Aug. 19, 1941. J. J. SHOEMAKER ET AL 2,253,400

ELECTRIC SWITCH

Original Filed Jan. 24, 1935 2 Sheets-Sheet 1

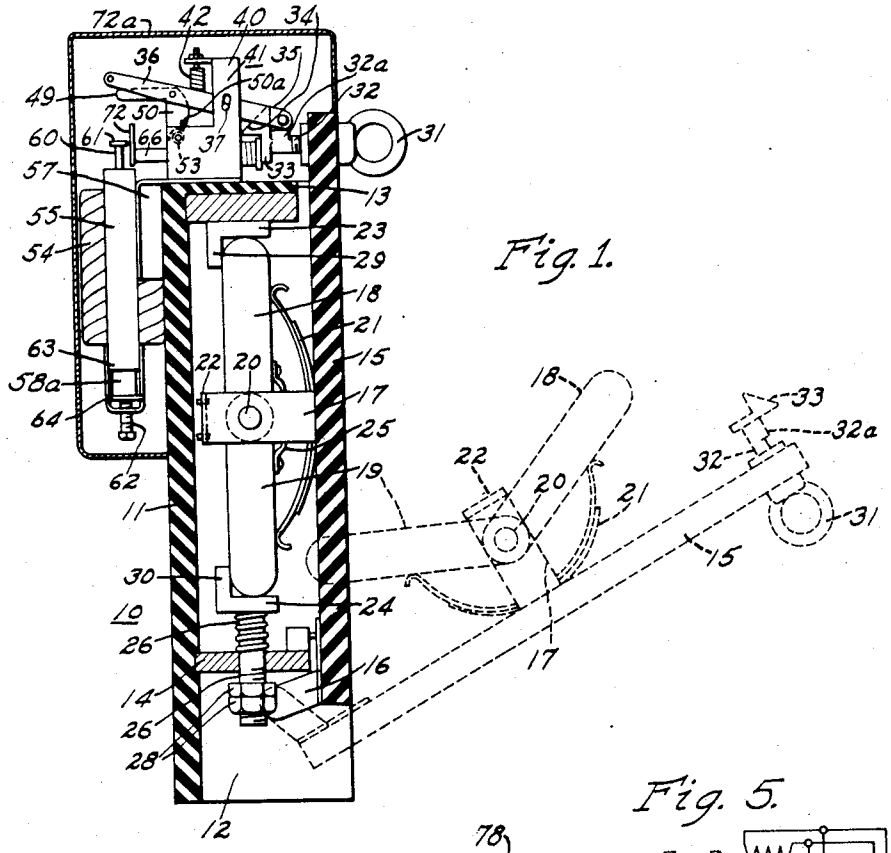
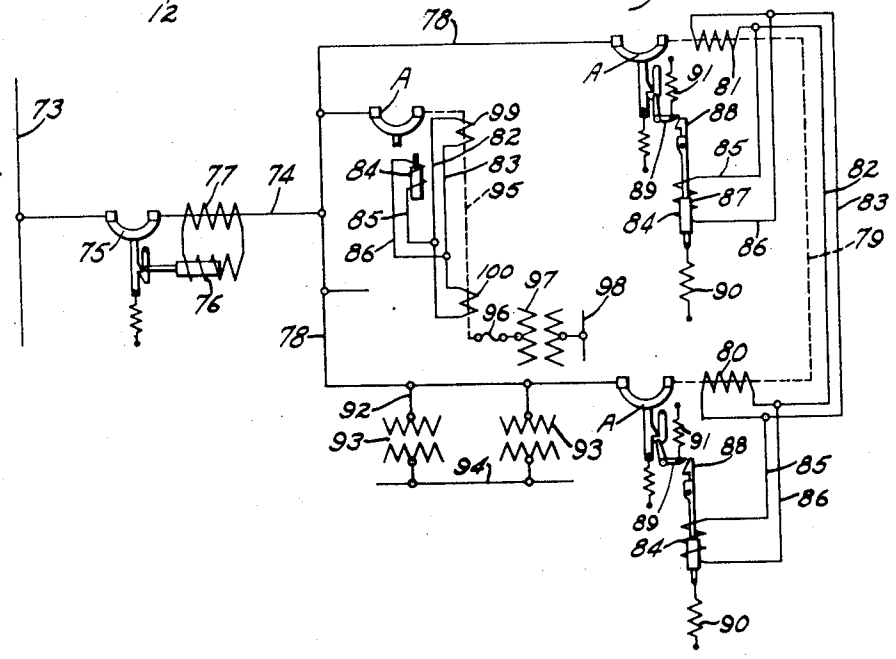


Fig. 1.

