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ADJUSTMENT MEANS FOR ELECTRICAL SWITCH

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*Fig. 1.*

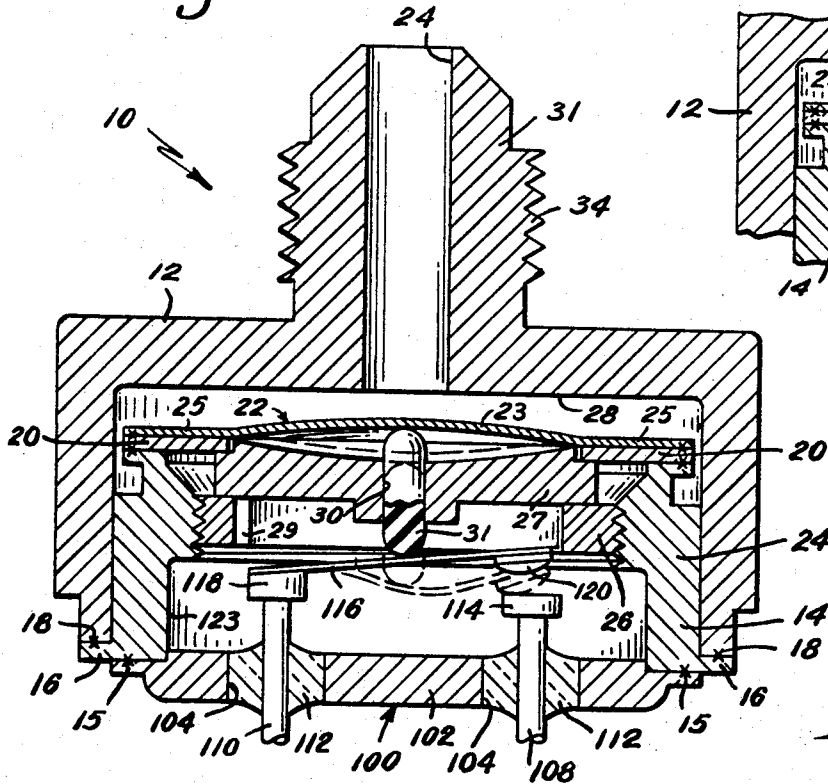


*Fig. 2.*

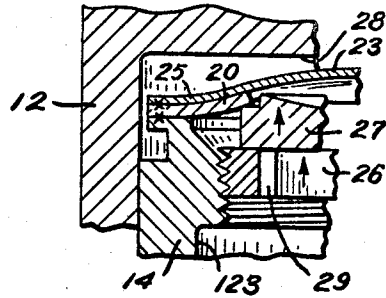


*Fig. 3.*

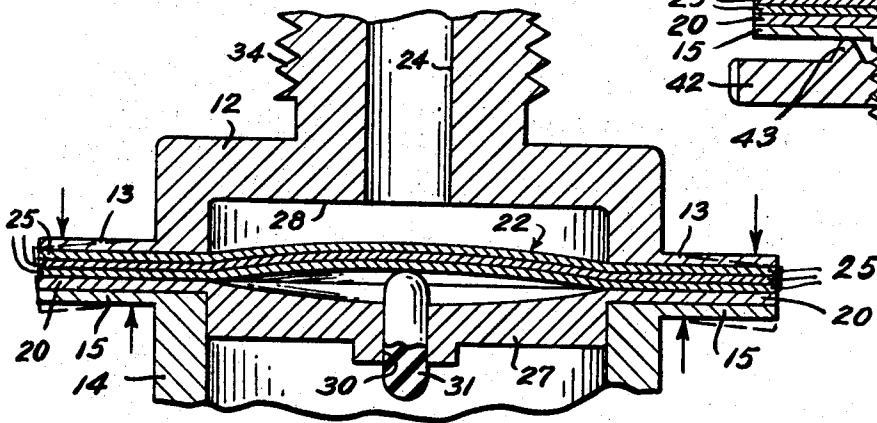
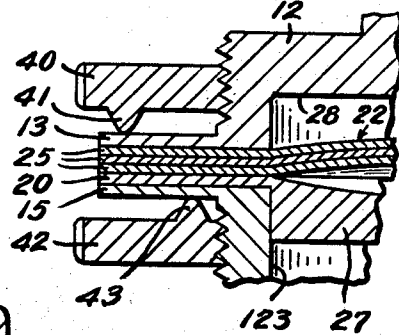


