

[54] **PRESSURE RESPONSIVE DEVICE HAVING IMPROVED MEANS FOR CALIBRATION**

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[58] Field of Search **200/83 S, 83 R, 83 W, 83 J, 200/83 P, 83 U; 327/323, 319; 92/13.2, 13, 101**

[56] **References Cited**

UNITED STATES PATENTS

3,367,244	2/1968	Charter	92/13.2
3,378,656	4/1968	Johnson	200/83 P
3,584,168	6/1971	Halpert et al.	200/83 S
3,676,620	7/1972	Modes	200/83 S

FOREIGN PATENTS OR APPLICATIONS

1,207,546	2/1969	France	200/83 V
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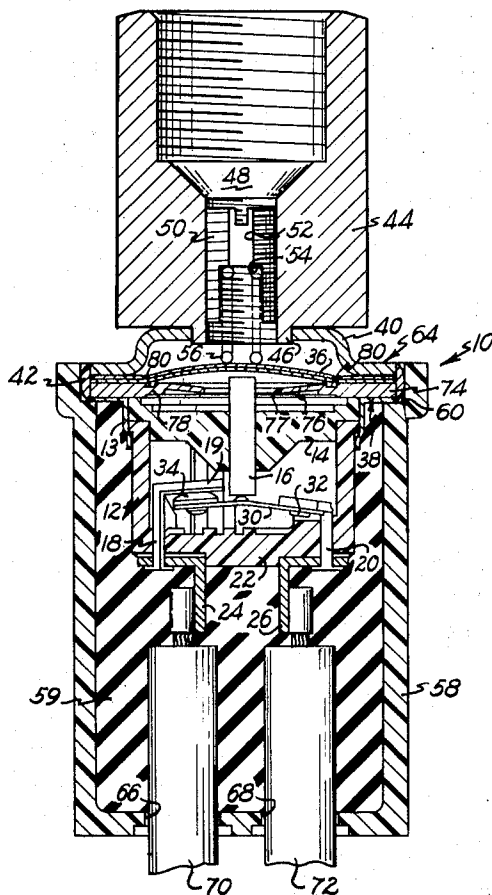
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[57]

ABSTRACT

A pressure responsive device comprises a first chamber having a port sealed from a second chamber by a pressure responsive snap acting diaphragm. At pressures above an actuation pressure the diaphragm snaps from a first configuration to a second opposite configuration causing a motion transfer pin to move and actuate an electrical switch. The diaphragm snaps back to the first configuration when pressure decreases to a deactuation pressure, different than the actuation pressure, thereby permitting deactuation of the switch. A special diaphragm support is provided to enable calibration of both the actuation and the deactuation pressure independently of one another.