Fig. 5.



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Fig. 2.

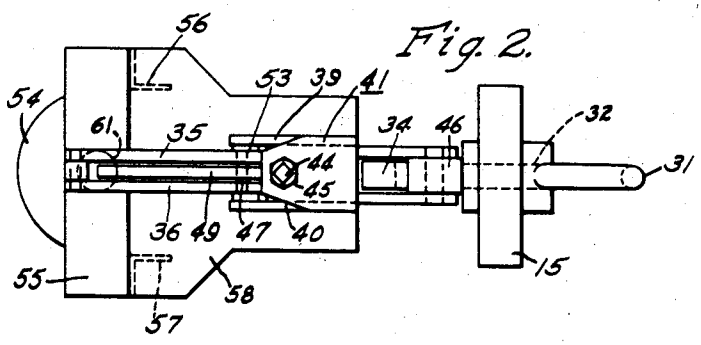


Fig. 3.

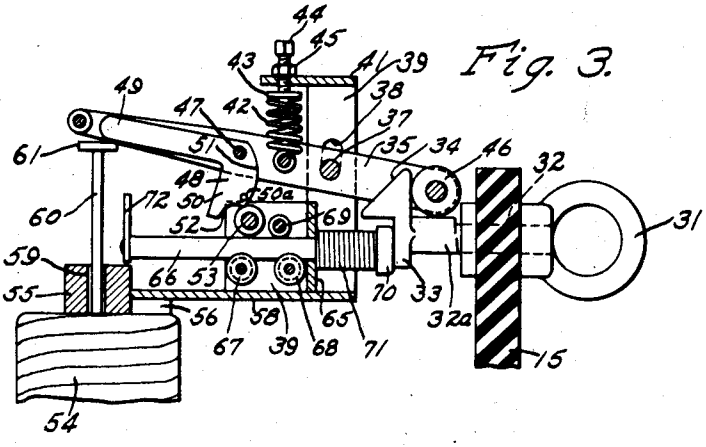
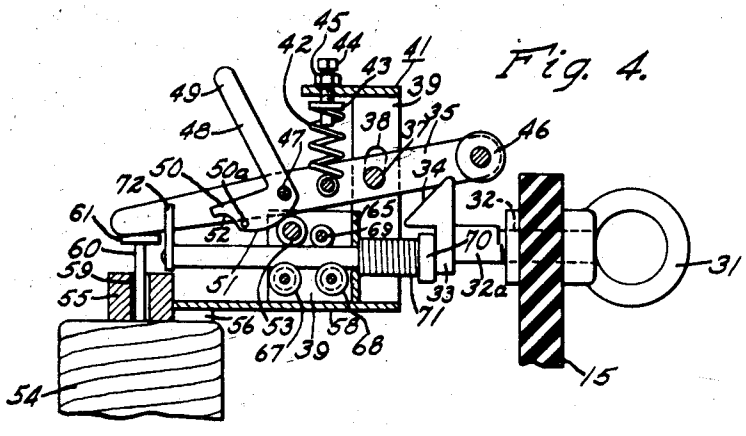


Fig. 4.



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2,253,400

ELECTRIC SWITCH

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Original application January 24, 1935, Serial No. 3,225. Divided and this application March 4, 1939, Serial No. 259,846

6 Claims. (Cl. 200—106)

This invention relates in general to alternating-current distribution systems, and is more particularly concerned with improved switching means therefor.

The present application is a division of our parent application Serial No. 3,225, filed January 24, 1935, which has matured into Patent No. 2,152,445. The present application is directed primarily with the switch structure employed in the system covered in the parent application.

In the usual type of distribution systems, utilizing a sectionalized loop, it has been the custom in the past to provide sectionalizing switches in the form of circuit breakers which are arranged so as to isolate a faulty section by opening during the flow of fault current. Such operation necessitates that the circuit breakers have sufficient interrupting capacity to open the fault current, thereby not only necessitating the use of an expensive device, but in addition requiring the use of auxiliary relay equipment, etc., for controlling the operation of the circuit breakers.

