United States Patent

Stiltner

[15] **3,683,137**

[45] **Aug. 8, 1972**

[54] PRESSURE SWITCH DIAPHRAGM ASSEMBLY WITH CLAMPING DIAPHRAGM SEALING MEANS

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[22] Filed: **Sept. 28, 1970**

[21] Appl. No.: **76,090**

[52] **U.S. Cl.** .....**200/83 B,** 92/102

[51] **Int. Cl.** **H01h 35/34**

[58] **Field of Search**.....200/83 R, 83 B, 83 H, 83 PA, 200/83 K, 83 J, 83 G, 83 WM; 92/93, 98 R, 102

[56] **References Cited**

UNITED STATES PATENTS

3,433,912	3/1969	Hutchinson et al.	200/83 R
3,204,055	8/1965	Barksdale	200/83 PA
2,537,308	1/1951	Hausen	200/83 R UX
3,335,641	8/1967	Toschkoff	92/98 R UX
3,540,305	11/1970	Sprung	200/83 R X

FOREIGN PATENTS OR APPLICATIONS

1,809,964	1/1970	Germany	200/83 WM
863,742	3/1961	Great Britain	200/83 R
1,129,210	5/1962	Germany	200/83 R

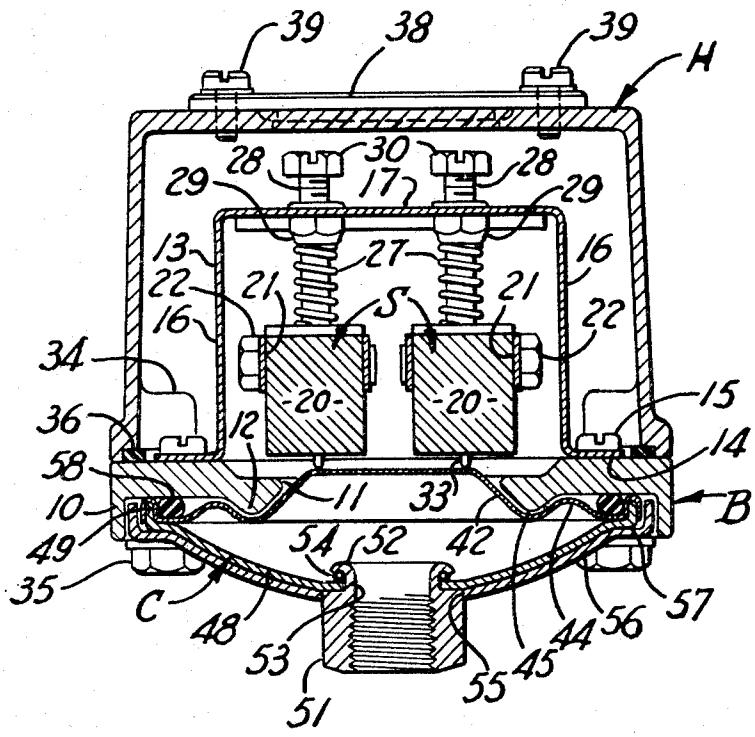
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[57] **ABSTRACT**

A pressure switch assembly in which the switch is actuated by a pressure responsive diaphragm which is held in assembled relation with the diaphragm bowl by a resilient seal ring and by a cap which is fastened to the switch base, the peripheries of the diaphragm and its bowl being sealingly engaged under the clamping force which deforms the seal ring, without a bond between or at the peripheries of the diaphragm and its bowl.

Such a pressure switch assembly in which the resilient seal ring backs up the diaphragm in the region of its outermost undulation where maximum stress occurs.

4 Claims, 4 Drawing Figures



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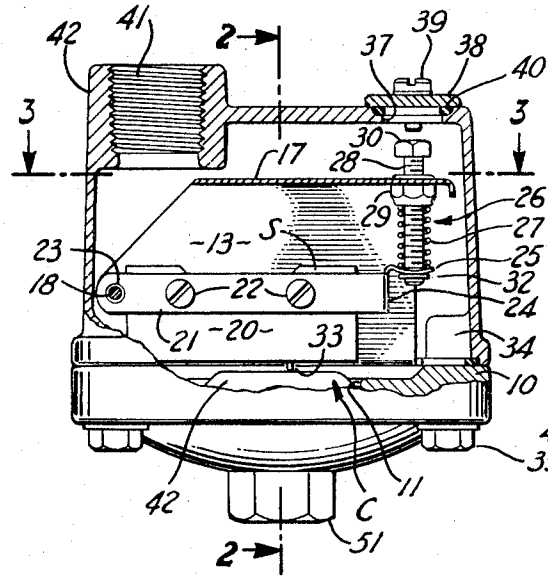


Fig. 1.

