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(54) Insulated switch assembly.

(57) A high voltage switch of the push-on, push-off variety is encased in a water-tight housing, which includes a flexible diaphragm which extends over the push-pole of the electrical switch. The water-tight housing is attached to the body of the overall switch assembly, which assembly would find primary utility with spas, pools hot tubs, jetted tubs and the like. A button assembly attached to the body provides for the multiple purposes of activating the electrical switch, directing water which might enter the body of the switch assembly away from the housing which encloses the electrical switch and toward drain holes in the body, and preventing access to the switch element and the diaphragm by the user of the switch assembly.

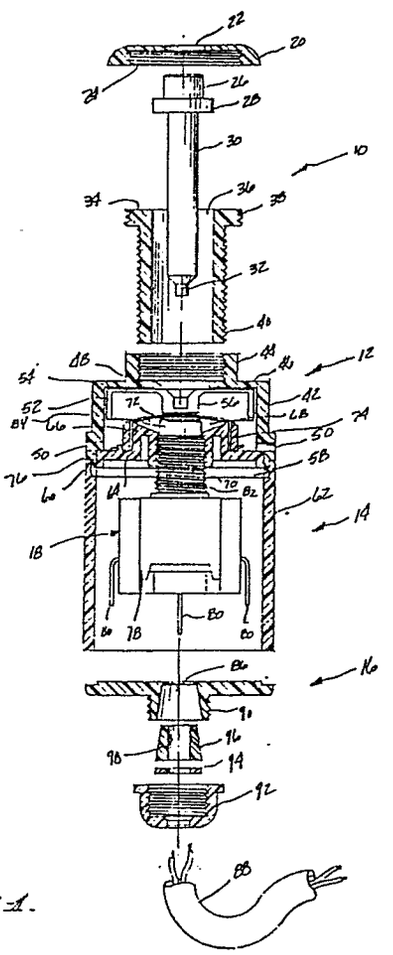

Fig. 1.

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INSULATED SWITCH ASSEMBLY

This invention relates to switch assemblies, and in particular, electrical switch assemblies which are insulated from the environment. This invention will find particular utility in conjunction with pools, hot tubs, jetted tubs, spas and the like.

With spas, for example, there are switches to control the pumps which force water or air into the spa, the heaters which maintain the water at a certain temperature, and the lights which illuminate the spa, among other things. Because it is inconvenient to exit the spa to activate the pump, heater or lights, most people prefer to have the controls located in close proximity to the spa. In the past, however, because of the difficulties encountered in providing sufficient insulation of electrical switches and the concomitant risk of electric shock, the use of high voltage electrical switches at the spa site has been avoided. Instead, air switches have been developed and used. These air switches incorporate bellows which are compressed when the switch button is depressed thereby forcing air through a pneumatic tube to activate an electrical switch which is located a safe distance from the spa. Also, extremely low voltage electrical switches have been used at the spa site. These low voltage switches, like air switches, are used to activate a high-voltage electrical switch located a safe distance from the spa.

While the air switches and low voltage switches work very well and are safe, their use necessarily involves added

costs, as they are used in conjunction with the high voltage electrical switch. In other words, if the high voltage electrical switch could be sufficiently insulated so that it could be used at the spa site, the use of the air switch or low voltage switch could be avoided.

Therefore, a need exists in the art for an insulated high voltage electrical switch which can be used at the spa site without risk of electrical shock or corrosion.

A switch assembly is provided wherein a conventional push-on/push-off type electrical switching element is completely encased in a water-tight housing which includes a flexible diaphragm which extends across the push-pole of the electrical switching element. The switch assembly further includes a button assembly, which, when depressed, acts on the push-pole of the electrical switching element to turn it on and off. The button assembly is designed such that it diverts any water which might enter the switch assembly away from the switching element. Drain holes are strategically placed so as to evacuate the water completely. To hinder possible misuse by the user, this invention also provides that the electrical switching element and the diaphragm covering same are not accessible by the user when the assembly is in place.

It is, therefore, the object of this invention to provide an insulated electrical switching element which can be used at pool, hot tub, jetted tub or spa site, within easy reach by the occupant.

Figure 1 is an exploded, cross-sectional view of the preferred embodiment of this invention.

