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CYLINDRICAL MEMBERS WITH ONE HAVING AN  
ELONGATED CONDUCTOR THEREON  
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Fig. 1.

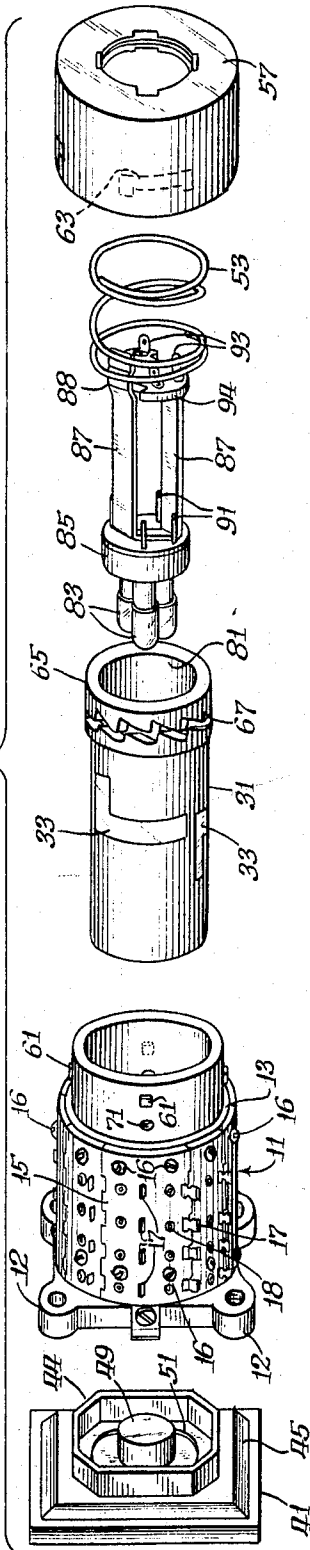


Fig. 2.

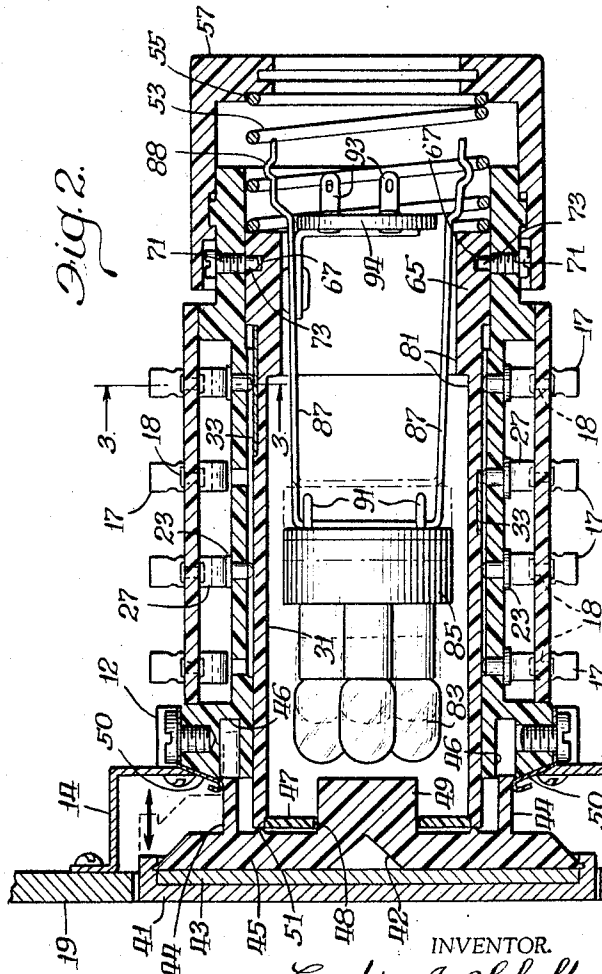
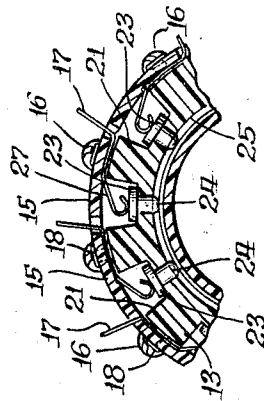


Fig. 3.



