April 25, 1967 D. E. CLARKE ETAL 3,316,379

SEAL FOR PUSH BUTTON ACTUATED DEVICE

Filed July 29, 1965 2 Sheets-Sheet 1

Fig. 1.

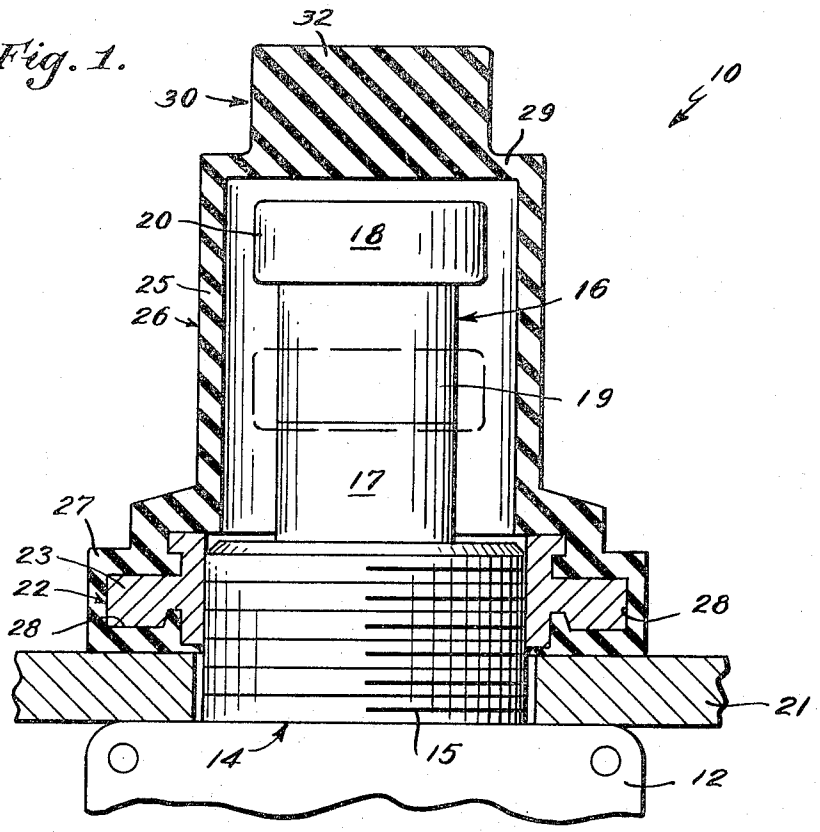
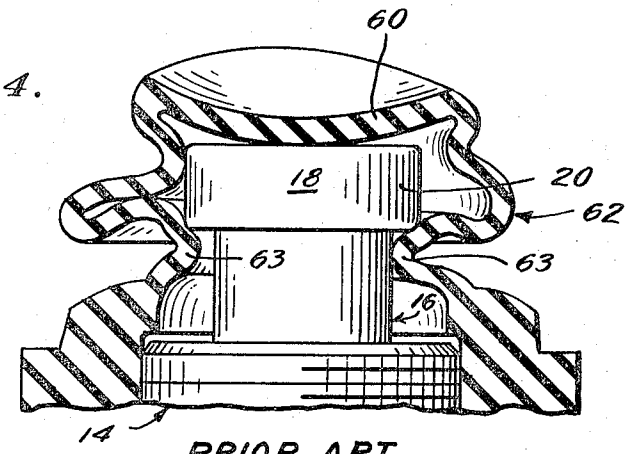


Fig. 4.



PRIOR ART

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Filed July 29, 1965 2 Sheets-Sheet 2

Fig. 2.

