. In this way it will be seen that when the balls 17 are in engagement with the abutment at the bottom of the recess 16, the bar 32 is forced outward by one of the balls 17 against the action of the spring 34 and the contact 28 is brought into engagement with the lower stationary contact 25, and that when the member 9 is unlocked so that the balls 17 are no longer in engagement with that abutment, the contact member 28 is brought into engagement with the upper stationary contact 26, as shown in Fig. 2.

To the lower end of the movable member 9 is rigidly secured a cross arm 35, carrying switch arms 36—36′, insulated therefrom, which, when the member 9 is in elevated position, engage the contacts 2—2 and 2′—2′, closing the switch, and when the member 9 is in depressed position disengage those contacts so as to open the switch.

The plate 35 is provided with perforated lugs 37, through which screws 38 pass, said screws extending into the iron plate 7. The heads of these screws limit the downward movement of the plate 35 and the parts connected thereto. The screws 38 are surrounded by springs 39 located between the plates 7 and the lugs 37, and force the plate 35 downward when the locking balls 17 are released so as to permit the switch to open.

The base 1 is provided with recesses and partial divisions 35′, one of which is partially broken away in Fig. 1, so as to clearly show one of the screws 38 and springs 39. The switch arms are thereby separated so as to prevent damage to the operating parts by any arcing that may occur upon the opening of the switch.

The circuit connections are shown in Fig. 9 in connection with a suitable two-button controlling switch 40. As shown in this diagram, one terminal of the solenoid 4 is connected to the line contacts 2 on the generator side and the other is connected to the standard 30 which carries the contact arm 27. The contacts 25 and 26 are connected to the binding posts 25′ and 26′ respectively, and from these posts conductors lead to a distance and are connected to the contacts 25^2 and 26^2 of the local circuit controller 40 having an "on" button 41 and an "off" button 42, whereby the free terminal of the solenoid can be connected across the circuit.

The operation of the switch is as follows: With parts in the positions shown in Fig. 2, the circuit is as shown in full lines in Fig. 9. When the button 41 is pressed, the solenoid 4 is energized, lifting the armature 10 until the balls 17 pass above the stationary abutment into holding position, as shown in Fig.

3. During the lost motion period of the armature, the releaser 21, guided by the balls 17, moves upward, so that the shoulder 22 does not engage the shoulder 23 on the movable abutment. The movable abutment is therefore free to push the balls 17 into holding position, when they reach the stationary abutment. As they move into this holding position, one of them pushes the bar 32 outward, causing the contact 28 to leave the contact 26 and engage the contact 25, thereby breaking the circuit containing the button 41 and making the circuit containing the button 40. The solenoid 4 is thereby deenergized as soon as the switch is locked. As soon as the solenoid is deënergized, the spring 14 moves the armature 10 downward, this being possible by reason of the lost motion between the armature 10 and the member 9. The shoulder 22 of the releaser is thus brought below the shoulder 23 of the movable abutment, and being unrestrained by the balls 17, is forced into alinement therewith by the spring 24. When the button 40 is thereafter actuated, the solenoid is again energized and the armature raised, this being possible on account of its lost motion. This causes the shoulder 22 of the releaser to engage the shoulder 23 of the movable abutment 18 and lift that abutment so that it releases the balls 17 and unlocks the member 9, which then descends under the action of the springs 39. As the balls 17 move out of engagement with the stationary abutment, the bar 32 moves from the position shown in Fig. 3 to that shown in Fig. 2, under the action of the spring 34, throwing the contact arm 27 out of engagement with the contact 25 and into engagement with the contact 26 and breaking the circuit through the solenoid 4 and the button 40, whereupon the armature 10 falls to the position shown in Fig. 2. It will be seen that a single coil acts both to close the switch and to unlock it when successively energized, and that when either of the buttons 40 and 41 has been actuated to operate the switch, the operated button immediately becomes dead and remains so until the switch has been operated by actuating the other button.

As will be evident to those skilled in the art, the embodiment described permits of various modifications without departing from the spirit of my invention or the scope of the appended claims.

What I claim is:

1. The combination of a member movable in both directions and normally tending to move in one direction, means for locking said member at the end of its movement in the other direction, lock releasing means, a solenoid and armature for alternately moving said member in said other direction and then releasing said locking means when successively energized, said armature being in operative relation to said member and said releasing means, two controlling-circuit terminals, and an auxiliary switch in operative relation to said terminals and controlled by said locking means for automatically connecting one of said terminals to said solenoid when said member is in locked position and the other to said solenoid when said member is unlocked.

2. The combination of a member movable in both directions and normally tending to move in one direction, a detent carried thereby, a stationary abutment engaged by said detent when said member has been moved in the other direction so as to lock the same, an armature in operative relation to said member and having lost motion relatively to said member, a detent-releaser connected to said armature and acting to release said detent during the period of lost motion of said armature when said member is locked, said detent holding said releaser out of operative position when said member is unlocked, and a solenoid acting upon said armature to move it in the opposite direction from that in which said member tends to move.

