May 3, 1949. E. F. KOHL 2,469,337

CONTROL APPARATUS FOR SWITCHES AND THE LIKE

Filed May 7, 1945 3 Sheets-Sheet 1

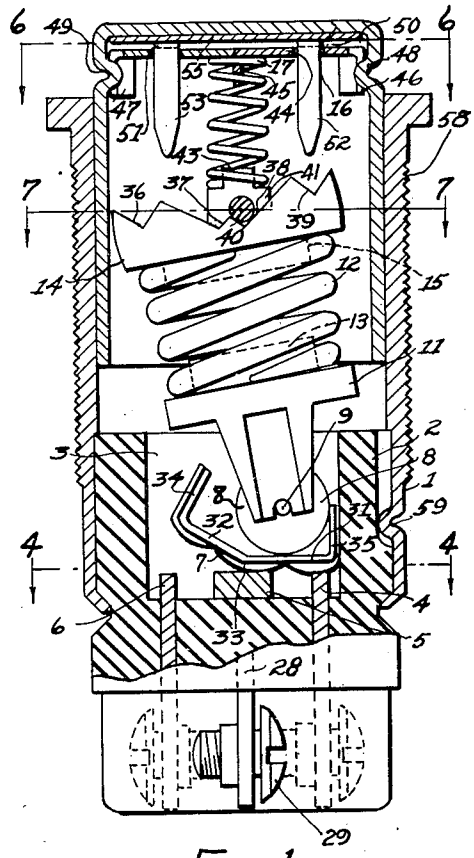


FIG. 1

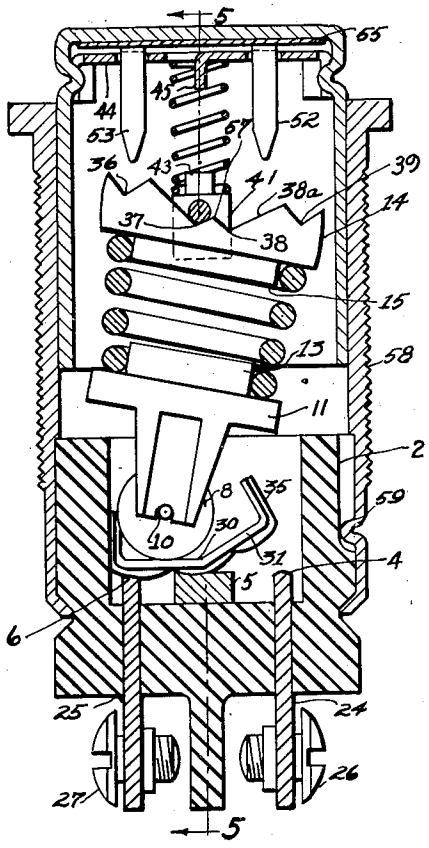


FIG. 2

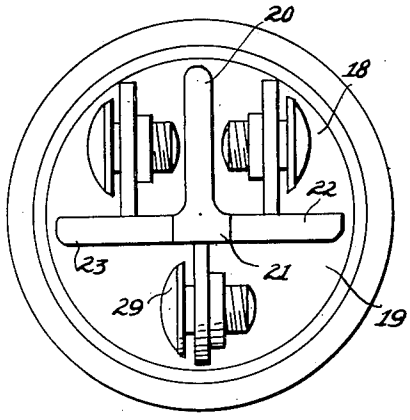


FIG. 3

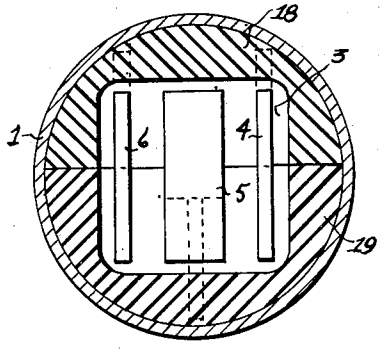


FIG. 4

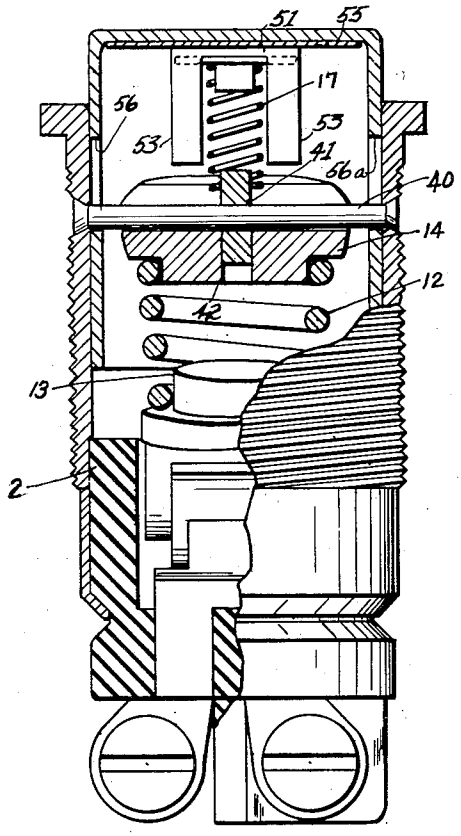
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FIG. 5