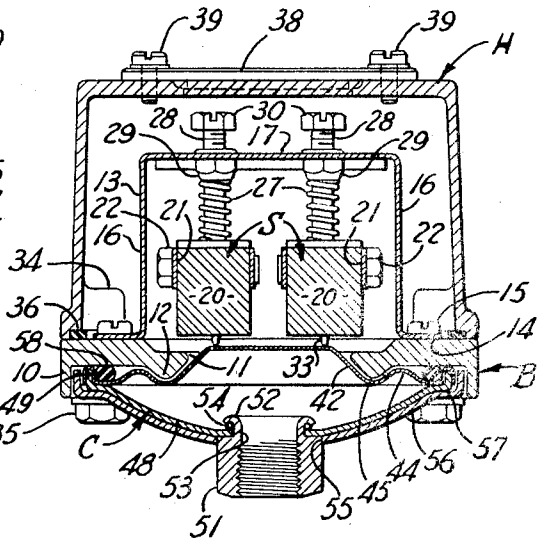


Fig. 2.

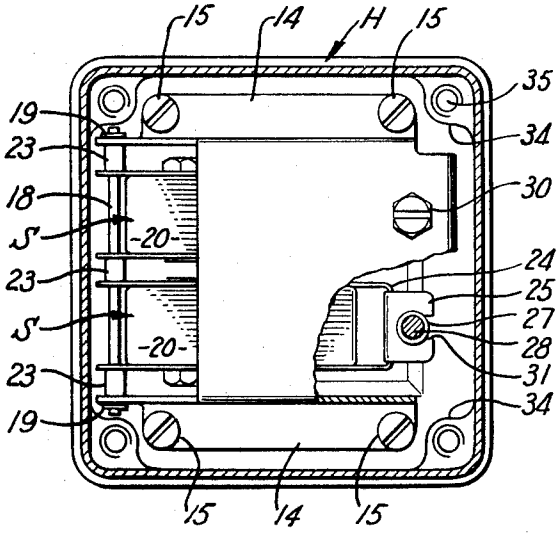


Fig. 3.

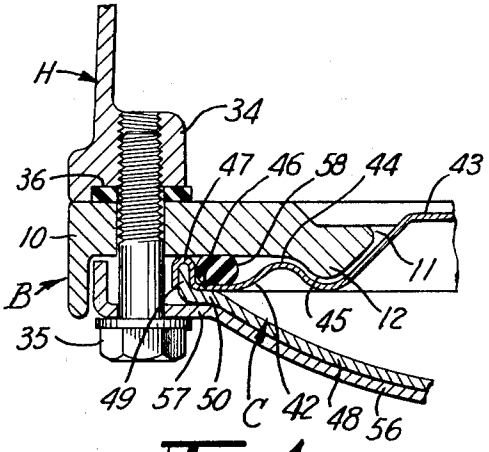


Fig. 4.

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PRESSURE SWITCH DIAPHRAGM ASSEMBLY WITH CLAMPING DIAPHRAGM SEALING MEANS

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to pressure switches, and more particularly to pressure switches of the type wherein the switch is actuated by a pressure responsive diaphragm forming part of a pressure capsule or diaphragm assembly.

More particularly, the invention involves improvements in the diaphragm assembly and its mounting or connection to the base of the switch, whereby various materials may be employed in the diaphragm and in its companion bowl which materials need not be capable of being connected by usual bonding, brazing or soldering materials.

2. The Prior Art

The prior art is exemplified by U.S. Pat. No. 3,204,055, granted Aug. 31, 1965, for Diaphragm Type Pressure Switch With Adjustable Leaf Spring Mounting.