10 Claims, 2 Drawing Figures



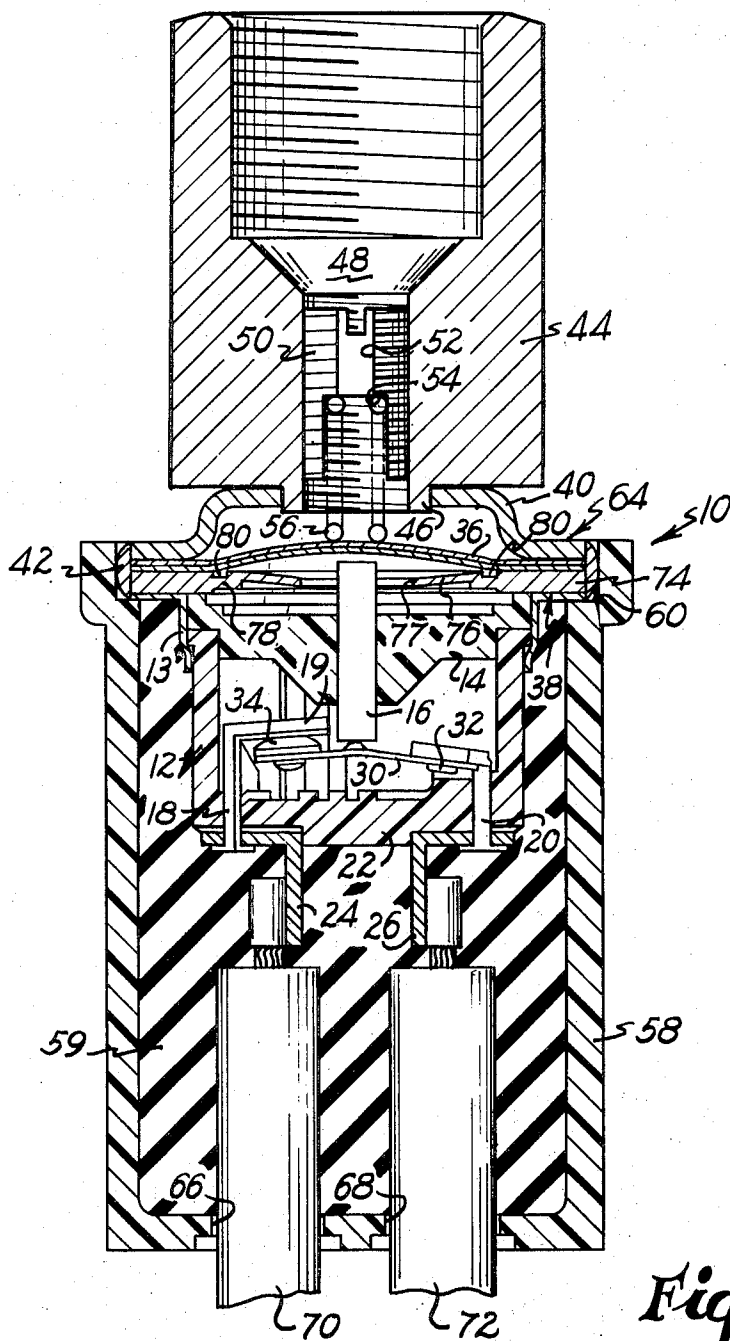


Fig. 1.

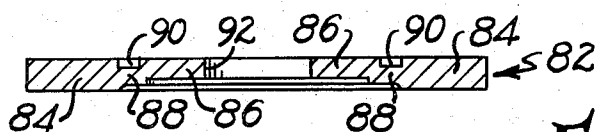


Fig. 2.

PRESSURE RESPONSIVE DEVICE HAVING IMPROVED MEANS FOR CALIBRATION

This invention relates generally to pressure responsive switches and more particularly to a pressure responsive switch having improved means for calibration.

BACKGROUND OF THE INVENTION

Devices are known for opening and closing an electrical circuit or an electrical switch in response to changes in values of pressure by admitting pressure to one side of a snap acting diaphragm causing it to snap from a first configuration to a second configuration at a predetermined value of pressure or actuation pressure and return at another value of pressure or deactuation pressure. The difference between these values of pressure is called the pressure differential of the diaphragm of the device.

In U.S. Pat. No. 3,378,656 issued Apr. 16, 1968 assigned to the assignee of the instant invention, it is taught that by altering the slope of the peripheral portion of the snap acting diaphragm the pressure differential of the diaphragm can be adjusted. It has been found that such alteration affects primarily the actuation pressure of the diaphragm. As described in the patent the diaphragm is attached along its periphery to a ring. The ring is deformed, as by forcing a tool member against it in order to change the slope of the outer peripheral edge of the diaphragm. In U.S. Pat. No. 3,584,168 issued June 8, 1971, also assigned to the assignee of this invention, it is taught that by providing an annular shaped calibration stop member the pressure differential of the diaphragm can also be adjusted. The adjustment effected by using this member is the deactuation pressure. As described in the latter patent a snap acting diaphragm is attached along its periphery to the periphery of the annular calibration stop member. To lower the deactuation pressure sufficient pressure is brought to bear against the diaphragm to deform the calibration-stop member. Conversely to raise the deactuation pressure a force is exerted, as by a tool, against the calibration-stop member deforming it toward the diaphragm. The force required to deform the calibration-stop member is substantially greater than any forces to which the diaphragm will be subjected during operation as a pressure responsive device. While both of these approaches are effective a problem exists when it is desired to adjust both the actuation and deactuation pressures. That is adjustment of the slope of the outer peripheral edge of the diaphragm tends to affect the position of the calibration-stop member and hence the deactuation pressure while adjustment of the calibration-stop member tends to affect the slope of the outer peripheral edge and hence the actuation pressure. Thus in order to obtain specific actuation, deactuation pressures it is frequently necessary for the person calibrating the device to cycle back and forth between the two adjustments and finally to make a judgment adjustment to obtain the required calibration.

