No 829,841. PATENTED AUG. 28, 1906.

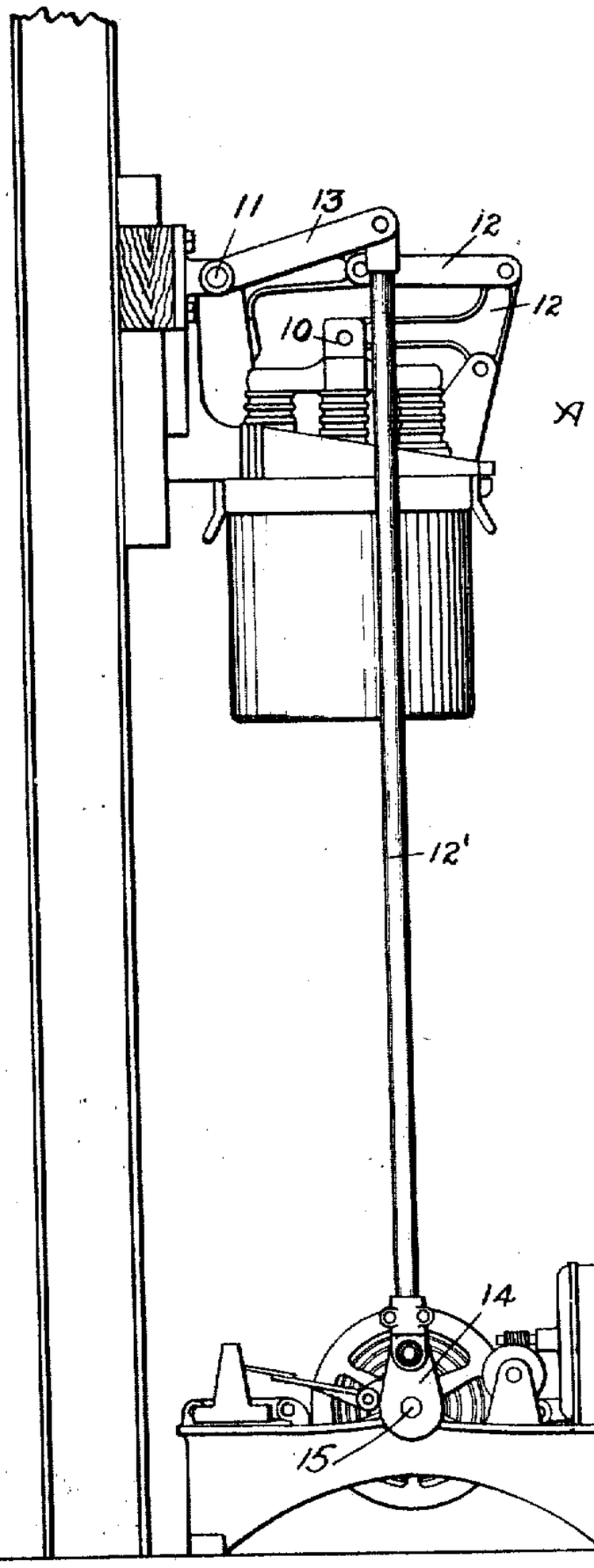
T. E. BUTTON.

SWITCH OPERATING MECHANISM.

APPLICATION FILED OCT. 1, 1904.

4 SHEETS—SHEET 1.

Fig. 1



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by Arthur S. Davis
Att'y.

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4 SHEETS—SHEET 2.

Fig. 2.

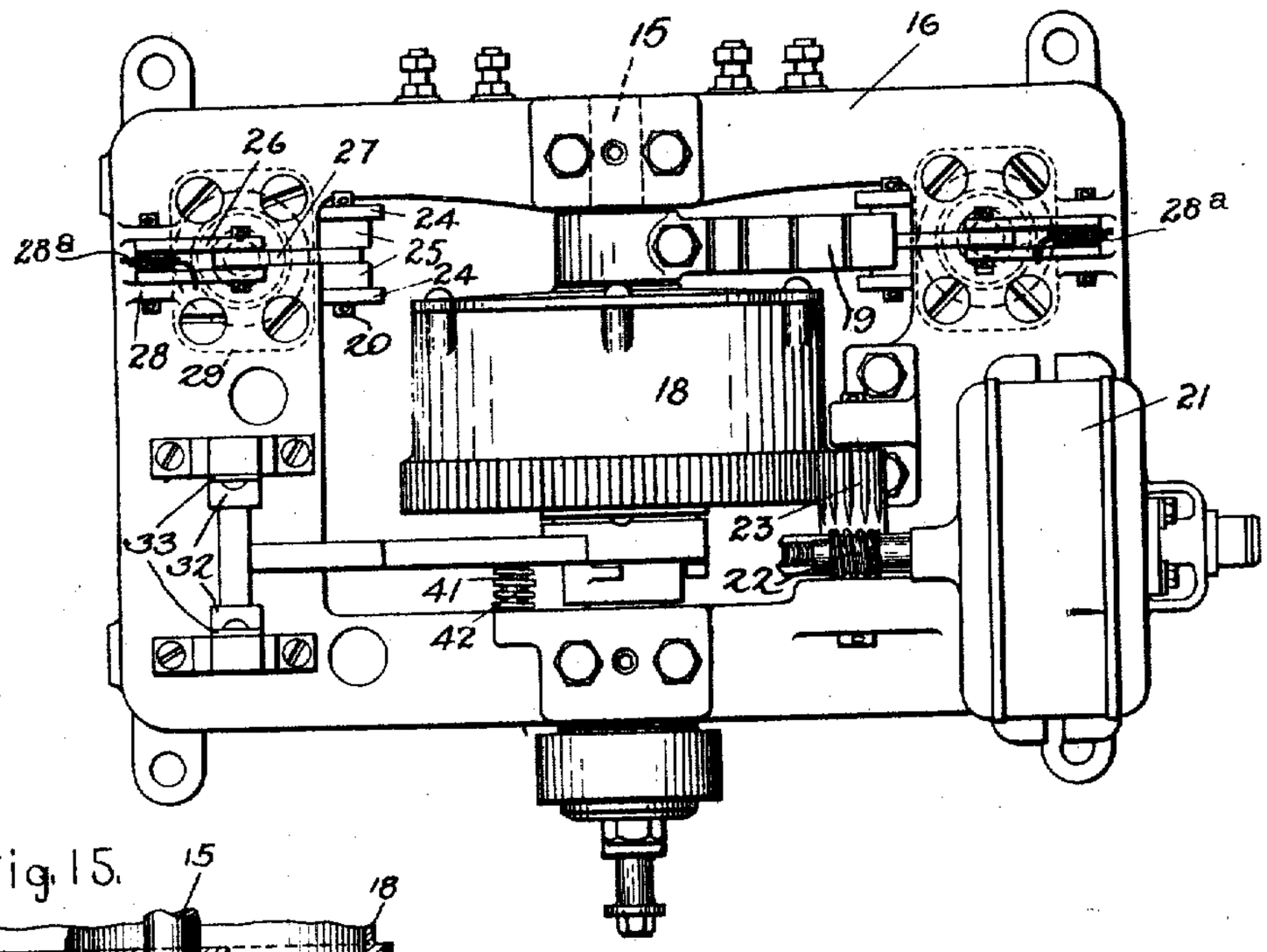


Fig. 15.