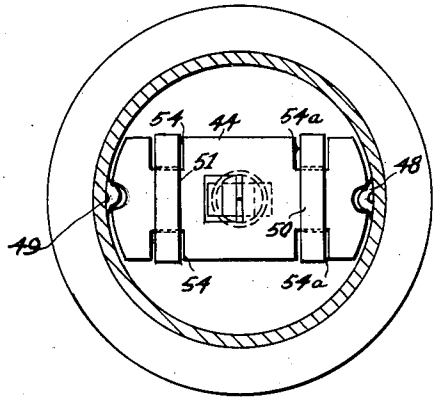


FIG. 6

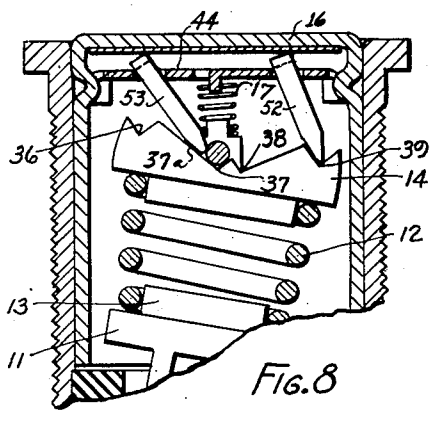


FIG. 8

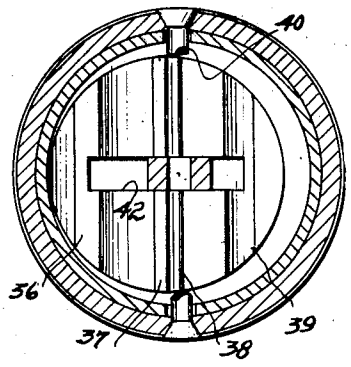


FIG. 7

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CONTROL APPARATUS FOR SWITCHES AND THE LIKE

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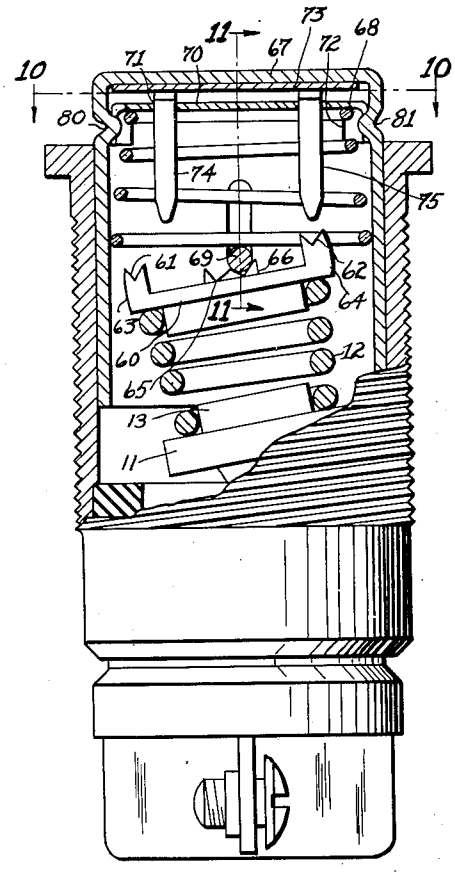


FIG. 9

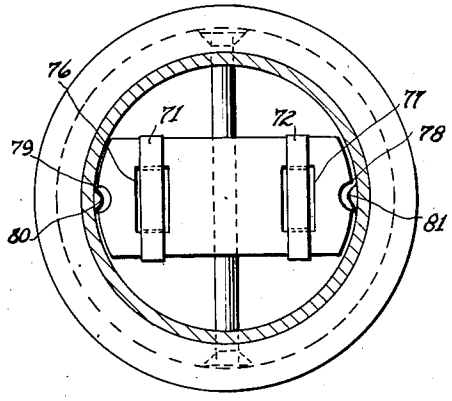


FIG. 10

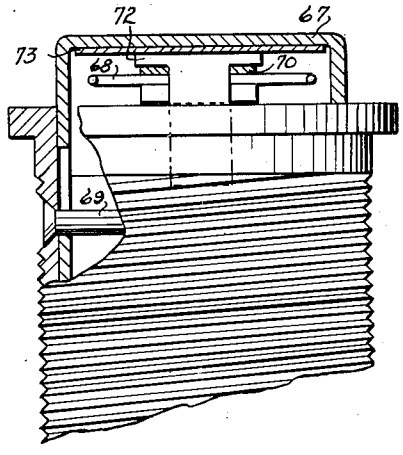


FIG. 11

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Patented May 3, 1949

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UNITED STATES PATENT OFFICE

2,469,337

CONTROL APPARATUS FOR SWITCHES AND THE LIKE

Everard F. Kohl, Lakewood, Ohio

Application May 7, 1945, Serial No. 592,492

18 Claims. (Cl. 200—68)

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My invention relates to apparatus for controlling the movement of contacts, valve parts, and the like. More particularly, it relates to an electrical switch that is a modification of the type shown and described in my copending application, Serial No. 562,496, filed on November 8, 1944.

In my copending application, a switch is disclosed in which the parts are so arranged that the major or predominant component of the force of a resilient member maintains a movable contact in engagement with a stationary contact when the movable parts of the switch are in either of two alternative positions. In that application a switch of the push button or plunger type is shown which when actuated moves the parts to interrupt one circuit and establish another circuit and in which the movable parts automatically return to their original position when the force upon the plunger is released. While such a switch has advantages in certain applications, it is often desirable to provide a switch which when actuated remains in its actuated position after the actuating member is released and in which the parts are so arranged that when pressure is again applied to the actuating member in the same direction, the parts will be returned to their original position.

It is therefore an object of the present invention to provide an improved device including a pair of spaced stationary parts and a third part which is movable from engagement with either stationary part into engagement with the other stationary part when an actuator is moved in the same direction for each actuation and which remains in its actuated position upon release of the actuator.

Another object of my invention is to provide an improved electrical switch having a contact which is movable from engagement with a stationary contact when an actuator is moved in one direction and the actuator is released and which is again movable into engagement with the stationary contact when the actuator is again moved in the same direction.