With the foregoing in mind, the present invention seeks to provide an economical system, wherein the expensive circuit breakers and auxiliary devices may in a large measure be dispensed with, and in which switches of the disconnecting type having little or no interrupting capacity may be used. In the novel switch to be hereinafter described, novel switching means are provided, whereby the opening of the switch contacts is delayed until the circuit in which the switches are disposed is deenergized.

It is an object of the present invention to provide a switch having improved actuating means which functions to trip the switch upon current flow changes from its normal amount or direction, but which will maintain the switch contacts closed until current ceases to flow, due to the circuit being deenergized elsewhere.

It is a further object of the present invention to provide in a switch of the character described, means to preset the switch for the tripping operation upon current flow changes, but which does not function to open the switch contacts until the current ceases to flow.

Another object of the invention is to provide improved means for sectionalizing a feeder, wherein a short circuited section of the feeder will be automatically cut out in response to the deenergization of the feeder, thus enabling the immediate reestablishment of service by energizing the remaining sections.

It is also an object of the invention herein described to provide in connection with a sectional feeder, means for selectively pre-setting the sectionalizing switches of a section having an abnormal condition therein, and which will operate upon the deenergization of the feeder to open the contacts of the pre-set switches only, whereupon the remaining sections may again be energized.

Still another object of the invention is to provide selective means for disconnecting one of a plurality of parallel feeders upon the occurrence of an abnormal condition therein, and in which the disconnection of the selected feeder will be delayed until the feeders are deenergized relative to a supply source, and which will permit the reenergization of the remaining feeders to reestablish the service.

Other objects of this invention will more fully appear from the following detailed description taken in connection with the accompanying drawings, which illustrate several embodiments thereof, and in which:

Figure 1 is a vertical sectional view through the housing of a switch utilized in the present invention, this view showing the operative relationship of the switch parts, when the switch is in normal closed position;

Fig. 2 is a plan view on an enlarged scale of the tripping and latching mechanisms of the switch shown in Fig. 1;

Fig. 3 is an enlarged fragmentary view in vertical section of the tripping and latching mechanism, illustrating the relative positions of the parts just after the switch has been preset, and prior to the latch releasing operation;

Fig. 4 is a similar view showing the operative relationship of the parts when the latch is released, and just before the switch door has opened to open the switch contacts; and

Fig. 5 is a schematic wiring diagram showing a distribution system and illustrating an application of the present invention.

Referring to Figures 1 through 4, the illustrated embodiment discloses the switch as comprising a box-like structure, generally indicated at 10, which is formed by a back member 11, a pair of side members 12—12 (only one being shown), and top and bottom members 13 and 14, respectively. The box is open on its forward side and is arranged to be closed by means of a cover 15 which is inwardly secured to the side members 12—12 by means of hinge brackets 16.

It will be observed that the bottom 14 is upwardly spaced from the lowermost edges of the back and side walls of the box, and that the hinge

brackets of the cover are pivoted to the side walls at a point below the bottom 14. With this arrangement, when the box cover is swung to open position, it may assume a natural hanging position below the box.

Mounted centrally in the middle of the cover or door 15 of the box is a bracket 17 which projects rearwardly from the door at substantially right angles thereto to form a support for a pair of pivotally mounted switch blades 18 and 19 which are oppositely disposed relative to a pivotal connection 20.

Between the switch blades 18 and 19 and the rear face of the door, there is mounted a leaf spring 21 which is arranged with its free ends bearing against the respective switch blades and normally tending to cause the outer ends of the blades to be moved away from the rear face of the door. This movement of the switch blades is limited by means of a stop which is formed by a plate 22 secured at the outer end of the bracket 17. The switch blades form a movable bridging contact which is moved out of and into bridging relation with an upper stationary contact 23 and a lower yieldingly mounted contact 24 by opening and closing the door of the switch box.

The switch blades are interconnected by means of a flexible jumper 25. The upper and lower contacts are respectively supported on the top and bottom of the box. The lower contact is provided with a threaded stem 26 which is supported for axial movement in the bottom 14. A compressing spring surrounds the stem 26, one end of this spring bearing against the contact head and the other end against the bottom 14, whereby the tendency of the contact is to move upwardly. Upward movement of the contact by the spring is limited by nuts 28—28 on the stem below the bottom member 14.