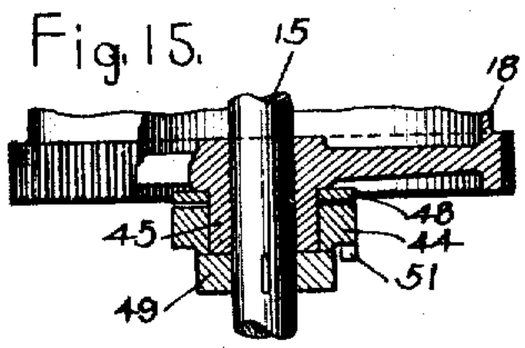
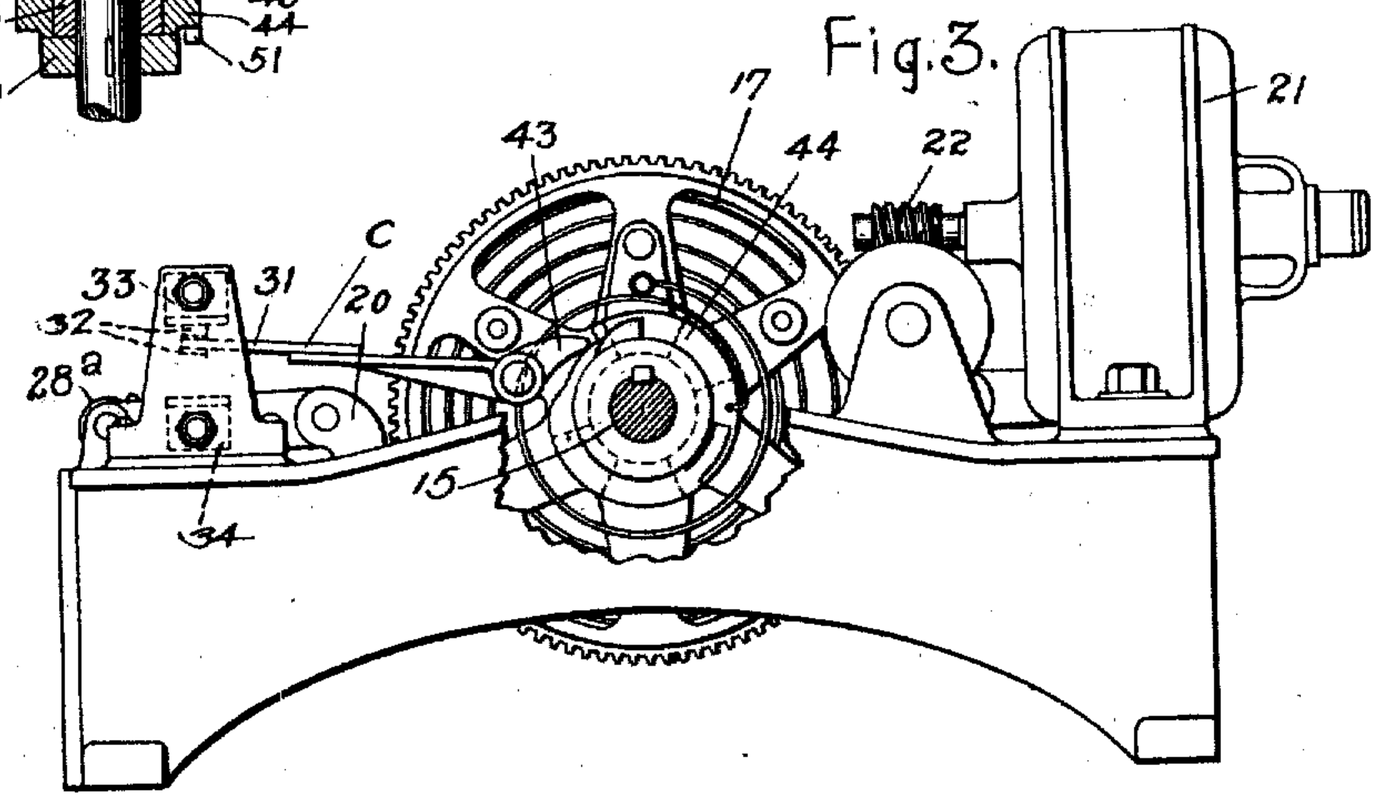


Fig. 3.



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4 SHEETS—SHEET 3.

Fig. 4.