Figures 2 through 5 show an alternative embodiment of the insulated switch assembly of the present invention, with Figure 2 being a sectional side view of the assembled device.

Figure 3 is a side cross-sectional view of the head piece showing the manner in which the flexible diaphragm is affixed thereto.

Figure 4 is a side cross-sectional view of the outer body of the switch assembly.

Figures 5A and 5B are top and side cross-sectional views, respectively, of the base plate.

The preferred embodiment is set forth in the Figure 1 in an exploded, cross-sectional view. It comprises, generally, a button assembly 10, a body 12, a housing 14 and an electrical switch 18. Except for the electrical switch 18, or as hereafter specifically otherwise designated, the materials used for this device are of a high impact, injected molded plastic or polyurethane material, having no electrical conductivity. These plastic or polyurethane components, except where shown joined by threaded means, are joined by conventional glue, epoxy or sonic welding.

The button assembly 10 comprises a circular cap 20, having a center hole 22 extending therethrough, and a threaded tap 24 on the underside thereof. A button 26 is sized and shaped such that it will extend through and be slidable within the center hole 22. Button 26 has an axially extending plug 27 which

snaps into an appropriately sized cavity in the top of collar 28 on plunger 30. This means of attachment allows button 26 and cap 20 to be interchangeable so that different color combinations can be used with the same switch assembly. Collar 28 has a significantly larger diameter than button 26 and hole 22 so that it will abut the underside of cap 20 to act as a stop. Plunger 30 extended perpendicularly beneath collar 28 and is axially aligned with button 26. Plunger 30 is an elongate cylindrical member having at its distal end a shoulder and neck portion 32. The final component of button assembly 10 is outer member 34. Outer member 34 is cylindrical in shape having a central cylindrical bore 36. The diameter of interior bore 36 is only slightly larger than the exterior diameter of collar 28, such that collar 28 fits snugly yet slidably within bore 36. An interior flange 37 acts as a stop against which collar 28 will abut within bore 36. Outer member 34 has a first threaded portion 38 which engages the threaded tap 24 on cap 20, and a second threaded portion 40 for attachment to the body 12. Threaded portion 40 is also used to secure the switch assembly to the tub top or deck by means of nut 41. It will be noted that when the threaded portion 38 is screwed into tap 24, a flat junction therebetween is achieved. The underside of cap 22 is positioned above the spa, pool or tub deck (not shown), and is secured thereto by nut 41, with the remainder of the switch assembly being below the deck.

Body 12 has an exterior piece 42 of unitary construction. Exterior piece 42 has an interiorly threaded neck 44 which extends perpendicularly above a top portion 46 of exterior piece 42. Neck 44 mates with outer member 34 of button assembly 10. A central aperture 48 is formed in top portion 46

through which plunger 30 extends. It will be noted that aperture 48 has a diameter less than the exterior of second threaded portion 40 on outer member 34 so that it can be attached tightly in neck 44. A series of holes 50 extend radially through outer piece 42 near its bottom end. Housed within outer piece 42 is a guard 52, which is cylindrical in shape and has a top piece 54 in which a receptacle 56 is formed. It will be noted that receptacle 56 is sized and shaped such that it mates snugly with the shoulder and neck portion 32 on plunger 30 of button assembly 10. The exterior diameter of guard 52 is only slightly less than the interior diameter of outer piece 42, such that guard 52 is slidable therein.

Body 12 has a peripheral flange 58 which extends perpendicularly down from outer piece 42, and mates with a outer peripheral flange 60 which extends perpendicularly above sleeve 62 on housing 14 to increase the contact surface between body 12 and housing 14. Housing 14 also comprises a head piece 64 to which the electrical switch 18 is attached. Head piece 64 is in turn attached to exterior piece 42 of body 12 such that the upper surface of head piece 64 is immediately adjacent to the bottom of radial holes 50. Head piece 64 is preferably of unitary construction and has an elevated neck portion 66 which defines a concave cavity 68 and a central threaded aperture 70. Threaded aperture 70, concave cavity 68, receptacle 56 on guard 52, aperture 48, plunger 30, button 26 and center hole 22 are all axially aligned.