SUMMARY OF THE INVENTION

Thus in order to reduce assembly costs and make the device amenable to quick and accurate calibration of both the actuation and deactuation pressures the instant invention provides a special calibration-stop member having a portion used for adjustment of the actuation pressure, another portion used for adjustment

of the deactuation pressure and means to isolate the two portions from each other. Essentially the improved calibration stop member comprises a relatively rigid annular flange joined to a variable cone center portion by an isolation land and groove which serve as a stress concentrator.

Thus among the several objects of the invention may be noted the provision of an improved pressure responsive device in which the actuation and deactuation pressures can be independently adjusted. Another provision is the provision of a pressure responsive device which is less expensive to produce than prior art devices having the same calibration tolerances, a device which can be readily produced on a high volume basis, one which can be easily calibrated by automated processes and one which is reliable and has a long usable life.

The invention accordingly comprises the constructions hereinafter described, the scope of the invention being indicated in the following claims.

BRIEF DESCRIPTION OF THE DRAWINGS

In the accompanying drawings, in which two of the various possible embodiments of the invention are illustrated,

FIG. 1 is a front cross section taken through the center of a pressure responsive device made in accordance with the invention, and

FIG. 2 is a front cross section taken through the center of an alternate calibration-stop member useful in the FIG. 1 embodiment.

Dimensions of certain of the parts as shown in the drawings may have been modified to illustrate the invention with more clarity.

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

DESCRIPTION OF THE PREFERRED EMBODIMENTS

In FIG. 1 numeral 10 represents a switch made in accordance with the invention. A housing 12 receives a hub portion 14 which in turn slidably receives a motion transfer pin 16 in a centrally located bore extending through the hub. Hub 14 is joined to housing 12 by collar member 13 crimped thereto. Members 18 and 20 extend through apertures in bottom wall 22 of housing 12 locking terminals 24, 26 as by staking in electrical connection therewith. Member 18 has a portion 19 extending laterally therefrom into the switch cavity 28 which serves as a stationary contact. Member 18 may be provided with a layer of material having especially high electrical conductivity characteristics such as copper or silver. A movable contact arm 30 formed of an electrically conductive material having good spring characteristics such as beryllium nickel cantilever mounted to member 20 in any convenient manner by riveting at 32. Contact 34 is mounted on the free distal end and is adapted to move into and out of engagement with portion 19 in response to the position of pin 16. A snap acting disc 36, either monometallic or multi-metallic is positioned adjacent an end of pin 16 and is adapted to change from the configuration shown in FIG. 1 to an over center configuration in which it biases pin 16 downwardly and with it movable arm 30 thereby opening the circuit through terminals 24, 26. Disc 36 is supported on calibration member 38 and is sand-

wiched between member 38 and cover 40. Preferably these members and collar 13 are sealed at their marginal periphery as by heliarc welding along their periphery as indicated at 42. It will be understood that other means may be employed to seal the diaphragm member from the pressure chamber as by clamping.

Port fitting 44 is provided with boss 46 which is received in a mating aperture in cover 40 and has a bore 48 therein for reception of pressure (or vacuum). Also shown is an adjusting screw 50 also having a longitudinally extending bore 52 and a spring seat 54 for reception of spring 56 which extends from the spring seat 54 to disc 36. Spring 56 and adjusting screw 50 are optional and may be used if it is desirable to narrow the pressure differential.

Housing 58 has an annular seat 60 which receives the outer peripheral portion 64 of cover 40, disc 38, member 38 and collar 13. Housing 58 is provided with apertures 66, 68 for reception therethrough of insulated wires 70, 72 which are connected respectively to terminals 24, 26 in any suitable manner as by crimping. Housing 58 is then back filled with suitable electrically a insulative material such as potting material 59.

Calibration-stop member 38 comprises a first annular outer portion 74, a second annular inner cone portion 76 and joined thereto by land 78 formed with a groove 80 therebetween which acts as an isolation means. Land 78 extends intermediate the bottom surface of outer portion 74 and the junction with inner portion 76. Bore 77 is provided in member 38 to permit pin 16 to pass therethrough.

Member 38 is formed of a material such as AISI type 304 Stainless Steel and is hydrogen annealed after forming to a Rockwell superficial hardness of (15-T) 73-90. This permits permanent deformation of member 38 as desired. It should be noted that for member 38 to function as intended no portion of 76 can be above the level of portion 74.

