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L. S. BARKSDALE
DIAPHRAGM TYPE PRESSURE SWITCH WITH
ADJUSTABLE LEAF SPRING MOUNTING
Filed Dec. 12, 1961

3,204,055

FIG. 1.

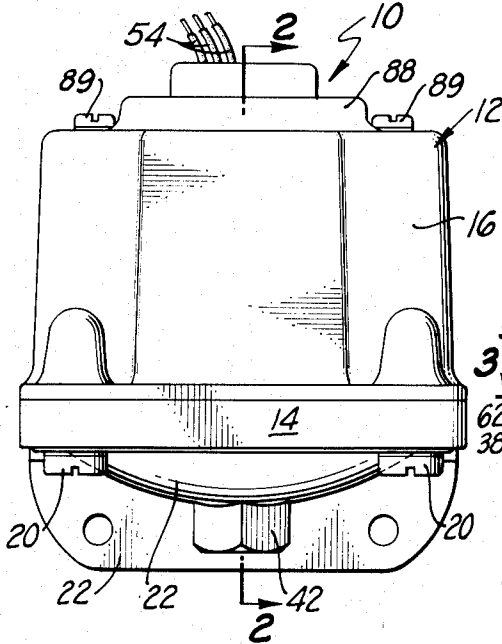


FIG. 2.

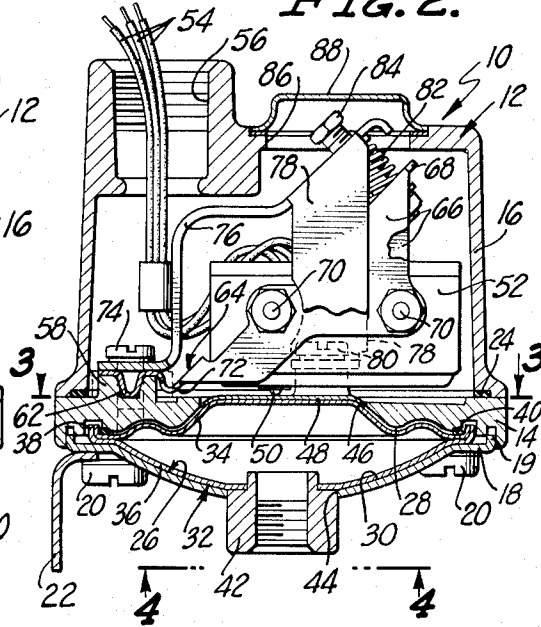


FIG. 3.

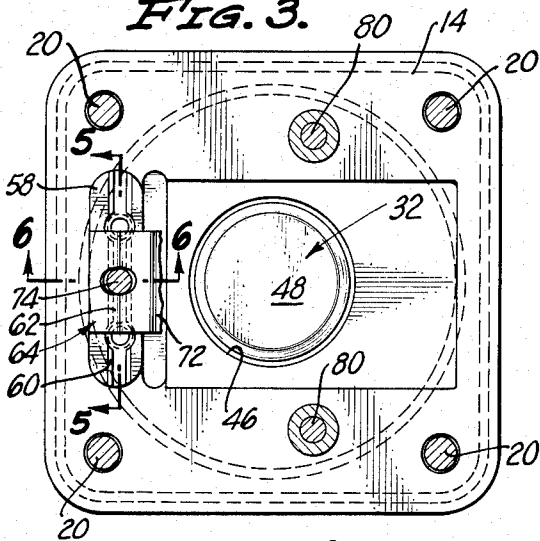


FIG. 4.

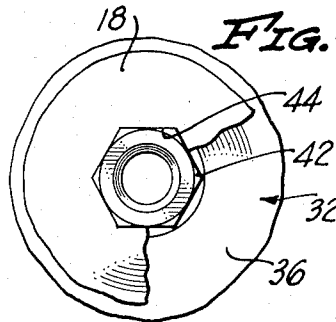


FIG. 5.

