Feb. 9, 1965 S. A. WOODWARD 3,169,173

PUSH-BUTTON SWITCH OPERABLE BY EXTERNAL ACTUATOR

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Fig. 1.

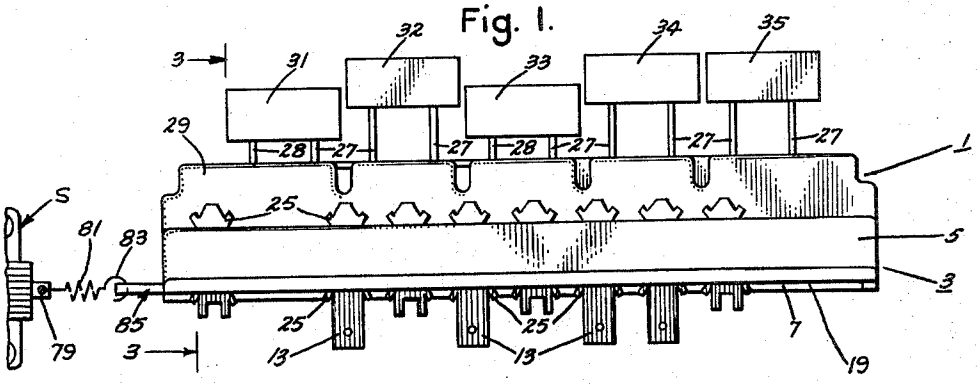


Fig. 2.

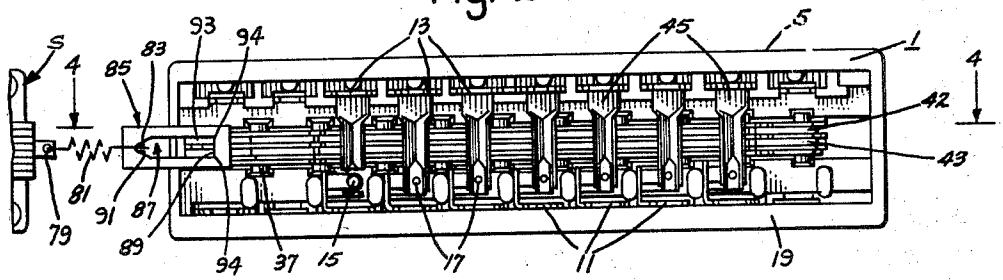


Fig. 4.

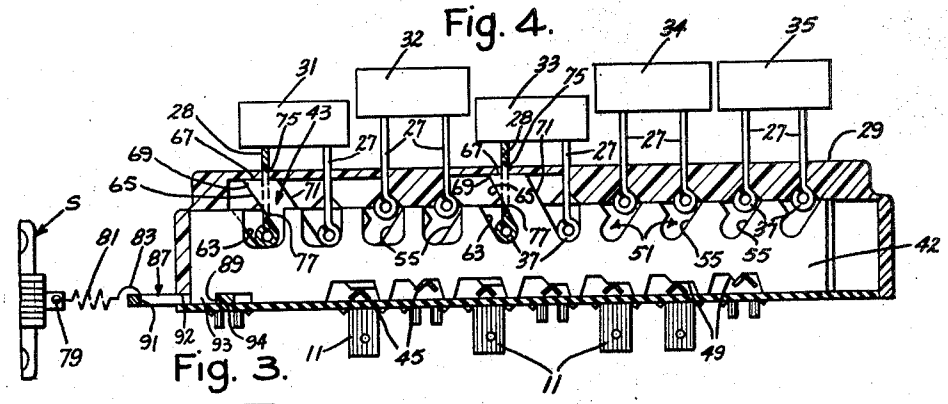
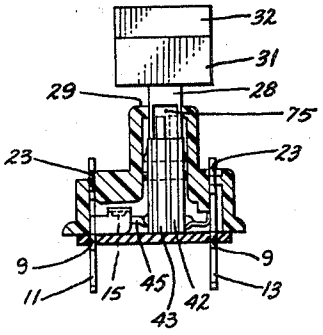


Fig. 3.



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Fig. 5.