Typically, in the use of such pressure switches, problems of service life and installation are encountered. Since the usual metal diaphragm and bowl are initially separate elements which are suitably bonded together about their peripheries, as by welding, brazing, soldering, or the like, the diaphragm is subject to early failure in the areas affected by the heat of the bonding operations, and the diaphragm assemblies are limited essentially to a few materials which can be joined readily without affecting the basic properties of the material. Ferrous materials or copper compounds have been most commonly employed. The assembly operations are, moreover, expensive. On the other hand, the readily bondable materials are inherently not practical for use in corrosive fluids, which has given rise to the practice of interposing a chemical seal between the pressure switch diaphragm capsule and the fluid pressure medium, to isolate the diaphragm capsule from the corrosive fluid. Such chemical seals are also expensive to manufacture and install.

SUMMARY OF THE INVENTION

The present invention provides a pressure switch with a diaphragm capsule assembly which is easy to manufacture, is durable, and may be composed of selected materials which will not be adversely affected by corrosive pressure fluid. The pressure switch is accordingly inexpensive to manufacture and may be installed directly in corrosive service, thereby eliminating the need for the usual chemical seal.

More particularly, the invention involves the provision of a pressure diaphragm capsule or assembly in a pressure switch, wherein the diaphragm and bowl may be of selected, desired similar or dissimilar materials, which materials need not be capable of bonding or connection by the usual welding, soldering or brazing methods. In accomplishing this object, the diaphragm and the bowl are adapted at their outer peripheries to be clamped in face-to-face sealing relation by a resilient seal ring and the usual end cap or closure, when the latter is fastened to the base of the switch assembly. Since the diaphragm and bowl are not bonded at their peripheries, various materials may be employed

which have desirable characteristics insofar as flex life and resistance to corrosive attack are concerned, but which are not inherently capable of being bonded, as by welding, soldering or brazing. However, even when ferrous or copper compounds are employed in the pressure capsule, the flex life of the diaphragm will be enhanced since the need for heating to effect the bond is eliminated.

In addition to the foregoing, the structure of the capsule diaphragm and the clamping of the peripheries of the diaphragm and bowl between the end cap and the switch base affords further advantages of durability or life of the diaphragm, in accordance with the present invention. More particularly, the diaphragm has its outermost undulation backed up by the resilient ring at the region of maximum flexure and stress on the diaphragm resulting in longer service life.

Not only does the cold manufacture of the pressure capsule, in accordance with the invention, that is, the clamping of the parts as distinguished from bonding of the type requiring high heat, allow the selection of materials from a wide range of materials, without limiting the pressure sensing capsule in either media compatibility or range of heat affected materials, but also a sensitive diaphragm assembly may be smaller in diameter than has been practical in heat bonded capsule assemblies, due to the comparatively large ratio of heat affected to non-heat affected areas in the diaphragm in the heat bonded assemblies.

This invention possesses many other advantages, and has other purposes which may be made more clearly apparent from a consideration of a form in which it may be embodied. This form is shown in the drawings accompanying and forming part of the present specification. It will now be described in detail, for the purpose of illustrating the general principles of the invention; but it is to be understood that such detailed description is not to be taken in a limiting sense, since the scope of the invention is best defined by the appended claims.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a view partly in side elevation and partly in section, showing a pressure switch assembly incorporating the invention,

FIG. 2 is a view in vertical section, as taken on the line 2—2 of FIG. 1;

FIG. 3 is a view in horizontal section, as taken on the line 3—3 of FIG. 2, with a portion broken away; and

FIG. 4 is an enlarged fragmentary detail view in section, showing the margin of the diaphragm capsule clamped between the switch base and the end cap of the assembly.

DESCRIPTION OF THE PREFERRED EMBODIMENT

As seen in the drawings, the switch assembly incorporating the invention generally comprises a switch base B adapted to support one or more switches S, the switches being enclosed by a cover or housing H, and the base B also being adapted to have a pressure responsive diaphragm assembly or capsule C secured thereto so as to effect operation of the switches S in response to a significant change in the pressure of a fluid medium in the capsule C. Such a general assembly

is well known and is exemplified in the aforementioned U.S. Pat. No. 3,204,055.

In the illustrative embodiment of the invention, the switch base B comprises a body **10** which has a central opening **11** circumscribed by an annular flange **12**. Means including a supporting bracket **13** mounts a number of switches S in relation to the opening **11** in the base for actuation by the pressure capsule C, as will be hereinafter described.

In the illustrative embodiment, the supporting bracket **13** is in the form of a channel-like stamping formed with suitable bottom flanges **14** which are turned outwardly and secured to the base body **10** by suitable fastenings **15**. The bracket **13** includes side walls **16** disposed in opposed relation and a top wall **17** bridging the side walls.