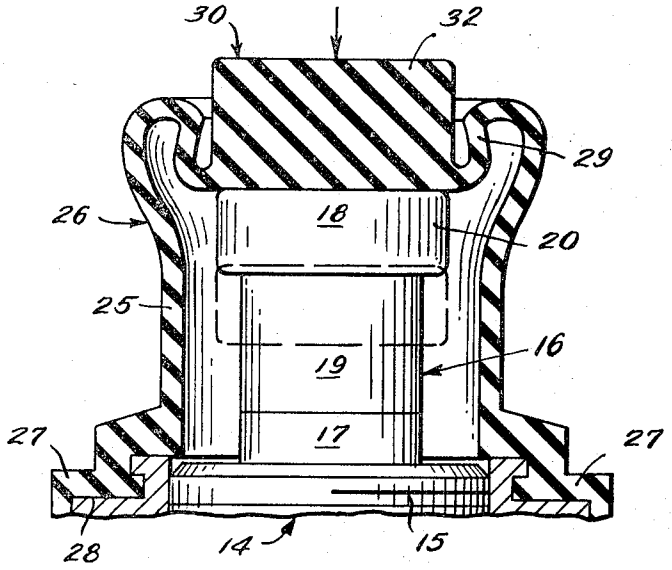


Fig. 5.

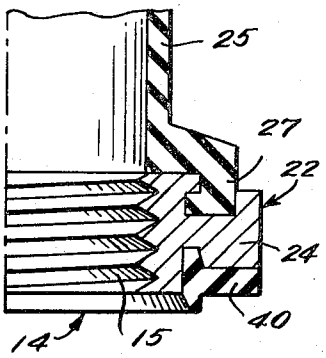


Fig. 3.

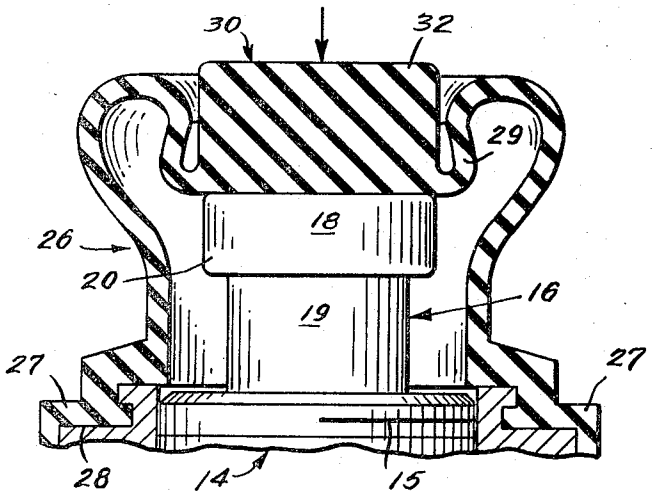
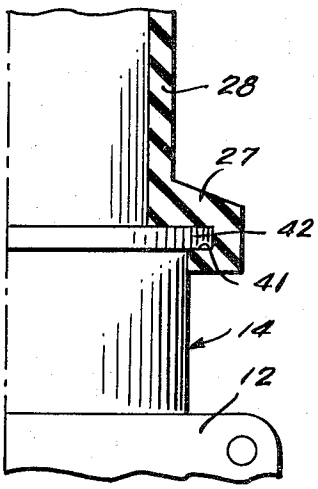


Fig. 6.



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SEAL FOR PUSH BUTTON ACTUATED DEVICE

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6 Claims. (Cl. 200—168)

This invention relates to electrical switches and, more particularly, to a fluid-tight seal for a push button actuated electrical switch.

It is an object of this invention to provide a seal to protect the interior switch parts from the deleterious effects of splashed water, oil, or other fluids or matter.

It is also an object of this invention to provide such a seal in which no deleterious interference occurs between the seal and the push button to affect the operation of the push button or the switch.

Other objects will be in part apparent and in part pointed out hereinafter.

The invention accordingly comprises the elements and combinations of elements, features of construction and arrangements of parts which will be exemplified in the structures hereinafter described and the scope of the application of which will be indicated in the appended claims.