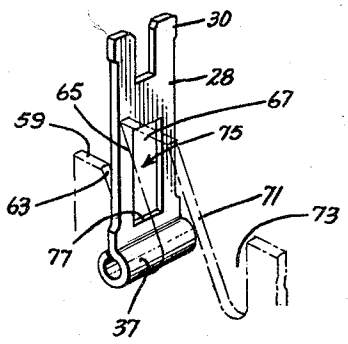
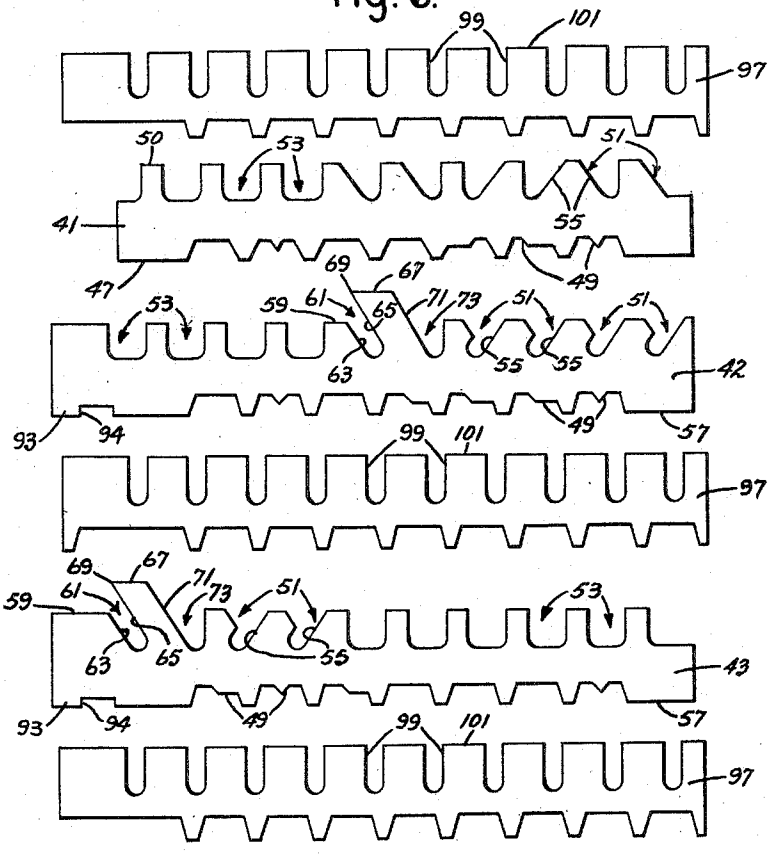


Fig. 6.



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United States Patent Office 3,169,173 Patented Feb. 9, 1965

3,169,173

PUSH-BUTTON SWITCH OPERABLE BY EXTERNAL ACTUATOR

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Filed Feb. 1, 1962, Ser. No. 170,382
5 Claims. (Cl. 200—5)

This invention relates to a push-button switch and particularly a multiple push-button switch with a series of manually controlled push buttons which may be depressed to control the operation of several circuits connected through the switch.

Push-button switches have been used in great numbers as appliance switches for electric ranges, washing machines, and room air conditioners, etc., to control the circuitry thereof. In some applications of these switches, it is desirable to operate one or more of the push buttons to their depressed positions by means of an external device, such as, for example, a solenoid. The principal object of the present invention is to provide a push-button switch with a novel, low cost, and efficient means for positively operating push buttons by an external device.

Another object of the present invention is to provide an improved push-button switch wherein coaction between push buttons and associated sliders is effectively employed to operate the pushbuttons to depressed positions in response to mechanical actuation by a device external to the switch.

In carrying out my invention, in one form thereof, I apply it to a multiple push-button switch with movable elongated sliders. This switch includes a base, and a plurality of pushrods which are mounted thereto to selectively control the relative positions of a plurality of cooperating sliders. Movable contacts are also mounted on the base and they are operated by movement of certain of the sliders in response to depression of the pushrods. By my invention, one or more of the switch actuating sliders is operably linked to an externally located solenoid and arranged to positively cooperate with one or more associated pushrods for depressing the pushrod in response to movement of the slider by the solenoid. The slider is arranged for reciprocating movement between first and second positions to operate one or more movable contacts, and the solenoid is arranged so that it moves the slider between its first position and its second position. One or more special inclined recesses are formed in the slider. Each of these recesses includes a pair of inclined upper and lower surfaces disposed in substantially parallel relative disposition. The lower inclined surface is acted upon by the inner end of an associated pushrod during the depression thereof to move the slider between its first position and its second position. The upper inclined surface is slidably and continuously cooperable with a slot formed in the pushrod between its ends to positively retract the pushrod from its outermost to its depressed position in response to actuation of the slider by the solenoid. With such an arrangement, actuation of the pushrods to their depressed positions is effectively achieved by an external device at a minimum cost.

