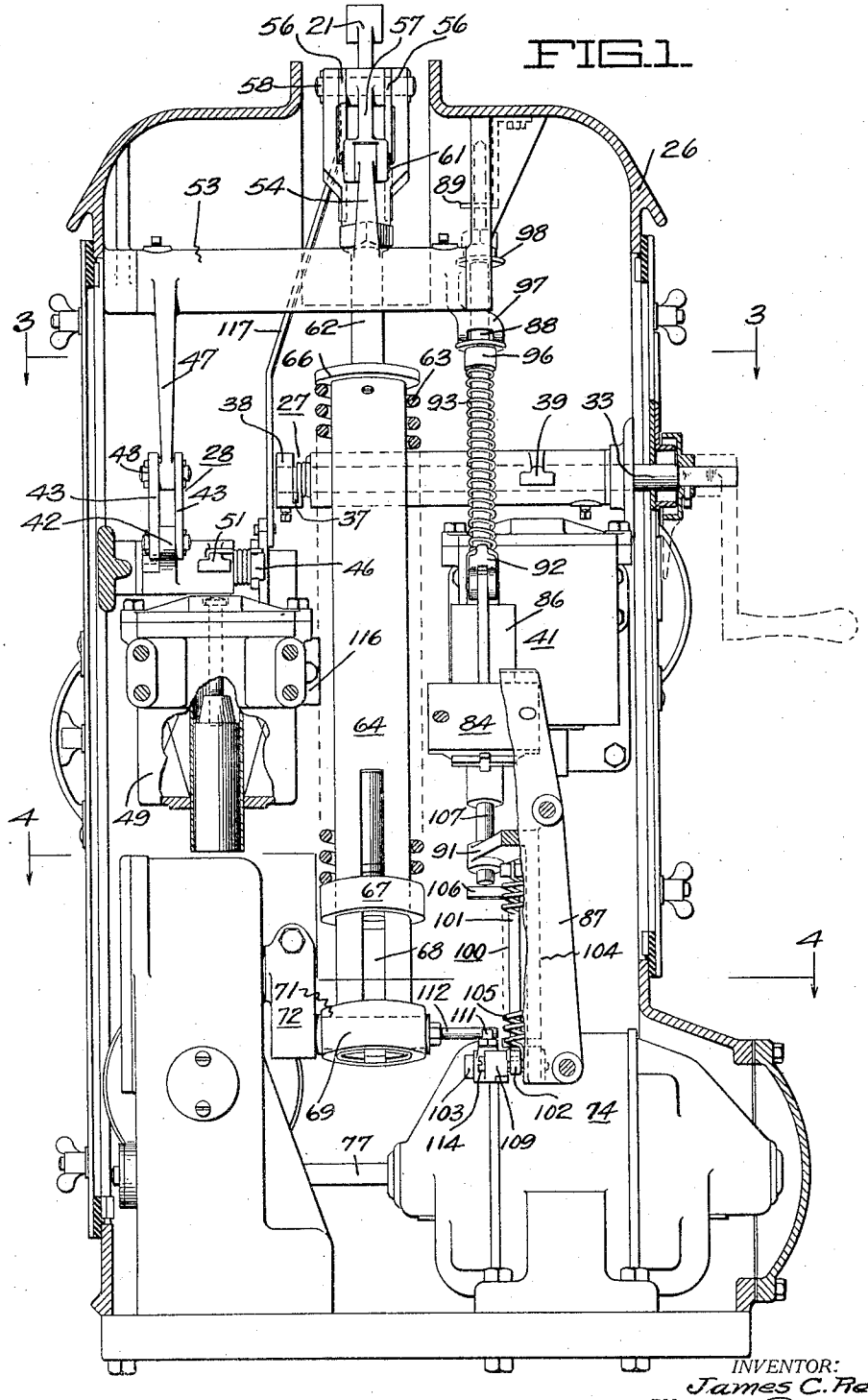
March 7, 1933. J. C. REA 1,900,584

SWITCH OPERATOR

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FIG. 1.