A further object of my invention is to provide an improved electrical switch including a pair of spaced stationary contacts and a third contact which is movable from engagement with either of the stationary contacts into engagement with the other stationary contact when an actuator is moved in the same direction for each actuation and which remains in its actuated position upon release of the actuator.

A still further object of my invention is to provide an improved electrical switch in which a

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movable contact is maintained in engagement with a stationary contact by the major or predominant component of the force of a resilient member and is movable into engagement with another stationary contact upon movement of an actuator to change the direction of the force of the resilient member to cause the major or predominant component of the force of the resilient member to maintain the movable contact in engagement with the second contact and which remains in its actuated position upon release of the actuator until the actuator is again moved in the same direction, whereupon the switch is again actuated to return the parts to their original position.

Other objects and advantages of my invention will be apparent as the specification proceeds.

My invention will be better understood by reference to the accompanying drawings in which:

Fig. 1 is a central cross sectional view of my improved switch with parts in elevation;

Fig. 2 is a view somewhat similar to that shown in Fig. 1 with some of the movable parts in a different position;

Fig. 3 is an end view of the switch showing the arrangement of the terminal bars;

Fig. 4 is a cross sectional view on the line 4—4 of Fig. 1;

Fig. 5 is a central sectional view of the switch on the line 5—5 of Fig. 2 with parts shown in elevation;

Fig. 6 is a cross sectional view of the switch on the line 6—6 of Fig. 1;

Fig. 7 is a cross sectional view on substantially the line 7—7 of Fig. 1 with parts broken away to show underlying structure;

Fig. 8 is a cross sectional view of the upper portion of the switch shown in Fig. 1 with the parts in the position they occupy when the actuator has been moved inwardly and just before release of the actuator;

Fig. 9 is a view partly in elevation and partly in section of a modified form of my switch;

Fig. 10 is a cross sectional view on the line 10—10 of Fig. 9; and

Fig. 11 is an elevational view of the upper portion of the switch shown in Fig. 9 with parts in cross section on the line 11—11, looking in the direction of the arrow.

Although my improved device may be utilized for various purposes, such as for opening and closing valve parts or moving valve parts into and from engagement with each other, as illustrated in the drawings, it is shown in the form of an electrical switch in which some of the switch

parts are similar to those shown in my copending application. The present invention, however, relates more particularly to the actuating mechanism which may be utilized with switches of various types.

As illustrated, the switch is enclosed in a tubular housing 1 provided at one end with a block of insulating material which extends into the housing in the form of a sleeve 2 and is provided interiorly with substantially rectangular side walls, as shown more particularly in Fig. 4, to form a chamber 3 to receive three aligned stationary contacts 4, 5, and 6, a movable contact 7, and a roll 8 provided with a shaft 9 which is journalled at opposite ends in recesses 10 in the legs of a carriage 11 which is formed of a suitable electrical insulating material. The upper portion of carriage 11 extends above chamber 3 to provide a seat for one end of a coil spring 12 which is maintained in place by a boss 13 extending upwardly from the carriage and the other end of spring 12 bears against an abutment 14 and is held in place by a boss 15 which extends downwardly from the abutment. Abutment 14 is movable by means of an actuator or plunger 16 which is normally maintained in its released position by means of a spring 17.

The block of insulating material serves as a support for contacts 4, 5 and 6 and may be formed in any desired manner and of any suitable electrical insulating material, such as a phenolic condensation product, and if desired the contacts may be molded in the insulating material. As shown more particularly in Figs. 3 and 4, the insulating material consists of a section 18 provided with an outwardly extending rib 20 which terminates in a rectangularly-shaped block 21 and a section 19 provided with a recess to receive block 21 and a pair of outwardly extending ribs 22 and 23 arranged on opposite sides of the block. Rectangularly-shaped slots are formed in section 18 to receive terminal bars 24 and 25 which as shown are integral with contacts 4 and 6, respectively. Terminal bars 24 and 25 are arranged on opposite sides of insulating rib 20 and as illustrated are provided with screws 26 and 27, respectively, to maintain suitable conductors in place. In a like manner a rectangularly-shaped slot is formed in section 19 to receive terminal bar 28 of contact 5 which is insulated from terminal bars 24 and 25 by ribs 22 and 23 and block 21 and is provided with a screw 29 to maintain a suitable conductor in place.

Contacts 4, 5 and 6 extend angularly from their respective terminal bars as illustrated more particularly in Fig. 4 and for strengthening purposes as well as for economical reasons, the movable contact 7 is preferably bimetallic. For instance, the portion engaged by roll 8 is formed of a comparatively strong and inexpensive material, such as bronze, and the portion which engages the contacts is formed of a highly conductive material, such as silver.

When movable contact 7 is in one position, it engages stationary contacts 4 and 5 and when it is in a different position it engages stationary contacts 6 and 5 and during its movement from contacts 4 and 5 to contacts 5 and 6, its central portion is first rocked upon contact 5 to cause it to engage contact 6 and it is then slid upon contacts 5 and 6 to provide a wiping action and in a like manner when contact 7 is moved from engagement with contacts 6 and 5 into engagement with contacts 5 and 4, it is first rocked upon contact 5 to cause it to engage contact 4 and

is then slid upon contacts 5 and 4 to cause a wiping action of the movable contact upon the stationary contacts and while the movable contact may be constructed in any desirable manner to effect these results, as illustrated in the drawings, it has a central apex 30 from which oppositely inclined faces 31 and 32 extend and the silver member has two flat portions opposite faces 31 and 32 to selectively engage contacts 6 and 4, respectively, and a central portion 33 to engage contact 5 which has an outer convex surface to facilitate its rocking action. The opposite ends of the movable contact are also provided with outwardly inclined flanges 34 and 35 for engagement by roll 8.

