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C. B. HUNTRESS ETAL
SEALED THUMBWHEEL SWITCH WITH INDICATOR AND
REMOVABLE ILLUMINATING MEANS
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FIG. 1.

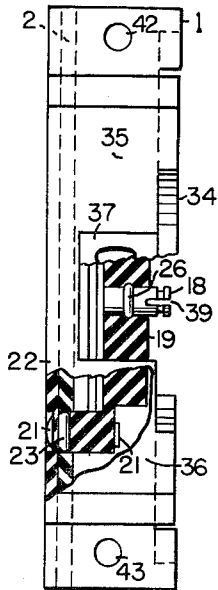


FIG. 2.

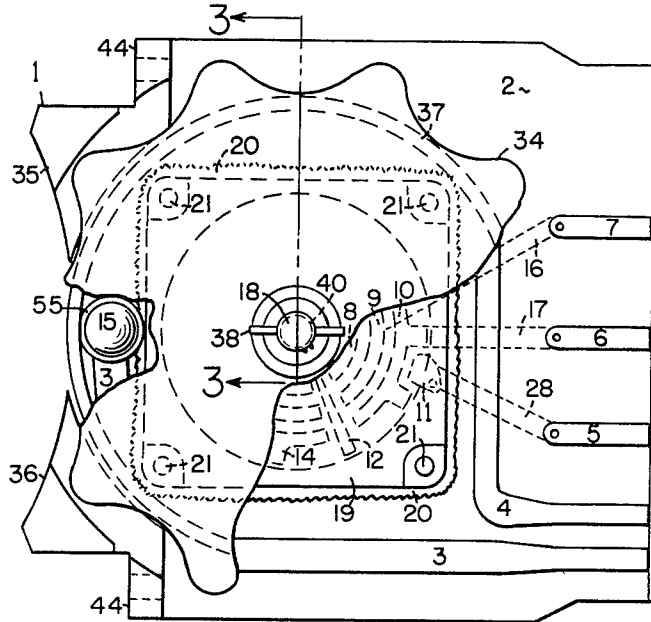


FIG. 4.

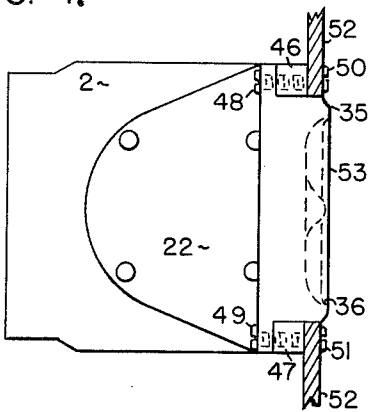
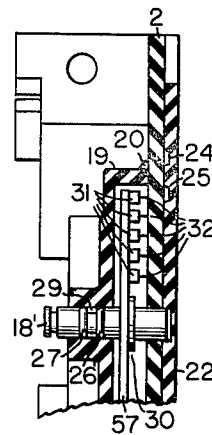


FIG. 3.



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SEALED THUMBWHEEL SWITCH WITH INDICATOR AND REMOVABLE ILLUMINATING MEANS

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8 Claims. (Cl. 200-167)

Our invention relates to multiposition switches, and particularly to such switches in which the contacts thereof are sealed within a chamber.

There is a widespread demand in the electronics industry for multiposition and perhaps for multicontact switches as well, for altering the connections between relatively low current circuits. Additionally, protection of the contacting surfaces from the uncertainties of the environment is desirable; but since switches of this type must have a rotary mechanical structure, of which the thumbwheel is an example, the art has been unable to provide a commercially practical sealed thumbwheel switch.

When illumination of the thumbwheel or its equivalent is required, an attempt to provide a sealed switch structure becomes complicated, with the possibility that a permanently installed lamp may limit the useful life of the switch to the period of the life of the lamp.

An explosion-proof switch is obtained, of course, by supplying a valid sealed switch structure.

We have been able to provide a sealed thumbwheel switch of desirable characteristics by employing an insulating board having conductive paths for forming stationary contacts, a housing, and by cementing one to the other. Additionally, a rotor carrying movable contacts is contained within a cavity formed between the board and the housing. The rotor is mounted on a shaft which extends through a journal in the housing and carries a thumbwheel. At least one resilient O ring surrounds the shaft within the journal, thereby making this part of the structure sealed regardless of the required motion of the elements.

It is desirable to pass the shaft through the insulating board in order to center the stationary contacts in the process of assembly. Therefore, we provide a cover over the board on the side away from the housing and seal this cover to the board with cement in, and adjacent to, a peripheral depression in the cover. In these ways the switch contacts are sealed from ambient conditions.