In the accompanying drawings in which one of the various possible embodiments of the invention is illustrated:

FIG. 1 is a sectional, partly fragmentary view of a seal according to the instant invention;

FIGS. 2 and 3 are views similar to FIG. 1 showing the seal in various stages of deformation;

FIG. 4 shows an example of a seal according to prior art;

FIG. 5 is an enlarged view similar to a portion of FIG. 1 showing a modification of the device; and

FIG. 6 is an enlarged view similar to a portion of FIG. 1 showing a third modification of the device of FIG. 1.

Similar reference characters indicate corresponding parts throughout the several views of the drawings.

Dimensions of certain of the parts as shown in the drawings have been modified for the purpose of clarity of illustration.

In certain types of electrical switch structures which employ a housing in which the parts of the electrical switch are contained therein, and in which a push button is employed which moves reciprocally in and out of the housing to permit manual actuation or resetting of the switch and to provide an indication of the condition of the switch, it is desirable to provide a seal to protect the entrance of foreign matter such as water, oil, dust and the like into the interior of the switch housing. An example of such a switch is shown in copending application Ser. No. 317,489, filed on Oct. 21, 1963, now Patent No. 3,257,523, in the name of David E. Clarke and assigned to the assignee of the instant invention.

Referring now to the drawings, there is shown in FIG. 1 one embodiment of the instant invention. A fragmentary portion of a switch including the seal according to the instant invention is shown in fragmented form and is generally indicated by reference numeral **10**. Switch **10** includes a housing **12** and the bushing **14** which provides an entrance (not shown) to the interior of housing **12** and which permits a push button **16** to move between the solid line extended position shown in FIG. 1 to the dotted line depressed position shown in FIG. 1.

If desired, push button **16** may include at its distal end **18**, a circumferentially extending flange **20** which permits easier manual grasp of the push button for manually moving it from the depressed, dotted line position shown in FIG. 1 to the extended solid line position.

Mounted on bushing **14** is a sealing enclosure **26** which surrounds the push button **16**. Enclosure **26** includes a tubular portion **25** and a closure portion **30** formed on the outer distal end of tubular portion **25**. Enclosure **26** is formed of a suitable, flexible and resiliently deformable material such as rubber.

In the embodiment shown in FIG. 1, switch **10** is retained in operating position on a mounting panel **21** having an aperture therein through which bushing **14** projects. Bushing **14** in the embodiment of FIG. 1 is threaded to receive a threaded nut **22**. Nut **22** includes a radially extending projection or flange **23**.

Enclosure **26** includes at its inner proximal end, at which it is mounted on the bushing **14**, a radially extending skirt portion **27** which includes a groove **28** which mates with the radially extending projection **23** of nut **22** and about which the skirt is molded. As nut **22** is screwed down that portion of skirt **27** adjacent the mounting plate **21** is pressed against the mounting plate to form a tight seal therebetween.

It will be understood that the walls of tubular portion **25** are sufficiently thin to permit easy manual deformation thereof such that push button **16** may be grasped and manually actuated for movement from the depressed position to the extended position as shown in FIG. 1.

It will be noted that the inner diameter and inner axial dimension of the enclosure **26** are sufficiently large by comparison with the corresponding external diameter of the flange **20** of push button **16** and the axial dimension of push button **16** such that the push button is able to move between its solid line extended position and its dotted line depressed position when the enclosure **26** is in its undeformed state. It will be understood that, in some cases, the inner axial dimensions of enclosure **26** may be equal to or slightly smaller than the axial extent or dimension of button **16** when a downward biasing force on the button in the extended position is unimportant.