While the switch so far described is similar to that shown in my prior application, according to the present invention improved means are provided for maintaining movable contact 7 in engagement with either stationary contacts 4 or 5 or stationary contacts 5 and 6 and for actuating the switch to cause contact 7 to move to its alternate positions. For this purpose, movable abutment 14 is provided with a plurality of laterally extending grooves 36, 37, 38 and 39 and when the switch is in the position shown in Fig. 1 of the drawing, movable contact 7 is maintained in engagement with stationary contacts 4 and 5 by means of spring 12 which is held under compression between carriage 11 and abutment 14 by means of a stationary rod 40 which fits in groove 38 of abutment 14.

As illustrated, rod 40 is secured at its opposite ends to housing 1 and carries a block 41, the lower portion of which is received within a longitudinally extending slot 42 formed in movable abutment 14 and while the block fits within the slot with sufficient snugness to prevent turning movement of the abutment, there is sufficient play to permit angular and lateral movement of abutment 14 from the position shown in Fig. 1 to the position shown in Fig. 2.

The upper portion of block 41 provides an abutment for one end of spring 17 which is held in position by a boss 43 extending upwardly from block 41 and the other end of spring 17 bears against a plate 44 which has a downwardly extending tongue 45 for maintaining the opposite end of the spring in place. To prevent turning movement of plate 44, it is provided with flanges 46 and 47 at its opposite ends, each of which has a central slot to receive beads 48 and 49, respectively, extending inwardly from actuator 16.

Plate 44 serves to support and maintain a pair of yokes 50 and 51 in properly spaced relation and the apertures in flanges 46 and 47 extend through the plate to permit inward and outward movement of the plate. As illustrated more particularly in Figs. 1, 5 and 6, each of the yokes is provided with a pair of downwardly extending prongs 52 and 53, respectively, which extend loosely through slots 54 and 54*a* in plate 4. Prongs 52 are bevelled at their lower portion to fit into groove 39 when actuator 16 is moved inwardly and the switch is in the position shown in Fig. 1 and prongs 53 are bevelled at their lower portion to fit into groove 36 when the switch is in the position shown in Fig. 2 and actuator 16 is moved inwardly.

As will be apparent from Figs. 1 and 2 of the drawings, plate 44 and yokes 50 and 51 are maintained in their uppermost position by the force of spring 17 and to prevent damage to the upper portion of the plunger or actuator, a disk or bearing plate 55 formed of hard steel or other

suitable material is interposed between yokes 50 and 51 and the upper portion of the actuator. Actuator 16 is also provided with slots 56 and 56a to receive rod 40 which limits the inward and outward movement of the actuator. Slots 56 and 56a are of sufficient length to permit actuation of the switch to either position and to permit a predetermined overtravel of the plunger after the switch is actuated and to also provide a space between prongs 52 and 53 above the movable abutment 14 when the force upon the actuator is released which permits a predetermined amount of pretravel before the switch is actuated.

When the parts are in the position shown in Fig. 1, it will be noted that carriage 11 is inclined upwardly toward the right as shown in Fig. 1 and spring 12 which is compressed between carriage 11 and abutment 14 inclines movable abutment 14 in a similar direction and the major or predominant component of the force of spring 12 is directed toward maintaining contact 7 firmly in engagement with stationary contacts 4 and 5, thus eliminating chattering at the contacts. When movable abutment 14 is in this position, groove 39 is directly below prongs 52 so that when actuator 16 is forced inwardly prongs 52 of yoke 51 enter groove 39 of the movable abutment and upon the application of additional pressure to the actuator, the angular position of abutment 14 is changed and the portion of the coil spring below groove 39 is compressed to a greater extent than the other portions of the spring, thus changing the direction of the force of spring 12.

During the inward movement of the actuator and the change in inclination of abutment 14, prongs 52 and 53 will be inclined to the right as illustrated in Fig. 8, forcing plate 44 away from bearing plate 55 and prongs 53 will ride over inclined wall 37a of groove 37 into contact with stationary rod 40 which passes over the apex between grooves 36 and 37 into groove 37 during the angular movement of the abutment. It will be noted that during the initial compression of that portion of spring 12 below groove 39, the abutment is first moved angularly changing the direction of the force of spring 12. During this initial compression of spring 12, lateral movement of abutment 14 is prevented by rod 40 which rests in groove 38. When the portion of spring 12 below groove 39 is compressed to a sufficient extent, however, the direction of the force of spring 12 changes and it moves abutment 14 laterally, causing rod 40 to pass over the apex between grooves 38 and 37 which causes a further rapid change in the direction of the force of spring 12.

When the direction of the force of spring 12 is changed, it of course exerts a force to move roll 8 into engagement with the inclined face 32 of movable contact 7 causing a rocking action of apex 33 of the movable contact upon stationary contact 5 and forcing the portion of the contact opposite face 32 into engagement with stationary contact 6. Roll 8 then engages flange 34 to slide movable contact 7 with a wiping action over stationary contacts 5 and 6 to the position shown in Fig. 2. During this movement, the portion of contact 7 opposite face 31 is maintained in engagement with contact 4 while roll 8 is moving over face 31 and consequently roll 8 is moving at high speed when it strikes face 32 which ensures a fast make and break of the contacts.

When actuator 16 is released, spring 17 returns it to its original position and during this movement spring 17 exerts a force upon plate 44 which returns prongs 52 and 53 to their original vertical position as shown in Fig. 2. At this time carriage 11 is inclined upwardly toward the left and abutment 14 is inclined in a similar direction and is maintained in that position by stationary rod 40 and the force of spring 12. When the parts are in the position shown in Fig. 2, the major or predominant component of the force of spring 12 is directed toward maintaining movable contact 7 in engagement with stationary contacts 6 and 5.