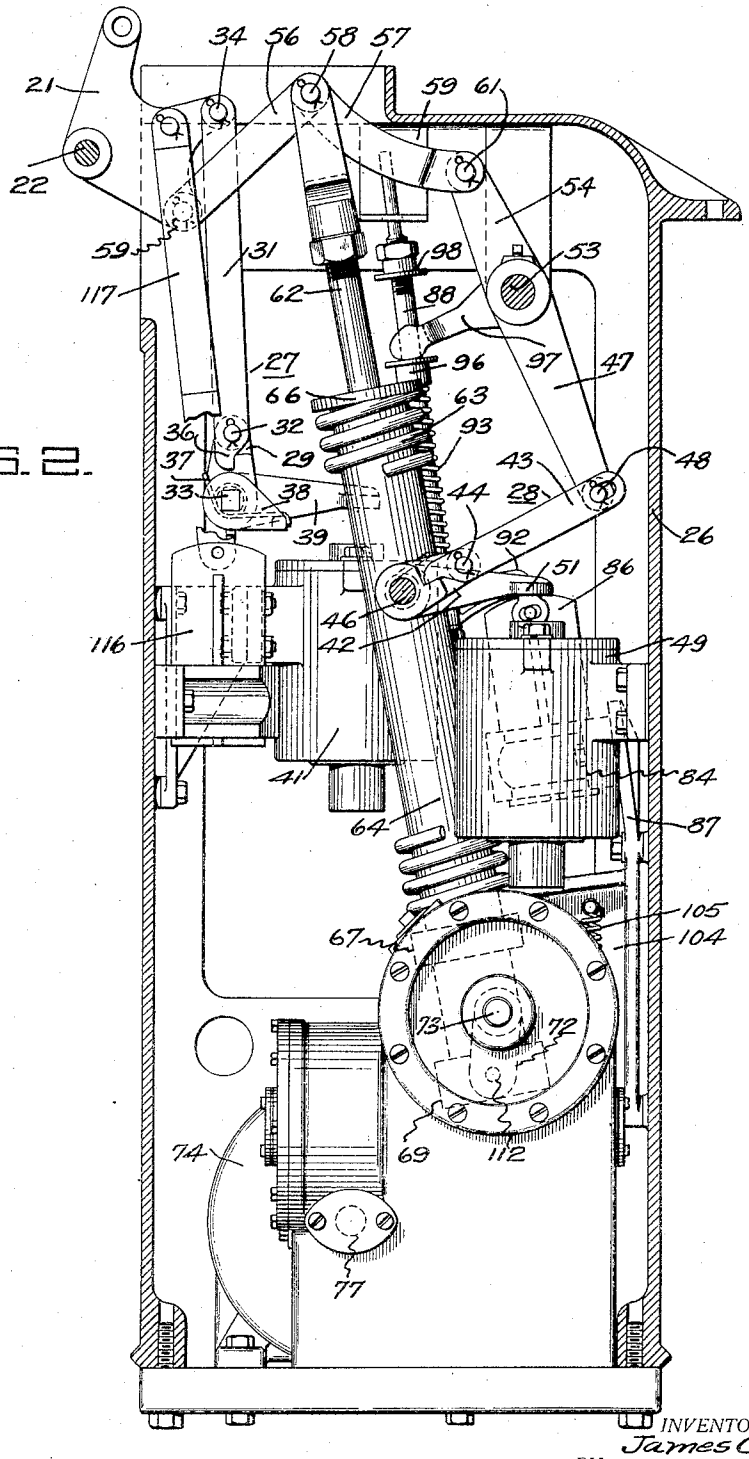
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BY White, Prost & Fryer
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SWITCH OPERATOR

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FIG. 2.



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SWITCH OPERATOR

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FIG. 3.

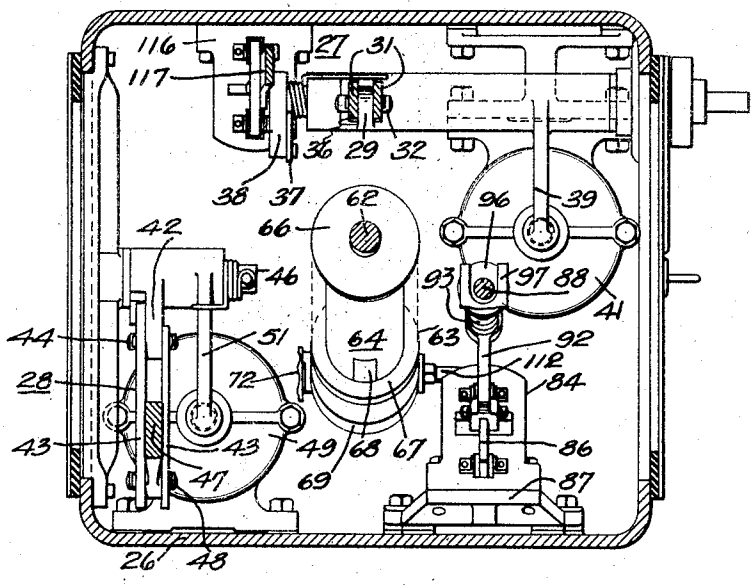
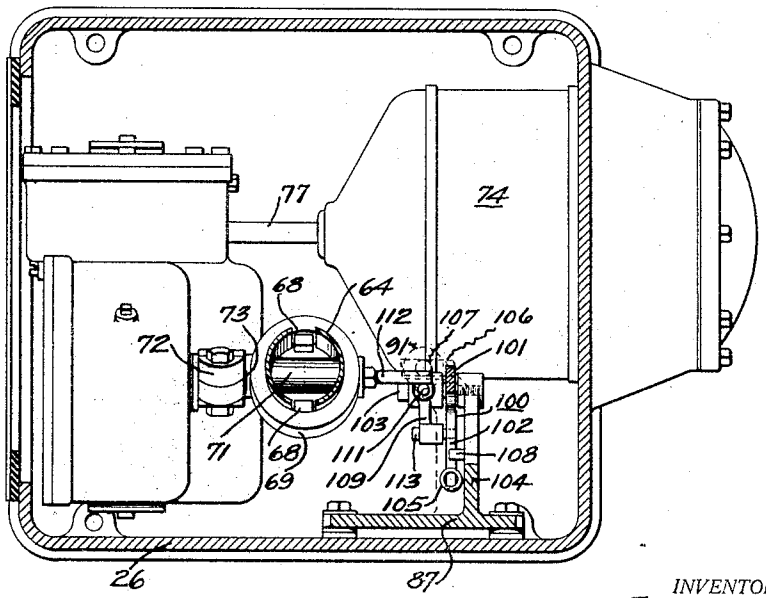


FIG. 4.