In Fig. 1, there is shown in dotted lines, the positions assumed by the switch blades 18 and 19 when the door is in open position. The blades are angularly disposed, and rest against the stop 22. If the door is now closed, the ends of the blades engage deflected portions 29 and 30 of the upper and lower contacts respectively, these portions serving as stops, so that as the door 15 is moved into fully closed position, the blades are moved into axial alignment, with the result that the blades function as a toggle and are forced against the contacts 23 and 24.

The door 15 is manually operable to closed position and is provided with a pull ring 31 which is adapted to receive an operating switch hook. Threaded into the body portion of the pull ring is a stem 32 having a head portion 33 which is extended outwardly beyond the stem and shaped to form a cam surface 34. Adjacent the head 33, the stem is provided with an upwardly extending boss 32a, the purpose of which will shortly be evident. Cooperatively associated therewith is a pair of spaced arms 35 and 36 which are secured together to form a latching lever. This lever is provided intermediate its ends with a trunnion 37, the ends of which are supported in aligned elongated arcuate openings 38 respectively disposed in the spaced legs 39 and 40 of a U-shaped bracket 41.

A compression spring 42 is connected at one end to the latching lever and at its other end bears against a plate 43 on a stem 44 which is threaded into the bracket 41 for axial movement, to enable the adjustment of the pressure exerted by the spring. The stem 44 may be locked in adjusted position by means of a lock nut 45. It will be observed that the compression spring is off center relative to the pivotal support of the latching lever and so disposed that there is a tendency for the latching lever to be rotated about the trunnion 37 in a counter-clockwise direction. The forward end of the latching lever is provided with a roller 46 for co-operation with the cam surface 34 of the head 33.

Pivotally mounted on a pivot pin 47 for swinging movement between the arms 35 and 36 is a trigger 48 having arms 49 and 50 which are substantially at right angles to each other. The arm 50 has one end thereof formed as a cam surface 51 which terminates near the end of the arm 50 in a swell 52.

The arm 50, when the switch is in closed position, is disposed so that the swell 52 engages a roller 53, as shown in Fig. 1. In this position, the arm 50 opposes the counter-clockwise movement of the latching arm under the influence of the compression spring 42 to unlatch the door. Also, when the arm 50 is so disposed, the arm 49 projects slightly below the associated end of the latching lever.

Mounted on the rear surface of the switch box is a tripping coil 54 which is surrounded by a frame 55. This frame is secured to a pair of spaced angle iron legs 56 and 57 which depend from a base plate 58 upon which the bracket 41 is mounted.

The lower side of the coil supporting frame is apertured to receive a solenoid core 58a and the upper side is apertured as shown at 59 to receive a stem 60 which is connected to and movable with the solenoid. The upper end of the stem 60 carries an abutment plate 61. The pick-up point of the solenoid is adjusted by means of adjusting screw 62 which is threadedly supported in a stirrup 63 which is secured to the frame 55. Associated with the screw 62 is a plate 64 which forms a seat for the solenoid, and which may be raised or lowered by means of the screw to vary the pick-up point of the solenoid.

Interconnecting the legs 39 and 40 of the bracket 41 is a web 65 which is apertured to receive a rod 66 for axial movement. The rod is guided by means of guide rollers 67, 68 and 69 (Figs. 3 and 4). The forward end of this rod is provided with a head portion 70 which is held in abutment with the head 33, when the door of the switch is closed, by means of an expansive spring 71 having one end bearing against the head 70 and its other end bearing against the web 65.

The other end of the rod 66 carries an outwardly projecting plate 72 which is arranged to contact the outer end of the arm 50 of the trigger, when the rod 66 is permitted to move under the influence of spring 71, by opening the switch door.

The operation of the tripping and latching mechanism will now be explained.

With the switch in closed position, the latching and tripping mechanism will be as shown in Fig. 1, the latching lever being locked against movement to release position by the trigger 48, since the swell 52 is in engagement with the roller 53.

Assuming that the coil 54 is now energized by connecting it to an electric circuit, the solenoid core 58a picks up and the abutment plate 61 strikes the arm 49 of the trigger and rotates the same in a clockwise direction to bring the arm 50 to such a position that the roller 53 is in engagement with the cam surface 51. So long as the coil is energized, the solenoid will oppose and

will supersede the action of the trigger in opposing movement of the latching lever to release position, as the plate 61 also engages the associated arm of the latching lever, as shown in Figs. 2 and 3.