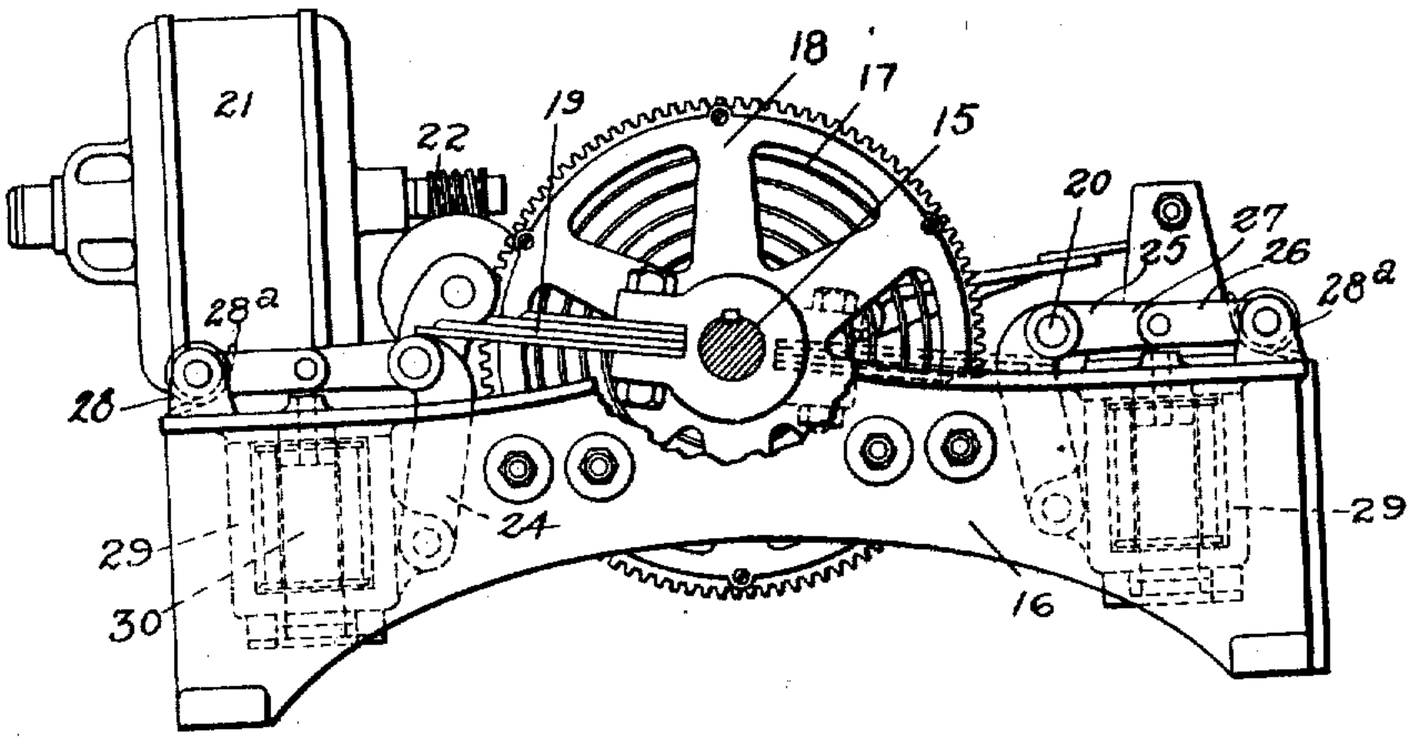


Fig. 5.

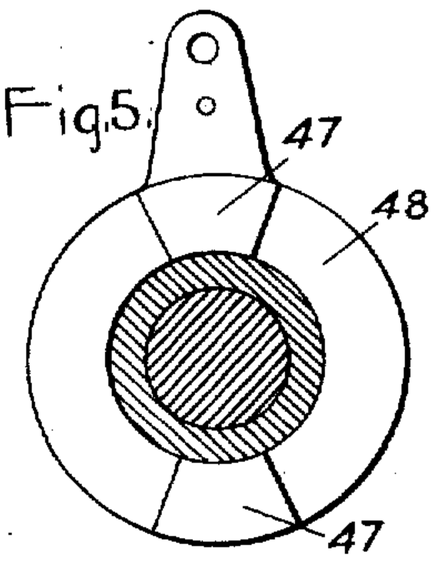


Fig. 6.

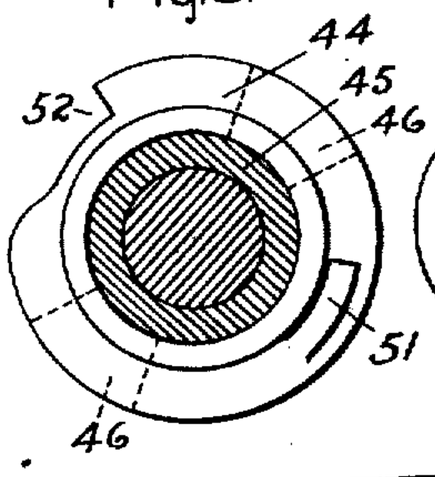


Fig. 7.

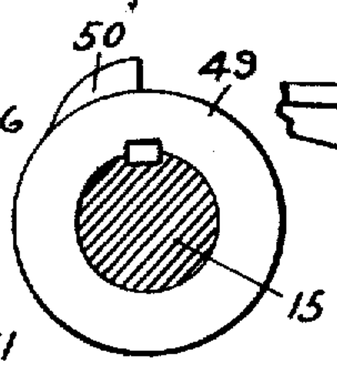


Fig. 8.

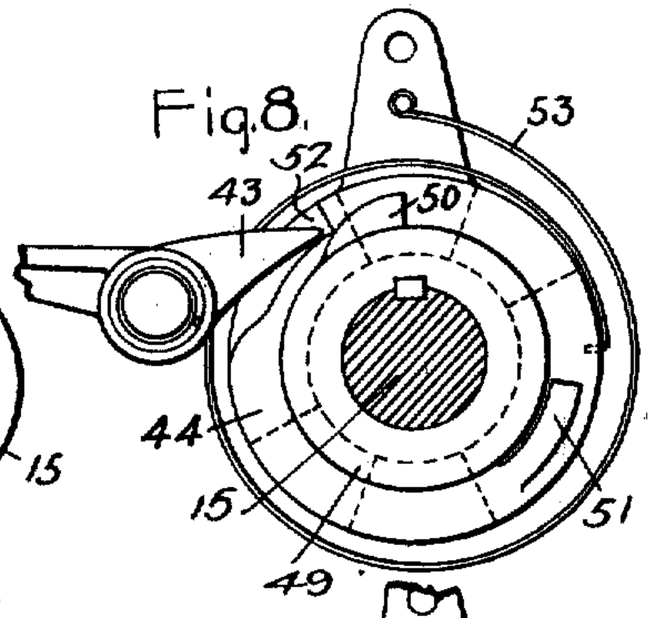


Fig. 10.

