



## UNITED STATES PATENT OFFICE

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## ELECTRIC-SWITCH-OPERATING MECHANISM

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My invention relates to power switches and particularly to motor actuated means for operating the same. One of the objects of my invention is the provision of improved means for operating the switch by an electric motor, which means after the switch has been closed by the motor shall operate to cause the switch to open in response to a decrease in voltage applied to the motor after a time which varies inversely with the degree of voltage decrease.

Another object of my invention is the provision of improved means in switch operating mechanism of this character whereby if the switch contacts tend to cling together when the switch is released, they will subsequently be positively separated.

My invention will be better understood from the following description taken in connection with the accompanying drawing, and its scope will be pointed out in the appended claims.

Referring to the drawing, Fig. 1 is a side elevation of a power switch and operating mechanism therefor involving my invention, the switch being shown in open position; Fig. 2 is a sectional view taken on the line 2-2; Fig. 3 is a view corresponding to Fig. 1, but with the switch in closed position; Fig. 4 is a detail of the operating mechanism; and Figs. 5 and 6 are circuit diagrams.

In the drawing I have chosen to show the power switch as a three phase liquid break type switch of common construction. The main frame 1 includes the extension 2 forming the cover of the pot 3 and through which extend the insulation bushings 4 supporting the fixed contacts 5. The movable bridging contacts 6 are suspended from the yoke 7 to which connects the operating lever 8. This lever is operated by a toggle comprising the link 10 and the bell crank lever 11 whose fulcrum is at 12. Lever 11 like lever 8 is in the form of a pair of spaced similar plates between which is mounted the large roller 14 and the small roller 15. Mounted below and in suitable bearing brackets is a shaft carrying the cam 16 and the gear 17. Coil spring 20 surrounding an extension of the shaft has one end secured to the adjacent bearing block and the other end secured to the adjustable nut 21 on the shaft. By this means the tension of the spring can be adjusted to have the desired tension.

Cam 16 has two distinct operating faces of which the long face 22 is adapted to be engaged by the large roller 14 and the short face 23 is adapted to be engaged by the small roller 15. The long face of the cam terminates at its outer end in the concentric portion 24 whereby the cam may rotate through a certain angle without affecting the switch operating toggle. The cam is also provided with a stop pin 25 which, when the cam has been rotated to a position corresponding to the full open position of the switch, engages the stop 26 which in turn engages and is limited by the spring buffer 27. Electric motor 30 is mounted on the frame 1 and mounted on its shaft is the pinion 31 engaging the gear 17. To prevent damage to the gear teeth when the cam reaches a limiting position, the pinion is attached to the motor shaft through a friction clutch comprising the friction disks 32 pressed together by the spring 33.

In the circuit diagram comprising Fig. 5, I have shown the motor 30 as connected through the auxiliary switches 35 and 36 and resistance 37 to the control circuit 38 which may be a branch of the circuit to which the main switch is connected. To close the main switch, both auxiliary switches 35 and 36 are closed when the cam is rotated in a counter clockwise direction to substantially the position shown in Fig. 3. Opening of the switch 36 throws the motor in series with the resistance 37 whose value is so chosen that the torque exerted thereby on the cam shaft at normal voltage shall substantially equal the opposing torque of the spring 20. The torque applied to the cam by the motor preferably slightly exceeds that of the spring thereby holding the pin 25 lightly against the stop 26 at normal voltage. Thus the motor floats on the line. If the line voltage falls below a predetermined value, the spring overcomes the motor and causes a backward rotation thereof and of the cam, but if there is a recovery of the normal line voltage before the cam has moved back far enough to permit the switch to open, the cam will be returned to

the position shown in Fig. 3 the degree of response being controlled by the adjusting nut 21. The switch operating mechanism thus gives to the switch an adjustable inverse voltage drop time limit opening characteristic.

If for any reason the switch should fail to open in response to backward rotation of the cam, as for example, the freezing together of the contacts, a continuation of the rearward movement of the cam to a position, such as shown in Fig. 4, brings the cam surface 23 into engagement with roller 15 and thus rocks bell-crank lever 11 to the switch open position.

In Fig. 6 I have shown another arrangement of auxiliary switches and resistance for controlling the motor together with other auxiliary switches for use in reversing the motor to open the switch. The double throw switch 40 having operating rod 41 corresponds with switches 35 and 36 of Fig. 5. In circuit with this switch is switch 42 which is moved to closed position by the hook 43 on the end of rod 41 and is retained closed against the force of spring 44 by the detent 45. The two pole switch 47 has the hook 48 mounted on its operating rod arranged when operated to swing the switch 42 to open position. This switch 47 serves to reverse the circuit connections to the field winding of the motor whence the cam 16 is quickly rotated in a clockwise direction and the main switch contacts positively separated if frozen together as indicated in Fig. 4. It should be noted that the resistance 37 is such that, as long as the roller 14 rides on the concentric portion of the cam the motor may turn forward and backward in accordance with changes in the voltage, but if the roller rides beyond the concentric portion allowing the switch to open, the motor torque will not be sufficient with the resistance in circuit to reclose the switch. Thus "pumping" of the switch due to voltage variations is prevented.

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

1. Actuating means for a power switch comprising a cam, a member operatively connected with said switch engaging the face of the cam, a resilient member connected with the cam and arranged to be tensioned by rotation thereof, an electric motor for rotating the cam to close the switch, a supply line for the motor, and means adapted to be operated after the motor has caused the switch to be closed for decreasing the torque thereof to cause it to float on the line.

2. Actuating mechanism for a power switch comprising a cam, a roller engaging the face of the cam and operatively connected with said switch, a spring arranged to be tensioned by the forward movement of the cam, an electric motor for rotating the cam to close the switch, a stop to limit the forward

movement of the cam, said motor having connections to a supply line including a resistance whereby the motor floats on the line and maintains the switch closed under normal voltage conditions, and means for short circuiting said resistance to close the switch.

3. Actuating mechanism for a power switch comprising a cam having a plurality of operating faces, an electric motor for rotating the cam in either direction, and a member operatively connected with said switch having a portion arranged to engage one face of the cam to close the switch when the motor rotates in one direction and having another portion arranged to engage another face of the cam to open the switch when the motor rotates in the opposite direction.

4. Actuating mechanism for a power switch comprising a cam, a spring opposing the forward rotation of the cam, a member engaging the cam and operatively connected with said switch, an electric motor for rotating the cam forwardly, circuit connections for said motor whereby the motor and cam are operated in a forward direction in opposition to the spring to close the switch, and means for subsequently inserting resistance in the motor circuit whereby the motor torque and the spring are substantially balanced.

5. Actuating mechanism for a power switch comprising a cam, a spring opposing the forward rotation of the cam, a member operatively connected with the switch having one portion engaging one part of the cam to close the switch in response to forward rotation of the cam and having another portion arranged to engage another part of the cam to open the switch in response to a predetermined backward rotation of the cam, an electric motor for rotating the cam to close the switch, means for decreasing the torque of the motor to cause it to substantially balance the force of said spring when the switch is closed, and means for reversing the motor to positively open the switch.

In witness whereof, I have hereunto set my hand this 13th day of September, 1928.

LUDWIG S. WALLE.