When the parts are in the position shown in Fig. 2, the switch may be actuated to the position shown in Fig. 1 by again moving actuator 16 inwardly. Since abutment 14 is now in a different position, however, as actuator 16 is forced inwardly, prongs 53 enter groove 36 of movable abutment 14 and compress the portion of spring 12 below groove 36 to a greater extent than the other portions of the spring, thereby changing the direction of the force of spring 12 and the inclination of movable abutment 14. As the inclination of abutment 14 changes, prongs 53 will be inclined toward the left, and prongs 52 upon engaging the inclined wall 38a of groove 38 will be inclined in a direction similar to prongs 53 and will finally engage stationary rod 40. During the initial compression of that portion of spring 12 below groove 36, rod 40 restrains lateral movement of abutment 14. When that portion of spring 12 below groove 36 is compressed to a sufficient extent, however, it causes lateral movement of abutment 14 and during this lateral movement, rod 40 rides over the apex between grooves 37 and 38 into groove 38, thereby causing a further rapid change in the direction of the force of spring 12.

The change in the direction of the force of spring 12 during the inward movement of the actuator forces roll 8 over movable contact 7 and as it engages face 31 of that contact, it rocks movable contact 7 upon stationary contact 5 and forces the portion of contact 7 opposite the face 31 into engagement with stationary contact 4, and during this movement the portion of contact 7 opposite face 32 is maintained in engagement with contacts 5 and 6 until roll 8 engages inclined face 31 at which time roll 8 is in rapid motion so that the circuit between contact 7 and contact 6 is quickly interrupted and the circuit between contact 7 and contact 4 is quickly established. Roll 8 then engages flange 35 and slides movable contact 7 over stationary contacts 5 and 4 with a wiping action and when the force upon actuator 16 is released, spring 17 returns the parts to the original position shown in Fig. 1.

In constructing grooves 36, 37, 38 and 39, it will be noted that grooves 37 and 38 are more deeply embedded in abutment 14 than grooves 36 and 39 and that the inclined faces of grooves 37 and 38 which converge to form apex 57 are comparatively short to permit rod 40 to ride over the apex into groove 37 when the switch is actuated to move abutment 14 from the position shown in Fig. 1 to the position shown in Fig. 2 and to ride over apex 57 into groove 38 when the switch is actuated to move abutment 14 from the position shown in Fig. 2 to the position shown in Fig. 1.

While the switch may be supported in any desired manner, as illustrated in the drawings, the housing 1 is threaded as indicated by the numeral 58 to engage a suitably threaded support. Housing 1 is also provided with an inwardly ex-

tending bead 59 which fits in a slot in sleeve 2 to prevent angular movement of sleeve 2.

Another modification of my invention is shown in Figs. 9 to 11, inclusive. This modification is similar to that disclosed in Figs. 1 to 8, inclusive, and the movable and stationary contacts are arranged in the same manner. The movable abutment 60, however, is of the floating type and a pair of spaced grooves 61 and 62 are provided in flanges 63 and 64 extending upwardly from the opposite ends of the abutment and arranged centrally upon the upper portion of the abutment 60 is an additional projection provided with grooves 65 and 66.

To normally maintain the actuator 67 in its released position, a spring 68 is provided, the lower portion of which engages a stationary rod 69 and the upper portion of which engages a plate 70. For actuating the switch, a pair of strips 71 and 72 are arranged between plate 70 and a bearing plate 73 and each strip is provided with a downwardly extending prong 74 and 75, respectively, which extend loosely through slots 76 and 77 in plate 70. As in the previous modification, plate 70 is provided with flanges having apertures 78 and 79 to permit inward and outward movement of the plate but the plate is prevented from substantial angular movement by means of beads 80 and 81 extending inwardly from actuator 16. The remainder of the switch is similar to that shown in Figs. 1 to 8, inclusive, and consequently the parts have been designated by the same reference numerals.

The operation of the switch is similar to that shown in Figs. 1 to 8, inclusive. When actuator 67 is forced inwardly, the bevelled portion of prong 75 is forced into groove 62 and compresses the portion of the spring below groove 62 and changes the direction of the force of spring 12 to actuate the switch in one direction and during the actuation of the switch, movable abutment 60 is inclined outwardly toward the left and is moved laterally to cause stationary rod 69 to ride over the apex between grooves 66 and 65 into groove 65 and prongs 74 and 75 are inclined to the right similar to the manner shown in Fig. 8. Upon the release of the actuator groove 61 will be directly under prong 74 and the switch may again be actuated to return the parts to the original position by again moving the actuator inwardly as will be apparent to those skilled in the art.

While the switch is shown and described as being of the type in which one electrical circuit is interrupted and another electrical circuit is established when the switch is actuated, it will of course be understood that the switch may be utilized to interrupt and establish a single circuit. In such case, contact 6 or contact 5 may be utilized as a stop. Other modifications of my invention will be apparent to those skilled in the art and it will of course be understood that I contemplate by the appended claims to cover any such modifications as fall within the true purpose and scope of my invention.

What I claim is:

1. Apparatus of the class described comprising a stationary contact and a movable contact, means for maintaining the movable contact in engagement with the stationary contact including a movable abutment provided with first and second grooves arranged adjacent opposite edges thereof, an actuator, means associated with said actuator including first and second inwardly extending prongs, resilient means for maintaining said actuator in a released position and the first prong in alignment with the first groove in said abutment when said abutment is in one position and said first prong being receivable in the first groove of said abutment to apply pressure to the abutment adjacent thereto to change its angular position when the actuator is moved inwardly, means responsive to the movement of said abutment for disengaging the stationary contact from the movable contact, and said resilient means being effective in returning said prongs to their normal position and for maintaining the second prong in alignment with the second groove in said abutment when the abutment is in the second position.

