United States Patent

[11] **3,588,395**

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[21] Appl. No. **763,232**
[22] Filed **Sept. 27, 1968**
[45] Patented **June 28, 1971**

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[54] **FLUID PRESSURE RESPONSIVE DEVICE**
5 Claims, 3 Drawing Figs.

[52] **U.S. Cl.** **200/83,** 92/101
[51] **Int. Cl.** **H01h 35/40**
[50] **Field of Search** ..... 200/83, 83 (.2); 29/622; 92/13, 101

[56] **References Cited**

UNITED STATES PATENTS

1,183,486	5/1916	Pardue	92/101
1,684,530	9/1928	Bast	200/83(.2)X
2,381,835	8/1945	Moorhead	200/83(.2)
3,302,269	2/1967	Cooper et al.	29/622
3,365,557	1/1968	Cooper et al.	200/83
3,367,244	2/1968	Charter	92/13
3,378,657	4/1968	Smith	200/83(.2)

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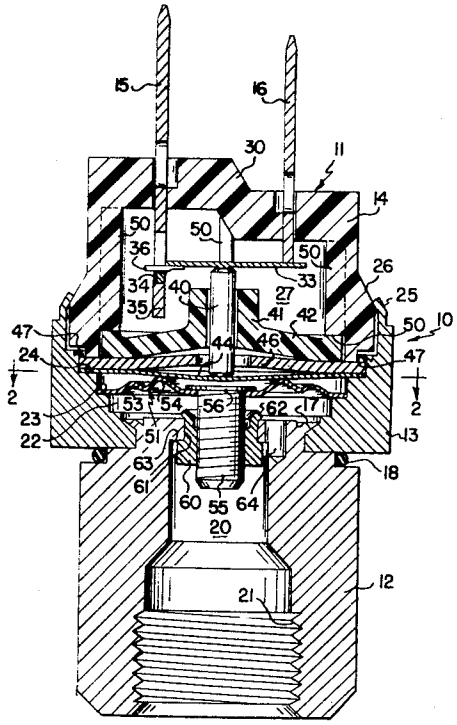
ABSTRACT: An electric switch enclosed in a housing adapted to be threaded onto a fluid line coupling is actuated by a reversing form-type snap disc which is engaged and moved by an annular corrugation about the intermediate section of a flexible metal diaphragm fixed at its edges and center and subjected to fluid pressure, the center of the diaphragm being adjustably positioned by a screw and nut structure to accurately determine the fluid pressures at which the diaphragm causes the snap disc to reverse its form.