Further aspects of my invention will become apparent hereinafter, and the specification concludes with claims particularly pointing out and distinctly claiming the subject matter which I regard as my invention. The invention, however, as to organization and method of operation, together with further objects and advantages thereof, may best be understood by reference to the following description when taken in conjunction with the accompanying drawings, in which:

FIG. 1 is a front elevational view of a multiple push-

button switch embodying one form of the present invention, the switch being operably linked to a fragmentarily illustrated solenoid;

FIG. 2 is a bottom view of the switch of FIG. 1, with the cover removed therefrom;

FIG. 3 is a sectional view taken generally along the lines 3—3 of FIG. 1;

FIG. 4 is a sectional view taken generally along the line 4—4 of FIG. 2, and including the cover;

FIG. 5 is a perspective view of one of the pushrods of the switch embodying the present invention, with a broken line fragmentary illustration of cooperating slider structure; and

FIG. 6 is a layout view showing the configuration of the movable sliders and guiding members of the switch.

Referring in detail to the drawings and in particular to FIGS. 1 and 4, there is shown a multiple push-button switch 1 wherein my invention has been advantageously employed. The switch housing 3 includes a hollow base 5 and a relatively thin cover plate 7 which are formed of suitable insulating material and cooperate to provide a compact supporting structure for the slider and manual actuating mechanisms of the switch. Cover plate 7 has two oppositely disposed rows of narow slots 9 (FIG. 3) through which terminals 11 and 13 extend. Terminals 11 are connected to and support fixed contacts 15 (FIGS. 2 and 3) and terminals 13 are connected to and support movable contacts 17. (See FIG. 2) To mount plate 7 to base 5, the plate is positioned on the bottom 19 of the base and secured thereto by the terminals 11 and 13 of the fixed and movable contacts. These terminals each extend through cover plate slots 9 and aligned or overlying slots 23 in the base 5 (FIG. 3) with appropriate projecting fingers 25 adajcent the outer surfaces of the base and plate being lapped over in the well-known manner to hold the terminals in place and secure together the cover and base.

To actuate switch 1, pushrods 27 and 28 extend downwardly through top wall 29 of base 5 into the hollow portion thereof. (See FIGS. 1 and 4.) The pushrods 27 and 28 have bifurcated outer ends 30 (as illustrated for pushrod 28 in FIG. 5) for securely engaging the push buttons 31–35, these pushrods also differing structurally from each other, as shall be explained in detail hereinafter. The push buttons 31 and 33 are each attached to the outer ends 30 of an adjacent pair of different pushrods 27 and 28 (as shown in FIG. 4), and the push buttons 32, 34, and 35 are each attached to an adjacent pair of identical pushrods 27 (FIG. 4). By arranging the pushrods in pairs for control by the push buttons 31–35, a means is obtained for operating these pairs in unison to effectively control and balance the push buttons during the reciprocation thereof.

For selectively controlling the switch contacts in response to reciprocation of pushrods 27 and 28, these pushrods have cylindrically configured actuating portions 37 (FIG. 4) formed at their inner ends. Portions 37 each cooperate with and act upon elongated switch actuating sliders 41, 42, and 43 to control the positions of movable contact supporting arms 45 of the switch. For a better understanding of the sliders 41, 42, and 43, attention is directed to the layout view of FIG. 6 wherein the sliders 41–43 are shown in detail. At the outset, it should be recognized that slider 41 is of a well-known standard type and that this invention relates to the construction, utilization, and mode of operation of sliders 42 and 43. Looking first at slider 41, it will be noted that its lower longitudinal edge 47 is shaped to provide cam surfaces 49 which are adapted to engage the central portion (FIG. 4) of certain predetermined movable switch arms 45 so as

to open and close circuits through these arms. The uppermost edge 50 of the slider 41 is provided with a series of adjacent pairs of similarly configured working recesses 51, and clearance recesses 53, respectively. Each adjacent pair of similarly configured working recesses 51 cooperates with an adjacent pair of conjunctively operated pushrods. More particularly, each adjacent pair of working recesses 51 includes a pair of working surfaces 55 sloped in the same manner, the surfaces 55 being engaged by the inner portions 37 of associated pushrods for shifting the slider 41 back and forth within the switch housing 3 in the well-known manner.