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**PUSHBUTTON OPERATED SWITCH HAVING RELATIVELY ROTATABLE CYLINDRICAL MEMBERS WITH ONE HAVING AN ELONGATED CONDUCTOR THEREON**

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10 Claims. (Cl. 200-167)

This invention relates to electrical switches, and more particularly to a multiple position switch adapted to interconnect a plurality of terminals in various configurations according to the position of the switch.

Rotary-type switches are often used to switch an electrical circuit to a variety of different conditions according to the relative rotary position of contact and wipers in a switch structure. Heretofore, such switches have been somewhat limited in the number of terminals which can be interconnected in each switch position and also in the possible electrical configurations of the interconnections.

Under certain circumstances it may be preferred to use a reciprocally actuated switch rather than a rotary-type switch to perform a switching operation. This is because reciprocally actuated switches, such as for example the type of switch that is actuated upon depression of a pushbutton, may be easier to actuate either manually or automatically. They may also provide a more attractive general appearance in that the pushbutton may be made flush with the surface of the panel on which it is mounted. A further advantage of the reciprocally actuated switch is that the pushbutton will remain in an upright position at all times making any printing thereon more easily readable. Heretofore, reciprocally actuated switches did not provide a high degree of circuit flexibility in that they have, for the most part, been limited to selecting one of two switch conditions. Furthermore, visual indication of the state of such switches has often been unsatisfactory.

Accordingly, it is an object of this invention to provide an improved multi-position rotary switch having a high degree of circuit flexibility and which is adaptable to reciprocal actuation.

Another object of the invention is to provide a rotary-type switch adapted to interconnect a large number of terminals in varying electrical configurations for each switch position.

Another object of the invention is to provide a rotary-type switch of improved construction which may be reciprocally actuated and which provides improved visual indication of the state of such switch.

A feature of the invention is the provision of a multi-position switch having relatively movable complementary surfaces wherein contact configuration on one surface can be changed to change the switch program.

Another feature is the provision of a switch having one member with a plurality of contacts spaced axially and angularly with respect to each other and another relatively rotatable member with printed circuits on the surface thereof to bridge the contacts in different axial and angular positions of the members relative to each other.

In the drawing:

FIG. 1 is an exploded perspective view of a switch constructed in accordance with the invention;

FIG. 2 is an enlarged half section assembly view of the switch; and

FIG. 3 is a sectional view taken along the line 3-3 of FIG. 2.

The multiple position switch of the invention comprises a pair of structural members having concentric complementary surfaces. One member carries conductors having axially and angularly spaced contact portions protrud-

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ing from the surface thereof. The other member carries one or more conductors on its surface, and the two members are relatively rotatable. Accordingly, predetermined combinations of the contact portions on the one member are engaged by a conductor carried by the other member when aligned therewith, thus bridging various sets of contacts in different axial and angular positions of the members relative to each other. An actuating mechanism is provided for rotating the one member with respect to the other. This actuating mechanism may include a linearly displaceable reciprocal actuating element which rotates the members relative to each other in steps through successive positions.

The switch of the invention may be provided in various embodiments. In one embodiment, one of the relatively rotatable members comprises a support structure with a cylindrical chamber and the other member comprises a cylinder disposed in the chamber. The conductor on the cylinder is a conductive strip of a given configuration so that it may be aligned with predetermined combinations of the contact portions of the conductors on the support structure as the cylinder is rotated with respect to the support structure. The support structure may be constructed to permit removal of the cylinder in order that cylinders having different numbers and configurations of conductive strips on the surface thereof may be selectively placed in the chamber for programming the switch. The cylinder may be hollow to accommodate an illumination structure which provides a visual indication of the condition of the switch. The actuating mechanism may include a zigzag cam track formed in the cylinder, with cam pins extending therein from the support structure. A pushbutton and opposing spring cause reciprocation of the cylinder upon depression and release of the pushbutton. When the cylinder reciprocates within the chamber, the cam and cam track cause rotation of the cylinder therein in discrete steps, each step corresponding to one reciprocation of the pushbutton.