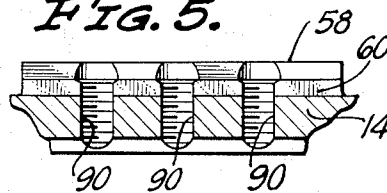
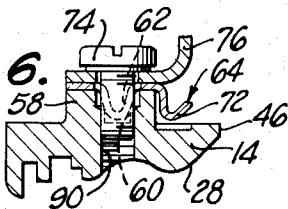


FIG. 6.



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3,204,055

DIAPHRAGM TYPE PRESSURE SWITCH WITH ADJUSTABLE LEAF SPRING MOUNTING

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4 Claims. (Cl. 200—83)

The present invention relates in general to a pressure switch or pressure switch assembly and, more particularly, to an improved diaphragm assembly for use in a pressure switch assembly and to an improved adjustable switch mounting for use in a pressure switch assembly.

A primary object of the invention is to provide a diaphragm assembly which includes a double-walled, hollow diaphragm unit or pressure capsule having an inner, flexible, diaphragm wall and an outer wall spaced outwardly from such inner wall, and which includes a housing containing the diaphragm unit and having spaced inner and outer walls respectively complementary to and engageable by the external surfaces of the inner and outer walls of the diaphragm unit. With this construction, the housing backs up and limits expansion of the diaphragm unit to prevent damage thereto.

Consequently, the walls of the diaphragm unit may be made thin enough to provide extreme sensitivity so that the diaphragm unit is capable of responding to very small pressure changes, the expansion-limiting housing preventing damage even with severe pressure overloads. Also, the diaphragm unit, which is made of relatively expensive materials, can be of thin-walled construction for purposes of economy since expansion thereof is limited by the housing, the latter being made of relatively inexpensive materials.

An important object is to provide a diaphragm unit which is readily replaceable. Thus, a pressure switch assembly with which the diaphragm unit of the invention is used may be restored to service, in the event of failure of the diaphragm unit, merely by replacing the diaphragm unit with a new one. Also, diaphragm units having different characteristics may be substituted readily to obtain different characteristics for the pressure switch assembly, without replacing the entire pressure switch assembly. Thus, stocking problems are minimized.

Another object is to provide a diaphragm assembly which includes a pressure inlet fitting mounted on the outer wall of the diaphragm unit in communication with the interior of such unit and projecting outwardly through the outer wall of the housing.

An important object in the foregoing connection is to make the pressure inlet fitting of noncircular, e.g., hexagonal, cross section and to provide the outer wall of the housing with a complementary hole therethrough in which the pressure inlet fitting has a relatively tight fit. With this construction, any torque applied to the pressure inlet fitting, as in connecting or disconnecting a pressure inlet line, is resisted by the outer wall of the housing and is not transmitted to the diaphragm unit, which is an important feature of the invention.

Another object of the invention is to provide a diaphragm assembly of the foregoing nature wherein the outer wall of the diaphragm unit, and the complementary outer wall of the housing, are dome shaped.

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Still another object of the invention is to provide a pressure switch assembly which includes a switch mounted on the housing and having an actuator engageable by the inner wall of the diaphragm unit, whereby to actuate the switch in response to movement of the inner wall of the diaphragm unit resulting from varying pressure in the diaphragm unit.

A further object of the invention is to provide the inner wall of the diaphragm unit with a central actuator pad on its external surface, such actuator pad being engageable with the actuator of the switch. The inner wall of the housing is provided with a central opening in register with such actuator pad to permit engagement of the actuator pad with the actuator of the switch.

The invention contemplates a mounting means for the switch which includes a leaf spring having a first portion connected to the housing and a second portion to which the switch is connected. An important object in this regard is to provide the leaf spring with a generally V-shaped third portion which is located between the first and second portions of the leaf spring and which acts as a flexible hinge means for the switch permitting pivotal movement of the switch toward and away from the diaphragm unit, thus eliminating pin bearings, which are subject to wear, with consequent inaccuracy.

Still another object is to provide adjustment means interconnecting the housing and the switch for pivoting the switch toward and away from the diaphragm unit about the flexible hinge means provided by the leaf spring.