2. Apparatus of the class described comprising a stationary contact and a movable contact, means for maintaining the movable contact in engagement with the stationary contact including a movable abutment provided with first and second grooves arranged adjacent opposite edges thereof, an actuator, means associated with said actuator including first and second inwardly extending prongs, resilient means for maintaining said actuator in a released position and the first prong in alignment with the first groove in said abutment when said abutment is in one position and said first prong being receivable in the first groove of said abutment to apply pressure to the abutment adjacent thereto to angularly move it when the actuator is moved inwardly, and means responsive to the movement of said abutment for disengaging the stationary contact from the movable contact, said resilient means being effective in returning said prongs to their normal position and for maintaining the second prong in alignment with the second groove in said abutment when the abutment is in the second position and said second prong being receivable in the second groove of said abutment to return the abutment to its original position when the actuator is again moved inwardly.

3. Apparatus of the class described comprising a stationary contact and a movable contact, means for maintaining the movable contact in engagement with the stationary contact including an inclined movable abutment provided with first and second grooves arranged adjacent opposite edges thereof, an actuator, a movable plate arranged interiorly of said actuator, first and second prongs associated with said plate and being movable angularly relative thereto, resilient means for normally maintaining said actuator in released position and said prongs perpendicular to said plate, said first prong being receivable in the first groove of said abutment to change the inclination of said abutment and the second prong being engageable with another portion of said abutment when said actuator is moved inwardly and said prongs being movable to an inclined position to follow the movement of said abutment during its angular movement, and means responsive to the change of the angular movement of said abutment for disengaging the movable contact from the stationary contact and changing the lateral position of said abutment, said spring being effective in returning said plate and said prongs to their original position when the actuator is released and the angular and lateral movement of said abutment being sufficient during the movement of said actuator to position its second groove in alignment with the second prong when the actuator is released.

4. Apparatus of the class described comprising a stationary contact, a movable contact, an actu-

ator, resilient means for maintaining the movable contact in engagement with the stationary contact, an abutment having oppositely disposed faces, said abutment being arranged in an inclined position and being movable both angularly and laterally and having one face engaging said resilient means, stationary means engaging the other face of said abutment for maintaining it in its inclined position, and means associated with said actuator for engaging one edge of said abutment to compress one portion of said resilient means to a greater extent than other portions to change the inclination of said abutment and the direction of force of said resilient means, said resilient means being effective during the compression of a portion thereof in moving said abutment in a lateral direction and forcing the movable contact from the stationary contact and said stationary means being effective in maintaining said abutment in its second inclined position to maintain the movable contact in its disengaged position.

5. Apparatus of the class described comprising a stationary contact, a movable contact, an actuator, means for maintaining the movable contact in engagement with the stationary contact including first resilient means, an inclined abutment having oppositely disposed faces, one face of which engages said resilient means and stationary means engaging the other face of said abutment, said abutment being movable both angularly and laterally, first means associated with said actuator for engaging one edge of said abutment during movement of said actuator to change the inclination of said abutment to compress one portion of said resilient means to a greater extent than the other portions and to change the direction of the force of said resilient means to force the movable contact and to move said abutment laterally from the stationary contact, and said stationary means being effective in maintaining the movable contact in its disengaged position, second resilient means for returning the actuator to its released position, and a second means associated with said actuator which is effective during a second movement of said actuator in the same direction for compressing another portion of the first resilient means to a greater extent than the other portions to change the direction of the force of the first resilient means to return the movable contact to its original inclined and lateral position.

6. Apparatus of the class described comprising a stationary contact, a movable contact, an actuator, means for maintaining the movable contact in engagement with the stationary contact including a first resilient means, an inclined abutment having oppositely disposed faces, one face of which engages said resilient means, and stationary means engaging the other face of said abutment, said abutment being movable both angularly and laterally, a second resilient means associated with said stationary means and said actuator for normally maintaining said actuator in released position, first means associated with said actuator for engaging one edge of said abutment during movement of said actuator to change the inclination of said abutment to compress one portion of the first resilient means to a greater extent than the other portions and to change the direction of the force of the first resilient means to force the movable contact from the stationary contact and move said abutment in a lateral direction and said stationary means being effective in maintaining the movable contact in its disengaged position and said second resilient means being effective in returning said actuator to its released position, and a second means associated with said actuator which is effective during a second movement of said actuator in the same direction for compressing another portion of the first resilient means to a greater extent than other portions to change the direction of the force of the first resilient means to return the movable contact to its original inclined and lateral position.

7. Apparatus of the class described comprising a stationary contact, a movable contact, an actuator, means for maintaining the movable contact in engagement with the stationary contact including a spring, an inclined abutment having one face engaging said spring and first and second grooves separated by an apex formed in the opposite face of said abutment, a stationary rod arranged in the first groove and serving to maintain said abutment in engagement with said spring, resilient means for maintaining said actuator in a released position, means associated with said actuator for engaging one edge of said abutment during movement of said actuator to change the inclination of said abutment and compress a portion of said spring to a greater extent than other portions to move said abutment laterally to cause said rod to enter the second groove on said abutment and change the direction of the force of said spring to force the movable contact from the stationary contact, said stationary means being effective in maintaining the movable contact in its disengaged position, and said resilient means being effective in returning said actuator to its released position after said actuation, and a second means associated with said actuator which is effective during a second movement of said actuator in the same direction for compressing a portion of said spring to a greater extent than other portions to return said abutment to its original inclined position and to move said abutment laterally to cause said rod to enter in the first groove of said abutment to change the direction of the force of said spring to return the movable contact to its original position.