Closure **30** includes, at a portion centrally located about the axis running lengthwise along tubular portion **25**, a thickened knob **32** formed thereon. The thickness of knob **32** exceeds the thickness of the wall of tubular portion **25** by an amount sufficient to permit the upper surface of knob **32** to project above the collapsed position of enclosure **26**. That portion of closure **30** not occupied by knob **32**, and which surrounds knob **32** at **29**, has an axial thickness and radial extent sufficient, in relation to the thickness of the wall of tubular portion **25** and the diameter of knob **32**, to permit portion **29** to be the weakest portion of enclosure **26**, when the knob **32** is subjected to a force in the vertically downward direction as viewed in FIG. 1.

In those cases where the diameter or transverse dimension of knob **32** is approximately equal to the interior diameter or transverse dimension of tubular portion **25** diminished by an amount equal to twice the thickness of the wall of tubular portion **25**, and the radial extent of portion **24** is consequently relatively small, the axial thickness of portion **29** is less than the transverse dimension or thickness of the wall of the tubular portion **25**. Where the diameter of knob **32** is substantially smaller than the interior diameter of tubular portion **25** as diminished by twice the thickness of the wall of tubular portion **25**, the axial thickness may be equal to or slightly thicker than the thickness of the wall of tubular portion **25**. In any event, the diameter of knob **32**, the axial thickness of portion **29** and the radial or transverse thickness of the wall of the tubular portion **25**, are related such that in the face of a force directed downwardly on the upper surface of knob **32**, the weakest portion of enclosure **26** and consequently the first portion to deform will be at portion **29** as will be further described in connection with FIGS. 2 and 3.

It is believed that the operation of and advantages of applicants' contribution can best be understood by examining the operation of a typical prior art device such as that shown in FIG. 4. In that device, enclosure **62** is similar to enclosure **26** in that it is mounted on a bushing **14** and encloses a push button **16** forming a portion of a switch such as that described in the aforementioned copending application of Clarke and which can move freely between positions similar to those shown in solid and dotted lines in FIG. 1.

To set the switch as is described in the aforementioned application to Clarke, push button **16** must be depressed by manually exerting force on the distal end **18** of button **16**. In the push button sizes contemplated in this application, the area of the manual digit used to actuate button **16** would exceed the area of closure **60** or at least would overlap a portion of the circumferential edge thereof.

In actuating button **16** downwardly as seen in FIG. 4, it has been found that enclosure **62**, and particularly the tubular portion **25** thereof, when made thin enough to permit manual grasp of the button **16** deforms in such a manner that convolutions **63** directed radially inwardly toward button **16** are formed.

Some of these convolutions **63** which bulge inwardly abut and frictionally engage the surface of the push button **16**. Where the push button includes a flange **18**, such convolutions can abut and engage the lower portion of the flange to exert a force having the deleterious effect of tending to urge the button **16** toward the extended position. Further, in some constructions, the convolutions can form prior to the positioning of the button **16** in the stable, depressed or fully reset condition and thus prevent the manual resetting of the switch. Another deleterious effect of these convolutions is that they are inclined to change the parameters within which the switch will operate by the exertion of non-manual forces on the push button **16**.

With this background, the advantages of applicants' device will be seen. The operation of the enclosure seal **26** can best be seen in FIGS. 2 and 3. It will be noted that as a force is applied in a downward direction, as viewed in FIGS. 2 and 3, to the distal end of the enclosure **26**, this force, even though exerted by an instrument having a surface area greater than that of the distal end of enclosure **26**, will be exerted on knob **32** only and not on the remainder of the surface of closure **30**. As a result the force will be centered about the central axis running lengthwise through tubular portion **25** and enclosure **26**. Since, as noted, the weakest portion of enclosure **26** is at portion **29** of closure **30**, the first deformation occurs at portion **29** and as the force on knob **32** increases and the push button moves from the solid line position toward the dotted line position as shown in FIG. 1, thereafter, the walls of tubular portion **25** deform and bulge outwardly in a radial direction from the axis of tube **25** and away from the push button **16**. It will be seen that as this force continues, the bend line moves down the walls of tube **25** toward the inner end of tubular portion **25** to permit further bulging in an outward direction. It will be also noted that at no time during the period in which the push button passes from the solid line to the dotted line position through the FIG. 2 and FIG. 3 positions are convolutions formed which bulge inwardly in a radial direction or towards the push button **16**.