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SWITCH OPERATOR

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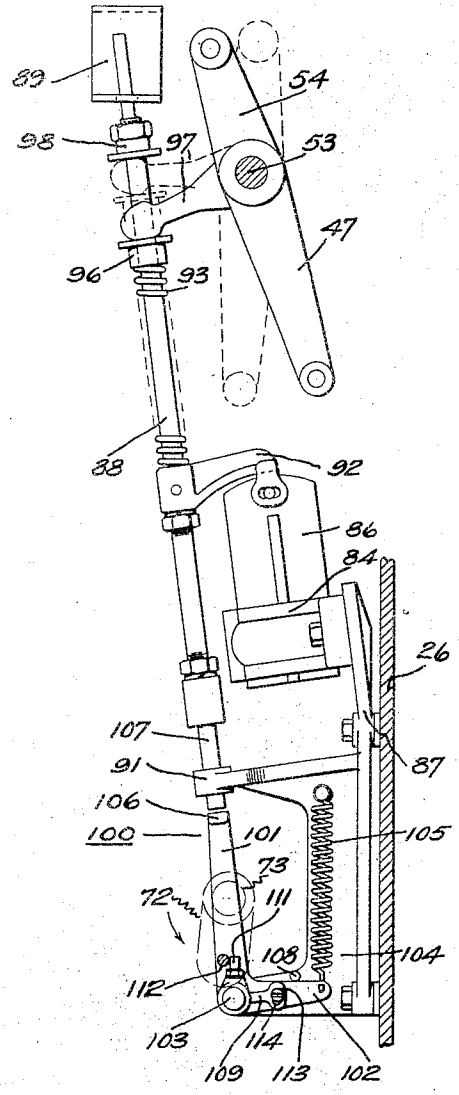


FIG. 5.

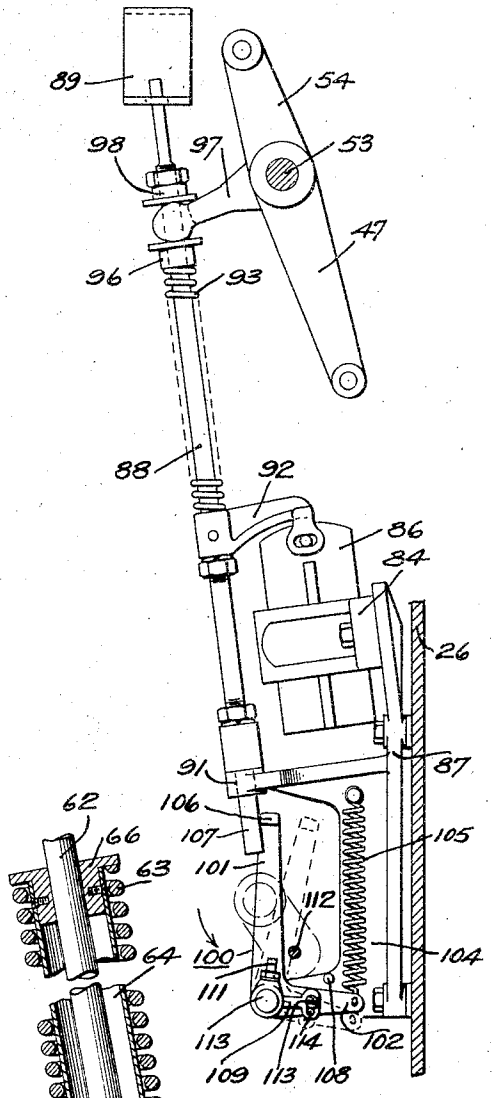


FIG. 6.

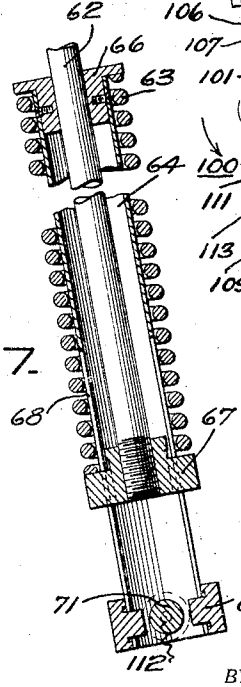


FIG. 7.

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FIG. 8.

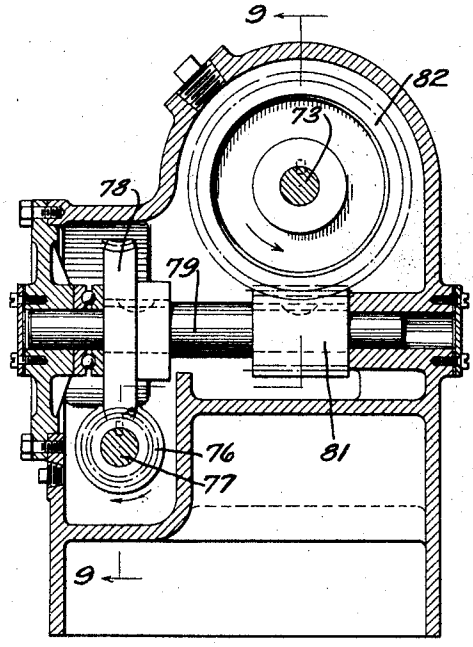


FIG. 9.

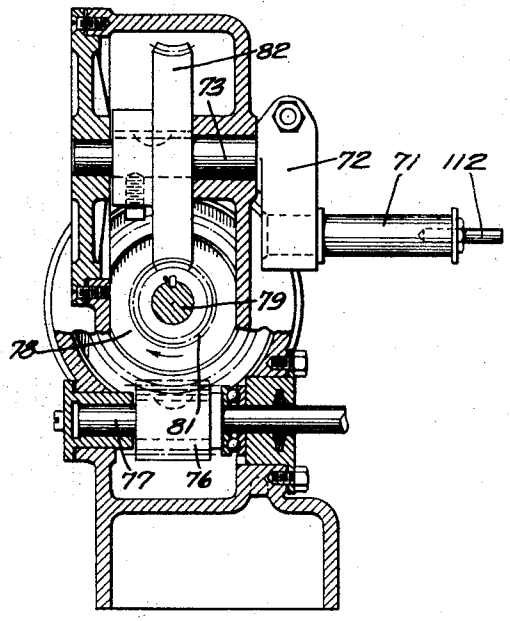


FIG. 10.