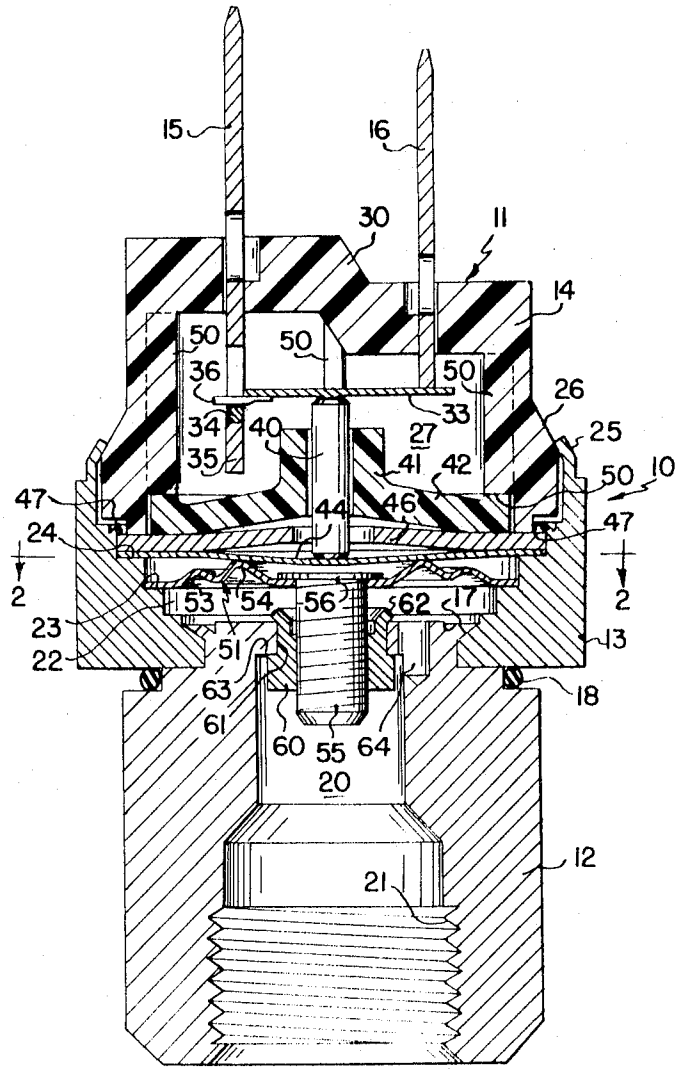


FIG. 1

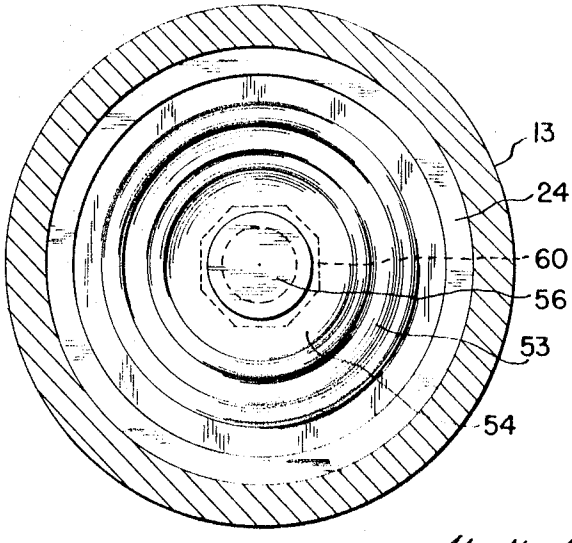


FIG. 2

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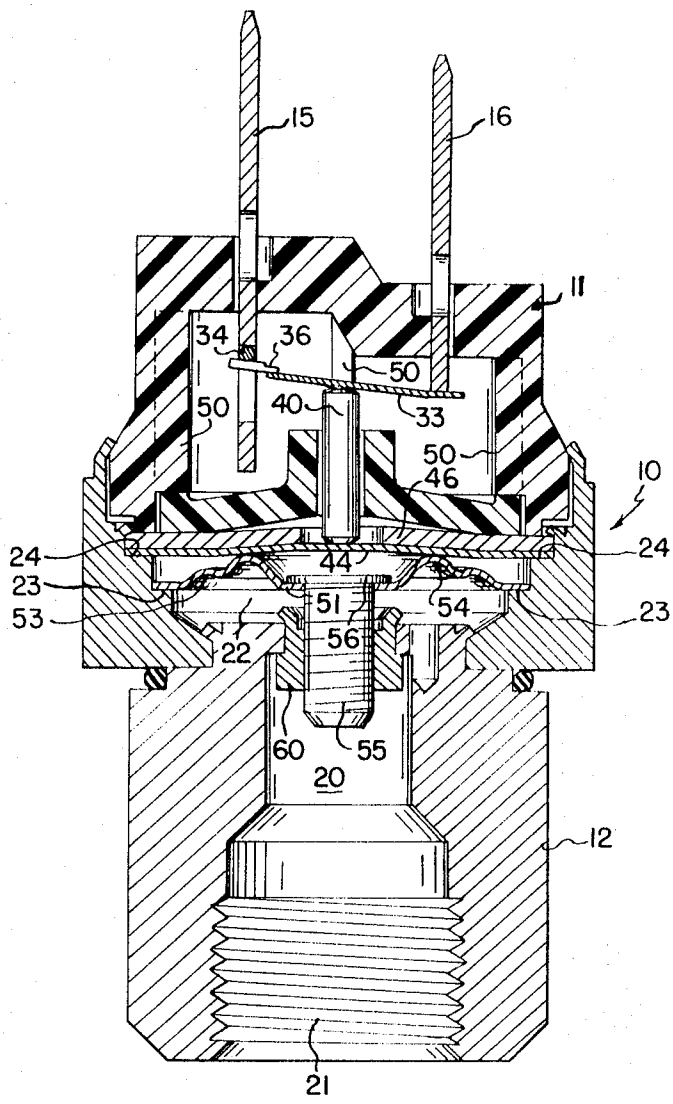