In some cases, it is desirable to enable visual detection of the condition of switch **10** by viewing button **16**, as is described in the aforementioned application of Clarke. Thus, button **16** can be provided with contrasting colored sections **19** and **17** with section **17** visible only in the extended position. In this case, enclosure **26** is formed of a relatively transparent rubber to permit such visual indication.

FIGS. 5 and 6 show exemplary alternate means of mounting the enclosure **26** on the bushing **14**. In the FIG. 5 embodiment the enclosure skirt **27** is divided into

an upper portion and a lower portion **40** between which the projection **24** of the nut **22** is inserted. In the FIG. 6 configuration, a flange **42** is provided on the bushing itself and nut **22** is dispensed with. In this embodiment, enclosure skirt **27** includes a groove **41** which snugly fits about the flange **42** of the bushing **14**. It will be understood that the deleterious inwardly directed convolutions discussed in connection with FIG. 4 could conceivably be eliminated by thickening the walls of tubular portion **25**. It has been discovered that this is not a feasible solution because in such a case manual grasp of button **16** would be prevented.

It will be understood that the actuating force which has been described as manual need not be manual but can be any external, mechanical or other actuating mechanism.

It will be noted that the problems solved by applicants' device can not be solved by enlarging the diameter of the bushing and hence the enclosure, since in most switch applications these dimensions must be kept small to permit compact mounting of multiple switches. Further, an enlarged bushing and enclosure would render manual grasp of the button **16** in the depressed condition difficult or impossible.

In view of the above it will be seen that the several objects of the invention are achieved and other advantageous results are obtained.

It is to be understood that the invention is not limited in its application to the details of construction and arrangements of parts illustrated in the accompanying drawings, since the invention is capable of other embodiments and of being practiced or carried out in various ways. Also, it is to be understood that the phraseology or terminology employed herein is for the purpose of description and not of limitation.

As many changes could be made in the above constructions without departing from the scope of the invention, it is intended that all matter contained in the above description or shown in the accompanying drawings, shall be interpreted as illustrative and not in a limiting sense, and it is also intended that the appended claims shall cover all such equivalent variations as come within the true spirit and scope of the invention.

We claim:

1. In a push button operated switch having a housing, a bushing providing an entrance to the interior of the housing, and a push button positioned in the bushing for reciprocating movement therewithin between a depressed position and an extended position, a device for sealing the interior of the housing from fluid, dust and the like comprising, an enclosure mounted at its inner end on the bushing in fluid-tight relationship therewith and enclosing the push button, the enclosure having interior transverse and axial dimensions sufficiently large in comparison to the corresponding exterior dimensions of the push button to permit reciprocal movement of the push button within the enclosure, the walls of the enclosure being relatively thin to permit manual grasp of the push button, the enclosure having a closure formed on its distal end, the closure having a portion weaker than the walls of the remainder of the enclosure, the closure having a thickened knob located centrally about the axis of the enclosure in the exterior of the closure, the exterior knob having a transverse dimension less than the interior transverse dimension of the enclosure whereby an actuating force applied to the closure at the distal end of the enclosure to actuate the push button are centered about an axis running lengthwise along the enclosure to permit, upon application of the actuating force, the walls of the enclosure to bulge in a direction away from the push button and to inhibit the formation of convolutions of the enclosure walls in a direction toward the interior of the push button.