Still another object of the invention is to provide a connection between the leaf spring mount for the switch and the housing, or other support, which includes a groove in the housing and which includes a rib on the leaf spring of generally V-shaped cross section disposed in such groove and secured to the housing by a single screw. With this construction, accurate orientation of the switch relative to the diaphragm unit is achieved automatically in a very simple manner.

A further object is to provide a pressure switch assembly of the foregoing nature incorporating either a single switch, or more than one switch, without changing any of the components, thereby providing flexibility of use while minimizing stocking problems.

The foregoing objects, advantages, features and results of the present invention, together with various other objects, advantages, features and results thereof which will be evident to those skilled in the pressure switch art in the light of this disclosure, may be achieved with the exemplary embodiment of the invention described in detail hereinafter and illustrated in the accompanying drawing, in which:

FIG. 1 is a side elevational view of a pressure switch or pressure switch assembly which embodies the invention;

FIG. 2 is a longitudinal sectional view taken along the arrowed line 2—2 of FIG. 1;

FIG. 3 is a transverse sectional view taken along the arrowed line 3—3 of FIG. 2;

FIG. 4 is a fragmentary elevational view, with parts broken away, taken as indicated by the arrowed line 4—4 of FIG. 2; and

FIGS. 5 and 6 are enlarged, fragmentary sectional views taken as indicated by the arrowed lines 5—5 and 6—6, respectively, of FIG. 3.

In the drawing, the pressure switch of the invention is designated generally by the numeral 10 and includes a housing 12 comprising a supporting base 14 sandwiched between a cup-shaped enclosure 16 and a dome-shaped cap 18, the latter having a peripheral skirt 19 extending into an annular groove in the base. The members 14, 16 and 18 are secured together by four screws 20, two of which also secure a mounting bracket 22 to the housing 12. An annular sealing element 24 provides a fluid-tight seal between the base 14 and the enclosure 16 to isolate the interior of the enclosure from its environment.

The base 14 and the cap 18 provide therebetween a cavity 26 having an inner wall 28 defined by the base and an outer wall 30 defined by the cap. Within the cavity 26 is a double-walled, hollow diaphragm unit 32 having an inner wall 34 adjacent and engageable with the inner wall 28 of the cavity, and having a dome-shaped outer wall 36 complementary to and seated against the outer wall 30 of the cavity. The inner wall 34 of the diaphragm unit 32 has the general configuration of a conventional flexible metallic diaphragm used in pressure responsive devices of various types, and the inner wall 28 of the cavity 26 is complementary to the external surface of the inner wall 34 of the diaphragm unit. Thus, the inner wall 34 of the diaphragm unit 32 is engageable with the inner wall 28 of the cavity 26 to limit expansion of the diaphragm unit 32 in response to a pressure rise within the diaphragm unit.

The inner and outer walls 34 and 36 of the diaphragm unit 32 are preferably separate elements initially, and are suitably bonded together around their peripheries, as by welding, brazing, soldering, or the like. The diaphragm unit 32 has an annular skirt 38 which extends into an annular groove in the base 14, an annular sealing element 40 being provided between the periphery of the diaphragm unit and the base, again for the purpose of isolating the interior of the enclosure 16 from its environment. As will be apparent, the annular sealing element 40 and the periphery of the diaphragm unit 32 are clamped between the base 14 and the cap 18, the grooves for the peripheral skirts 19 and 38 on the cap and the diaphragm unit being deep enough to permit the desired clamping movement.

The outer wall 36 of the diaphragm unit 32 has suitably bonded thereto, as by welding, brazing, soldering or the like, a central pressure inlet fitting 42 which communicates with the interior of the diaphragm unit and which projects outwardly through the cap 18. In the particular construction illustrated, the pressure inlet fitting 42 is internally threaded for the threaded insertion thereto of a pressure inlet line, not shown. The portion of the pressure inlet fitting 42 which projects outwardly through the cap 18 is noncircular, preferably hexagonal, in cross section. The cap 18 is provided with a hole 44 therethrough which is of complementary cross section and within which the pressure inlet fitting 42 fits relatively tightly, e.g., with a sliding fit. With this construction, any torque transmitted to the pressure inlet fitting 42, as in threadedly connecting a pressure inlet line thereto, is resisted by the cap 18, and is not transmitted to the diaphragm unit 32.