Referring now more particularly to the drawings, the switch of the invention includes a support structure 11 which may be of plastic or other material. Support structure 11 includes a rectangular flange 12 for mounting on brackets 14 of control panel 19 (FIG. 2). Support structure 11 is comprised of a body 13 and a plurality of lug strips 15 mounted thereon by screws 16. Each of lug strips 15 carries a plurality of lugs 17 attached thereto by rivets 18.

Body 13 of support structure 11 is provided with a plurality of recesses 21 in which are disposed contact pins 23. Contact pins 23 are disposed in respective holes in the bottom of recesses 21, and each contact pin has a contact portion 24 extending into a cylindrical chamber 25 in body 13 of support structure 11. Contact portions 24 constitute one set of switch contacts as will be explained in more detail subsequently. Each of lugs 17 has a resilient end 27 extending into one of the recesses 21 to engage the head of a respective one of contact pins 23 and hold the pin in the hole in the bottom of recess 21. Accordingly, the lug 17 and the resilient end 27, together with contact pins 23 with contact portions 24, constitute a conductor from the inner cylindrical surface of cylindrical chamber 25 to the exterior of support structure 11. According to the particular switch configuration desired, certain of lugs 17 may be unnecessary. In such a case the associated contact pin 23 may be removed.

A hollow cylinder 31 has one or more conductive strips 33 disposed on the outer surface thereof. These may be placed thereon according to a laminated or printed circuit board technique, and may be of any desired configuration. Cylinder 31 is disposed in cylindrical chamber 25 of support structure 11 to be rotatable therein, and the outer surface of cylinder 31 and the inner surface

of chamber 25 are complementary. When cylinder 31 is rotated in chamber 25, conductive strips 33 will engage various combinations of contact portions 24 according to the presence or absence of contact pins 23, and to the configuration of conductive strips 33.

By varying either or both of these latter two items, the switch may be programmed to electrically connect any of the various lugs on the outer surface of support structure 11. Electrical crossover of conductive strips 33 may be accomplished by running a conductor through the cylinder 31 and along the inside surface thereof. Thus, the switch of the invention operates in three dimensions rather than the more conventional two dimensional planer configurations common to other rotary switches. The switch of the invention permits interconnection of contacts spaced both axially and circumferentially, i.e., at a plurality of angular positions, and each such contact may be connected in a circuit of different configuration in each discrete position of rotation of the cylinder 31. It will be seen that great variety of switch states is possible, and that any of the contacts may be bridged or interconnected irrespective of their relative axial or circumferential positions. These switch states may be repeated during a single revolution of cylinder 31 by making the configuration of the conductors on the surface of the cylinder redundant. For example, by repeating a given configuration of conductors on the surface of cylinder 31, four times when the switch has 12 discrete positions during its rotation, a particular switch state will be repeated every third position during the course of a single rotation.

A reciprocal actuating mechanism is provided for rotating cylinder 31 and chamber 25 through a series of discrete steps. This mechanism includes a pushbutton structure comprising a pushbutton 41, a transparent color plate 43, and a light conducting actuating member 45. Cylinder 31 has a disc 47 force fit in its hollow interior at one end thereof. Disc 47 has an opening 48 therein through which a cylindrical light conducting projection 49 on actuating member 45 extends. Actuating member 45 has a reflecting conical bore 42 for diffusing light from projection 49, and further has an annular bearing ridge 51 thereon which engages the end of cylinder 31. Projecting wall 44 mates in channel 46 in body 13 to guide the pushbutton structure, which is secured to body 13 by clips 50. Pushbutton 41 is shown flush with the surface of panel 19, but of course other ways of mounting would be well within the scope of the invention.