In order to provide illumination we extend the board forward of the sealed mechanism and position a small lamp upon the board just behind the central drum portion of the thumbwheel, from which position light shines through the translucency of the drum.

An object of our invention is to provide a sealed thumbwheel switch.

Another object is to provide such a switch having illumination means that may be replaced without destroying the seal of said switch.

Another object is to provide a thumbwheel switch structure that is relatively inexpensive to manufacture and that has a long operating life.

Other objects will become apparent upon reading the following detailed specification and upon examining the accompanying drawings, in which are set forth by way of illustration certain embodiments of our invention.

FIG. 1 shows a front elevation view, partly in section, of our thumbwheel switch,

FIG. 2 shows a side elevation view of the same, with the thumbwheel partly broken away to show other elements of the structure,

FIG. 3 shows a fragmentary section, particularly of the

inner part of the structure, taken along line 3-3 in FIG. 2, and

FIG. 4 shows an end elevation view, to a smaller scale, of the manner of mounting plural thumbwheel switches.

In FIGS. 1 and 2, numeral 1 indicates the frame which holds the switch to a front panel or otherwise constitutes the front surround for the thumbwheel. Numeral 2 indicates an insulating board having conducting paths 3, 4, 5, 6, 7, etc., as may be seen in FIG. 2. These conductive paths also extend to the central part of the switch and form stationary contacts, of which 8, 9, 10, 11, 12 and 14 are representative. Conductive paths 3 and 4 in the illustrative switch of FIG. 2 connect to the two terminals of illuminating lamp 15. In this embodiment, connections between paths 5, 6 and 7 and stationary contacts 9, 10 and 11 (etc.) are made on the reverse side of board 2 by connections 16, 17 and 28, respectively, which connections are shown dotted. Paths 5, 6 and 7 form connections to external circuits by engaging female contacts in a known connection plug, which has not been shown.

A rotor 57 is secured to shaft 18', as shown in FIG. 3. Shaft 18' is journaled in housing 19, which housing is sealed to board 2 by a first-mentioned application of cement 20. This cement is of the epoxy type suited to permanently join insulating materials, of which Ablestik #69-1 is an example. This sealing is accomplished after the housing, board and cover 22 have been joined by eyelets 21 in the four corners of the housing, as may be seen in FIG. 2. In FIG. 1, frame 1 has been broken away to show this assembly, which also includes a resilient O ring 23 to prevent leakage due to the eyelets. In a typical embodiment the O ring may be a Parker size 2-2 (A-191338).

A peripheral depression 24 is provided in cover 22, as shown in FIG. 3. Preferably two such depressions, spaced one from the other, are provided, as 24 and 25. Just before the assembly is performed a ring of epoxy or equivalent cement is placed upon the cover on the "land" between the two depressions. When the assembly is accomplished the epoxy is forced fully over the land and into each of the depressions 24 and 25. The cement has not been shown in FIG. 3, since it would obscure the depressions in this figure. This constitutes a second-mentioned cement.

In a basic embodiment shaft 18 is sealed by one O ring 26, which is seen in the center of the journal in housing 19 in FIG. 1. The ring extends between a reduced diameter of the shaft and the bore of the journal in the housing. The O ring is made of resilient material, such as a high grade of rubber, or buna N-nitrile, so that it deforms when placed in position. Because of its resilient properties the ring effects a seal.

Additionally, we have found that a suitable lubricant significantly aids in the sealing process. Such a lubricant is placed around the O ring and resides in the minor spaces adjacent to it between the shaft and the journal. A silicone grease devoid of creep characteristics and capable of maintaining essentially the same viscosity from -65° to +100° C. is preferred. Such is available commercially as the Dow Corning D.C. 33 silicone grease.

A more effective alternate construction for the O ring structure is to provide two such rings 26' and 27, as is shown in FIG. 3. These rings are spaced in a reduced diameter section of shaft 18'. An annular cavity 29 then results between the O rings, which cavity is filled with the lubricant previously described.

It will be noted that the single O ring 26 of FIG. 1 has been shown disposed partially within the journal. An annular recess is turned in the journal to a depth only sufficient to allow removal of the shaft by deformation of the O ring. The recess performs the

desirable function of positioning the ring, and two spaced recesses may be employed for the double ring embodiment of FIG. 3.

Rotor 57 carries a plurality of spring metal contact fingers 31. These are normally aligned radially, with one finger disposed to engage one group of circularly disposed stationary contacts having a given diameter. For example, the second from the top finger 31 in FIG. 3 rides upon the group of stationary contacts 10 in FIG. 2. In practice, we prefer to employ the same plurality of wiper contacts 32, which are individually welded to fingers 31. The wiper contacts are formed of round contact wire having a diameter of approximately $\frac{1}{64}$ inch diameter by $\frac{3}{16}$ " long of Paliney #7 material. The wiper contacts are each bent near the free end so that a curved part of the wire touches the stationary contacts, rather than a free end of the wire, which tends to gouge the stationary contacts when the rotor is rotated in the direction toward the free ends.