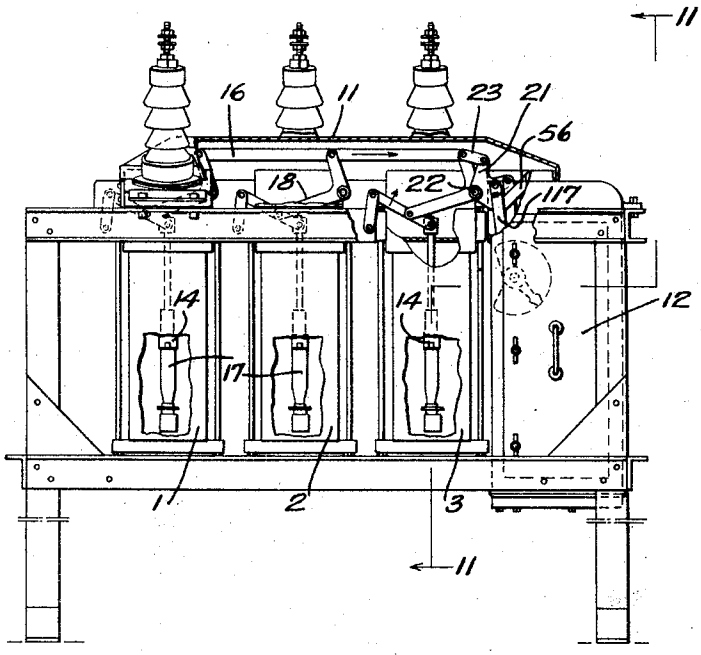
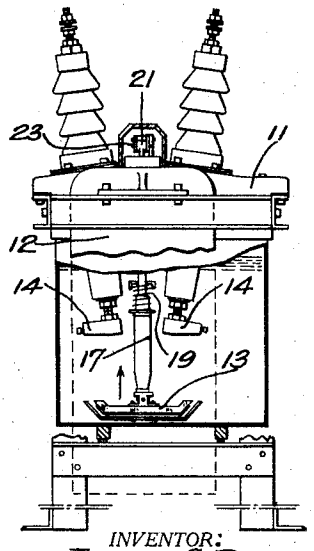


FIG. 11.



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SWITCH OPERATOR

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FIG. 12.

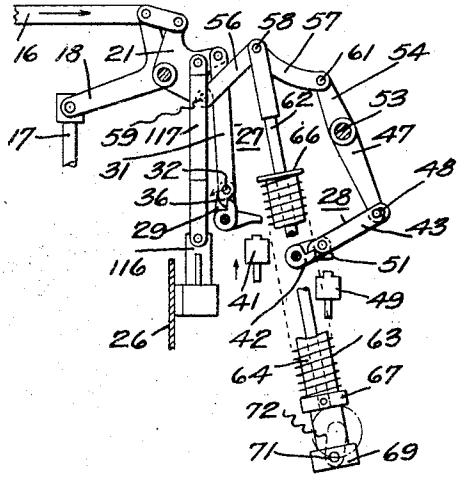


FIG. 13.

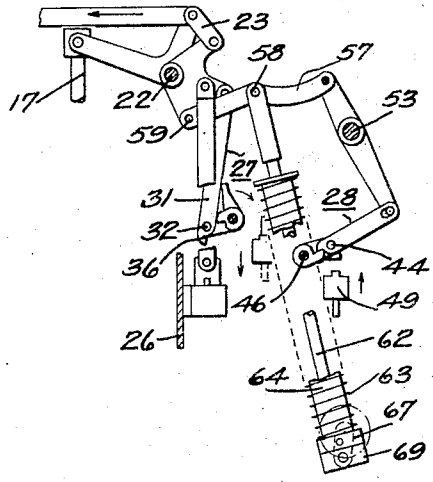


FIG. 14.

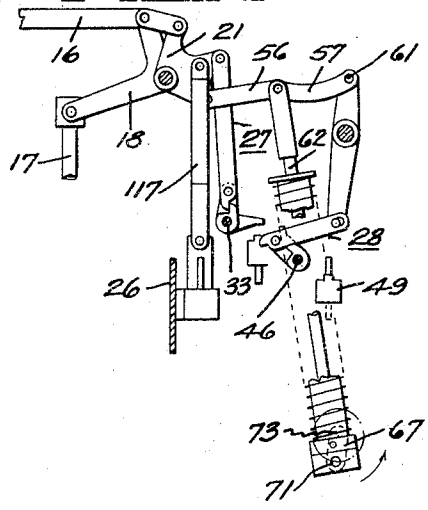


FIG. 15.

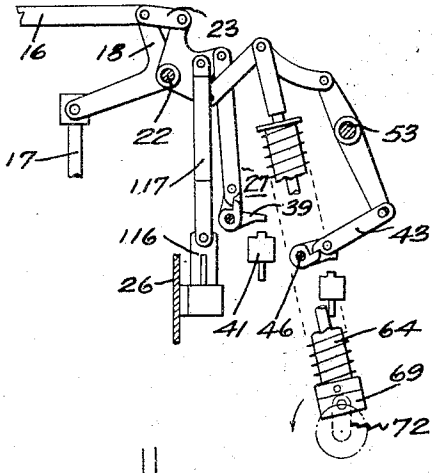
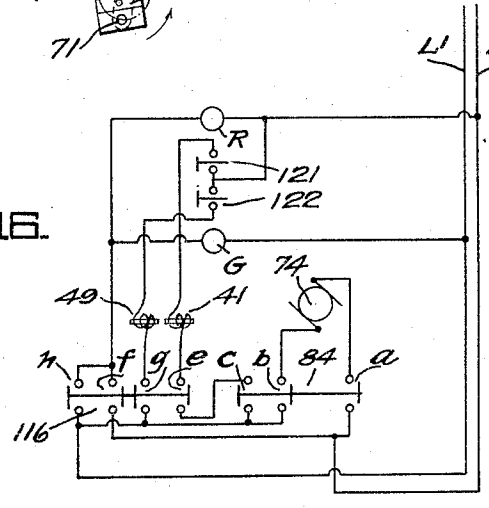


FIG. 16.