Turning now to a detailed explanation of an important aspect of my invention, which is the provision in my improved switch of an effective and simplified means for positively operating one or more of the push buttons by an external actuating device, attention is directed to the sliders 42 and 43 of FIG. 6. In the illustrated switch 1, sliders 42 and 43 are of elongated construction, and are slightly longer than slider 41. A solenoid S is located on the left side of switch 1, as shown in FIGS. 1, 2, and 4, and is operably linked to the ends of the two sliders 42 and 43, as shall be described in detail hereinafter. Sliders 42 and 43 are adapted to efficiently operate push buttons 31 and 33 in response to energization of solenoid S. More particularly, the sliders 42 and 43 are constructed similarly to slider 41 in that they have their lower longitudinal edges 57 shaped to provide cam surfaces 49 (FIG. 6). These cam surfaces 49 of the sliders 42 and 43 engage certain predetermined movable switch arms 45 to open and close circuits through these arms in the same manner as described for slider 41. The uppermost longitudinal edges 59 of the sliders 42 and 43 somewhat resemble slider 41 in that they include a series of adjacent pairs of similarly configured working recesses 51 and clearance recesses 53. However, in accordance with the present invention, each of these sliders 42 and 43 further includes a special inclined recess 61 which opens into edge 59 thereof. Recess 61 includes a pair of inclined and opposed lower and upper surfaces 63 and 65, respectively (viewing FIG. 6), which are disposed in substantially parallel disposition.

In the particular illustrated embodiment of the present invention, the inclined surface 63 is shorter in length than the inclined surface 65 and is disposed closest to the solenoid S. The longer inclined surface 65 is thus disposed farther away from the solenoid S than its opposed surface 63, and, as shown in FIG. 6, it terminates at projecting horizontal surface 67 to form pointed edge 69. As shown in FIGS. 4 and 6, the surfaces 67 and 65 are related to each other by an acute angle to form the pointed edge 69. The other side of horizontal projecting surface 67 (i.e., the side farthest away from the solenoid S) is disposed at an obtuse angular relationship with an elongated working surface 71. Working surface 71 is formed, as shown in FIG. 6, so that it is parallel to the inclined surfaces 63 and 65 and forms part of a working recess 73.

As previously mentioned, the pushrods 27 and 28 of switch 1 differ from each other in their construction. This difference resides in the fact that the pushrods 27 are of generally solid or imperforate construction between their bifurcated outer ends 30 and actuating portions 37, whereas, pushrods 28, as shown in FIG. 5, have an elongated slot 75 formed between their inner and outer ends. To put this another way, pushrods 27 are constructed similarly to the pushrods 28 shown illustratively in FIG. 5, except for the fact that they have no slots 75 formed therein between their ends. The slot 75 has an oblong rectangular configuration and includes a lower transverse edge 77 which is adjacent and parallel to the axis of cylindrical portion 37. Briefly stated, the purpose of the slot 75 in pushrods 28 is to enable the upper surface 65 of the special recess 61 of each of the sliders 42 and 43 to slidably cooperate with its associated pushrod 28 for positively and continuously controlling the movement of this pushrod from its outermost to its depressed position in response to energization of solenoid S.

For operating the sliders 42 and 43 in response to a mechanical force exerted thereupon by the externally located solenoid S, as shown in FIGS. 1, 2, and 4, plunger 79 of the solenoid S has a coiled tension spring 81 suitably connected at one of its ends thereto. Spring 81 has a looped end 83 which is hooked into engagement with an apertured link 85. More particularly, the link 85 is a flat, elongated and rectangularly configured piece of metal, as shown in FIG. 2, and it has an elongated aperture 87 formed in it. Aperture 87 includes a transverse surface 89 on the right side thereof, as shown in FIG. 2, and an apex 91 on the left side thereof (FIG. 2). The link 85 is extended outwardly through an end wall of the switch housing 3, being positioned in a suitable slot 92 (FIG. 4) formed in base 5. Each of the sliders 42 and 43 has a foot 93 near its left end (viewing FIG. 6). Foot 93 provides a shoulder 94 which faces inwardly, or toward the other end of the slider, and the foot 93 is positioned in the aperture 87 of link 85. As shown in FIG. 4, the transverse surface 89 of link aperture 87 thus engages shoulders 94 of the feet 93 of the two sliders 42 and 43. (See also FIG. 6.) From viewing FIGS. 2 and 4, it will be seen that looped end 83 of spring 81 is hooked through aperture 87 and around apex 91 of the link 85 to enable the solenoid S to pull the sliders 42 and 43 to the left upon each energization of the solenoid. Each time the solenoid S is energized, surface 89 of the link thus pulls shoulders 94 of the sliders 42 and 43 to the left, to mechanically actuate the pushrods 28 and their associated push buttons 31 and 33 from their outermost to their depressed positions.