Normally, the several fingers 31 are all part of one large piece of spring metal, such as beryllium copper, which is eyeletted to rotor 57. In this way one common brush completes a return circuit to a full circumference stationary contact and contact of any of the other wiper contacts with a stationary contact makes connection between the common circuit and the circuit of the given contact. However, the several fingers 31 may be arranged to make connections one to the other in any desired manner, of which connections in pairs is an example. One wiper makes connection to a stationary contact of some circumferential extent and its companion makes contact with specific stationary contacts at selected thumbwheel positions. Additionally, a wiper pair may be arranged with respect to stationary contacts to connect two of the latter at one thumbwheel position, make no contacts at another thumbwheel position and connect two entirely separate stationary contacts at still another thumbwheel position.

Insulating board 2 may be of epoxy-filled fiberglass material that is initially completely covered on each side with an adherent coat of copper. Each side is photosensitized. So-called art work is provided to expose each side of the board according to the configuration of stationary contacts and connections required and the board is exposed photographically in accordance with the art work provided. A set-up camera is normally employed, which makes multiples of the individual art work and thereby allows a relatively large number of boards to be exposed at one time. The exposure is usually on a reduced scale (as one-fourth the size of the art work). The boards are then developed by a known process and the unwanted copper is etched away.

After the wanted copper configuration is obtained, free of any resist, we prefer to plate low stress nickel over the copper, then rhodium over the nickel and finally gold over the rhodium. This sequence of plated layers provides a good metallic surface to resist the wear of the wiper contacts.

Rotor 57 is normally molded of a plastic material, such as polycarbonate, with shaft 18 (or 18') as an insert, and collar 30 to promote a firm fit of the rotor to the shaft.

A thumbwheel 34 of molded insulating material, is shown fragmentarily in both FIGS. 1 and 2. There is the known manually operable element of the switch that extends into a central slot at the front of the frame 1 and is bounded by arcuate lips 35 and 36 of that frame. As shown in FIG. 1, the slot is larger to the right to accommodate the several projections of the thumbwheel. A cylindrical portion 37 of the same is preferably made of translucent material in this illuminated model. Opaque numerals, as from 0 to 9, are normally provided on the cylindrical portion. The top of the numeral 8 is to be seen in FIG. 1. The thumbwheel is rigidly attached to the end of shaft 18 (or 18') on the opposite side

of the journal or housing 19 with respect to rotor 57. This is accomplished by inserting pin 38 in slot 39 (FIGS. 2 and 1) and also placing spring retaining ring 40 in the circumferential groove at the end of the shaft so that it bears upon the pin and upon the disk portion of the thumbwheel. The thumbwheel is not shown in FIG. 3 to allow the other inner elements to be seen.

In order that our permanently sealed thumbwheel switch may nevertheless be illuminated, small lamp 15 is positioned just behind the cylindrical portion 37 of the thumbwheel and in front of the sealed housing 19. This positions it in the center of the slot formed by lips 35 and 36. The lamp may be the LA64 type of incandescent lamps known for extremely small size. These have a rim outer contact and a button inner bottom contact. The lamp may be soldered or otherwise affixed to a conductor, such as a rim-contacting conductor 3 shown and the button contact similarly connected to conductor 4. Otherwise, board 2 may be provided with a novel socket according to a co-pending patent application of co-inventor Gabrielian, Serial No. 349,396, filed Mar. 4, 1964.

Additionally, the lamp may be supported and electrical contact made to its two terminals by a separate socket mounted upon board 2. The lamp is typically of the incandescent type, but may instead be of the gaseous glow type. A socket 55 is shown in FIG. 2.

Frame 1 and board 2 are rigidly joined by epoxy cement or the equivalent. The frame has mounting holes 42 and 43 in a recessed front corner surface 44. These holes allow individual mounting of a switch, whether it be alone or one of a group. Particularly if it be one of a group this is an important advantage, in that to replace a lamp, a component that may be associated with the switch such as a resistor, or to perform any other possible service, the affected switch can be removed. In ganged arrangements of the prior art, long bolts have been employed and passed through all of the switches of a group, thus making it difficult to remove and service a single switch.