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Patented Mar. 7, 1933 1,900,584

UNITED STATES PATENT OFFICE

JAMES C. REA, OF OAKLAND, CALIFORNIA

SWITCH OPERATOR

Application filed January 3, 1928. Serial No. 244,129.

This invention relates generally to apparatus for effecting operations of electrical switches. It is particularly applicable to systems for the remote control of large transmission line switches.

It is an object of this invention to simplify the construction of switch operators so that they can be more readily manufactured and will be more reliable in operation.

It is a further object of this invention to improve upon the construction of switch operators of the general type disclosed in the patent to Wilkins et al. No. 1,612,483 issued December 28th, 1926. The operator disclosed in that patent utilizes spring means adapted to be placed in stressed condition by a resetting device such as a motor. The spring means is retained in stressed condition by a pair of mechanisms, and responsive to successive tripping of these mechanisms, two different switching operations may be performed. At the end of the second operation, the motor may be manually or automatically energized to restore the spring means to stressed condition and to reset the mechanisms. While the disclosure in the Wilkins patent is the practical embodiment of generic invention, the particular structure employed is comparatively complicated and expensive to manufacture. In this invention I have provided an apparatus capable of being used in the system of Wilkins, but I have materially simplified the mechanical details. For example I have utilized only a single spring which must be placed in stressed condition by the motor, in place of two springs employed by Wilkins et al., although the apparatus still completes two switching operations before a winding operation is required.

It is a further object of this invention to generally improve upon the resetting mechanism of a switch operator of the general type shown in the Wilkins Patent 1,612,483.

It is a further object of this invention to devise a switch operator which may be readily combined with a high tension switch of the oil immersed type to form a relatively compact switching unit.

Further objects of the invention will appear from the following description in which I have set forth the preferred embodiment of my invention. It is to be understood that the appended claims are to be accorded a range of equivalents consistent with the state of the prior art.

Referring to the drawings:

Figure 1 is a side elevational view in cross section illustrating the mechanism constituting the switch operator of this invention.

Fig. 2 is a cross sectional elevational view of the mechanism as shown in Figure 1, as viewed from the left side of Fig. 1.

Fig. 3 is a cross sectional view taken along the line 3—3 of Fig. 1.

Fig. 4 is a cross sectional view taken along the line 4—4 of Fig. 1.

Fig. 5 is a detail view illustrating the construction and mode of operation of the mechanism for controlling the switch for the resetting motor.

Fig. 6 is a view similar to Fig. 5 illustrating the mechanism of Fig. 5 in a different operating position.

Fig. 7 is a detail illustrating the single spring which is stressed by the resetting motor.

Fig. 8 is a cross sectional detail illustrating the drive connection between the resetting motor and the resetting crank.

Fig. 9 is a cross sectional view taken along the line 9—9 of Fig. 8.

Fig. 10 is a side elevational view partly in cross section, illustrating a standard form of electrical switch being controlled by an operator constructed in accordance with this invention.

Fig. 11 is a cross sectional view taken along the line 11—11 of Fig. 10.

Figs. 12, 13, 14 and 15 are details illustrating the mode of operation of the operators.

Fig. 16 is a circuit diagram illustrating the manner in which the operator is combined with an electrical switch for automatic operation.

The invention may be outlined briefly as comprising a pair of mechanisms, preferably in the form of toggles, which are adapted to be tripped for effecting switching operations.

These two mechanisms are adapted to conjointly retain a single spring in stressed condition. The switch to be operated is generally biased toward one position, say open position, as by gravity or by means of an additional spring. The elements are so correlated that upon tripping of one of the mechanisms, the switch is moved from one position to another,—say from open to closed position—, against the force of the bias. Upon subsequent tripping of the other mechanism, the bias becomes effective to return the switch to open position. One or both mechanisms may be reset by motor or manual means effective after two switching operations have been effected, the resetting means also serving to restore the single spring to stressed condition.

The general manner in which the device of this invention is employed has been illustrated in Fig. 10, in which I have shown an electrical switch 11 of conventional construction which is operated by means of a device 12 constructed in accordance with this invention. While a variety of electrical switches may be employed, it may be explained that the particular switch shown is adapted to control polyphase lines and is made up of a plurality of units 1, 2 and 3, each of which is provided with a movable contact 13 adapted to cooperate with a pair of relatively stationary contacts 14. When the switch is used for heavy currents these contacts are generally immersed in oil as shown. Contacts 13 are adapted to be raised to closed and dropped to open position by some suitable actuating member such as a rod 16. For example I have shown a construction in which the movable contacts 13 are carried by rods 17 which are vertically slidable and are connected to rod 16 thru a suitable motion transmission linkage 18. The movable contacts are biased as by means of gravity toward open position, and for providing an added force for effecting separation of the contacts, I preferably utilize a spring 19 mounted upon rods 17 and which is adapted to be compressed when the contacts 13 and 14 are closed. With this arrangement force must be applied to rod 16 to simultaneously move the switch to closed position, but when rod 16 is released, the switches are automatically returned to open position because of the above mentioned bias. Adjacent one end of the switch 11, I have shown a bell crank 21 or other suitable member which is pivotally mounted as at 22 and which is connected to rod 16 as by means of link 23. Bell crank 21 is controlled by the operator 12 to effect reciprocation of actuating rod 16.