FIG. 3

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FLUID PRESSURE RESPONSIVE DEVICE

BACKGROUND OF THE INVENTION

The present invention relates to a pressure operated snap action control device, such as an electric switch of the general type shown in U.S. Pat. No. 3,177,313 in which an electric switch contained within a housing is snap actuated by the reversing of form of a distorted dish-shaped disc in response to changes in pressure applied thereto by a flexible diaphragm subjected to fluid pressure to which the switch is to respond. In the type of switch mentioned it is important that the control occupy a minimum of space which presents a problem in providing compact and yet accurate means for adjusting the fluid pressures at which the switch is actuated.

THE INVENTION

The present invention provides a switch mechanism in a relatively compact housing which is adapted to be actuated in one direction by snap movement of a dish-shaped member acted upon by a flexible diaphragm subjected to fluid pressure to which the switch is to respond, the periphery and center portions of the diaphragm being fixedly supported and the annular intermediate section being corrugated and engaging and applying pressure to the curved surface of the snap disc, and the center of which diaphragm is accurately positioned by a screw and nut structure relative to the snap disc so that the annular corrugated portion of the diaphragm may be made to actuate the snap disc in response to attainment of a given fluid pressure against the diaphragm.

The invention provides a reliable and accurate pressure responsive switch mechanism which can be inexpensively manufactured in a compact housing and readily calibrated to provide accurate response to fluid pressures.

Other objects and advantages of the invention will be apparent from the following description of preferred forms thereof, reference being made to the accompanying drawings wherein:

FIG. 1 is a sectional view of a fluid pressure responsive switch embodying the invention;

FIG. 2 is a sectional view taken substantially along 2–2 of FIG. 1; and

FIG. 3 is a sectional view similar to FIG. 1, showing a modified form of the invention.

In FIGS. 1 and 2 of the drawings, a pressure responsive switch device **10** is shown which is particularly suitable for interrupting the circuit of the compressor motor of a refrigerating system, not shown, should the pressure of the refrigerant reach an undesirable relatively high value. The device **10** comprises a housing **11** which includes an assembly of an internally threaded coupling member **12**, which is adapted to be threaded onto a pipe fitting in the appropriate section of the refrigerating system A collar **13**, and a cap **14**. A pair of switch terminal prongs **15,16** project from the cap **14** and provide a convenient electrical connection with a terminal plug in the compressor motor circuit of the refrigerating system.

The coupling member **12** is preferably formed of a short section of hexagonal brass stock and has a necked end which projects through an axial opening through the collar **13** and is hermetically attached to the collar by rolling a portion **17** of the necked end against the edges of the opening in the collar. Preferably, a solder joint **18** is formed in an undercut surrounding the abutting surfaces of the neck and collar. The member **12** has a bore **20** which is enlarged and threaded at **21** so that the member **12** can be easily attached to a refrigerating system by threading the member onto a standard connector provided in the piping circuit of the system.

The collar **13** has annular coaxial recessed portions of progressively larger diameters which provide a circular fluid chamber **22**, annular shoulders **23,24** respectively, and an annular lip **25** which is adapted to receive the open end of the cap **14** and to be turned against a sloping annular shoulder **26** formed on the cap to secure the cap to the collar.