According to our invention two bars 46 and 47 are used to assemble a group of switches, which bars extend the length of the side-by-side disposed group. An end view of such an assembly is shown in FIG. 4. Each of these bars, which may be of anodized metal, is provided with threaded holes to receive individual switch mounting screws, as 48 and 49. These threaded holes are spaced apart along the bars to be in accord with the spacing between hole 42, shown in FIG. 1, and the next adjacent holes 42 of the switches on each side of the first mentioned switch hole. The same spacing is arranged for the holes at the bottom of the switches; holes 43.

At preferably two points on each bar which do not coincide with the location of any screws of 48 or 49, but spaced therefrom as far as conveniently possible, there are provided additional threaded holes for screws such as 50 in the upper bar and 51 for the lower bar. These screws pass through appropriate holes in panel 52 and into the additional threaded holes in the two bars.

With our multiple switch structure the whole group can be removed from the panel by unfastening the four screws threaded into the additional threaded holes. If only one or two switches are to be removed, each can be removed by unfastening the two screws 48 and 49 associated with it.

It is to be noted that the forward extent of lips 35 and 36 is sufficient to prevent damage to the switch by destructive pressure upon the thumbwheel should the switch be forced against a flat vertical surface, or to prevent unwanted actuation of a thumbwheel by a similar circumstance. That is, a flat surface brought flush with the front of the switch assembly does not touch the projections of the thumbwheels. Also shown in FIG. 4 is an additional edge piece 53. This is preferably provided at each end of a row of switches, which row progresses downward through the panel in FIG. 4. Piece 53 "finishes" the

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front appearance of the assembly by completing the ridge formed at the top and bottom by lips 35 and 36 around the ends of the operating aperture of the assembly.

A detent mechanism is normally employed in each thumbwheel switch. This is arranged between the rotatable thumbwheel and the stationary housing to insure that the former comes to rest at specific circumferential positions, thus to make specific connections between the stationary contacts and the rotor wipe contacts. This is a standard mechanism and so has not been illustrated.

Modifications may be made in the size, proportions, shape and relative relations of the elements in the illustrative embodiments shown without departing from the scope of our invention as hereinafter claimed.

Having thus fully described our invention and the manner in which it is to be practiced, we claim:

1. A sealed thumbwheel switch comprising;
 - (a) an insulated board having conductive paths forming stationary switch contacts,
 - (b) a housing,
 - (c) a first portion of cement to seal the periphery of said housing to said board,
 - (d) a shaft journaled through said housing and said board,
 - (e) a rotor attached to said shaft having wiper contacts to bear upon said stationary contacts,
 - (f) a thumbwheel attached to said shaft on the side of said housing opposite to said rotor,
 - (g) a resilient O ring having a lubricant surrounding said shaft within said journal in said housing,
 - (h) a cover over said insulating board on the side of said insulating board opposite said housing, adjacent to and enclosing said shaft,
 - (i) a peripheral depression in said cover, and
 - (j) a second portion of cement adjacent to and within said depression to seal said cover to said insulating board,
 - (k) said first and second portions of cement and said O ring sealing said stationary and said wiper contacts within an enclosure comprising said board, said cover and said housing.
2. The sealed thumbwheel switch of claim 1 in which,
 - (a) said lubricant is a non-creeping silicone grease.
3. The sealed thumbwheel switch of claim 1 in which;
 - (a) two O rings are spaced along said shaft within said journal, and
 - (b) lubricant is provided between said O rings.

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4. The thumbwheel switch of claim 1 which additionally includes;

- (a) plural eyelets passing through said housing, board and cover, and
- (b) a resilient O ring surrounding each said eyelet within said board to said each said eyelet.

5. Means to mount a plurality of thumbwheel switches according to claim 1 in which there is additionally included;

- (a) a frame for each said switch attached to said board adjacent to said thumbwheel,
- (b) holes in the top and bottom of each said frame,
- (c) top and bottom bars, each having a plurality of threaded holes,
- (d) each of said threaded holes spaced one from another to allow said plurality of thumbwheel switches to be positioned adjacent one to the other,
- (e) screws to pass through said holes and into said threaded holes,
- (f) at least one additional threaded hole in each said bar, which additional threaded hole is spaced away from any of said plurality of threaded holes, and
- (g) at least one additional screw threaded into said additional threaded hole to fasten each said bar to a panel member.

6. The thumbwheel switch of claim 1 which additionally includes;

- (a) a socket having electrical contacts attached to said board external to said housing and adjacent to said thumbwheel and illumination means fastened within said socket by said contacts for illuminating said thumbwheel.

7. The thumbwheel switch of claim 6 in which;

- (a) said illumination means comprises an miniature incandescent lamp.

8. The thumbwheel switch of claim 6 in which;

- (a) said illumination means comprises a gaseous glow lamp.

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