The opposite enlarged end 65 of cylinder 31 is engaged by a coil spring 53, held in a recess 55 in a cap 57. Cap 57 is secured to body 13 of support structure 11 by means of a plurality of locking projections 61 extending from body 13, which projections cooperate in corresponding L-shaped locking grooves 63 on the interior surface of cap 57. Coil spring 53 biases the cylinder outwardly in chamber 25. This causes reciprocal motion of cylinder 31 in chamber 25 according to depression and release of pushbutton 41 as shown by the dotted lines in FIG. 2.

Reciprocal motion of cylinder 31 in chamber 25 is converted into rotation in discrete steps by means of a camming arrangement. A zigzag cam track 67 is formed in the enlarged end 65 of cylinder 31. A plurality of screws 71 having cam projections or pins 73 thereon are threaded through the wall of support structure 11 so that cam pins 73 extend into zigzag cam track 67. These cam pins also serve to hold cylinder 31 against the bias of coil spring 53, and limit the linear displacement of the cylinder in chamber 25.

As pushbutton 41 is depressed and then released so that spring 53 returns it to its original position, the reciprocating movement of cylinder 31 in chamber 25 causes cam pins 73 to first move along one tack of cam track 67 and then, as spring 53 returns the cylinder to the outward position, to ride along the other tack. The action between cam pins 73 and cam track 67 causes cylinder 31 to rotate within chamber 25. Each depres-

sion and release of pushbutton 41, and hence reciprocation of cylinder 31 in chamber 25, causes rotation of cylinder 31 in a discrete step. Each of these steps may result in a different configuration for the switch, or the switch may be programmed so that any number of configurations may repeat with predetermined frequency as cylinder 31 rotates in chamber 25. Of course, cylinder 31 could also be rotated directly by a rotary knob, possibly being detent positioned where desired.

Illumination to provide a visual indication of the condition of the switch is provided in the hollow interior 81 of cylinder 31. Illumination is provided by a plurality of bulbs 83 mounted in a socket 85. Socket 85 is held in the interior 81 of cylinder 31 so that bulbs 83 are disposed adjacent the pushbutton by means of a pair of support clips 87. Support clips 87 have ridges 88 which cooperate with spring 53 to suspend socket 85 in place. Further support is provided by clips 87 wedging against the walls of the hollow interior 81 of cylinder 31. Electrical connection from the bulbs to the exterior of the switch is accomplished through a plurality of connecting lugs 91, which may be connected to a corresponding plurality of connecting lugs 93 in a terminal board 94 held between support clips 87. When actuating member 45 is made of a light conductive material, and where pushbutton 41 is translucent or transparent, light will shine through color plate 43. The bulbs 83 may be electrically connected to lugs 17, so that a predetermined condition of the switch will energize one or all of the bulbs for different degrees of brightness.

There are numerous other possible ways of visually indicating the condition of the switch of the invention. Projection 49 might be eliminated and disc 47 made without opening 48. Then the disc 47 might be made opaque or translucent and provided with a transparent portion or portions to constitute a shutter which changes light intensity or the position of a light spot on the pushbutton. Plate 43 may be made neutral and color provided by using colored bulbs. If a shutter technique is used, various colors or combinations thereof could be selectively transmitted to the pushbutton display surface according to the condition of the switch. The various indications selected may be repeated during a single rotation of the switch if the condition of the switch is made redundant during a single rotation.

It may therefore, be seen that the invention provides an improved reciprocally actuated switch having a high degree of circuit flexibility with improved visual indication of the condition of the switch. The switch may be preprogrammed for a variety of configurations and conditions, and the construction is simple, strong and reliable.