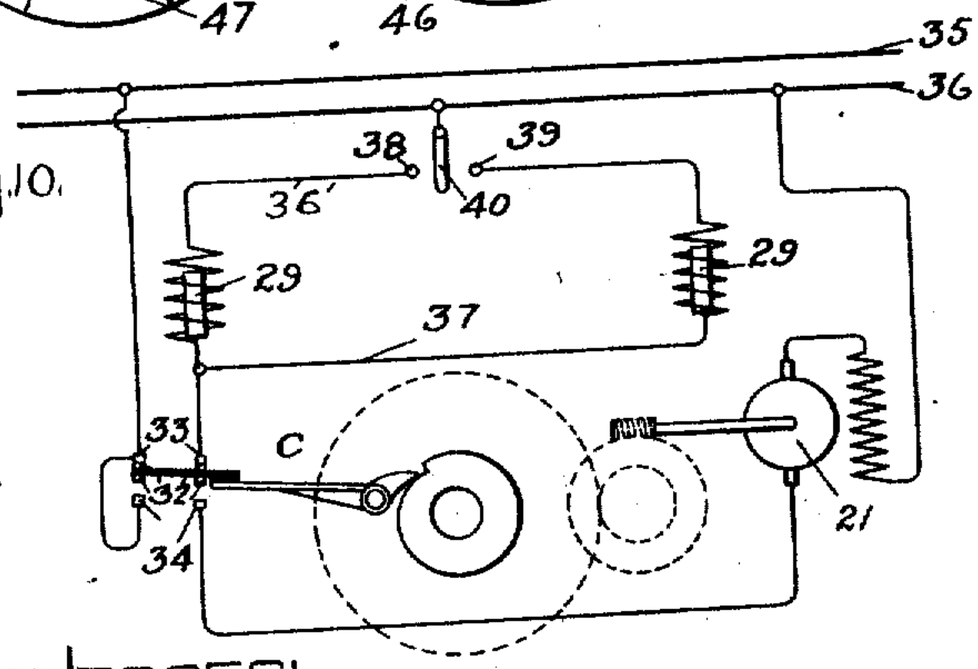
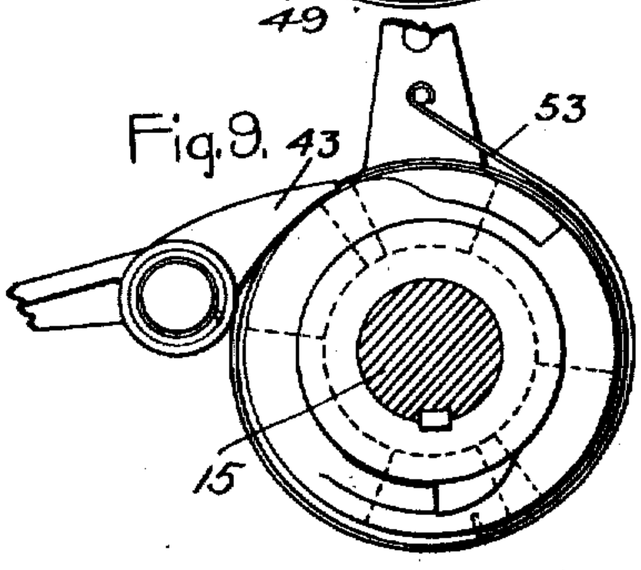


Fig. 9.



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SWITCH OPERATING MECHANISM.

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4 SHEETS—SHEET 4.

Fig. 11.

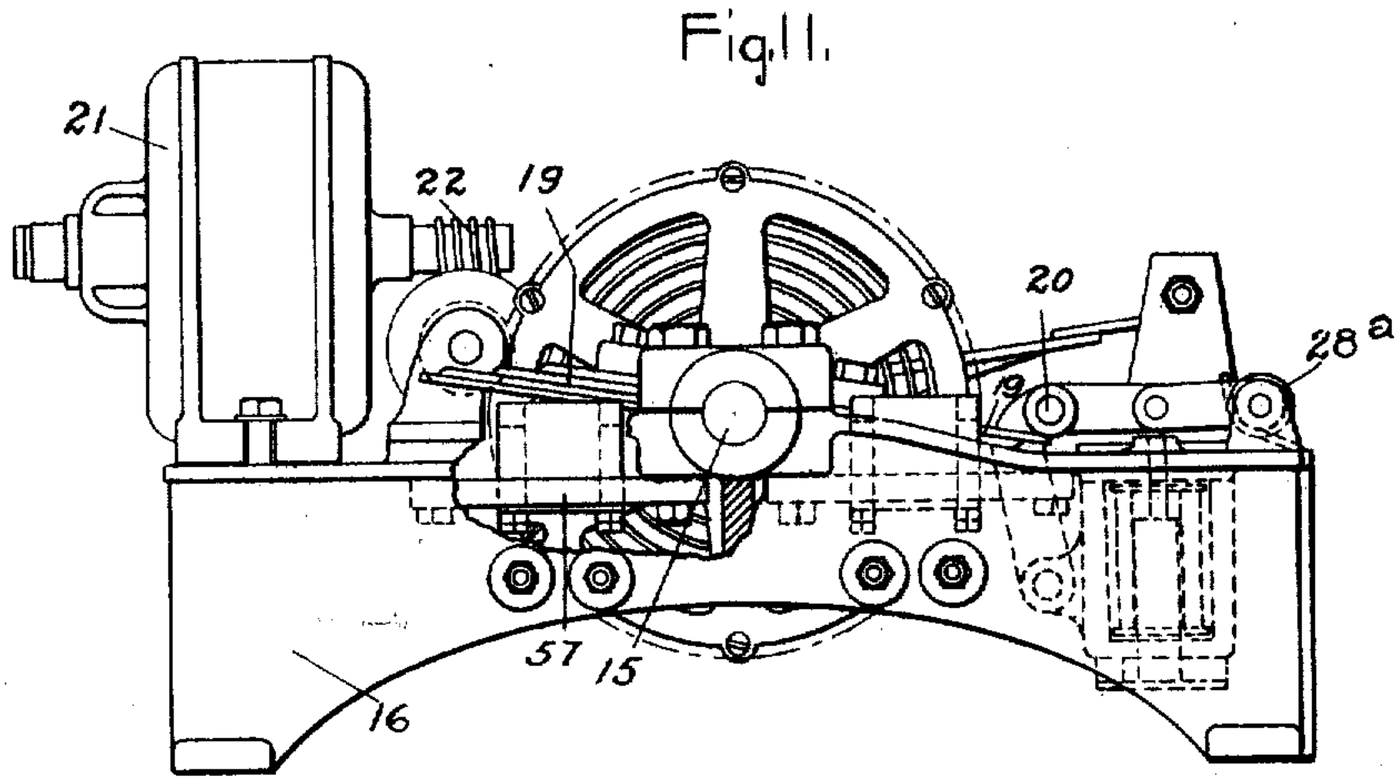


Fig. 12.