Completing housing 14 is a flexible diaphragm 72 which completely covers the entire neck portion 66 on head piece 64. Diaphragm 72 is preferably constructed of polyurethane, is .005 inches thick and is commercially obtainable from J.P. Stevens &

Co., East Hampton, Maine (part no. MP 2080). Diaphragm 72 is held in position on head piece 64 by means of a compression ring 74 which is sized and shaped such that it fits snugly around the assemblage of neck 66 and diaphragm 72, and abuts an elevated flange 76 on top piece 64.

A-1 Electrical switch 18 is a standard push-on/push-off type bipolar double throw electrical switch. A switch commercially available from Carlingswitch, West Hartford, Connecticut, Model No. PA 344, has proven effective. This switch has a body 78, contacts 80 for the electrical wire 88, and a threaded neck 82 A-1 through which a push-pole 84 extends. The switch 18 is activated A-1 by pushing on the push-pole 84. The switch 18 is attached to top piece 64 by threading neck 82 into threaded aperture 70 such that push-pole 84 extends an appreciable distance into cavity 68. The distance push pole 84 should extend into cavity 68 must be A-1 sufficient that the switch 18 can be activated easily in that position.

The housing 14 is completed by base plate 85 which is attached to the bottom of sleeve 62. As shown in Figure No. 1, base plate 85 is molded separately from sleeve 62. It is preferred, however, to have base plate 85 formed integrally with sleeve 62. Base plate 85 has a central aperture 86 through which the wire 88 can pass for attachment to the contacts 80. To ensure that water will not enter housing 14 through aperture 86, a water tight seal must be created around wire 88. This is accomplished as follows. Aperture 86 is in the shape of a frustum. Base plate 85 has an elongate, threaded neck portion 90 around aperture 86. Before wire 88 is attached to the contacts 80, it is threaded through, in the following order, a compression cap 92, a thrust washer 94 and a rubber frustum 96. Frustum 96

has an interior bore 98 extending therethrough. The diameter of bore 98 closely proximates the exterior diameter of wire 88 such that there is a snug fit therebetween. Similarly, the exterior configuration of frustum 96 closely approximates the interior configuration of aperture 86 so that there is close mating therebetween. It will be appreciated that after wire 88 is passed through this assemblage and connected to contacts 80, compression cap 92 can be tightened onto neck 90, which will bring the thrust washer 94 to bear upon frustum 96 and subject the frustum 96 to a constricting force, causing it to seal exteriorly against aperture 86, and interiorly against wire 88, to create a water tight seal. It will be appreciated that electrical switch 18 is now encased in a water tight housing comprising diaphragm 72, head piece 64, a portion of body 12, sleeve 62 and base plate 85.

Once the various components are assembled, neck portion 32 of plunger 30 will reside within receptacle 56 of guard 52. Hence, the electrical switch 18 can be activated by pressing on button 26 which will cause guard 52 to move downward within body 12 such that the underside of receptacle 56 will contact the flexible diaphragm 72 immediately adjacent push-pole 84, causing it to be depressed thereby activating switch 18.

It will also be noted that the guard 52 serves two additional purposes. First, any water that might seep into button assembly 10 through aperture 22 will be caught by guard 52 and directed away from the diaphragm 72 to the interior sides of body 12 where it will, by virtue of surface tension, trickle down the sides of body 12 and out through holes 50. In addition, guard 52 prevents access to diaphragm 72 even if the cap 22 and button 26/plunger 30 assembly are removed. This guards against damage to the diaphragm 72 or switch 18.

Having described fully the preferred embodiment of this invention, we shall also describe an alternate embodiment, which is shown in Figures 2-5. This embodiment comprises an outer body generally designated 110, a button assembly generally designated 112, an interior housing generally designated 114, an electrical switch, generally designated 115, and a base plate, generally designated 116.

Looking at Figure 4, the outer body 110 is shown in cross section. It comprises an elongate cylindrical sleeve 118, having a threaded exterior. A circular, bevelled flange 120 extends exteriorly and radially around the periphery of the top end of cylindrical sleeve 118. The underside of flange 120 will abut the top of the tub or spa deck and will be secured there by nut 121 which can be tightened against the underside of the tub or spa deck. Running the length of the sleeve 118 is a central bore 122. Near the upper end of sleeve 118, the diameter of central bore 122 is abruptly reduced so as to form shoulder 124. Near the other end of sleeve 118 the diameter of central bore 122 is abruptly increased so as to form circular groove 126.