Spanning the side walls **16** of the bracket **13**, adjacent to one end thereof, is a pivot pin **18**, the ends of which extend through the walls **16** and are held in place by suitable means such as snap rings **19**. The switches S are pivotally mounted on the pin **18**, and accordingly the body **20** of each switch is mounted between laterally spaced arms **21** which are secured to the respective switch bodies by suitable fasteners **22**. Appropriate spacers **23** are provided on the pivot pin to space the switches S relative to one another and relative to the side walls **16**, when more than one switch S is employed, or to centralize a single switch between the side walls **16**, if only one switch S is employed, so that the switch bodies **20** are positioned as desired relative to the opening **11** in the body **10** of the switch base B.

At the opposite ends of the switch supporting arms **21** from the pivot pin **18**, the arms are connected by an end wall **24** having an outwardly extended flange **25** which provides a seat for spring means **26** adapted resiliently bias the switch bodies **20** downwardly about the pivot pin **18**. The spring means **26** includes a coiled compression spring **27** disposed about an adjuster screw **28** which is threaded through a nut **29** affixed in the top wall **17** of the supporting bracket **13**. At its upper end, the screw **28** is adapted for engagement by a tool for rotating the screw, as by the provision of the usual screw head **30**. At its lower end, the screw **28** extends through an opening or slot **31** in the spring seating flange **25** of the switch supporting arms **21** and has an abutment **32** fixed thereon, so that normally, the spring **27** biases the switches S downwardly until the spring seat **25** is in engagement with abutment **32**.

Each of the switches S includes an actuator pin **33** extending downwardly for actuation by the pressure capsule C, as will be later described, but it is now apparent that adjustment of the switches S and actuator pins **33** relative to the pressure capsule for desired switch operation, in response to a given pressure in the capsule, may be easily effected by adjustment of the screws **28**, and that the switches S are otherwise free for upward pivotal movement about the pivot pin **18** against the influence of the spring means **26**.

The housing H may be of any suitable form and may be suitably made for attachment to the body **10** of the base B. Illustratively, the housing H is a rectangular dome, corresponding in peripheral shape and size with the base **10**. Interiorly, at its corners, the housing H has enlarged lugs or portions **34** adapted to receive screw fasteners **35** for connecting the housing to the switch base B. A peripheral seal **36** is provided about the housing H to preclude entry of foreign matter into the housing at the interface between the base B and the housing H. In order to enable access to the housing H for adjustment of the switch biasing spring means **26**, the housing has an opening **37** adapted to be closed by a plate **38** which is removably secured in place by fasteners **39**, a peripheral seal **40** being provided engageable under the plate **38** to prevent entry of foreign matter. Finally, the housing H has a threaded opening **41** in a neck **42** adapted to accommodate the usual conductor cable having leads (not shown) connectable to the switch or switches S in a well known manner requiring no illustration herein.

The present invention resides in the pressure responsive diaphragm assembly C, which is combined or assembled with the switch base B so as to effect operation of the switch means S in response to a significant change in the pressure of a medium supplied to the capsule C.

More particularly, a flexible diaphragm **42** is provided, the diaphragm having a central disc-like portion **43** adapted for engagement with the switch actuators **33**. Extending outwardly from the central portion **43** of the diaphragm is a compliant or undulated annular section, including at least one undulation **44**. The portion of the diaphragm **42** which underlies the base body **10** is preferably backed up by the under-surface **45** of the annular portion **12** of the body **10** of the base B, which surface **45** is normally spaced from the opposing surface of the diaphragm **42** but substantially conforms to the latter in contour, whereby excessive excursion of the diaphragm is precluded under high internal pressure conditions in the capsule C. Radially outwardly from the undulation **44**, the diaphragm has a flat, annular portion **46**, and a marginal, inverted, annular channel section **47**.

The diaphragm or capsule assembly **42** also includes a dished bowl **48** having a marginal, annular flange **49** projecting axially so as to be disposed in the channel section **47** of the diaphragm. Adjacent to the flange **49** is an annular flat portion **50** adapted for complemental, face-to-face engagement with the opposing face of the flat portion **46** of the diaphragm **42**. In order to admit pressure fluid to the capsule C, between the diaphragm **42** and the bowl **48**, the bowl is provided with a central fitting **51**, having an inwardly extending flange **52** which extends through an opening **53** in the bowl and is outwardly flared or swaged to confine a seal ring **54** in sealing engagement with the inner surface of the bowl **48**. Such assembly of the fitting **51** with the bowl **48** eliminates the need for the application of heat, to bond the fitting in the bowl, as is now customary.