3. The combination of a member movable in both directions and normally tending to move in one direction, a detent carried thereby, a stationary abutment engaged by said detent when said member has been moved in the other direction so as to lock the same, an armature in operative relation to said member and having lost motion relatively to said member, a detent-releaser connected to said armature and acting to release said detent during the period of said lost motion when said member is locked, said detent holding said releaser out of operative position when said member is unlocked, a solenoid acting upon said armature, two controlling-circuit terminals and means in operative relation to said terminals for connecting one of said terminals to said solenoid when said member is locked, and the other terminal to said solenoid when said member is unlocked.

4. The combination of a member movable in both directions, and normally tending to move in one direction, an armature in operative relation to said member and having lost motion relatively thereto, a solenoid for moving said armature, a detent carried by said movable member, a stationary abutment with which said detent engages to lock the member when moved in the other direction, movable means tending to force said detent into locking position when in proper relation to said stationary abutment, a releaser carried by said armature for retracting said movable abutment during said period of lost motion when said member is locked and tending to engage said movable means but held in idle position by said de-

tent when said detent is out of engagement with said stationary abutment, said releaser being free to move into alinement with said movable means when said member is locked.

5. The combination of a member movable in both directions and normally tending to move in one direction, an armature in operative relation to said member and having lost motion relatively thereto, a solenoid for moving said armature, a detent carried by said movable member, a stationary abutment with which said detent engages to lock the member when moved in the other direction, movable means tending to force said detent into locking position when in proper relation to said stationary abutment, a releaser carried by said armature for retracting said movable means during said period of lost motion when said member is locked and tending to engage said movable means but held in idle position by said detent when said detent is out of engagement with said stationary abutment, said releaser being free to move into alinement with said movable means when said member is locked, two controlling-circuit terminals, and a switch controlled by said detent and in operative relation to said terminals for connecting one of said terminals to said solenoid when said member is locked and the other terminal to said solenoid when said member is unlocked.

6. The combination of a member movable in both directions and normally tending to move in one direction, an armature in operative relation to said member and having lost motion relatively thereto, a solenoid for moving said armature, a detent carried by said movable member, a stationary abutment with which said detent engages to lock the member when moved in the other direction, movable means carried by said member and tending to force said detent into locking position, a releaser carried by said armature for retracting said movable means during the period of said lost motion when said member is locked and tending to engage said movable means but held in idle position by said detent when said detent is out of engagement with said stationary abutment, said releaser being free to move into alinement with said movable means when said member is locked, two circuit-controlling terminals and a switch controlled by said detent and in operative relation to said terminals for connecting one of said terminals to said solenoid when said member is locked, and the other terminal to said solenoid when said member is unlocked.

7. The combination of a tubular member movable in both direction and normally tending to move in one direction, a tubular armature surrounding the same and having lost motion relatively thereto, a solenoid surrounding said armature for moving the same in the other direction, a detent, an abutment with which said detent engages to lock said member when moved in said other direction, movable means tending to force said detent into locking position, a releaser connected to said armature for retracting said movable means during the period of said lost motion when said member is locked.

8. The combination of a tubular member movable in both directions and normally tending to move in one direction, a tubular armature surrounding the same, a solenoid surrounding said armature and in operative relation thereto for moving the same, a detent, an abutment with which said detent engages to lock said member when moved in said other direction, movable means tending to force said detent into locking position, a releaser connected to said armature for retracting said movable means, two controlling-circuit terminals and a switch controlled by said detent and in operative relation to said terminals for connecting one of said terminals to said solenoid when said member is in locked position and the other to said solenoid when said member is unlocked.

9. The combination of a tubular member movable in both directions and normally tending to move in one direction, a tubular armature surrounding the same and having lost motion relatively thereto, a solenoid surrounding said armature for moving the same in the other direction, a detent, an abutment with which said detent engages to lock said member when moved in said other direction, movable means tending to force said detent into locking position, a releaser connected to said armature for retracting said movable means during the period of said lost motion when said member is locked, and tending to move into alinement therewith but held in idle position when said detent is out of engagement with said abutment.

10. The combination of a tubular member movable in both directions and normally tending to move in one direction, a tubular armature surrounding the same and in operative relation thereto, a solenoid surrounding said armature for moving the same, a detent, an abutment with which said detent engages to lock said member when moved in said other direction, movable means tending to force said detent into locking position, a releaser connected to said armature for retracting said movable means and tending to move into alinement therewith but held in idle position by said detent when said detent is out of engagement with said abutment, two controlling-circuit terminals and a switch controlled by said detent for connecting one of said terminals to said solenoid when said member is in locked position and the other to said solenoid when said member is unlocked.