The cap **14**, which is preferably formed of a molded dielectric material, is generally cylindrical in shape and has a cavity **27** opening at one end of the cap. The prongs **15,16** are embedded in the end wall **30** of the cap **14** and the inner ends project into the cavity **27**. A leaf spring-type contact arm **33** is welded to the inner end of the terminal prong **16** and extends over a fixed contact member **34** attached to the end of a contact bar **35** projecting from the end of the terminal prong **15**. The arm **33** carries a contact **36** and is biased to engage the contact **36** with the contact member **34** to complete a circuit between the terminal prongs.

The switch arm **33** is adapted to be moved to deflect contact member **36** from contact member **34** by a plunger **40** which is guided for longitudinal movement in a bushing **41** formed on a circular spacer plate **42**. The lower end of the plunger **40**, as viewed in FIG. **1**, rests on the central portion of a snap disc **44**, which, as explained more fully hereinafter, snaps upwardly and downwardly as viewed in the drawings to impart snap movements to the plunger **40** and cause it to move the contact arm **33** to open and close the switch contacts **34,36** respectively.

The snap disc **44** is formed of a suitable sheet metal having the central portion distorted into a concave, dish shape and is internally stressed so that the central portion is urged to one side or the other of a plane common to the peripheral portions of the disc. The disc **44** is formed to be inherently biased so that the central portion tends to bow downwardly as seen in FIG. **1**.

The disc **44** is positioned in the housing **11** by the outer edges thereof being pressed to the annular shoulder **24** by a circular stop plate **46** having its peripheral edges overlying the edges of the disc and being pressed to the disc by staking as seen at **47**. The stop plate **46** has a central opening through which the plunger **40** freely extends, and the central portion of the plate is bowed upwardly and forms a stop surface complementary to the disc to limit the upward switch opening snap movement of the central portion of the disc **44**. The spacer plate **42** is positioned against the stop disc **46** and is retained in place by the ends of four ribs **50**, formed on walls of the cavity **27**, bearing against the rim of the spacer plate. Only these ribs **50** appear in the drawings.

The snap disc **44** is adapted to be moved from the position shown in FIG. **1** to engage the under side of stop disc **46** and move the plunger **40** to open switch contacts **34,36** by a metallic flexible diaphragm **51**, the outer edges of which are soldered to the annular shoulder **23** of the collar **16** so that the diaphragm forms a flexible end wall of the chamber **22**. The diaphragm **51** is preferably formed of a thin sheet material, such as stainless steel or beryllium copper, and has two coaxial annular corrugations **53,54** which are located axially relative to a threaded post **55** which extends through a central opening in the diaphragm and which has a head **56** soldered to the diaphragm in a rigid gastight connection. The post **55** is part of a structure by which the center of the diaphragm is restrained from movement so that changes in pressure against the underside of the diaphragm causes the corrugated portions **53,54** to move laterally. The annular corrugation **54** is adapted to engage the dished portion of the snap disc **44** about an area concentric with the center of the disc and to cause the disc to snap move to the under side of the stop plate **46** when a certain pressure is applied to the under side of the diaphragm, as is explained more fully hereinafter.

The post **55** is threaded into a nut **60** which is rotatably supported in an opening **61** formed in the upper end of the coupling member **12**. The nut **60** is restrained against axial shifting by laterally projecting shoulders **62,63** formed at opposite ends of the nut and engaging opposite face edges of the opening **61**. By rotation of the nut **60** the threaded post **55** is shifted axially and thereby adjustably positions the corrugated portion **51** of the diaphragm **51** relative to the snap disc **44**. To increase the fluid pressure at which the snap disc **44** will be actuated by the diaphragm **51** to open the switch contacts, the nut **60** is adjusted to move the post **55** from the disc and to

decrease this pressure the nut is adjusted to move the post towards the disc.

Fluid pressure is applied to the under side of the diaphragm **51** through a bored opening **64** formed in the upper end of the coupling **12** to provide a passage from the bore **20** to the chamber **22**.