The shoulder 124 operates to retain the button assembly 112 within body 110. This is best seen in Figure 2. In this embodiment, button assembly 112 comprises an outer member 128 (which resembles an inverted cup), a cylindrical cavity 130 therein, and a top piece 134. The exterior diameter of outer member 128 abruptly increases to form exterior shoulder 132. It will be appreciated that top piece 134, after installation of the device at the spa site, is presented to the user of the device as the button which is to be pushed to activate the electrical switch. For aesthetic purposes, some may prefer to have the top piece 134 level with the top of flange 120 of body 110.

Accordingly, the relative placement of exterior shoulder 132 on button assembly 112, and interior shoulder 124 on outer body 110, are important and should be coordinated to obtain a level upper surface. It should also be appreciated that while the button assembly 112 must be slidable within interior bore 122 of outer body 110, for aesthetic purposes, long life, and to reduce the amount of water which can seep therebetween, the fit between the outer member 128 and outer body 110 should be such that it is snug, but allows for free sliding of the button assembly therein.

Button assembly 112 is completed by a plunger 136 which is attached to the underside of top piece 134 and extends perpendicularly therebelow. As will be explained in more detail, it is plunger 136 which contacts the electrical switch 115 to turn it on and off when the button assembly 112 is pushed down relative to outer body 110.

Interior housing 114, as shown in Figure 2, comprises a cylindrical sleeve 138 which has an exterior diameter which is appreciably less than the interior diameter of sleeve 118 such that a space 140 exists therebetween when they are arranged coaxially as shown in Figure 2. Sleeve 138 is hollow, having a central bore 142 which extends therethrough. At the upper end of sleeve 138, a head piece 144 is attached. As best seen in Figure 3, head piece 144 is of unitary construction, having a radially extending flange 146, a cavity 148 in its upper side, and a centrally located threaded aperture 150 extending coaxially therethrough.

Attached to the top of head piece 144 is a flexible diaphragm 152 of the same material used in the preferred embodiment. As best seen in Figure 3, the exterior diameter of head piece 144 is reduced around its upper outside edge to create

a peripheral groove 154 which accommodates therein flexible diaphragm 152 which extend down the side of head piece 144. Flexible diaphragm 152 is held into position on head piece 144 by means of compression ring 156, as shown in Figures 2 and 3. It will be appreciated that the depth of peripheral groove 154 is only slightly less than the thickness of the material used in flexible diaphragm 152, such that compression ring 156 exerts a compressive force on flexible diaphragm 152 to hold it into position.

Compression ring 156 has an exterior diameter equal to that of sleeve 138. Looking at Figure 2, it will be appreciated that the assemblage of sleeve 138, head piece 144 and compression ring 156 presents a cylindrical element having uniform exterior diameter such that the space 140 between housing 114 and sleeve 118 is constant and unobstructed. The importance of this feature will be discussed infra.

The electrical switch 115 is the conventional push-on, push-off bipolar electrical switching element having a body 162, electrical contacts 164, an exteriorly threaded neck portion 166 on one end of the body 162, and a push-pole 168 which extends through the threaded neck portion 166. Electrical switch 115 is turned on and turned off by successively depressing push-pole 168. Electrical switch 115 is attached to the housing 114 by means of the threaded neck portion 166 which is screwed into the threaded aperture 150 in head piece 144. Looking at Figure 2, the depth of head piece 144 should be such that when the electrical switch 115 is attached snugly to head piece 144, the top of push-pole 168 extends slightly above the top of head piece 154, causing the flexible diaphragm to be distended slightly. It will also be appreciated that the depth of cavity 148 in head

piece 144 must be sufficient to allow push-pole 168 to be depressed far enough to activate electrical switch 115.