*Fig. 4.*



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## ADJUSTMENT MEANS FOR ELECTRICAL SWITCH

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### ABSTRACT OF THE DISCLOSURE

Electrical switches are shown with improved means for adjusting the snap-acting characteristics of a snap-acting diaphragm. An exemplary pressure responsive electrical switch is shown having upper and lower casing members provided with cavities which are hermetically sealed from one another by a snap-acting diaphragm mounted therebetween. One cavity admits pressure to one side of the diaphragm while the other cavity houses an electrical switch which is actuated in response to movement of the diaphragm. The adjustment of the pressure differential of the snap-acting diaphragm is such that it can be effected without affecting the hermetic seal. In one embodiment the diaphragm is mounted on a flexible annular ring which cooperates with a threaded annular member which can be moved upwardly to stress and bend the flexible annular ring and hence the peripheral portions of the diaphragm which results in changing of the pressure differential of the diaphragm.

Another embodiment shows the peripheral portion of the diaphragm projecting axially beyond the casing members and mounted between flexible ring flanges of the casing members. A force can be directly applied to the ring flanges to thereby bend the projecting peripheral portion of the diaphragm. A way of applying a force to the ring flanges is shown employing threaded rings which are movable to bring abutments on the rings into pressure engagement with the ring flanges to bend the flanges and projecting peripheral portions of the diaphragm. The casing members are shown to be cylindrical in configuration however could be varied to include rectangular, octagonal or other polygonal shapes.

This invention relates generally to electrical switches, and, more particularly, to pressure responsive devices adapted for actuating electrical switches and the like.

Among the several objects of the invention is the provision of a pressure responsive device which is particularly adapted for miniaturization and for lightweight, hermetically sealed and open construction and which is capable of sensing relatively wide ranges of values in pressure, which has a high degree of sensitivity and is capable of operating within a relatively narrow range of pressure values.

It is a further object of the invention to provide such a pressure responsive device in which adjustment of the magnitude of the pressure differential of the device can be easily achieved without deleteriously affecting the resistance of the device to vibration or without affecting its sensitivity.

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 structure hereinafter described and the scope of the application of which will be indicated in the appended claims.

In the accompanying drawings in which several of the various possible embodiments of the invention is illustrated,

FIG. 1 is an elevational view partly in section of a device according to the instant invention;

FIG. 2 is an enlarged view of a portion of the device shown in FIG. 1;

FIG. 3 is a view similar to FIG. 1 of a second embodiment of a device according to the instant invention; and

FIG. 4 is an enlarged view of a portion of the device showing a third embodiment of the device shown.

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

Dimensions of certain of the parts as shown in the drawings may have been modified or exaggerated for the purposes of clarity of illustration.

In devices of the type contemplated by the instant invention, it is frequently desired to open or close an electrical circuit or operate an electrical switch in response to changes in the values of pressure and this is accomplished by admitting pressure to one side of a snap acting diaphragm which will snap move from one position to another at a predetermined value of pressure and return to its original position at another value of pressure. The difference between these pressure values is called the pressure differential of the diaphragm of the device. It is frequently desired to alter the magnitude of this differential to narrow or widen it and thereby to vary its sensitivity. It is desirable to perform this variation without altering the magnitude of the movement of the snap acting diaphragm, since this may deleteriously affect the stability of the position of the diaphragm and hence of the devices which it is set to operate. It has been found that by altering the slope of the peripheral portion of the snap acting diaphragm such an advantageous differential adjustment can be achieved.