Referring to Fig. 4, it will be observed that when the coil is deenergized, the core drops and permits the counter-clockwise movement of the latching lever under the influence of the spring 42 about its trunnion 37 as a pivotal axis. This movement of the latching lever to release position causes the roller 46 to disengage the head 33 and at the same time, the engagement of the cam surface 51 on the trigger causes the trigger arm 49 to assume a position substantially at right angles to and above the associated end of the latching lever. Movement in this direction is arrested by a stop pin 50a.

As soon as the head 33 is released, the expansion spring 71 moves the rod 66 to the right, as viewed in Fig. 4, to automatically open the door of the switch box to disengage the switch contacts. As soon as the door is released, and kicked outwardly by the action of spring 71, it continues by virtue of gravity to assume a depending position below the box. Simultaneously with this action, the plate 72 will be moved into engagement with the outer end of arm 50 and will rotate the arm in a counter-clockwise direction. This movement and the action of the cam surface 51 on the roller 53 will reset the latching lever to normal position, as shown in Fig. 1.

The switch may be reclosed and latched in closed position by simply manually closing the door of the switch. As the door comes to fully closed position, the cam surface 34 engages the roller 46 and raises the roller, the latching lever in this case being pivotally rotated about the pivot 47 a limited amount as determined by the length of the arcuate openings 38. As soon as the door has seated, the roller will drop behind the head 33 striking the boss 32a and latch the door in closed position. The boss 32a is of such height that it will prevent lever 35 from pivoting about trunnion 37 when the roller 46 is at its lowermost position, and also prevents the lever 35 from kicking up when the door 15 is closed. Such kicking would tend to release the trigger arm 50.

The entire tripping and latching mechanism is enclosed within a suitable housing 72a.

A typical installation in which a switch as described may be used is shown in Fig. 5, comprising a distribution system which includes a primary source of supply, as 73, which represents a sub-station bus. Connected to this bus is a feeder 74 in which is mounted a main circuit breaker 75. This circuit breaker is arranged to trip on overload, and is provided with a trip coil 76 which is connected in the usual manner to a current transformer 77. The feeder 74 may be an underground cable or overhead main and is connected to an overhead main 78 which, in this instance, has its ends connected through switches such as described in connection with the present invention to a bridging underground cable 79, whereby a primary loop is formed, this loop having an underground section of cable which it is desirable to protect against internal short circuit.

In the usual arrangement, either expensive sectionalizing circuit breakers would be used, which would necessitate expensive auxiliary devices, such as relays, etc.; or in order to cut down the cost, hand operated switches would be used, which require considerable time to operate and cause objectionably long interruption of the entire circuit in case of a cable fault. In the present scheme using switches A, current transformers 80 and 81 are placed at the ends of the cable 79, these current transformers being connected by means of conductors 82 and 83 in such a manner that, when current flows through the current transformers in the same direction, there will be opposing potentials in the conductors 82 and 83. As soon, however, as there is a short circuit in the cable lying between the current transformers, current will flow in opposite directions through the current transformers, and a potential will be built up between the conductors 82 and 83. Advantage is taken of this fact to provide tripping potential for the trip coils 84 of switches A. These trip coils are connected across conductors 82 and 83 by conductors 85 and 86 in each case.

When a short circuit occurs on the cable, the operation of the switches A is as follows:

The coil 84 being energized picks up the solenoid 87 to cause a spring latch 88 to engage a tripping latch 89. So long, however, as the coil 84 is energized, the switches A will not be tripped. The short circuit on the cable will cause the circuit breaker 75 to trip out on overload and the primary loop will be deenergized, with the result that the trip coils 84—84 of the switches A will likewise be deenergized. This enables a spring 90 to actuate the solenoid in such a direction as to trip the switches A. As soon as the switches have been tripped, a spring 91 will return the tripping latch to normal position, so that when the switch is reclosed it will be latched in closed position.

It will, therefore, be seen that the tripping of switches A, to isolate the bridging cable, will not take place until after the primary circuit has been deenergized in response to tripping the main circuit breaker 75. Consequently the switches A do not have to interrupt the fault or load current and consequently do not have to be designed so as to have interrupting capacity characteristics. These switches may, therefore, be constructed at materially less cost than in the case of oil circuit breakers for a similar purpose.