Housing 114 is sealed, and held in position relative to outer body 110, by means of base plate 116. Base plate 116 is shown in plan view in Figure 5A, and in cross-section view in Figure 5B. Base plate 115 comprises an outer ring 170 which has interior and exterior diameters equal to that of sleeve 118. Outer ring 170 has a perpendicular flange 172 which mates with the groove 126 on the bottom of sleeve 118. Base plate 116 has an inner ring 174 which is attached to outer ring 170 by means of spokes 176 defining arcuate holes 178 therebetween. The exterior diameter of inner ring 174 is equal to the exterior diameter of sleeve 138. Inner ring 174 has a peripheral outer groove 180 around its upper edge into which fits the bottom end of sleeve 138. An aperture 182 is formed in inner ring 174 through which wire 184 may pass for connection to the electrical switch 115. A plug 186 fits snugly around the wires 184 within aperture 182 to present a water-tight seal. It will be appreciated that the combination of the housing 114, base plate 116 and plug 186 create a water-tight encasement for switch 115. It will also be appreciated that the sealing components shown with the preferred embodiment could also be incorporated here.

The relative lengths of outer body 110, button assembly 112, and housing 115 are such that the plunger 136 will rest upon the top of the push pole 168 when it is in the fully extended position. Because the push-pole 168 of this switch has a rounded concave contour, a matching convex indention 188 is formed in the end of plunger 136 so that contact on the diaphragm 152 is spread over a greater area.

In operation, pressing down on top piece 134 of button assembly 112 causes plunger 136 to depress the push-pole 168, thereby activating switch 115. Because this invention is designed for use in close proximity to swimming pools, hot tubs, spas and the like, it is likely that the upper surface of the device will, from time to time, be splashed with water. While the electrical switch 115 is encased in water-tight housing 114, and hence would not be contacted by the water, this invention provides further precautionary measures against water contamination of switch 115. Specifically, it should be noted that the outer member 128 and top piece 134 of button assembly 112 are of unitary construction. Accordingly, water can only enter the top of this device by seeping down the space 190 between outer body 110 and button assembly 112. It will also be noted that due to the design of button assembly 112, and specifically the fact that the exterior diameter of outer member 128 is greater than the exterior diameter of the housing 114, water which does seep in thusly is directed away from housing 114. Indeed, the water is made to contact the interior walls of outer sleeve 118, and hence, by virtue of surface tension, will travel down the interior surface of sleeve 118, never contacting the top of top piece 144 or flexible diaphragm 152. The water can drain out of the device through holes 178 in base plate 116.

Although a detailed description of the preferred and an alternate embodiment have been set forth, it would be apparent to those skilled in the art that many modifications and embellishments upon those embodiments are possible without departing from the inventive concept presented here. Indeed, wide variations in the shape of the button assembly, body, housing, and base plate have been shown in the two preceding

embodiments. Other variations, for example, replacing the button assemblies shown with some non-conductive elongate member utilizing a clutch-cable type mechanism, would be possible without departing from the inventive concept here presented. Accordingly, this invention is not to be limited to any specific embodiment set forth, but is of the full breadth and scope of the appended claims.

C L A I M S

1. A switch assembly comprising:

(a) a body;

(b) an electrical switch attached to a housing attached to said body, said switch having a push-pole extending from one end thereof, said switch being activated by pushing on said push-pole and said push-pole extending through an aperture in said housing;

(c) flexible diaphragm means attached to said housing and completely covering said push-pole, the combination of said housing and said flexible diaphragm means completely encasing said electrical switch;

(d) a button assembly attached to said body and operable to activate said electrical switch; and

(e) drainage means in said body for allowing fluid which might enter the switch assembly to drain out of said body.

2. The invention of Claim 1 wherein said body, housing and button assembly are designed and constructed such that fluid which might enter the body is diverted away from said flexible diaphragm means and towards said drainage means.

3. The invention of Claim 1 further comprising means for shielding said flexible diaphragm means from access by the user of the switch assembly.

4. The invention of Claim 1 wherein said housing comprises an outer body and an interior plate attached to and in sealing contact with said outer body, said electrical switch attached to said interior plate, said interior plate having an aperture through which said push-pole extends.

5. The invention of Claim 4 wherein said electrical switch has a hollow exteriorly threaded neck portion through which said push-pole extends, and said aperture in said interior plate has a circular flange around its periphery, said circular flange having interior threads to which said threaded neck portion of said electrical switch is attached.

6. The invention of Claim 4 wherein said flexible diaphragm means is attached to said interior plate.

7. The invention of Claim 4 wherein said interior plate has an elevated collar surrounding said aperture, and said flexible diaphragm means is fitted over said collar and held in place there by a compression ring which fits snugly around said collar.