#### I claim:

1. A multiple position switch including in combination, first and second insulating members having concentric complementary surfaces positioned adjacent to each other, a plurality of electrical contacts carried by said first member and spaced axially and circumferentially with respect to each other on said complementary surface of said first member, elongated electrical conductor means disposed on a portion of said complementary surface of said second member and insulated thereby, said first and second members being relatively rotatable with said conductor means successively engaging various predetermined angularly and circumferentially spaced ones of said contacts when aligned therewith, actuating means coupled to one of said first and second members for rotating said members relative to each other, thereby aligning said conductor means with predetermined combinations of said contacts for electrically interconnecting the same according to the operation of said actuating means.

2. A multiple position switch including in combination, first and second insulating members having concentric complementary surfaces positioned adjacent to each other, electrical conductor means carried by said first member on a surface thereof opposite said cylindrical surface,

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said conductor means having contact portions protruding from said complementary surface of said first member and spaced axially and circumferentially with respect to each other, a plurality of discrete conductive strips each having a given configuration and disposed on said cylindrical surface of said second member, said conductive strips being insulated from each other by said second member, said first and second members being relatively rotatable with said conductive strips each successively engaging various predetermined combinations of angularly and circumferentially spaced ones of said contact portions when aligned therewith, actuating means coupled to one of said first and second members for rotating said members relative to each other, thereby aligning each of said conductive strips with predetermined combinations of said contact portions for electrically interconnecting the same according to the operation of said actuating means.

3. A multiple position switch including in combination, a support structure having a cylindrical chamber, a plurality of electrical conductors mounted on said structure and having contact portions protruding into said cylindrical chamber and spaced axially and circumferentially with respect to each other, an insulating cylinder having a plurality of separate elongated electrical conductor means on the surface thereof, said cylinder being disposed in said chamber to be rotatable therein with each of said conductor means successively engaging various predetermined combinations of angularly and circumferentially spaced ones of said contact portions when aligned therewith, actuating means coupled to said cylinder for rotating the same, thereby successively bringing said conductor means into alignment with predetermined combinations of said contact portions for electrically interconnecting the same according to the operation of said actuating means.

4. A multiple position switch including in combination, a support structure having a cylindrical chamber, a plurality of electrical conductors mounted on said structure and having contact portions protruding into said cylindrical chamber and spaced axially and circumferentially with respect to each other, an insulating cylinder having a plurality of electrically conductive strips each of a given configuration disposed on the surface thereof and insulated from each other, said cylinder being disposed in said chamber to be rotatable therein with said conductive strips each successively engaging various predetermined combinations of angularly and circumferentially spaced ones of said contact portions when aligned therewith, actuating means coupled to said cylinder for rotating the same, thereby successively bringing each of said conductive strips into alignment with predetermined combinations of said contact portions for electrically interconnecting the same according to the operation of said actuating means, said support structure being constructed to permit removal of said cylinder from said chamber so that cylinders having different configurations of conductive strips on the surface thereof may be selectively placed in said chamber for programming said switch.

5. A multiple position switch including in combination, a support structure having a cylindrical chamber, a plurality of electrical conductors mounted on said structure and having resilient contact portions protruding into said cylindrical chamber and spaced axially and circumferentially with respect to each other, an elongated hollow insulating cylinder having an electrically conductive strip printed on the surface thereof, said cylinder being mounted in said chamber to be rotatable therein with said conductive strip successively engaging various predetermined combinations of angularly and circumferentially spaced ones of said contact portions when aligned therewith, actuating means coupled to said cylinder for rotating the same, thereby successively bringing said conductive strip into engagement with predetermined combinations of said contact portions for electrically interconnecting the same according to the operation of said

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actuating means, said support structure being constructed to permit removal of said cylinder from said cylindrical chamber so that interchangeability of different cylinders with different configurations of conductive strips is possible, and illumination means disposed in the interior of said cylinder and cooperating with means movable with said cylinder for providing a visual indication of the position of said switch.