Referring now to the drawings, particularly FIG. 1, there is shown an exemplary pressure responsive device generally designated by reference numeral 10. Pressure responsive device 10 includes upper and lower casing members 12 and 14 respectively which may be formed of material having suitable strength and corrosion resistance such as, for example, stainless steel. Casing member 14 is provided with a peripherally extended flange 16 which is aligned with a lower portion of casing member 12 to permit positioning of the casing members in telescoped relationship as shown in the FIG. 1 and to permit joining as, for example, by welding at 18.

As seen in FIG. 1, casing member 14 includes mounted on an inner portion thereof between casing 14 and casing 12, a flexible ring member 20. The inner peripheral portion 21 of member 20 projects radially inwardly beyond the portion of casing 14 on which it is mounted to create an overhang or freely movable portion. Mounted on ring 20 as, for example, by welding at the radial periphery of the ring is a diaphragm member 22 which includes a deformed portion 23 which is responsible for its snap movement between the solid line position and the dotted line position shown in FIG. 1.

In the assembled form shown in FIG. 1, casing members 12 and 14 provide cavities or compartments 28 and 123, respectively which are hermetically sealed from one another by the welding of diaphragm 22 to ring 20 and of ring 20 to housing 14. It will be understood that other means than welding may be employed to clamp and seal.

Casing member 12 has formed thereon a mounting member 31 which includes an orifice or port 24 which communicates with the interior of compartment 28 and which serves as an inlet to admit a source of pressure to which diaphragm member 22 is to respond.

There is a critical force of a predetermined value which when exerted on diaphragm 22 will cause snap movement of member 22 toward the dotted line position from the solid line position of FIG. 1.

In the diaphragm construction shown in FIG. 1, the deformed portion 23 is responsible for this snap movement. In general the degree of deformity of portion 23

determines the magnitude of the force required to actuate member 22.

In addition, the value of the pressure required for actuation may be varied by providing a spring member (not shown) within aperture 24, one end of which is fixed and the other end of which bears against deformed portion 23 to alter the magnitude of the pressure required for actuation as disclosed and claimed in co-pending U.S. patent application Ser. No. 317,338, filed in the name of Carl N. Johnson on Oct. 18, 1963 and entitled "Condition Responsive Devices" and assigned to the assignee of the instant invention. In addition, this value may be altered by varying the number of diaphragms employed as shown in FIG. 3.

Preferably, diaphragm member 22 is formed of a relatively thin, corrosion-resistant, strong material such as, for example, stainless steel and is in the form of a disc of substantially uniform thickness. It will be noted that the peripheral portion 25 of diaphragm member 22 is substantially undeformed and lies in a plane along the flexible annular ring member 20 which is mounted on the inner portion of casing 14.

Received in threaded engagement on the interior of the cavity formed by casing member 14 is an annular ring member 26 on which rests a wall portion 27 which, together with the diaphragm 22 divides cavity 123 formed by casing member 14 from cavity 28 formed by casing 12. Received within a central aperture 30 in wall portion 27 is a motion transfer pin 31 formed of electrical insulating material, the upper end of which bears against the deformed portion 23 of diaphragm member 22 and the lower portion of which bears against a switch mechanism generally designated by reference numeral 100.

Exemplary switch 100 is substantially identical to that described in co-pending application Ser. No. 317,338, filed in the name of Carl N. Johnson, entitled "Condition Responsive Devices" and assigned to the assignee of the instant invention now abandoned in favor of continuation application Ser. No. 575,194, filed Aug. 25, 1966, which issued as Patent No. 3,335,242 on Aug. 8, 1967 and also described in copending application Ser. No. 432,067, filed in the name of Lawrence E. Cooper and Edmunds Kadisevskis and assigned to the assignee of the instant invention. Other exemplary mechanisms actuable by the pressure responsive device 10 include the several other switch species disclosed in the above application of Copper et al. as well as the so-called W-blade switch mechanism disclosed in U.S. Patent No. 2,777,032, dated Jan. 6, 1957 and the overcentering switch shown and described in copending application Ser. No. 518,360, filed Jan. 3, 1966, entitled "Snap Acting Overcentering Means for Electrical Switches," in the name of Carl N. Johnson and assigned to the assignee of the instant invention issued as Patent No. 3,322,915 on May 30, 1967.