8. The invention of Claim 7 wherein a circular flange is formed in said interior plate around said collar, so that said compression ring fits snugly between said flange on one side of said compression ring, and said flexible diaphragm means on said collar on the other side of said compression ring.

9. The invention of Claim 1 wherein said drainage means comprises a series of drain holes formed in said outer body

immediately adjacent to said interior plate on the side of said interior plate opposite said electrical switch.

10. The invention of Claim 1 wherein said housing further comprises a bottom plate which has a hole through which wire leads connected to said electrical switch may pass, said hole being thereafter sealable against the passage of fluid therethrough.

11. The invention of Claim 1 wherein said button assembly comprises:

(a) a button plate slidably contained within said body such that it contacts said flexible diaphragm means immediately adjacent to said push-pole, said button plate capable of movement co-axially with said push-pole within said housing sufficient to activate said electrical switch; and

(b) button means slidably attached to said body, a first end of which extends through an appropriately sized aperture in said body such that said first end is presented to the user of the switch assembly, and a second end of which impinges upon said button plate, said button means capable of movement co-axially with said push-pole sufficient to activate said electrical switch.

12. The invention of Claim 11 wherein said button plate is larger than said aperture in said body such that even if said

button means is removed, said button plate cannot be removed from said body.

13. The invention of Claim 1 wherein said body comprises an outer sleeve and said housing comprising an inner sleeve, said inner sleeve having an exterior size appreciably less than the interior size of said outer sleeve such that there is a space therebetween, with said electrical switch being attached to said inner sleeve and said button assembly being attached to said outer sleeve.

14. The invention of Claim 13 further comprising a base plate which is attached to the ends of said outer sleeve and said inner sleeve, said base plate having a series of vents sized and positioned such that fluid accumulated between said outer sleeve and said inner sleeve can pass therethrough.

15. The invention of Claim 14 wherein said base plate further has a hole through which/the extend wire leads attached to said electrical switch, said hole being thereafter sealable against the passage of fluid therethrough.

16. The invention of Claim 15 wherein said inner sleeve comprises a head piece to which said electrical switch and said flexible diaphragm means are attached, and which has an aperture through which said push-pole of said electrical switch extends.

17. The invention of Claim 16 wherein said aperture in said head piece has interior threads, and said electrical switch has a hollow neck portion through which said push-pole extends,

said neck portion having exterior threads which engage the interior threads on said aperture in said head piece.

18. The invention of Claim 16 wherein said flexible diaphragm means fits over said head piece and is attached to said head piece by means of a compression ring.

19. The invention of Claim 13 wherein said button assembly has an exterior configuration which closely approximates the interior configuration of said outer sleeve, such that said button assembly is slidable within said outer sleeve, and retaining means for retaining said button assembly within said outer sleeve.

20. The invention of Claim 19 wherein said retaining means comprises an exterior shoulder on said button assembly which engages an interior shoulder on said outer sleeve.

21. The invention of Claim 20 wherein said button assembly comprises an outer member and an inner member attached to said outer member, said inner member contacting said flexible diaphragm means immediately adjacent said push-pole of said electric switch.

22. The invention of Claim 19 wherein the exterior configuration of said button assembly is larger than the cross-section of said inner sleeve, such that fluid which might enter said outer sleeve around said button assembly is directed away from said flexible diaphragm means and towards said drainage means.

23. The invention of Claim 21 wherein said inner-member has an indention which accommodates the exterior configuration of said push-pole.

24. A switch assembly comprising:

a) a body attachable to the deck of a hot tub, spa or the like;

b) a button assembly attached to said body,

c) an electrical switch encased in a water-proof housing which is attached to said body such that said button assembly is operable to activate said switch; and

(d) drainage means in said body for evacuating water which might enter the switch assembly.

25. The invention of claim 24 in which said water-proof housing has a flexible diaphragm means which extends across the push-pole of said electrical switch.

26. The invention of claim 25 in which said button assembly comprises an interchangeable button attached to a plunger.

27. The invention of claim 26 further comprising a guard slidably housed in said body to prevent access to said flexible diaphragm means even if said button and said plunger are removed.