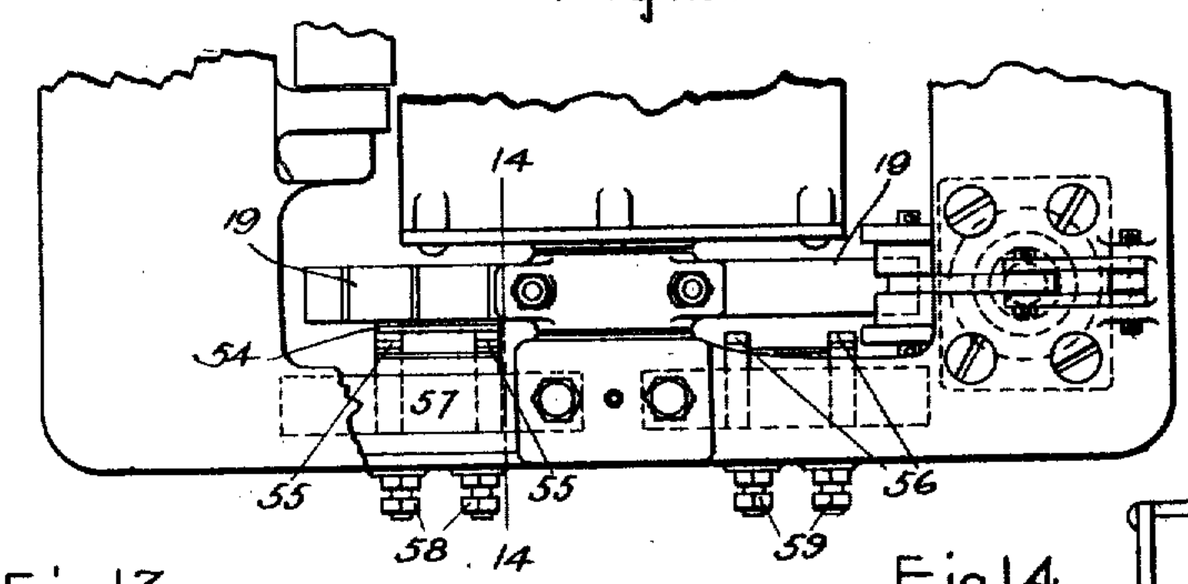


Fig. 13.

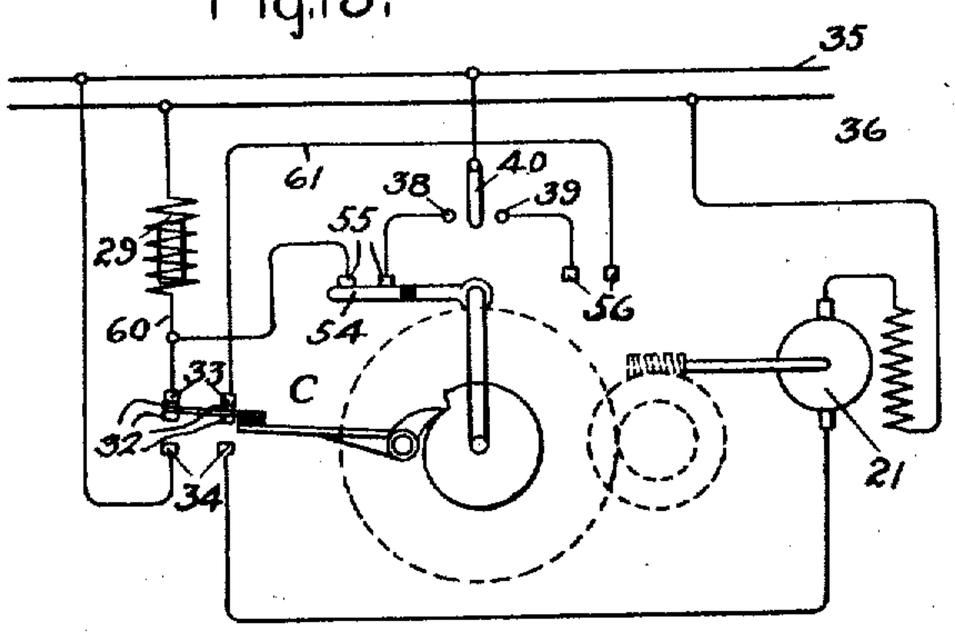
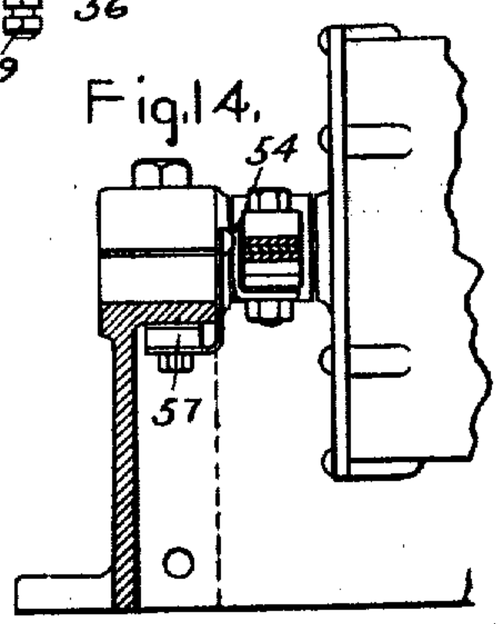


Fig. 14.



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by Albert G. Davis

Atty.

UNITED STATES PATENT OFFICE.

THEODORE E. BUTTON, OF SCHENECTADY, NEW YORK, ASSIGNOR TO GENERAL ELECTRIC COMPANY, A CORPORATION OF NEW YORK.

SWITCH-OPERATING MECHANISM.

No. 829,841. Specification of Letters Patent. Patented Aug. 28, 1906.

Application filed October 1, 1904. Serial No. 226,727.

To all whom it may concern:

Be it known that I, THEODORE E. BUTTON, a citizen of the United States, residing at Schenectady, county of Schenectady, State of New York, have invented certain new and useful Improvements in Switch-Operating Mechanisms, of which the following is a specification.

My invention relates to electric switches, such as are employed in handling large currents at high potential, in which the movements of the switch are controlled through the agency of a simple controlling-switch located in an auxiliary low-potential circuit and usually at a point distant from the main switch in order to insure safety to the operator. It has been proposed heretofore to construct switches of this type so that the throwing of the controlling-switch to operate the main switch will start the power-supply means, usually an electric or air motor, which will then apply its power directly to the movement of the switch either solely or sometimes with the assistance of spring mechanism previously energized.

One object of my invention is to provide a switch which will be independent in operation of the direct action of the motor, which can be closed or opened by the release of stored energy, and which will still be automatic in operation. I accomplish this by providing operating mechanism which is so constructed that it may be energized by the motor and so maintained until tripped by the controlling means to throw the switch and which will then automatically cut in the motor for a predetermined period to again store up energy for a subsequent switch operation. In this connection I also make the storing capacity of the mechanism such that the switch may be operated a plurality of times for each single operation of the motor, and I so arrange the motor-controlling mechanism that the motor will be cut in only when the switch is open, the advantage of this being that the switch may always be opened by the power stored in the operating mechanism, even though the motor be disabled.