2. In a push button operated switch having a housing, a bushing providing an entrance to the interior of the

housing, and a push button positioned within the entrances in the bushing for reciprocating movement in an axial direction therewithin between a depressed position and an extended position, the push button having a circumferentially extending flange at the distal end thereof to facilitate manual grasp of the push button, a device for sealing the entrance and protecting the interior of the housing from fluid, dust and the like comprising a manually deformable enclosure including a tubular portion mounted at its inner end on the bushing in fluid-tight relationship therewith, the tubular portion of the enclosure having an interior diameter and axial dimension exceeding the exterior diameter and axial dimensions respectively of the push button flange to permit reciprocal movement of the push button within the enclosure, the walls of the tubular portion of the enclosure being relatively thin to allow manual deformation thereof to enable grasp of the flange of the push buton to permit manually actuated movement of the push button from the depressed position to the extended position, the enclosure having a closure portion formed on the distal end thereof, the closure for the distal end of the enclosure having walls thinner than the walls of the tubular portion of the enclosure, the closure having a thickened knob located centrally about the axis of the tubular portion of the enclosure on the exterior surface of the closure, the knob having a diameter less than the interior diameter of the tubular portion of the enclosure by an amount exceeding the thickness of walls of the closure and a thickness exceeding the thickness of the walls of the tubular portion, such that forces applied to the closure at the distal end of the enclosure to actuate the push button by an instrument having a surface area greater in extent that the corresponding surface area of the closure are centered about the axis running lengthwise along the tubular portion of the enclosure whereby, upon application of such forces to the closure end to move the push button to the depressed position, the initial deformation of the enclosure takes place at the portion of the closure unoccupied by and surrounding the knob to permit the tubular walls of the enclosure to bulge in a direction away from the push button and to inhibit the formation of convolutions of the enclosure walls extending in the direction of the push button.

3. A device as set forth in claim 2 wherein the enclosure is formed of a transparent material and the push button includes an indicator visible through the enclosure to indicate its position.

4. A device as set forth in claim 2 wherein the outer portion of the bushing includes a flange and the inner end of the tubular portion includes a flared portion having a groove therein which receives the bushing flange to seal the enclosure and the bushing.

5. In combination, a push button operated switch including a housing, a bushing providing an entrance to the interior of the housing, a push button positioned within the entrance in the bushing for reciprocating movement in an axial direction therewithin between a depressed position and an extended position, the bush button having a

circumferentially extending flange at the distal end thereof to facilitate manual grasp of the push button, a device for sealing the entrance and protecting the interior of the housing from fluid, dust and the like comprising a manually deformable enclosure having a tubular portion mounted at its inner end on the bushing in fluid-tight relationship therewith, the tubular portion of the enclosure having an interior diameter and axial dimension exceeding the corresponding dimensions of the push button flange to permit reciprocal movement of the push button within the enclosure, the walls of the tubular portion of the enclosure being relatively thin to allow manual deformation thereof to enable grasp of the flange of the push button to permit manually actuated movement of the push button between the depressed position to the extended position, the enclosure having a closure portion formed on the distal end thereof, the closure for the distal end of the enclosure having walls thinner than the walls of the tubular portion of the enclosure, the closure having a thickened knob located centrally about the axis of the tubular parts of the enclosure on the exterior surface of the closure, the knob having a diameter less than the interior diameter of the tubular portion of the enclosure by an amount exceeding the thickness of walls of the closure and a thickness exceeding the thickness of the walls of the tubular portion, such that forces applied to the closure at the distal end of the enclosure to actuate the push button by an instrument having a surface area greater in extent than the corresponding surface area of the closure are centered about the axis running lengthwise along the tubular portion of the enclosure whereby, upon application of such forces to the closure end to move the push button to the drepressed position, the initial deformation of the enclosure takes place at the portion of the closure unoccupied by and surrounding the knob to permit the tubular walls of the enclosure to bulge in a direction away from the push button and to inhibit the formation of convolutions of the enclosure walls extending in the direction of the push button.

6. In the combination set forth in claim 5, a nut threadedly engaged with the bushing and the proximal end of the enclosure being molded around the nut to permit mounting the enclosure in the bushing by threaded engagement.

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