6. A multiple position switch including in combination, a support structure having a cylindrical chamber, first conductor means mounted on said support structure and having resilient contact portions protruding into said cylindrical chamber and being spaced axially and circumferentially with respect to each other, a cylinder having second conductor means on the surface thereof, said cylinder being mounted in said chamber to be rotatable therein, with said second conductor means successively engaging various predetermined combinations of angularly and circumferentially spaced ones of said contact portions when aligned therewith, linearly displaceable reciprocal actuating means connected to said cylinder for linearly displacing the same within said chamber in reciprocating fashion, and translating means coupling said cylinder to said structure and responsive to reciprocation of said cylinder in said chamber to rotate said cylinder with respect to said support structure to successive positions, thereby aligning said second conductor means with predetermined combinations of said contact portions according to the operation of said actuating means.

7. A multiple position switch including in combination, a support structure having a cylindrical chamber, a plurality of conductors mounted on said structure and having resilient contact portions protruding into said cylindrical chamber, an elongated hollow cylinder having conductor means on the surface thereof and further having a zigzag cam track formed therein, said cylinder being mounted in said chamber to be rotatable and linearly displaceable therein with said conductor means engaging predetermined combinations of said contact portions when aligned therewith, a manually depressible push button connected to said cylinder for displacing the same longitudinally in said cylindrical chamber, resilient means biasing said cylinder against the displacement of said button to provide reciprocal action, cam means on said support structure extending into said cam track in said cylinder to cause rotation of said cylinder responsive to reciprocal linear displacement thereof, said cam means being removable from said cam track to permit removal of said cylinder from said chamber for replacement thereof, whereby repeated reciprocal actuation of said push button will rotate said cylinder to successively bring said conductor means into alignment with predetermined combinations of said contact portions according to the operation of said push button.

8. A multiple position switch including in combination, a support structure having a cylindrical chamber, a plurality of conductors mounted on said structure and having contact portions protruding into said cylindrical chamber, a cylinder having conductor means on the surface thereof, said cylinder being mounted in said chamber to be rotatable therein with said conductor means engaging predetermined combinations of said contact portions when aligned therewith, linearly displaceable reciprocal actuating means coupled to said cylinder for rotating the same through successive positions responsive to linear displacement of said actuating means, said actuating means including a push button structure at one end of said cylinder, said cylinder having a hollow interior portion, illumination means mounted in said hollow interior portion, said illumination means comprising a socket and a light bulb mounted therein, and further comprising resilient clip means engaging the walls of said hollow interior portion of said cylinder for securing said illumination means therein, said push button structure including means for transmitting light to the exterior surface there-

of for providing a visual indication of the condition of said switch.

9. A multiple position switch including in combination, a support structure having a cylindrical chamber, a plurality of electrical conductors mounted on said support structure and having resilient contact portions protruding into said cylindrical chamber, said contact portions being positioned at a plurality of angular positions about said chamber and at a plurality of axial positions along said chamber, an insulating cylinder having electrical conductor means on the surface thereof, said cylinder being mounted in said chamber to be rotatable to a plurality of discrete positions therein, with said conductor means bridging various combinations of said contact portions for electrically interconnecting the same in certain positions of said cylinder, and reciprocal actuating means cooperating with said support structure and said cylinder for rotating said cylinder to said discrete positions with respect to said chamber.

10. A multiple position switch including in combination, a support structure having a cylindrical chamber, a plurality of electrical conductors mounted on said support structure and having resilient contact portions protruding into said cylindrical chamber, said contact portions being positioned at a plurality of angular positions about said chamber and at a plurality of axial positions

along said chamber, an insulating cylinder having a plurality of electrically conductive strips on the surface thereof and insulated from each other, said cylinder being mounted in said chamber against said resilient contact portions to be rotatable to a plurality of discrete positions in said chamber, with said conductive strips bridging various combinations of said contact portions for electrically interconnecting the same in certain positions of said cylinder, and push button operated reciprocal actuating means cooperating with said support structure and said cylinder for rotating said cylinder to said discrete positions with respect to said chamber.

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