The device **10** is assembled by joining the collar **13** with one end of the coupling member **12** as described, the nut **60** being assembled in the coupling prior to the joining of the coupling with the collar. The diaphragm **51** is then positioned on the shoulder **23** by threading the post **55** through the nut **60** and the edges of the diaphragm are then soldered to the shoulder **23**, after which the snap disc **44** is placed over the diaphragm and against the annular shoulder **24**. The stop and spacer plates **46,42** are then positioned over the disc **44** in the order shown in FIG. **1** and the plunger **40** is inserted through the guide bushing **41**. The cap **14**, having the switch arm **33** attached to the terminal **31**, as described, is then inserted into the open end of the collar **13** with the end surface **47** engaging the stop plate **46**. The lip **25** of the member **12** is then rolled against the tapering shoulder **26** of the cap **14** to secure the cap to the collar.

The device **10** may then be calibrated by threading the coupling member **12** onto a fixture in which a given fluid pressure is maintained, and the nut **60** is then rotated one direction or the other to cause the disc **44** to be snapped against the plate **46** and open switch contacts **34,36** through the action of plunger **40** on the arm **33**. This arrangement provides a relatively easy and accurate calibration of the operating pressures of the device.

The device **10** as just described is operative to open the switch contacts in response to an increase in fluid pressure to a predetermined value. In some instances it is desirable to provide a switch mechanism which will open its switch contacts in response to a decrease in fluid pressure to a given value and in this event the switch mechanism of the device **10** can be modified as shown in FIG. **3** in which contact **36** is supported on the upper face of the arm **33** and contact **34** is attached to a laterally projecting part of the terminal **15** extending above the contact **36**. The nut **60** is then adjusted so that the fluid pressure in excess of the pressure at which switch opening is desired causes the diaphragm to maintain the disc **44** in the position shown in FIG. **3**. When the pressure falls to the value desired to cause opening of the switch, the diaphragm **51** collapses under the inherent bias of the disc **44** and causes the arm **33** to follow the plunger **40** and the disc downwardly to separate contacts **34,36**. Here again, accurate calibration of the switch opening pressure is easily obtained by adjustment of the nut **60** following assembly of the device.

Although but two forms of the invention have been described it will be apparent that other forms, modifications and adaptations thereof could be made, all falling within the scope of the claims which follow.

I claim:

1. A pressure responsive control device comprising, means forming a housing having a cavity adapted to be placed in communication with a source of fluid pressure, a flexible diaphragm forming one end of said cavity, said diaphragm having an annular corrugation therein, means to secure said diaphragm to the sides of said cavity whereby said corrugated portion thereof may flex laterally of said diaphragm proper, means to adjustably position the portion of said diaphragm centrally of said annular corrugation to limit movement of said portion of said diaphragm at least in one direction to less than the movement of the corrugated portion of said diaphragm, and control means actuated by movement of said corrugated portion of said diaphragm in said one direction.

2. A pressure responsive control device as set forth in claim **1** in which said means to adjustably position said portion of said diaphragm comprises a threaded post attached to the center of said diaphragm, a rotatable nut into which said post is threaded, and means for rotatably supporting said nut and preventing axial movement thereof.

3. A pressure responsive control device as set forth in claim **2** in which said housing comprises a coupling member having a threaded internal bore, said coupling member having a part rotatably supporting said nut in alignment with said threaded bore.

4. A pressure responsive control device comprising, means forming a housing having a movable switch member therein, a snap disc supported in said housing about its edges, the central portion of said snap disc having a concave area therein, means interconnecting said concave area with said switch member, a flexible diaphragm in said housing and adapted to be subjected to fluid pressure, means securing said diaphragm about its edges to said housing, and means to fixedly position said central portion of said diaphragm against movement, the portions of said diaphragm intermediate its edges and center having an annular corrugation adapted to engage said concave area of said disc.

5. A pressure responsive control device as set forth in claim **4** further characterized by means to adjustably position said central portion of said diaphragm relative to said disc.