Preferably, the body of the fitting **51** is polygonal in form and extends through a complemental opening **55** in the usual end plate **56** which generally conforms in contour to the bowl **48** of the capsule assembly C and has a marginal flat portion **57** which underlies the flat portion of the bowl **48**.

The fasteners **35**, which secure the base plate B to the housing H, as previously described, also serve to clamp the end plate, at least in the region of the flat portion **57**, against the bowl **48**, at least in the region of the marginal flat portion **50** of the bowl, the latter being clamped against the marginal flat portion **46** of the

diaphragm **42**. The clamping force is applied to a resilient, deformable ring **58** which is interposed between the flat portion **46** of the diaphragm **42**, to deform the ring **58** and compressively hold the opposing faces of the flat portion **46** of the diaphragm **42** and the flat portion **50** of the bowl **48** in face-to-face sealing engagement, whereby to confine pressure fluid in the diaphragm capsule, without resorting to the usual bond between the peripheries of the diaphragm and the bowl. Maximum deformation of the ring **58** will occur when the channel portion **47** of the diaphragm abuts with the under-surface of the body **10** of the base.

The resilient ring **58** is preferably of such size that when it is substantially fully deformed, as shown, its inner periphery lies closely adjacent to the outer curve of the undulation **44** of the diaphragm **42** so as to resiliently back up the diaphragm in the annular region of such outer curve of the undulation **44**, at which region maximum stress occurs during flexure of the diaphragm.

By virtue of the construction described above, as previously indicated, the materials of which the diaphragm **42** and the bowl **48** are composed may be selected from a wide range of materials which are insensitive to the fluid medium to which the capsule C is to be subjected. This advantage results from the fact that these materials are not limited to ferrous or copper materials, which enable the usual welding brazing, or soldering of the outer peripheries of the diaphragm and the bowl, since a face-to-face, bondless, seal is provided by applicant's construction. Direct application of the switch assembly to a fluid system is thus feasible, without necessitating the use of a costly chemically inert fluid seal between the switch capsule C and the fluid medium in a system.

Longer life expectancy of the capsule is also accomplished since there are no heat affected areas at which failure is particularly likely. A comparatively smaller, but sensitive assembly may also be employed in view of the elimination of heat affected areas in the diaphragm.

I claim:

1. In a pressure switch assembly comprising: a switch base having an opening, switch means, switch supporting means mounting said switch means in said opening, a pressure capsule including a flexible metal diaphragm and a metal bowl mounted on said base, said diaphragm having a portion operatively engageable with said switch means in said opening to actuate said switch means responsive to a change in pressure in said capsule, and a pressure fitting leading through said bowl into said capsule; the improvement wherein said base has an annular surface, said diaphragm and said bowl having complemental flat annular marginal sealing portions disposed in face-to-face sealing engagement and aligned with the annular surface of said base, a clamping member having an annular clamping surface engaging the marginal portion of said bowl to force said marginal portions of said bowl and said diaphragm towards said surface of said base, and a resiliently deformable ring interposed between said marginal portion of said diaphragm and said surface of said base to resiliently maintain said marginal portions of said diaphragm and said bowl in sealing contact.

2. A pressure switch assembly as defined in claim **1**, wherein said diaphragm has an annular undulation adjacent to its marginal sealing portion, and said resiliently deformable ring contacts said diaphragm adjacent to said undulation and resiliently resists flexure of said diaphragm.

3. A pressure switch assembly as defined in claim **1**, wherein one of said diaphragm and said bowl has an annular and axially flanged periphery providing an axially opening peripheral channel adjacent to its marginal portion, and the other of said diaphragm and said bowl has an annular axially projecting peripheral flange adjacent to its marginal portion and disposed in said channel, said flanged periphery contacting one of said annular surfaces to limit deformation of said ring.

4. A pressure switch as defined in claim **1**, wherein said pressure fitting is connected to said bowl, said bowl having a central opening, said fitting having an annular end flange turned back in said opening into opposing relation to the inner surface of said bowl, and a seal ring underlying said turned back flange in sealing engagement therewith and with said bowl surface.

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