Another object of my invention is to provide means for automatically rendering the tripping means by which the switch-operating mechanism is set in motion inoperative during the operation of the motor, thus preventing inadvertent tripping of the mechanism before the power necessary to operate the switch properly is stored.

Another object of my invention is to provide novel means for stopping the movable switch-contacts in their extreme open and closed positions. This is accomplished by providing means for stopping the crank by which motion is transmitted to the movable switch member always in a dead-center.

Other objects of my invention will be apparent from the following detailed description taken in connection with the accompanying drawings, and the different parts, improvements, and combinations which I regard as my invention will be specifically set forth in the appended claims.

In said accompanying drawings, Figure 1 is an elevation of a switch and its operating mechanism constructed in accordance with my invention. Fig. 2 is a plan view of the operating mechanism for said switch. Figs. 3 and 4 are side elevations of said mechanism, the former showing the motor-controlling switch and the latter the stop and tripping mechanism. Figs. 5, 6, and 7 are detailed views of the cam for operating the motor-controlling switch and its coöperating parts. Fig. 8 is a view illustrating the parts shown in Figs. 5, 6, and 7 assembled and in the position which they would occupy when the main switch is closed. Fig. 9 is a view similar to Fig. 8, showing the parts in the position which they occupy when the switch is first opened and the motor is first cut in, and Fig. 10 is a diagram illustrating principally the motor-circuit and the control-circuits. In Figs. 11 to 14, inclusive, I have shown certain modifications of the construction illustrated in the preceding figures by which I am enabled to dispense with one of the tripping-coils. Of these figures, Fig. 11 is a view similar to Fig. 4. Fig. 12 is a plan view. Fig. 13 is a diagram similar to Fig. 10. Fig. 14 is a sectional view taken on the line 14 14 of Fig. 12, and Fig. 15 is a detailed view of the end of the spring-case and adjacent parts.

Throughout these several views like characters refer to like parts.

In the present application my invention is shown in connection with the switch A of the type shown in Patent No. 714,436, granted November 25, 1902, to Badeau. This switch has a reciprocatory member 10, which derives its movement from a rock-shaft 11,

through the agency of a suitable system of links and levers 12. Motion is transmitted to the rock-shaft 11 by the connecting-rod 12', which is connected at its upper end to the crank 13 on said rock-shaft and at its lower end to a crank 14 on the shaft 15 of the power-driven operating mechanism. This shaft 15 is journaled at its opposite ends in a rectangular frame or base 16 and by its rotations transmits the necessary movement to the movable element of the switch A. Power to drive the shaft is obtained through a coiled spring 17, wound about the shaft and secured at one end to the shaft and at the other to the cylindrical case 18, which is mounted so as to rotate freely upon the shaft. At one end of the case 18 is an arm 19, which is rigidly secured to the shaft 15 and by engagement with stops 20 prevents the rotation of the shaft while the spring is being wound. The power for winding the spring may be obtained from any suitable source, such as the electric motor 21, mounted upon the base 16. Through suitable worm-gearing 22 and spur-gearing 23 the power of the motor is transmitted to the spring-case 18, and whenever the motor is supplied with current the case 18 is rotated, so as to wind the coiled spring 17, and thereby store up energy in the mechanism, so that when the obstructing-stop 20 is removed from the path of the arm 19 the shaft will be free to rotate. The stops 20 consist, essentially, of upwardly-extending links 24 24, pivoted at their lower ends to the base 16 and provided with rollers 25 at their upper ends and adapted to extend into the path of rotation of the arm 19, the end of the arm 19 bearing against the rollers 25. Toggles made up of links 26 and 27 connect the upper ends of the links 24 to fixed lugs 28 on the frame 16, and springs 28' tend to hold the toggles in the position shown. These toggles serve to hold the stops 20 in engaging position and are adapted to be tripped by means of solenoids or tripping-coils 29, located below the toggle and suitably secured to the frame 16. These magnets 29 are provided with cores 30, which are drawn upward when the solenoid is energized with sufficient force to trip the toggle, and thereby remove the stops.

In order to automatically cut in the motor 21 when the spring 17 is run down, the motor-controlling switch C is provided. This switch consists of the arm 31, having contacts 32 adapted to bridge fixed contacts 33 33 when in one position and fixed contacts 34 34 when in another. These contacts are suitably mounted upon and insulated from the frame 16. The contacts 33 33 are included in circuit with the solenoids 29 and the contacts 34 34 in circuit with the motor 21, as clearly illustrated in Fig. 10. As shown in that figure, one of the terminals 33 is connected to a suitable supply-main 35 and the other contact 33 is connected by way of two branches 36' 37, extending through the solenoids 29 in parallel to the fixed terminals 38 39, respectively, of a simple switch 40, whose movable member is directly connected to the other supply-lead 36. From this it will be seen that when the switch-arm 31 is in the position illustrated in Figs. 3 and 10 a circuit may be completed through either solenoid by simply throwing the controlling-switch 40 to the proper position. Obviously this controlling-switch may be located at any desired point. It will be clear from the preceding description that if the arm 19 is in contact, say, with the stop 20 at the left in Fig. 4, the throwing of the controlling-switch 40, so as to close the circuit through the solenoid 29 at the right in said figure, will have no effect upon the rotation of the shaft 15, and consequently no effect upon the operation of the switch. However, if the controlling-switch 40 is thrown in the opposite direction the solenoid 29 at the left will be energized and its stop will be drawn out of the way, so that the shaft 15 will be free to make a half-revolution—that is, free to rotate until the arm 19 is brought up against the under side of the stop 20 at the right, as indicated by the dotted lines in Fig. 4. Thus it is apparent that each position of the switch 40 always corresponds to a definite position of the main switch A, and the position of the latter may be known by the position of the former. It is apparent that if the spring 17 were wound up by hand the above manipulation of the controlling-switch 40 would have the desired effect of properly throwing the switch A; but in order to make use of the motor 21 for this purpose the motor-controlling switch C is employed. This switch is operated upon each complete rotation of the shaft 15 to close the circuit between the contacts 34 34, and thereby through the motor 21, as will be apparent upon an inspection of Fig. 10. It will then be directly connected between the supply-mains 35 and 36. The movable member 31 of the switch C is pivoted at the point 41 to the frame 16 and is normally held by a spring 42, with its end 43 in contact with a cam 44, loosely mounted on a sleeve 45 of the spring-case 18.