8. Apparatus of the class described comprising a stationary contact, a movable contact, an actuator, means for maintaining the movable contact in engagement with the stationary contact including a coil spring, an inclined movable abutment having oppositely disposed faces, one face of which engages said spring and stationary means engaging the opposite face of said abutment, said abutment being movable both angularly and laterally, resilient means for maintaining said actuator in released position, first means associated with one portion of said actuator for engaging said abutment to change its inclination to a second position and to compress one portion of said spring to a greater extent than other portions to change the direction of the force of said spring to disengage the movable contact from the stationary contact and move said abutment in a lateral direction and said stationary means being effective in maintaining the movable contact in its disengaged position when said actuator is released, and second means associated with said actuator which is effective during a second movement of said actuator in the same direction for engaging another portion of said abutment when said abutment is in its second position to compress another portion of said spring to change the direction of the force of said spring to return

the movable contact to its original inclined and lateral position.

9. Apparatus of the class described comprising a stationary contact, a movable contact, an actuator, means for maintaining the movable contact in engagement with the stationary contact including a coil spring, an inclined movable abutment having one face engaging the coil spring and stationary means engaging the other face of said abutment about which said abutment may be moved and the face of said abutment remote from said spring being provided with first and second grooves adjacent its respective opposite edges, resilient means for maintaining said actuator in released position, a pair of prongs associated with said actuator, one of which is in alignment with one of said grooves when said abutment is inclined in one direction and is engageable therein during movement of said actuator to move said abutment to change its inclination to compress one portion of said spring to a greater extent than other portions to change the direction of the force of said spring to cause disengagement of the movable contact from the stationary contact and said stationary means being effective in maintaining said contact in disengaged position when said actuator is released and the movement of said abutment during said actuation being effective in aligning the second groove with the second prong on said actuator so that during a second movement of said actuator in the same direction, the second prong enters the second groove and moves said abutment to return it to its original inclined position and compresses one portion of said spring to a greater extent than other portions to change its direction of force to return the movable contact into engagement with the stationary contact.

10. Apparatus of the class described comprising a stationary contact, a movable contact, an actuator, means for maintaining the movable contact in engagement with the stationary contact including a coil spring, an inclined abutment having one face engaging said spring and stationary means for preventing disengagement of said abutment from said spring, said abutment being movable both angularly and laterally and being provided with a longitudinally extending groove and the stationary means having a block arranged in said groove to guide the movement of said abutment, resilient means associated with said block and said actuator for maintaining the actuator in its released position, means associated with one portion of said actuator for engaging one edge of said abutment during movement of said actuator and changing the inclination of said abutment to compress one portion of said spring to a greater extent than other portions to change the direction of the force of said spring to a sufficient extent to disengage the movable contact from the stationary contact and move said abutment laterally and second means associated with said actuator which is effective during a second movement of said actuator in the same direction for engaging another portion of said abutment to return said abutment to its original inclined and lateral position and to change the direction of the force of said spring to return the movable contact into engagement with the stationary contact.

11. Apparatus of the class described comprising a stationary contact, an actuator, a movable contact, means for maintaining the movable contact in engagement with the stationary contact including a coil spring, an inclined abutment having one face engaging said spring and a stationary rod engaging the other face of said abutment to prevent disengagement of said abutment from said spring, resilient means having one end bearing on said rod and the other end associated with said actuator for normally maintaining said actuator in its released position, means associated with one portion of said actuator for engaging one edge of said abutment during movement of said actuator and changing the inclination of said abutment to compress one portion of said spring to a greater extent than other portions to change the direction of the force of said spring to a sufficient extent to disengage the movable contact from the stationary contact, and second means associated with said actuator which is effective during a second movement of said actuator in the same direction for engaging another portion of said abutment to return said abutment to its original inclined position and to change the direction of the force of said spring a sufficient extent to return the movable contact into engagement with the stationary contact.

12. Apparatus of the class described comprising a stationary contact, a movable contact, an actuator, resilient means for maintaining the movable contact in engagement with the stationary contact, an abutment arranged in an inclined position and being movable both angularly and laterally and having one face engaging said resilient means, stationary means engaging the other face of said abutment for maintaining it in its inclined position, means associated with said actuator for engaging one edge of said abutment to compress one portion of said resilient means to a greater extent than other portions to change the inclination of said abutment and the direction of the force of said resilient means, means associated with said abutment and stationary means for preventing lateral movement of said abutment until the portion of said resilient means has been compressed to a considerable extent, said resilient means being effective after the compression of a portion thereof in laterally changing the position of said abutment to rapidly change the direction of the force of said spring to force the movable contact from the stationary contact and said stationary means being effective in maintaining said abutment in its second position to maintain the movable contact in its disengaged position.

13. Apparatus of the class described comprising a stationary part, a movable part, means for maintaining the movable part in engagement with the stationary part including an abutment movable angularly in opposite directions and resilient means arranged between said abutment and the movable part, said abutment having inner and outer oppositely disposed faces, the inner face being in engagement with said resilient means and being inclined in a direction to incline said resilient means to a position in which the force of said resilient means maintains the movable part in engagement with the stationary part, a movable actuator, first means associated with said actuator which is responsive to the movement of said actuator toward said abutment for engaging one edge of the outer face of said abutment and angularly moving said abutment in a direction to compress one portion of said resilient means to a greater extent than other portions to thereby change the inclination of said abutment and said resilient means to positions in which the force of said resilient means disengages the movable part from the stationary part,

and second means associated with said actuator which is responsive to the movement of said actuator a second time in the same direction for engaging the opposite edge of the outer face of said abutment to angularly move said abutment in the opposite direction to compress another portion of said resilient means to a greater extent than other portions to return said abutment and resilient means to their originally inclined positions in which the direction of the force of said resilient means is effective in returning the movable part into engagement with the stationary part.