Referring now to Figures 1 to 4 inclusive, the moving parts of the operator are preferably enclosed in a suitable housing 26. The apparatus for effecting movement of the bell crank 21 includes two mechanisms indicated generally at 27 and 28, which are adapted to be tripped for effecting successive switch operations. These mechanisms may be conveniently formed as collapsible toggles and I have therefore shown mechanism 27 as comprising links 29 and 31 which are connected together as by means of pivot pin 32. Link 29 is pivotally mounted to the casing 26 as by means of pin 33, while link 31 is pivotally secured to an arm of the crank 21 as by means of pin 34. By means of abutting shoulders 36, toggle 27 may be maintained extended but slightly past dead center position when a force is exerted upon pivot pin 34 in the direction of pin 33. Link 29 is preferably biased so as to tend to straighten the toggle 27, as by means of a spring 37, one end of this spring bearing upon the link 29 and the other end bearing upon the relatively stationary member 38. A finger 39 is also disposed upon shaft 33 and is fixed with respect to link 29. A solenoid or other magnetic device 41 is adapted to engage this finger 39 and rotate link 29 in a counter clockwise direction, thus effecting breaking of the toggle 21.

Toggle mechanism 28 is likewise made up of a pair of links 42 and 43 pivotally connected together as by means of pin 44. Link 42 is journaled with respect to casing 26 as by means of shaft 46, while link 43 is pivotally connected to an arm 47 as by means of a pin and slot connection 48. Toggle 28 is also adapted to be broken by suitable means such as a solenoid 49 which is arranged to engage a finger 51, this finger being disposed upon shaft 46 and fixed with respect to link 42.

As has been previously mentioned, I utilize a single spring which is adapted to be placed under stress during a resetting operation, and this spring is preferably cooperatively associated with mechanisms 27 and 28 so that both of these mechanisms carry a portion of the force of the spring when in locked or extended position. The spring and associated linkage for correlating the same with mechanisms 27 and 28 is as follows: Arm 47 is journaled with respect to casing 26 as by means of shaft 53, and fixed with respect to this arm, there is another arm 54. Interposed between arm 54 and crank 21 there is a linkage consisting of links 56 and 57 which are pivotally connected together as by means of pin 58, while link 56 is pivotally connected to crank 21 as by means of pin 59 and link 57 is pivotally connected to arm 54 as by means of pin 61. Associated with links 56 and 57 in a manner to apply a force to pin 58, there is a rod 62 or other suitable force applying member.

For applying a force to rod 62 I preferably utilize a single compression spring 63, and this spring is preferably disposed upon a suitable supporting sleeve 64 within which the rod 62 is slidably disposed. As shown in de-

tail in Fig. 7, the upper end of sleeve 64 is provided with a collar 66 or other suitable means forming an abutment for the upper end of spring 63, while the lower end of the spring is adapted to seat upon a member 67 secured to the lower end of rod 62. The lower portion of sleeve 64 is preferably slotted as indicated at 68 so as to permit relative sliding movement between rod 62 and sleeve 64. A block 69 is secured to the lower end of sleeve 64, and journaled with respect to this block there is a crank pin 71, this crank pin being carried by a suitable crank 72 disposed upon a crank shaft 73.

As will be presently explained, rotation of crank 72 serves both the purpose of resetting mechanisms 27 and 28 after the same have been tripped, and also serves to restore the spring 63 to stressed condition for future switching operations. In certain types of operators this crank may be operated by hand, although for automatic operation resetting or for remote control I prefer to employ an electrical motor. A suitable motor has been indicated at 74 and is preferably connected to the crank shaft 73 thru a suitable speed reduction drive. Such a drive connection may consist of a worm 76 fixed upon shaft 77 and which is driven directly by motor 74. Worm 76 drives a worm gear 78 which is fixed upon a shaft 79, and also mounted upon shaft 79 there is another worm 81 adapted to drive a worm gear 82 mounted upon the crank shaft 73.

Since I have designed the device of this invention so that the motor 74 is automatically energized to reset the tripping mechanisms and for reconditioning the spring 63, I preferably provide suitable switches which are cooperatively associated with the other mechanisms to close and subsequently interrupt the motor circuit. These switches may also control other circuits as will be presently explained. Thus disposed within the casing there is a switch 84 provided with contacts necessary for controlling the external circuit, and which is provided with the usual movable member 86 for controlling opening and closing of the contacts. As shown in detail in Fig. 6, switch 84 may be mounted upon a suitable bracket 87 fixed with respect to one wall of housing 26, and movable member 86 is cooperatively associated with a rod 88. Rod 88 is slidably retained with respect to the housing, as by means of brackets 89 and 91 slidably engaging the ends thereof. Fixed to the rod 88 there is an arm 92 having connection with a switch member 86, and disposed about rod 88 there is a compression spring 93. The lower end of compression spring 93 is adapted to seat against a suitable member fixed with respect to rod 88, such as an arm 92 while the upper end is adapted to press against a collar or other member 96 which is slidably disposed upon rod 88. Collar 96 is adapted to be engaged by one side of an arm 97, while the other side of this arm is adapted to engage a collar 98 fixed with respect to rod 88. Arm 97 is carried upon shaft 53 and is rotatable together with arms 54 and 47.