The cam 44 is provided with projecting lugs 46 46, (shown by the dotted lines in Fig. 6,) which coöperate with similar lugs 47 47 on the face of an engaging member 48, which is rigidly secured to the spring-case 18. These lugs 46 and 47 are so located that the cam 44 has considerable play with reference to the member 48. On the opposite side of the cam 44 from the member 48 is a member 49, which is keyed to the shaft 15 and provided with a lug 50, which is adapted to engage a coöperating lug 51 on the outer face of the cam to transmit motion from the shaft 15 to the cam. The cam 44 is provided with a depression 52, into which the end 43 of the switch

member 31 is adapted to fall to bring said member 31 into the position illustrated in Fig. 3. The purpose of the member 49 on the shaft 15 is to rotate the cam into the position illustrated in Fig. 9, so as to close the motor-circuit, and thereby automatically start the motor to wind the spring 17, and the purpose of the member 46 on the spring-case 18 is to bring the cam 44 into the position illustrated in Fig. 8, so as to break the motor-circuit, and thereby stop the winding of the spring and to restore the circuit through the tripping-solenoids 29 29. In order that this may be more fully understood, if it be assumed that the switch A is open and the spring is wound, then the parts will occupy the position shown in Fig. 8, except that the member 49 would lie in a position to bring the lug 50 directly beneath the shaft 15—that is, one hundred and eighty degrees from its present position. If then the operating mechanism is tripped for the purpose of closing the switch A, the shaft 15 will make a half-revolution clockwise, which will bring the parts into the position illustrated in Fig. 8. If the operating mechanism is again tripped, the semirotation of the shaft will bring the lug 50 into engagement with the lug 51 on the cam 44 and move the cam into the position illustrated in Fig. 9, thereby throwing upward the end 43 of the switch member 31 breaking the circuit at the terminals 33 33 and closing it between the terminals 34 34, thus starting the motor. As the motor drives the spring-case 18 it will carry the lugs 47 47 in a clockwise direction, considering the parts as illustrated in Fig. 8, into engagement with the coöperating lugs 46 46 on the cam 44 and continue to rotate the cam until the end 43 drops into the depression 52, thus breaking the motor-circuit and restoring the controlling-circuit. Although not essential to the operation, I provide a spring 53, which is coiled about the cam 44 and secured at one end to said cam and at the other to the member 48, which is mounted on the spring-case for the purpose of bringing the coöperating lugs 46 and 47 into engagement when unrestrained by the operation of the mechanism.

Referring now particularly to the modified structure illustrated in Figs. 11 to 14, inclusive, it will be seen that the shaft 15 is provided with two arms 19 19, which coöperate with a single stop 20 to permit the desired half-revolution of the shaft necessary to give the proper movement to the movable element of the switch A. The construction of the tripping and stop mechanism is identical with that shown in the other figures and previously described. However, in this form of the invention, where one tripping-coil only is used, it is necessary to provide some means for deënergizing it as soon as the mechanism has been released in order that the stop 20 may return to its engaging position soon enough to catch an arm 19 and stop the shaft 15 when it has made a half-revolution. For this purpose I provide one of the arms 19 with the contact 54, which is adapted to electrically connect the fixed contacts 55 55 when in one position and the contacts 56 56 when in the other. These fixed contacts 55 56 are secured to and insulated from the frame 16 at their lower ends by a bar 57, which is securely bolted to the under side of the flanged portion of said frame, as clearly illustrated. The upper ends of the contacts 54, 55, and 56 are free and by reason of the resiliency of the metal make a satisfactory electrical engagement. The contacts 55 and 56 are provided with binding-posts 58 and 59, respectively. In making the electrical connections for this form of the invention the motor-circuit is completed, as before, by the switch C engaging the contacts 34 34, but the circuits for the tripping-coil 29 are arranged somewhat differently than illustrated in Fig. 10.

As clearly illustrated in Fig. 13, the terminal 38 of controlling-switch 40 is connected to one of the contacts 55, and the other contact 55 is connected directly to the branch 60, leading from one of the contacts 33 to the tripping-coil 29. The other terminal 39 of the controlling-switch is connected to one of the contacts 56, and the other contact 56 is connected by the wire 61 to one of the contacts 33. With this arrangement of circuits it will be seen that two branches extend from the controlling-switch 40 to the tripping-coil 29. One of these extends through the contacts 55 55 and the other through the contacts 56 56 and contacts 33 33. These connections are so arranged that in order to open the main switch A the circuit is completed through the contacts 55 55, and to close the switch the circuit is completed through the other branch embracing the contacts 56 56 and 33 33. By having the opening circuit broken at one instead of two points the likelihood of failure in opening the switch due to poor contact is greatly reduced. If now it is desired to open the main switch, assuming that the parts are in the position shown in Fig. 13, the controlling-switch 40 is thrown to the left and the controlling-circuit is completed between the supply-mains 35 36 through the branch including the contacts 55 55. This will then energize the coil 29 and release the shaft 15, which will immediately begin to rotate, and thereby break the circuit between the contacts 55 55. This will deënergize the coil 29 and allow the stop 20 to fall back into its engaging position in time to catch the arm 19 and stop the rotation of the shaft 15. At the instant the coil 29 is tripped by this movement of the controlling-switch the cam 44, which actuates the motor-controlling switch C and its coöperating parts, is in the posi-

tion illustrated in Fig. 8, and as the shaft 15 rotates it simultaneously breaks the controlling-circuit at the contacts 55 55 and carries the lug 50 on the member 49 into engagement with the lug 51 on the cam, and thereby actuates the cam to throw the motor-controlling switch C across the terminals 34 34 in the motor-circuit. The motor being thus set in motion continues to rotate until its circuit is broken through the action of the spring-case 18 and the cam 44, as previously described. In the rotation of the shaft 15 the bridging contact 54 will be carried over to the fixed contacts 56 56 practically at the same time that the motor-circuit is closed; but a movement of the controlling-switch to the contact 39 will not energize the tripping-coil 29, since this branch of the controlling-circuit is broken at the contacts 33 33. After the spring has been fully wound, however, the circuit at the contacts 33 33 is closed, and thereafter any movement of the controlling-switch 40 to the contact 39 will close the circuit through the coil 29 and again trip the mechanism, this time to close the main switch. From the above it will be seen that, as in the other arrangement of circuits illustrated in Fig. 10, the tripping mechanism can never be operated while the motor is in operation.

With either form of the switch mechanism illustrated I am enabled to obtain a strong positive switch movement and provide means which prevent the tripping of the mechanism except when the spring is properly wound. It is also apparent that many of the parts and combinations which I have illustrated in the present forms of my invention are capable of application in other connections, and I therefore do not wish to be limited to the specific application herein disclosed. It will also be apparent that many alterations and modifications may be made in the specific structure illustrated without departing from the spirit of my invention, and I therefore aim to cover by the terms of the appended claims all such alterations and modifications.