28. The invention of claim 27 wherein said button assembly and said guard are designed and constructed to divert fluid which might enter said body away from said flexible diaphragm means and toward said drainage means.

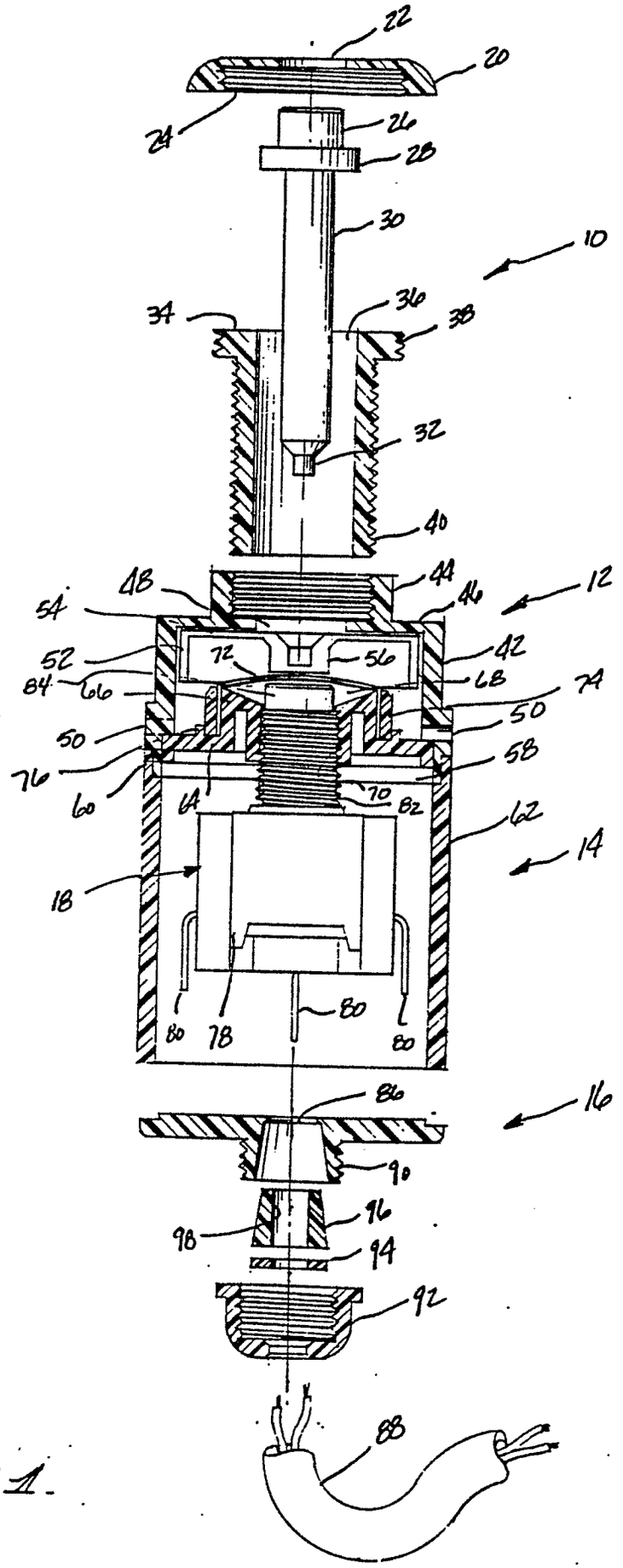
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FIG. 1.