As seen in FIG. 1, casing member 14 includes cup-shaped recess or cavity 123 suitable for the reception of switch 100 which includes a metallic header plate 102 mounted in sealing relationship on bushing 14 at 15. Header 102 includes open-ended apertures 104 in which are respectively disposed and hermetically sealed relationship, electrically conductive terminals 108 and 110 and about which is disposed glass sealant 112 to hermetically seal and maintain terminals 108 and 110 in electrically insulated relationship with respect to the header 102. Where an open construction is desired, a phenolic header plate 102 may be employed. Terminal 108 has mounted at one end thereof an electrically conductive contact 114. Switch 100 further includes an electrically conductive contact-carrying spring member 116 which is electrically connected to and cantilever mounted adjacent one end thereof on a portion 118 of terminal member 110 as shown. Spring member 116 carries an electrical contact 120 adjacent the free end thereof which is positioned for movement into and out of engagement with stationary contact 114. Spring member 116 is moved from the solid line posi-

tion to the dotted line position shown in FIG. 1 in response to movement of motion transfer member 31 and diaphragm member 22 from the position shown in FIG. 1 to the dotted line position shown in FIG. 1. It can thus be seen that a pressure sufficient to actuate member 22 will move contacts 120 and 114 into and out of engagement.

Turning now to FIGS. 1 and 2, it can be seen that when ring member 26 is rotated within the threaded portion of housing 14 as by a tool inserted in slot 29 the ring member 26 can be made to move up or down as viewed in FIG. 2 along a direction parallel to the direction of motion of the central portion 23 of diaphragm 22. When moved upwardly as shown in FIG. 2, ring 26 engages the periphery of wall portion 27 which rests on its and urges it upwardly until a peripheral portion of the wall 27 engages the inner end of flexible ring 20. Further movement of ring member 26 moves flexible ring member 21 from the position shown in FIG. 1 to the position shown in FIG. 2 which thus stresses and bends the peripheral or marginal portion 25 of the diaphragm 22. Movement in the other direction releases the ring 20 and marginal portion 25. This axial movement has the effect of narrowing or widening the pressure differential of diaphragm 22 depending on the direction moved. It will be noted that this variation of the pressure differential can be accomplished without, in any way, deleteriously affecting the movement of the diaphragm member 22 which could deleteriously affect the contact pressure or the pressure of engagement of contact member 120 and 114 or could cause inadvertent opening and closing of the circuit in switch 10 by lowering the contact forces at or around the operating points. A further embodiment of the device is shown in FIG. 3 where wall 27 and the deformable ring portion 20 are shown as formed integrally and together with the peripheral portion 25 of diaphragm member 22 which project beyond housing 12 and 14 in an axial direction. It will be noted that casing members 12 and 14 are formed with peripherally extending flanges 13 and 15 such that the flanges, the diaphragm periphery 25 and the flexible ring portion 20 form a sandwich extending radially from the housing. It will be seen that when this projecting marginal portion is engaged by forces tending to deform or bend the peripheral portion 25 of the diaphragm 22 from the solid line position to the dotted line position shown in FIG. 3, the adjustment of the pressure differential described above can be accomplished. This embodiment has the added advantage of providing for adjustment of the switch without entering the hermetically sealed portion thereof. Alternatively, as shown in FIG. 4, the housing 12 and 14 can be filled with threaded portions on which are mounted in threaded engagement ring portions 40 and 42 which have abutments 41 and 43 respectively which engage the radially extended portion 25 of the diaphragm to permit bending thereof to effect the pressure differential adjustment. Members 40 and 42 can be locked into adjusted position.