14. Apparatus of the class described comprising first and second stationary contacts, a movable contact, means for maintaining the movable contact in engagement with the first stationary contact including an abutment movable angularly in opposite directions and resilient means arranged between said abutment and the movable contact, said abutment having inner and outer oppositely disposed faces, the inner face being in engagement with said resilient means and being inclined in a direction to incline said spring to a position in which the force of said resilient means maintains the movable contact in engagement with the first stationary contact, a movable actuator, first means associated with said actuator which is responsive to the movement of said actuator toward said abutment for engaging an edge of the outer face of said abutment and angularly moving said abutment in one direction to compress one portion of said resilient means to a greater extent than other portions to thereby change the direction of the force of said resilient means for disengaging the movable contact from the first stationary contact and forcing it into engagement with the second stationary contact, and second means associated with said actuator which is responsive to the movement of said actuator a second time in the same direction for engaging the opposite edge of the outer face of said abutment to angularly move said abutment in the opposite direction and compress another portion of said resilient means to a greater extent than the remaining portion to return said abutment and said resilient means to their originally inclined positions in which the direction of the force of said resilient means is effective in returning the movable contact into engagement with the first stationary contact.

15. Apparatus of the class decribed comprising a stationary contact, a movable contact, an actuator, means for maintaining the movable contact in engagement with the stationary contact including a movable abutment arranged in an inclined position and having oppositely disposed inner and outer faces, resilient means interposed between the movable contact and said abutment and engaging the inner face of said abutment, and stationary means engaging the outer face of said abutment, first means associated with said actuator and being movable in response to the movement of said actuator to engage one edge of the outer face of said abutment to move said abutment in an angular direction and compress one portion of said spring to a greater extent than other portions to thereby change the direction of the force of said spring to disengage the movable contact from the stationary contact, said stationary means being effective in maintaining said abutment in its second inclined position to maintain the movable contact in its disengaged position, and second means associated with said actuator which is responsive to the movement of said actuator a second time in the same direction for engaging the opposite edge of the outer face of said abutment to angularly move said abutment in the opposite direction to compress another portion of said resilient means to a greater extent than the remaining portions to thereby return said resilient means and said abutment to their originally inclined positions in which the direction of the force of said resilient means is effective in returning the movable contact to its original position in engagement with the stationary contact.

16. Apparatus of the class described comprising a stationary contact, a movable contact, means for maintaining the movable contact in engagement with the stationary contact including first resilient means, a movable abutment having oppositely disposed inner and outer faces, the inner face of which is in engagement with said resilient means, and a stationary rod which engages the outer face of said abutment and maintains said abutment in engagement with said resilient means, an actuator movable toward and away from said abutment, a second resilient means for normally spacing said actuator from said abutment, said actuator having first means associated therewith for engaging an edge of the outer face of said abutment during movement of said actuator toward said abutment to compress one portion of the first resilient means to a greater extent than other portions to thereby change the direction of the force of the first resilient means for disengaging the movable contact from the stationary contact, said rod, movable abutment and first resilient means being effective in maintaining the movable contact in its disengaged position when the force upon said actuator is released, and second means associated with said actuator which is responsive to the movement of said actuator a second time in the same direction for engaging the opposite edge of the outer face of said abutment to angularly move said abutment in the opposite direction to compress another portion of the first resilient means to a greater extent than the remaining portions to thereby return the first resilient means to its originally inclined position in which the direction of its force is effective in returning the movable contact to its original position in engagement with the stationary contact.

17. Apparatus of the class described comprising a stationary contact, a movable contact, an actuator, resilient means for maintaining the movable contact in engagement with the stationary contact, an abutment arranged in an inclined position and being movable both angularly and laterally and having one face engaging said resilient means, means associated with said actuator for engaging one edge of said abutment for compressing one portion of said resilient means to a greater extent than other portions to angularly move said abutment to change its inclination and the direction of the force of said resilient means, means for restraining lateral movement of said abutment during the initial compression of a portion of said resilient means which restraining means becomes ineffective after said resilient means is compressed to a predetermined extent to thereby permit rapid lateral change in the position of said abutment and rapid change in the direction of the force of said spring to force the movable contact from the stationary contact.

18. Apparatus of the class described comprising a stationary contact, a movable contact, an

actuator, resilient means for maintaining the movable contact in engagement with the stationary contact, an abutment arranged in an inclined position and being movable both angularly and laterally and having one face engaging said resilient means, means associated with said actuator for engaging one edge of said abutment for compressing one portion of said resilient means to a greater extent than other portions to change the inclination and the direction of force of said resilient means, means for restraining the lateral movement of said abutment during the initial compression of a portion of said resilient means which restraining means becomes ineffective after the portion of said resilient means has been compressed to a predetermined extent to thereby permit lateral change in the position of said abutment to rapidly change the direction of the force of said resilient means to force the movable contact from the stationary contact, second means associated with said actuator which is responsive to the movement of said actuator a second time in the same direction for engaging the opposite edge of said abutment to angularly move said abutment in the opposite direction to compress another portion of said resilient means to a

greater extent than the remaining portion and said restraining means being again effective in preventing lateral movement of the abutment during initial compression of a portion of said resilient means to thereby effect a rapid change in the lateral position of said abutment when said restraining means becomes ineffective to rapidly increase the force of said resilient means in returning the movable contact in engagement with the stationary contact.

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