Since an important function of the sliders 42 and 43 is to perform mechanical work in respones to an external device, these sliders are slightly thicker than the switch actuating slider 41, to enhance their sturdiness and durability. (See FIG. 2.) To help stabilize the reciprocating movement of the pushrods 27 and 28, as shown in FIG. 6, three elongated guiding members 97 have been provided. The guiding members 97 are of thin slider-like configuration (resembling slider 41 in thickness), but they are different from the sliders 41–43 in that they are incapable of any considerable longitudinal movement within the base and perform no switch actuating functions. These members 97 have a series of narrow vertical slots 99 formed therein. The slots 99 open into top longitudinal edge 101 of the members 97 and are in alignment with the openings in the top wall of the base through which the pushrods are extended. It will be understood by those skilled in the art that slots 99 slidably engage portions 37 of the pushrods and help to control the reciprocating movement of the various pushrods between their outermost and depressed positions. The guiding members 97 also serve to help prevent any undesirable relative movements of the sliders 41, 42, and 43.

Turning now to a detailed explanation of the operation of the improved switch 1 embodying the present invention, attention is directed to FIG. 4. Any of the push buttons 31–35 may, of course, be manually depressed to actuate certain predetermined movable contacts of the switch. However, whenever the solenoid S is energized, the switch 1 is actuated to the position where it is shown in FIG. 4. The solenoid S is linked to the sliders 42 and 43 so that it pulls them to the left when it is energized. The points 69 of the sliders 42 and 43 are then moved toward the solenoid, and upper surfaces 65 of inclined recesses 61 act upon the transverse edges 77 of these pushrods to force the two push buttons 31 and 33 to their depressed position. When the switch 1 is in the position where it is shown in FIG. 4, the solenoid S, which is operated by a means external to the switch, has thus pulled down the two push buttons 31 and 33 to their depressed positions to provide an indicating means for the operator of the switch, such as, for example, the housewife, of the

condition of the appliance which is being controlled, as a result of the actuation of the solenoid. As shown in FIG. 4, it will further be seen that when the switch is in this position, certain of the switch arms 45 are held open by slider 42 and others are allowed to close by slider 42. During the movement of sliders 42 and 43 to their left or solenoid actuated position (FIG. 4), working surfaces 55 of slider 42 act upon portions 37 of the pushrods associated with push buttons 34 and 35 and return the push buttons 34 and 35 to their outermost positions if they are depressed. At the same time, working surfaces 55 of slider 43 return push button 32 to its outermost position if it happens to be depressed.

With the switch 1 in the position shown in FIG. 4, when the solenoid mechanism is energized, the two push buttons 31 and 33 are held in their depressed positions and push buttons 32, 34, and 35 are held in their outermost positions. However, when the solenoid is deenergized, subsequent depression of either of the push buttons 34 or 35 will cause the actuating portions 37 of these push buttons to act upon working surfaces 55 of the slider 42. The slider 42 thereupon moves to the right to actuate push button 33 back to its outermost position. Thus, as slider 42 moves from the position wherein it is shown in FIG. 4, in a direction to the right, the lower inclined surface 63 of inclined recess 61 acts upon actuating section 37 of the pushrod 28 associated with push button 33 to move push button 33 outwardly from its depresesd position to its outermost position. The contact blades controlled by the slider 42 are thereupon actuated to another predetermined position.

When the push-button switch 1 is in the position shown in FIG. 4, and the solenoid S is deenergized, if push button 32 is then depressed, this has no effect upon push button 33. However, the actuating portions 37 of the pushrods of push button 32 then engage working surfaces 55 of the slider 43 and move slider 43 to the right. The lower inclined edge 63 of recess 61 of slider 43 thereupon engages actuating section 37 of the pushrod 28 for push button 31 and returns push button 31 from its depressed to its outermost position.