It will be understood that the housing members could alternatively be made of phenolic material as desired. It will also be noted that casing members 12 and 14 while preferably cylindrical in configuration to permit diaphragm member 22 to be made of a complementary circular shape corresponding to cylindrical configuration of the casing members, such a cross sectional configuration may be varied to include rectangular, octagonal or other polygonal shape. Threaded portion 34 of member 31 permits a means of mounting or securing the pressure responsive device on a source of pressure which is to be sensed.

It will thus be seen that the objects of the invention are achieved. Thus, a pressure sensitive switch permitting compact, hermetically-sealed or open construction is provided whose differential may be adjusted without deleteriously affecting the operation of the switch in a simple and inexpensive manner.

In view of the above, it will be seen that the several

objects of the invention are achieved and other advantageous results are obtained.

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.

It is to be understood that the invention is not limited in its application to the details of construction and arrangement of elements 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.

I claim:

1. A pressure responsive device comprising first and second casing members respectively providing first and second cavities; a snap-acting diaphragm positioned intermediate and permanently secured to a peripheral portion of at least one of said first and second casing members so that the diaphragm separates and hermetically seals the first cavity from the second cavity; the diaphragm having a deformed portion therein responsible for its snap action; an orifice provided by the first casing member communicating with the first cavity to admit fluid under pressure against one side of said diaphragm to effect snap movement of the diaphragm in a direction toward the second casing member; means mounted and positioned on the second casing for actuation thereof in response to snap movement of said diaphragm; a motion transfer member positioned intermediate the actuatable means and the diaphragm to transmit snap movement of the diaphragm to the actuatable means; and means mounted on one of said casing members adjacent the peripheral portion of the snap acting diaphragm, the means movable to bend the peripheral portion of said snap acting diaphragm and said peripheral portion of said one casing member out of the plane of the diaphragm to modify the pressure differential of the snap acting diaphragm.

2. A device as set forth in claim 1 wherein the peripheral portion of the snap acting diaphragm is mounted on one of the casing members, said one of the casing members including a portion movable toward and away from the peripheral portion of the snap acting diaphragm member and operable to exert force on the peripheral portion of the diaphragm member and the said one casing member to adjustably vary the pressure differential of the diaphragm.

3. A device as set forth in claim 1 wherein the diaphragm member is mounted on the second casing member and said second casing member includes a threaded portion on which is mounted in threaded engagement a

ring member operable to exert a force on flexible portions of the periphery of the snap acting diaphragm to effect adjustable variation of the pressure differential of the diaphragm.

4. A device as set forth in claim 1 wherein the peripheral portions of the snap acting diaphragm mounted on said portion of said one casing member extends radially outward from the walls of the casing to permit bending of the peripheral portions of the snap acting diaphragm exteriorly of the casing to effect variable adjustment of the pressure differential of the snap acting diaphragm.

5. A device as set forth in claim 4 wherein the exterior of said one of said casing members is threaded to receive a threaded ring; a threaded ring mounted on the threaded casing member and including abutment means thereon engageable with a peripheral portion of the snap acting diaphragm to effect movement thereof to adjust the pressure differential.

6. A device as set forth in claim 5 wherein the means responsive to movement of the diaphragm comprises an electrical switch including a contact-carrying arm having a contact thereon capable of movement into and out of engagement with a stationary contact in response to movement of the motion transfer member to open and close a circuit between contacts.

7. A switching device comprising a casing member defining a cavity therein, a snap acting diaphragm permanently secured to a peripheral portion of said casing member to seal said cavity, said diaphragm having a deformed portion therein responsible for its snap action, force exerting means mounted on said casing member adjacent the peripheral portion of the diaphragm, the force exerting means movable to bend the peripheral portion of said casing member and the peripheral portion of said snap acting diaphragm out of the plane of the diaphragm to modify the snap acting characteristics of the diaphragm.

8. A device as set forth in claim 5 wherein the exterior of the other of said casing members is threaded to receive a threaded ring; a second threaded ring mounted on the threaded exterior of the said other casing member, the second ring including abutment means engageable with a peripheral portion of the snap-acting diaphragm at a point spaced radially inwardly from the outer peripheral edge of said diaphragm.

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