Since the outer wall 36 of the diaphragm unit 32 is normally seated against the outer wall 30 of the cavity 26, since the inner wall 34 of the diaphragm unit 32 is seatable against the inner wall 28 of the cavity 26 to limit expansion of the diaphragm unit in response to rising pressure, and since any torque applied to the pressure inlet fitting 42 is not transmitted to the diaphragm unit, the inner and outer walls of the diaphragm unit may be quite thin. Normally, the inner and outer walls 34 and 36 of the diaphragm unit 32 are made of relatively expensive materials, such as stainless steel and/or beryllium copper. The fact that the invention permits the use of thin walls 34 and 36 thus minimizes the cost of the materials used in making them, relatively cheap materials being used for the reinforcing base 14 and cap 18. Consequently, the invention results in considerable economies in the costs

of the materials going into the diaphragm assembly formed by the base 14, the cap 18 and the diaphragm unit 32.

The central portion of the inner wall 34 of the diaphragm unit 32 projects through a central opening 46 in the base 14. Bonded to the external surface of the central portion of the inner diaphragm-unit wall 34, as by welding, brazing, soldering, or the like, is an actuator pad 48 engageable with the actuator 50 of a microswitch 52. The latter is disposed within the enclosure 16 and is mounted on the base 14 in a manner to be described. Leads 54 connected to the switch 52 extend through a threaded opening 56 in the enclosure 16, such opening being adapted to have a conduit, not shown, for the leads threaded thereto.

The base 14 is provided thereon within the enclosure 16, and to one side of the central opening 46 in the base, with a raised rib 58 provided therein with a longitudinal groove 60 the sides of which are bevelled. This groove receives therein a transverse, generally V-shaped portion 62 of a cantilever leaf spring 64 the free end of which terminates in spaced side plates 66 interconnected by a web 68. The switch 52 is disposed between the side plates 66 and is suitably connected thereto, as by bolts 70.

The leaf spring 64 is provided with a generally V-shaped portion 72 parallel to the V-shaped portion 62 and located between the V-shaped portion 62 and the side plates 66. The V-shaped portion 72 serves as a flexible hinge means permitting pivotal movement of the switch 52 toward and away from the actuator pad 48 of the diaphragm unit 32 for the purpose of adjusting the pressure setting of the pressure switch 10, as will be described.

The leaf spring 64 is secured to the base 14 by a single screw 74 which extends through the V-shaped portion 62 of the leaf spring and is threaded into the base. With this construction, the switch 52 is automatically positioned accurately relative to the actuator pad 48 in a very simple manner upon assembly, due to the positioning action of the V-shaped portion 62 of the leaf spring 64 in the groove 60, and the positioning action of the screw 74.

The screw 74 also secures to the base one end of a bracket 76 which is bifurcated at its other end to provide two arms 78 receiving the switch 52 and the free end of the leaf spring 64 therebetween. The arms 78 are secured to the base 14 by screws 80.

The bracket 76 and the leaf spring 64 are biased apart by a compression spring 82 inserted between the bracket and the web 68 interconnecting the side plates 66 of the leaf spring. The extent to which the leaf spring 64 is biased away from the bracket 76, in opposition to the action of the spring 82, is determined by an adjusting screw 84 interconnecting the members mentioned and extending through the compression spring 82. The adjusting screw 84 is accessible through an opening 86 in the enclosure 16, such opening normally being closed by a cap 88 secured by screws 89. As will be apparent, the adjusting screw 84 controls the position of the switch 52 relative to the diaphragm unit 32, and thus determines the pressure setting of the pressure switch assembly 10.

In addition to the various advantages hereinbefore mentioned, the construction disclosed provides a pressure switch 10 which will operate in any position, which is not influenced by vibration, which is extremely accurate, and which retains its accuracy, without any drift in its pressure setting, throughout its entire operating life, the latter being extremely long.