As soon as the faulty cable has been cut out, the main circuit breaker 75 may be reclosed in any of the usual ways, such as by an electric operating means, or by automatic reclosing equipment. The primary feeder 74 being energized, the primary main 78 may again reestablish service to branch feeders such as 92, which feed through step-down transformers 93 to energize a utilization circuit 94, which may be a low voltage network.

The switch A, such as described herein, may also be used for disconnecting a branch feeder such as shown at 95 from the primary loop. In this case, as shown in Fig. 5, the feeder 95, which may be an underground cable, is connected through a fuse 96, step-down transformer 97 to a utilization circuit 98 which may be a network fed from other sources than the sub-station bus 73. Current transformer 99 and 100 are provided at the ends of the cable 95, the same as in the case of the bridging cable 79, and the tripping coil of the switch is connected in the same manner, and the tripping mechanism of the switch A in this case operates in the same manner, as previously described, upon a short circuit in the cable 95.

From the foregoing description, it will be ap-

parent that this invention provides a novel switch for a system of distribution at a very economical cost; which avoids the necessity of providing expensive circuit breakers which must have sufficient interrupting capacity to interrupt fault current; and in which the parts are arranged to preset the switch and delay opening of the switch contacts until after the circuit in which the switch is connected has been deenergized elsewhere.

A portion of the subject matter herein disclosed is disclosed and claimed in our copending application Serial No. 363,646, filed October 31, 1940.

But, it is of course to be understood that, although we have described in detail the several embodiments of our invention, the invention is not to be thus limited, but only insofar as defined by the scope and spirit of the appended claims.

We claim as our invention:

1. In an electric switch device, an electric switch, latching means for releasably latching said switch in closed position, said latching means requiring actuation from a first condition into a second predetermined condition before said latching means can be actuated for releasing said switch, electroresponsive means responsive to a predetermined energization for actuating said latching means into said second predetermined condition, means responsive to deenergization of said electroresponsive means for actuating said latching means into a third condition for releasing said switch, and means rendered operative by a release of said switch for restoring said latching means to said first condition upon reclosure of said switch.

2. In an electric switch device, an electric switch having a plurality of movable elements including latching means for releasably latching said switch in closed position, said latching means requiring actuation from a first condition into a second predetermined condition before said latching means can be actuated for releasing said switch, electroresponsive means responsive to a predetermined energization for actuating said latching means into said second predetermined condition, and means responsive to deenergization of said electroresponsive means for actuating said latching means into a third condition for releasing said switch, each of said movable elements moving only in a single plane during the actuation of said latching means from said first condition into said second and third conditions.

3. In an electric switch device, an electric switch, latching means for releasably latching said switch in closed position, said latching means requiring actuation from a first condition into a second predetermined condition before said latching means can be actuated for releasing said switch, electroresponsive means responsive to a predetermined energization for actuating said latching means into said second predetermined condition, means responsive to deenergization of said electroresponsive means for actuating said latching means into a third condition for releasing said switch, means biasing said switch towards open position, and independent means responsive to the release of said switch for resetting said latching means to latching condition.

4. In an electric switch device, an electric switch having first contact means and second contact means movable from a closed position wherein said second contact means engages said first contact means with substantial pressure to an open position wherein said contact means are disengaged, mounting means for initially establishing a rolling action between said contact means to decrease said substantial pressure prior to complete disengagement of said contact means, latching means for releasably latching said switch in closed position, said latching means requiring actuation from a first condition into a second predetermined condition before said latching means can be actuated for releasing said switch, electroresponsive means responsive to a predetermined energization for actuating said latching means into said second predetermined condition, means responsive to deenergization of said electroresponsive means for actuating said latching means into a third condition for releasing said switch, and means rendered operative by a release of said switch for restoring said latching means to said first condition upon reclosure of said switch.

5. In an electric switch device, an electric switch, main latching means for latching said electric switch in closed positions, auxiliary holding means for holding said main latching means in latching position, and electroresponsive means responsive to a predetermined energization for replacing said auxiliary holding means, said electroresponsive means being designed to release said main latching means for an unlatching operation on removal of said predetermined energization.

6. In an electric switch device, an electric switch biased towards open position, main latching means for latching said electric switch in closed positions, auxiliary holding means for holding said main latching means in latching position, electroresponsive means responsive to a predetermined energization for replacing said auxiliary holding means, said electroresponsive means being designed to release said main latching means for an unlatching operation on removal of said predetermined energization, and means effective following the release of said main latching means for restoring said latching means and said holding means to their operative conditions.

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