Rod 88 is associated with suitable means for retaining the same in its upper or raised position during a resetting operation of crank 72 and for releasing this rod to permit the same to move to its lower position under the force of spring 93 at the end of a resetting operation. To provide such means I have shown a bell crank 100 having arms 101 and 102 and which is suitably journaled as by means of pin 103, this shaft being carried by a convenient bracket 104, (see Fig. 4). Arm 102 of this bell crank is connected to suitable biasing means such as a tension spring 105, whereby the crank is urged to rotate in a counterclockwise direction. The other arm carries a finger 106 adapted to engage and cooperate with the extended lower end 107 of rod 88. Rotation of crank 101 in a counterclockwise direction is limited as by means of a stop pin 108, so that when this bell crank is permitted to rotate in a counterclockwise direction, finger 106 will be arrested directly below the extension 107. This position of the bell crank is clearly shown in Fig. 5. Also carried by pin 103 and journaled to the same there is a small lever 109 and this lever has secured thereto and carries projecting pin 111. Pin 111 is adapted to be engaged and tripped by pin 112, this latter pin being carried by the crank pin 71. Lever 109 is operably connected to the arm 102 by means of a pin 113 which is fixed to and projects from arm 102 and which engages in a slot 114 provided in the end of lever 109. The cooperative arrangement between lever 109 and the bell crank 100 is such that when pin 111 is tripped by rotation of crank 72, rotation of lever 109 carries with it bell crank 100 and thus moves the bell crank out of engagement with the lower end of rod 88.

In Fig. 2 I have shown another switch 116 which may be disposed within the housing 26, and this switch may be controlled directly by movements of the bell crank 21. For example I have shown this switch as directly connected to the bell crank as by means of a link 117.

The operation of the device may be best explained by referring to Figures 12 to 15 inclusive. Fig. 12 shows the principal parts of the mechanism with the spring 63 in stressed condition and the toggle mechanisms 27 and 28 extended. When in this condition pivot pin 58 is considerably above pivot pins 59 and 61 so that the force of spring 63 tends to move pins 59 and 61 apart. The force exerted upon pivot pin 59 tends to rotate crank 21 in a clockwise direction, but

such rotation is prevented by the toggle 27. Likewise the force upon pivot pin 61 tends to rotate arms 54 and 47, but such rotation is prevented by the toggle mechanism 28. Assuming that the switch is now in open position, if it is desired to close the switch, toggle 27 is broken either manually or by electrical current applied to solenoid 41. As a result crank 21 is rotated in a clockwise direction and assumes the position shown in Fig. 13, while rod 62 moves downwardly under the force of spring 63 to straighten out the links 56 and 57. To open the switch after a closing operation, toggle 28 is broken either manually or by electrical current applied to solenoid 49, thus permitting arms 54 and 47 to rotate in a clockwise direction and consequently permitting bell crank 21 to rotate back in a counterclockwise direction under the normal switch bias. The complete open position is shown in Fig. 14. When moving from closed to open position, it is to be noted that no force is applied to spring 63 and therefore this spring does not interfere with such movements. Furthermore the pivotal mounting of the lower end of sleeve 64 upon the crank 72 permits the upper end of rod 62 together with spring 63 to swing bodily from the position shown in Fig. 13 to that shown in Fig. 14 when the switch is open.

After the operator has again opened the switch and is in the position shown in Fig. 14, I preferably energize the motor 74, either automatically or otherwise in order to effect a resetting operation. Before energizing the motor the crank 72 will occupy its lowest position shown in Figs. 12 to 14 inclusive. Upon energization of the motor crank 72 is rotated slowly in a counterclockwise direction and upon its upward movement lifts rod 62 to effect resetting of both toggles 27 and 28 providing toggle 27 has not already been reset during the preceding switch operation. During subsequent downward movement of crank 72, rod 62 will be retained in raised position by virtue of the set toggles 27 and 28, so that spring 63 is compressed. The motor is preferably deenergized when one revolution of crank 72 has been completed and this function may be accomplished automatically by controlling the circuit of motor 74 from switch 84.

When the apparatus is in the position illustrated in Figs. 12 and 13 it is to be noted that the switch actuating rod 88 is in its lower position due to the position assumed by arms 54 and 47. When the position shown in Fig. 14 is assumed, rotation of arms 54 and 47 lift rod 88 and permit the finger 106 to move directly beneath the lower end of the same. Therefore when the crank 72 is rotated to effect a resetting operation, rotation of arms 54 and 47 to their original position as illustrated in Fig. 15, merely compresses spring 93 while the rod 88 is retained in its upper position by finger 106. When rod 88 is in its upper position switch 84 is in a position to permit closing of the energizing circuit to the motor, so that the motor is automatically energized to effect a resetting operation when the apparatus assumes the position shown in Fig. 14. Due to the fact that rod 88 remains in its upper position while crank 72 is being rotated, the motor remains energized until the completion of one revolution of crank 72. At the end of the last half revolution of crank 72, pin 112 engages and trips pin 111 thus causing finger 106 to move out of engagement with the lower end of rod 88. Thus rod 88 is permitted to quickly return to its lower position to actuate switch 84 and thus deenergize the motor circuit.