Thus the device may be assembled by first forming a subassembly by welding together cover 40, diaphragm 36, calibration-stop member 38 and collar 13. At this point the actuation pressure rating can be adjusted by permanently deforming the outer periphery margin of member 38 by using an appropriate tool, until the slope of the outer peripheral margin of diaphragm 36 is such that the diaphragm snaps at the desired actuation pressure. Once this is accomplished the deactuation pressure rating can be adjusted by introducing through cover 40 sufficient pressure to deform portion 76 of member 38 changing the angle of this conical portion to the desired amount when the diaphragm will snap back to its original configuration at the desired deactuation pressure. The thickness of portion 76 is such that a pressure substantially above any operating pressures to which the device will be subjected to in use as a switch is required to deform the portion. Due to the existence of groove 80 and land 78 the stresses created upon deformation of portion 76 are concentrated in land 78 and portion 74 is unaffected by this deformation. Thus each pressure setting can be carefully, accurately and independently adjusted. Another advantage offered by use of the groove is that it standardizes the tangent line of contact between the dishd portion of the diaphragm and calibration-stop member. Without the groove the tangent line could vary around the periphery of the diaphragm thereby affecting both pressure settings.

FIG. 2 shows an alternate calibration-stop member 82 comprising first outer annular portion 84 joined to second inner annular portion 86 by land 88 formed with isolation groove 90 therebetween. Aperture 92 is provided to permit pin 16 to pass therethrough. Member 82 is particularly useful when it is desirable to provide a narrower pressure differential since portion 86 is virtually on the same level as outer portion 84 prior to calibration.

Although the invention has been described with respect to a specific preferred embodiment thereof, many variations and modifications will immediately become apparent to those skilled in the art. It is therefore the intention that the appended claims be interpreted as broadly as possible in view of the prior art to include all such variations and modifications.

I claim:

1. A condition responsive device comprising a circular snap-acting diaphragm having a dishd surface movable to and from first and second overcenter configurations;

calibration means including a member having first and second portions, and means separating the first and second portions so that the second portion can be deformed without affecting the first portion, the member positioned adjacent a surface of the diaphragm; and

actuation means positioned adjacent the diaphragm and responsive thereto, the actuation means in contact with the diaphragm when the diaphragm is in the first configuration and out of contact with the diaphragm when the diaphragm is in the second configuration.

2. A device according to claim 1 in which the first portion of the member is a relatively stiff annular flange, the second portion of the member is a relatively thin flange, and the means separating the two portions from each other includes an isolation groove defined in the member between the portions.

3. A condition responsive assembly comprising a generally circular diaphragm deformed into a dishd shape to render it snap acting from a first configuration to a second opposite configuration upon the occurrence of the condition,

a calibration-stop member comprising a first relatively rigid annular flange portion, the periphery of the diaphragm and the flange being generally coincident and attached to one another, the member having a second relatively flexible portion extending radially inwardly from the flange portion, and means separating the first and second portions so that the second portion can be deformed without affecting the first portion.

4. An assembly according to claim 3 in which the means separating the first and second portions is a circular groove.

5. An assembly according to claim 4 further including a first chamber formed on the side of the diaphragm remote from the calibration stop-member, a port formed in the first chamber to permit ingress and egress of a fluid medium, and means mounted adjacent the diaphragm on the side of the diaphragm opposite the first chamber responsive to the snapping of the diaphragm from one configuration to the other upon the occurrence of a predetermined pressure in the first chamber.

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6. An assembly according to claim 5 in which the means responsive to the snapping of the diaphragm from one configuration to the other includes an electric switch comprising a base member having an open end, a stationary contact and a movable contact arm disposed in the base, the movable arm adapted to move into and out of engagement with the stationary contact, a hub having a bore extending therethrough closing the open end of the base, an aperture provided in the calibration-stop member and a motion transfer pin slidably received in the bore of the hub extending from the movable contact arm through the aperture in the calibration-stop member to a point adjacent the diaphragm so that in one configuration of the diaphragm the movable contact arm is separated from the stationary contact.

7. An assembly according to claim 6 in which two electrical leads extend from the electrical switch, a casing is disposed about the electrical switch and is pro-

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vided with two apertures through which the leads extend, and electrically insulative potting material fills the space between the casing and the switch and leads.

8. An assembly according to claim 3 in which the second portion of the calibration-stop member is annular in shape and is thinner than the first flange portion and a land and groove separate the two portions from one another.

9. An assembly according to claim 8 in which the second portion of the calibration-stop member is conical in shape.

10. An assembly according to claim 7 including a port fitting positioned in the port of the first chamber, the fitting having a threaded bore, a tubular threaded member adjustably positioned in the bore of the fitting and a coil spring extending between the tubular threaded member and the diaphragm.

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