It will be understood that my new and improved push button switch such as herein illustrated provides a simple and efficient means for positively controlling the positioning of one or more push buttons in response to an external actuating device, such as a solenoid. It should be realized that certain aspects of my invention may be incorporated efficiently and beneficially in other various types of push-button switches.

While in accordance with the patent statutes, I have described what at present is considered to be the preferred embodiment of my invention, it will be obvious to those skilled in the art that various changes and modifications may be made therein without departing from my invention, and I, therefore, aim in the following claims to cover all such equivalent variations as fall within the true spirit and scope of this invention.

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

1. In a push-button switch of the type arranged for actuation by an external device, a housing including an insulating base, contact means including at least one movable contact disposed on said housing, an elongated slider carried by said housing for reciprocating movement between first and second positions to actuate said movable contact, said slider being movable from said first to said second position by an external device, a pushrod mounted for reciprocating movement between an outer position and a depressed position in relation to said housing, and positive engaging means on said slider and said pushrod for moving said slider from said first position to said second position in response to depression of said pushrod and for depressing said pushrod in response to movement of said slider from said first to said second position by the external device.

2. The switch of claim 1, wherein the positive engaging means includes an inclined recess opening into a longitudinal edge of said slider and a slot formed in said pushrod between the ends thereof, said recess including a pair of generally opposed inclined surfaces, one of said inclined surfaces being slidably engaged with a wall of said slot to positively retract said pushrod from its outermost position to its depressed position when the slider is moved from its first position to its second position by the external device, the other of said inclined surfaces being slidably engaged with a switch actuating portion of the pushrod to move said slider from said first position to said second position in response to depression of said pushrod.

3. In a multiple push-button switch of the type arranged for actuation by an external device, a housing including an insulating base, a plurality of switch actuating pushrods mounted on said housing, and a plurality of switch actuating sliders positively engaging said pushrods and responsive to movement of said pushrods, contact means including a plurality of movable contacts supported by said housing, each of said switch sliders including a plurality of inclined working surfaces engageable by certain of said pushrods and at least one cam surface for engaging certain movable contacts of said switch, one of said sliders being movable from a first position to a second position by an external device, said slider having an inclined recess opening into a longitudinal edge thereof, said recess including a pair of opposed inclined surfaces, one of said pushrods being reciprocably mounted on said housing to coact with the inclined recess of said slider, said pushrod having a slot formed therein between its ends, one of said inclined surfaces of said recess being slidably engageable with a side of said slot to positively retract said pushrod from its outermost position to its depressed position when said slider is moved from its first position to its second position by said external device, the other of said inclined surfaces of said recess being slidably engageable with a switch actuating portion of the one pushrod to move said slider from said first position to said second position in response to depression of said pushrod.

4. In a push-button switch of the type arranged for actuation by an external device, a housing including an insulating base, contact means including at least one movable contact disposed on said housing, at least one pushrod reciprocably mounted on said housing to control said movable contact, said pushrod having a slot formed therein between its ends, a movable slider disposed in said housing, said slider being movable from a first position to a second position by an external device, and said slider having an inclined recess formed in one side thereof for slidable engagement with said pushrod, the recess of said slider being slidably engageable with the slot of the pushrod to positively retract said pushrod from its outermost position to its depressed position when the slider is moved from its first position to its second position by the external device, said pushrod being slidably engageable with said recess to move said slider from the first position to the second position in response to depression of said pushrod.

5. In a multiple push-button switch of the type arranged for actuation by an external device, a housing including an insulating base, a plurality of switch actuating pushrods mounted on said housing, at least one switch actuating slider carried by said housing and engageable with said pushrods and responsive to movement of said pushrods, contact means including a plurality of movable contacts supported by said housing, said switch slider including at least one inclined working surface engageable by an associated first pushrod and at least one cam surface for engaging certain movable contacts of said switch, said slider being movable from a first position to a second position by an external device, said slider having in addition to said one working surface for engagement with said first associated pushrod an inclined recess formed in one side thereof for slidable engagement with a second pushrod, said second pushrod having a slot formed therein between

its ends, the inclined recess of said slider being slidably engageable with the slot of said second pushrod to positively retract said second pushrod from its outermost position to its depressed position when the slider is moved from its first position to its second position by the external device, said working surface of said one slider being slidably engageable with said first pushrod if said first pushrod is in the depressed position to return said first pushrod to its outermost position when the slider is moved from its first to its second position, and said second pushrod being slidably engageable with said inclined recess to move said slider from the first position to the second position in response to depression of said second pushrod.

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