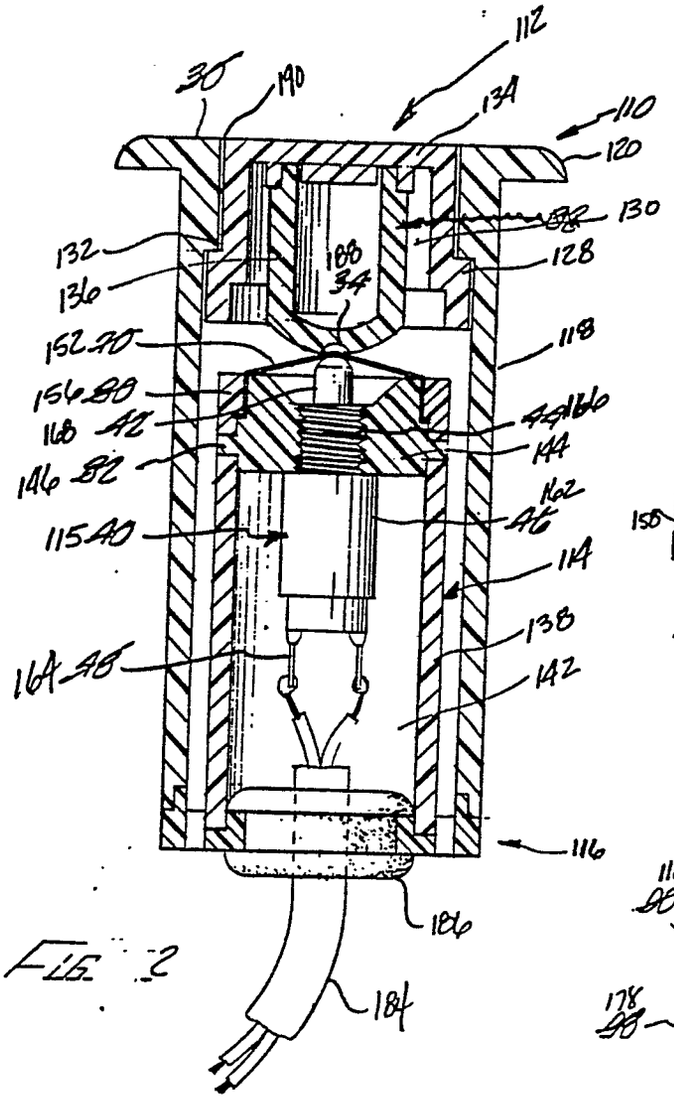

FIG. 2

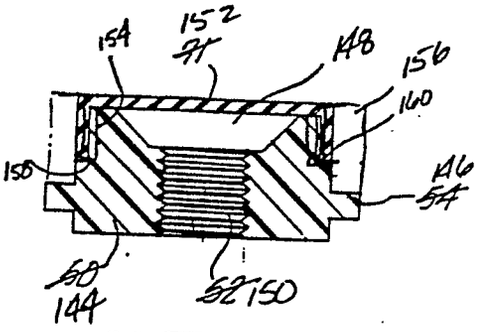

FIG. 3

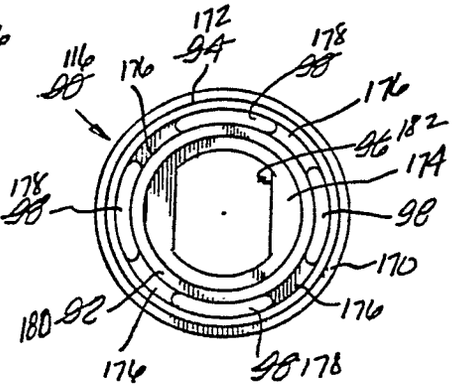

FIG. 5A

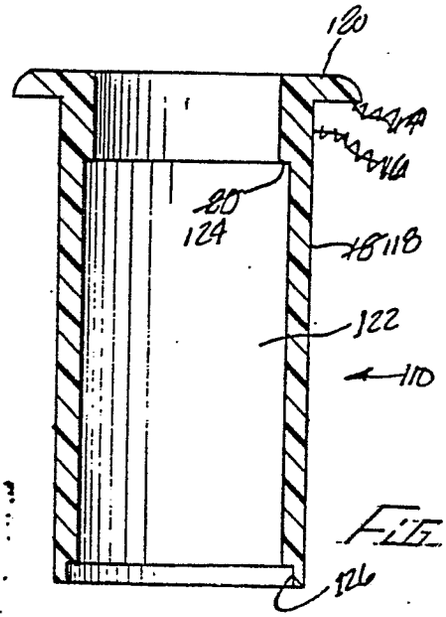

FIG. 4

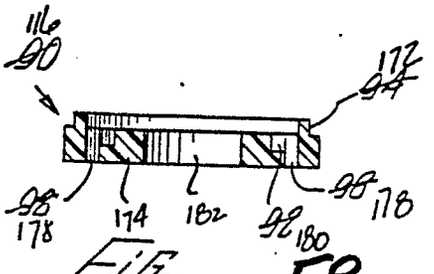

FIG. 5B