What I claim as new, and desire to secure by Letters Patent of the United States, is—

1. In switch-operating mechanism, the combination of a movable member, a motor, connecting means between said motor and member whereby energy sufficient for one or more movements of said member may be stored by a single operation of said motor, and means for automatically starting said motor only at the completion of said movements to store up energy for subsequent movements.

2. In switch-operating mechanism, the combination of a reciprocatory member, a motor, connecting means between said motor and member whereby energy may be stored for the operation of said member, and means for automatically starting said motor at the completion of a to-and-fro movement of said member to store up energy for subsequent movements.

3. The combination of a switch, a motor, connecting means between said motor and the movable element of said switch whereby energy may be stored for the movement of said element, and means for automatically starting said motor at the completion of the opening movement of said switch to store up energy for subsequent movements.

4. The combination of a switch, a motor, connecting means between said motor and the movable element of said switch whereby energy sufficient to open and close said switch may be stored by a single operation of said motor, and means for automatically starting said motor only at the completion of each closing and opening of the switch to store up energy for subsequent movements.

5. The combination of an electric switch, means for storing energy to operate said switch, means for releasing the stored energy, and means for setting said storing means in operation only after said switch has completed its movement.

6. The combination of an electric switch, means for storing energy to operate said switch, means for releasing the stored energy, and means for setting said storing means in operation and rendering the releasing means inoperative during the operation of said storing means.

7. In switch-operating mechanism, the combination of a movable member, a motor, connecting means between said motor and member for storing energy supplied by said motor, means for releasing the stored energy to operate said member, and means for starting said motor and rendering said releasing means inoperative during the operation of said motor.

8. In switch-operating mechanism, the combination of a movable member, an electric motor, connecting means between said motor and member for storing energy supplied by said motor, a control-circuit including electrically-actuated means for releasing the stored energy to operate said member, and switching means for making and breaking the control-circuit alternately with the motor-circuit.

9. In switch-operating mechanism, the combination of a movable member, an electric motor, connecting means between said motor and member for storing energy supplied by said motor, a control-circuit including electrically-actuated means for releasing the stored energy to operate said member, and switching means actuated by said connecting means to make and break the control-circuit alternately with the motor-circuit.

10. The combination of an electric switch, comprising a reciprocatory switch member, a

spring-actuated crank-shaft for governing its movements, one or more arms rigidly secured to said shaft, and one or more stops coöperating therewith, said arms and stops being so located that said crank will be stopped on dead-center to hold said switch member in its extreme open and closed positions.

11. In switch-operating mechanism, the combination of two rotatable members, a spring for transmitting motion from one to the other, a motor for rotating one member to energize said spring, a movable stop for preventing the rotation of the other member, and motor-controlling means operated by the latter member to start said motor and by the former member to stop said motor.

12. In switch-operating mechanism, the combination of a crank-shaft, a spring-case rotatably mounted thereon, a spring coiled about said shaft and secured at its opposite ends to said shaft and said case, a motor geared to said case and adapted to wind up said spring, a movable stop for preventing the rotation of said shaft, motor-controlling means operated by said shaft to start said motor and by said case to stop said motor.

13. In switch-operating mechanism, the combination of a crank-shaft, a spring-case rotatably mounted thereon, a spring coiled about said shaft and secured at its opposite ends to said shaft and said case, an electric motor geared to said case and adapted to wind up said spring, means for permitting an intermittent rotation of said shaft, a switch for making and breaking the motor-circuit, a cam for operating said switch, means actuated by the crank-shaft to move said cam to close said switch, and means actuated by the spring-case to move said cam to open said switch.

14. In switch-operating mechanism, the combination of an operating-shaft, spring mechanism for storing up energy to rotate said shaft, a movable stop adapted to prevent said rotation, an electric motor for energizing said spring mechanism, and a motor-controlling switch operated by said shaft.

15. In switch-operating mechanism, the combination of an operating-shaft, spring mechanism for storing up energy to rotate said shaft, a movable stop adapted to hold the shaft against rotation, an electric motor for energizing said spring, a control-circuit including electrically-actuated means for moving said stop from its engaging position, and a controlling-switch operated by said shaft to close the motor-circuit and open the control-circuit or vice versa to close the control-circuit and open the motor-circuit.

16. The combination of a tripping-coil, mechanism to be freed thereby, an electric motor for operating said mechanism, a controlling-switch included in circuit with said coil, and means operated by said mechanism to make and break said circuit and the motor-circuit alternately.

17. The combination of a tripping-coil, mechanism to be freed thereby, an electric motor for operating said mechanism, a controlling-switch included in circuit with said coil, means operated by said mechanism to make and break said circuit at one point, and means to make and break said circuit at another point and the motor-circuit alternately.

18. In switch-operating mechanism, the combination of a movable member, an electric motor, connecting means between said motor and member whereby energy may be stored by said motor for the operation of said member, electrically-operated means for releasing said energy comprising a tripping-coil, a controlling-switch included in circuit with said coil, means operated by said connecting means for making and breaking said circuit at one point, and means operated by said connecting means to make and break said circuit at another point and the motor-circuit alternately.

19. The combination of a tripping-coil, mechanism to be freed thereby, a controlling-switch, a circuit including said switch and coil and comprising two branches leading from said switch to said coil, and means operated by said mechanism to make and break said branches alternately.

20. In switch-operating mechanism, the combination of a movable member, an electric motor, connecting means between said member and motor whereby energy may be stored by said motor for the operation of said member, electrically-operated means for releasing said energy comprising a tripping-coil, a controlling-switch, a control-circuit including said coil and switch and comprising two branches leading from said switch to said coil, means operated by said connecting means to make and break said branches alternately, and means operated by said connecting means to make and break one of said branches and the motor-circuit alternately.

21. In switch-operating mechanism, the combination of an operating-shaft, spring mechanism for storing up energy to rotate said shaft, an arm secured to said shaft, a movable stop adapted to lie in the path of said arm to prevent the rotation of the shaft, a tripping-coil for moving said stop from said path, fixed contacts included in circuit with said coil, and a bridging contact carried by said arm and adapted to engage said fixed contacts to close the circuit through said coil.

In witness whereof I have hereunto set my hand this 29th day of September, 1904.

THEODORE E. BUTTON.

Witnesses:

BENJAMIN B. HULL,

HELEN ORFORD.