11. The combination of a tubular member movable in both directions and normally tending to move in one direction, a tubular armature surrounding the same and in operative relation thereto, a solenoid surrounding said armature for moving the same, a detent, an abutment with which said detent engages to lock said member when moved in said other direction, movable means tending to force said detent into locking position, a releaser located within said tubular member and connected to said armature for retracting said movable means and tending to move into alinement therewith but held in idle position by said detent when said detent is out of engagement with said abutment, two controlling-circuit terminals and a switch controlled by said detent for connecting one of said terminals to said solenoid when said member is in locked position and the other to said solenoid when said member is unlocked.

12. The combination of a tubular member movable in both directions and normally tending to move in one direction, a tubular armature surrounding the same and in operative relation thereto, a solenoid surrounding said armature for moving the same, a detent carried by said movable member, a stationary abutment with which said detent engages to lock said member when moved in said other direction, movable means tending to force said detent into locking position, a releaser located within said tubular member and connected to said armature for retracting said movable means and tending to move into alinement therewith but held in idle position by said detent when said detent is out of engagement with said abutment, two controlling-circuit terminals and a switch controlled by said detent for connecting one of said terminals to said solenoid when said member is in locked position and the other to said solenoid when said member is unlocked.

13. The combination of a tubular member movable in both directions and normally tending to move in one direction, a tubular armature surrounding the same and in operative relation thereto, a solenoid surrounding said armature for moving the same in the other direction, a detent carried by said movable member, a stationary abutment with which said detent engages to lock said member when moved in said other direction, movable means carried by said member and tending to force said detent into locking position, a releaser located within said tubular member and connected to said armature for retracting said movable means and tending to move into alinement therewith but held in idle position by said detent when said detent is out of engagement with said abutment.

14. The combination of a switch arm, contacts coöperating therewith, a solenoid and an armature therefor, a locking element, means controlled by said solenoid through said armature for moving said switch arm against opposition to a locked closed position when solenoid is energized while said switch arm is in open position and for releasing said locking element and allowing said switch arm to open when said solenoid is energized while said switch arm is in a closed position, two solenoid operating terminals, and a solenoid controlling switch operated by the said locking element for automatically transferring the connection from the then live solenoid-operating terminal to the corresponding dead operating terminal after each successive function of said solenoid has been performed.

15. The combination of a member movable in both directions and normally tending to move in one direction, means for locking said member at the end of its movement in the other direction, releasing means, a solenoid and armature for alternately moving said member in said other direction and then releasing said locking means when successively energized, said armature being in operative relation to said member and said releasing means, two controlling circuits for said solenoid, circuit controllers therein, and automatic means for breaking one of said controlling circuits after said member is either locked or unlocked and making the other after said member is moved toward either locked or unlocked position.

16. The combination of a switch arm normally tending to move to open position, contacts coöperating therewith, a solenoid and an armature therefor, locking means for holding said switch arm in closed position, means controlled by said solenoid through said armature for moving said switch arm to locked closed position when said solenoid is energized while said switch arm is in open position, and for releasing said locking means and allowing said switch arm to move to open position when said solenoid is energized while said switch arm is in closed position, an auxiliary controlling circuit for energizing said solenoid to close said switch arm, an automatic circuit breaker in said auxiliary circuit and controlled by said locking means so as to locally open said auxiliary circuit after said switch arm has been locked in closed position and to close said auxiliary circuit while said switch arm is unlocked, a second auxiliary circuit for energizing said solenoid when said switch arm is in closed position, and manual circuit controlling means for said auxiliary circuits.

17. The combination of a switch arm normally tending to move to open position, contacts coöperating therewith, a solenoid and an armature therefor, locking means

for holding said switch arm in closed position, means controlled by said solenoid through said armature for moving said switch arm to locked closed position when said solenoid is energized while said switch arm is in open position, and for releasing said locking means and allowing said switch arm to move to open position when said solenoid is energized while said switch arm is in closed position, an auxiliary controlling circuit for energizing said solenoid to close said switch arm, an automatic circuit breaker in said auxiliary circuit, locally opening said auxiliary circuit after said switch arm has been locked in closed position and closing said auxiliary circuit upon the unlocking of said switch arm, a second auxiliary circuit having a gap automatically closed when said switch arm is in closed position and open when said switch arm is in open position and in addition manual circuit controlling means for manually controlling said auxiliary circuits.

18. The combination of a member movable in both directions and normally tending to move in one direction, means for locking said member at the end of its movement in the other direction, releasing means, a solenoid and armature for alternately moving said member in said other direction and then releasing said locking means when successively energized, said armature being in operative relation to said member and said releasing means, two controlling circuits for said solenoid, manual circuit controlling means therein, and automatic means for opening a gap in one of said controlling circuits after said member has been moved to locked position and closing said gap when said member is unlocked and closing a gap in the second auxiliary circuit when said member is in locked position and opening said gap when said member is unlocked.

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