Figure 16 is a circuit diagram illustrating the manner in which switches 84 and 116 are connected to effect automatic resetting and winding operations. Switch 84 is preferably provided with three sets of contacts *a*, *b* and *c*, and is adapted to close contacts *a* and *b* while contacts *c* are open, and close contacts *c* when contacts *a* and *b* are open. Switch 116 is preferably provided with four sets of contacts *e*, *f*, *g* and *h* and is adapted to effect closing of contacts *e* and *f* while contacts *g* and *h* are open, and to close contacts *g* and *h* while contacts *e* and *f* are open. Solenoids 41 and 49 are adapted to be energized from a suitable source of current such as represented by current supply lines L_1 and L_2 and are controlled respectively by two switches 121 and 122. The motor 74 is adapted to be energized from a suitable source of current such as the lines L_1 and L_2 and its circuit includes certain of the contacts of switch 84 and 116 as shown. Green and red signal lights G and R are also associated with the arrangement so as to give a light indication of open and closed positions of the switch. With the apparatus in the positions shown in Fig. 12, contacts *e* and *f* are closed while contacts *g* and *h* are open. Likewise switch 84 is positioned so as to have contacts *c* closed and contacts *a* and *b* open. To effect closing of the switch, switch 121 is closed by an operator or by any other suitable control, thus energizing solenoid 41 through a circuit which may be traced from line L_2 thru switch 121, solenoid 41, contacts *e* and back to line L_1 thru contact *c* of switch 84. Energizing of solenoid 41 immediately breaks toggle 27 and thus causes closing of the main switch in a manner which I have previously explained. Closing of this main switch brings the operator to the position shown in Fig. 13, and causes switch 116 to be actuated to open contacts *e* and *f* and close contacts *g* and *h*. Switch 84 however remains in the same position. To open the main switch, switch 122 is closed to complete a circuit which may be traced from line L_2, thru

switch 122, solenoid 49, contacts g, and back thru line L_1. Energizing of solenoid 49 immediately breaks toggle 28 to effect opening of the switch so that the switch operator assumes the position shown in Fig. 14. In this position switch 84 has been actuated to close contacts a and b and open contact c, and switch 116 has been actuated to close contacts e and f and open contacts g and h. An energizing circuit for motor 74 is thus completed from lines L_1 and L_2 thru contacts a and b. The motor then operates to effect a complete revolution of crank 72, during the first half of which the toggle 28 is reset and during the last half of which the spring 63 is retensioned. At the completion of one revolution of crank 72 switch 84 is again actuated in a manner which has been previously described, to close contact c and open contacts a and b, thus de-energizing the motor and preventing further rotation of crank 72. The operator is now in position to effect two more switching operations before a resetting operation is necessary. As long as the switch is closed, the red light R is illuminated, while when the switch is open the green light G is illuminated. The circuit for lamp R may be traced from line L_2 thru contact h and back thru line L_1 so that as long as contacts g and h are closed, lamp R will be illuminated. The circuit for lamp G may be traced from line L_1, thru contacts f and back thru line L_2, so that as long as contacts e and f are closed, lamp G will be illuminated.

I claim:

1. In a switch operator, two mechanisms adapted to be tripped for controlling switch operations, means biasing said switch toward one of two positions, linkage means interconnecting both said mechanisms, spring means adapted to apply opposed forces to two points, one of said points being located on said linkage means and movable for operations of said switch to either of said positions, the other of said points being relatively fixed, and means cooperably associating said mechanisms and said linkage means with said switch for effecting the other one of said switching operations in response to tripping of one of said mechanisms, said stationary point of spring application being positioned so that said bias may move the switch to said one position without affecting the condition of said spring.

2. In a switch operator, a single spring, two tripable mechanisms for conjointly retaining said spring in tensioned condition, means for effecting two switch operations upon separate tripping of said mechanisms, and means for first resetting both of said mechanisms into tripping position and for then restoring said spring to stressed condition after the second switch operation.

3. In a switch operator for effecting at least two switching operations, a spring means for effecting at least one of said switch operations, support means for said spring means, linkage means for maintaining said spring means in stressed condition, said spring means being adapted to apply its force to a fixed and a movable point of application, the position of said movable point of application shifting with respect to said support for each switch operation.

4. In a switch operator for effecting the operations of a switch biased to open position independently of said operator, a movable member connecting said switch and said operator, spring means effective to move said member in one direction to cause one of the two operations of said switch, means comprising a pair of mechanisms for conjointly maintaining said spring means in stressed condition and for rendering the same ineffective to cause a switch operation, said spring means causing said one switching operation upon the tripping of one of said mechanisms, and means for permitting free return movement of said member for performing said other switching operation.

5. In a switch operator, a pair of mechanisms adapted to be tripped, linkage mechanism interconnecting said mechanisms, an actuating rod connected to said linkage mechanism and to a normally fixed point, and a spring in stressed condition cooperatively positioned on said rod and applying its force to the points of connection of said rod.

6. In a switch operator, a pair of toggle mechanisms adapted to be tripped successively to effect at least two switch operations, means for resetting said mechanisms when tripped, said means being operative only upon a succession of operations of said toggle mechanisms, means connecting said resetting means and said toggle mechanisms, and a spring positioned on said connecting means and adapted to be restored to stressed condition by said resetting means after successive switch operations.

7. In a switch operator, spring means for supplying power for switching operations, two tripable mechanisms for effecting control of said spring means, and resetting means effective first to reset said mechanisms and then to retension said spring means.

8. In a switch operator, toggle mechanisms adapted to be tripped to effect at least two switch operations, and a spring in stressed condition co-operatively associated therewith having two points of application, one of said points being relatively fixed during said switch operations, the other of said points of application being movable during both of said switch operations.

9. In a switch operator, toggle mechanisms adapted to be tripped to effect at least two switch operations, means for resetting said toggle mechanisms when tripped, and spring means for biasing said mechanisms to set

position, said spring means being positioned between a point capable of only radial movement and a point on said mechanisms laterally movable for both of said switch operations.

10. In a switch operator, toggle mechanisms adapted to be tripped to effect at least two switch operations, toggle linkage interconnecting said mechanism, and a spring cooperatively associated with said linkage and having a point of application thereon, said point of application being movable for both of said switch operations.

11. In a switch operator, toggle mechanisms adapted to be tripped to effect at least two switch operations, linkage interconnecting said toggle mechanisms, a crank member, a spring having a point of application on said crank member and a point of application on said linkage, said point on the linkage being movable for both of said switch operations.

In testimony whereof, I have hereunto set my hand.

JAMES C. REA.