It will be noted that the rib 58 on the base 14 is provided therein with three spaced screw-receiving holes 90, FIG. 5. When only the single switch 52 is used, only the central one of the holes 90 is used to receive the screw 74, the actuator 50 of the switch 52 under such conditions being engageable by the center of the actuator pad 48 of the diaphragm unit 32. However, two switches, not shown, each similar to the switch 52, may be used side by side, their actuators being engaged by points on the actuator pad 48 spaced equidistantly from the center

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thereof. In this event, two of the leaf-spring switch mounts 64 and two of the brackets 76 are employed, the mounts 64 being secured by two screws 74 extending into the end holes of the row shown in FIG. 5 of the drawing. Thus, two switches may be used with no change in any of the components disclosed.

Although exemplary embodiments of the invention have been disclosed herein for purposes of illustration, it will be understood that various changes, modifications and substitutions may be incorporated in such embodiments without departing from the spirit of the invention as defined by the claims which follow:

I claim:

1. In a pressure switch assembly, the combination of
 - (a) a double-walled, hollow, sealed diaphragm unit having an inner diaphragm wall and an outer wall spaced outwardly from said inner wall;
 - (b) a housing containing said diaphragm unit and having spaced inner and outer walls respectively complementary to and respectively engageable by and engaged by the external surfaces of said inner and outer walls of said diaphragm unit;
 - (c) a pressure inlet fitting mounted on said outer wall of said diaphragm unit in communication with the interior of said diaphragm unit and projecting outwardly through said outer wall of said housing;
 - (d) a switch having an actuator engageable by said inner wall of said diaphragm unit; and
 - (e) means mounting said switch on said housing in a position wherein said actuator is engageable by said inner wall of said diaphragm unit, including a leaf spring having a first portion connected to said housing and a second portion to which said switch is connected, said leaf spring having a generally V-shaped third portion which is located between said first and second portions thereof and which acts as a flexible hinge means for said switch permitting pivotal movement of said switch toward and away from said diaphragm unit.
2. In a pressure switch assembly, the combination of
 - (a) a double-walled, hollow, sealed diaphragm unit having an inner diaphragm wall and an outer wall spaced outwardly from said inner wall;
 - (b) a housing containing said diaphragm unit and having spaced inner and outer walls respectively complementary to and respectively engageable by and engaged by the external surfaces of said inner and outer walls of said diaphragm unit;
 - (c) a pressure inlet fitting mounted on said outer wall of said diaphragm unit in communication with the interior of said diaphragm unit and projecting outwardly through said outer wall of said housing;
 - (d) a switch having an actuator engageable by said inner wall of said diaphragm unit;
 - (e) means mounting said switch on said housing in a position wherein said actuator is engageable by said inner wall of said diaphragm unit, including a leaf

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spring having a first portion connected to said housing and a second portion to which said switch is connected, said leaf spring having a generally V-shaped third portion which is located between said first and second portions thereof and which acts as a flexible hinge means for said switch permitting pivotal movement of said switch toward and away from said diaphragm unit; and

(f) adjustment means interconnecting said housing and said switch for pivoting said switch toward and away from said diaphragm unit about said flexible hinge means.

3. In a switch assembly, the combination of

- (a) a support;
 - (b) a switch having an actuator;
 - (c) a leaf spring having a first portion connected to said support, a second portion to which said switch is connected, and an intermediate, third portion of generally V-shaped cross section acting as a flexible hinge means permitting pivotal movement of said switch relative to said support; and
 - (d) adjustment means interconnecting said support and said switch for pivoting said switch relative to said support about said flexible hinge means.
4. In a switch assembly, the combination of
- (a) a support having a groove;
 - (b) a switch having an actuator;
 - (c) a leaf spring having a first portion of generally V-shaped cross section disposed in said groove and connected to said support, a second portion to which said switch is connected, and an intermediate, third portion of generally V-shaped cross section parallel to said first portion and acting as a flexible hinge means permitting pivotal movement of said switch relative to said support; and
 - (d) adjustment means interconnecting said support and said switch for pivoting said switch relative to said support about said flexible hinge means.

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