United States Patent [19]

Greenwood

[11] **3,723,684**

[45] **Mar. 27, 1973**

[54] **PRESSURE RESPONSIVE SWITCH WITH PARALLEL CONTACT BLADES BENT APART BY AXIAL FORCE APPLIED BY DIAPHRAGM**

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[52] **U.S. Cl.**.....**200/83 R,** 200/83 N, 200/83 S, 337/400

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

[58] **Field of Search**.....200/67 DB, 83 N, 83 S, 83 R, 200/83 P, 166 J, 166 BH; 337/399, 400, 396

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[57] **ABSTRACT**

A pressure switch for use in, for example, an automobile air bag safety buffer system in the event of a collision. The switch contacts are carried by, for example, plastic leaf springs that are column loaded. A flexible spring diaphragm loads the springs when fluid pressure is applied to the diaphragm. The switch contacts may be snap fit onto the springs. A loading adjustment screw may be provided, if desired. The switch cavity may also be vented to the atmosphere, if desired, to ensure the correct pressure differential across the diaphragm.

1 Claim, 7 Drawing Figures

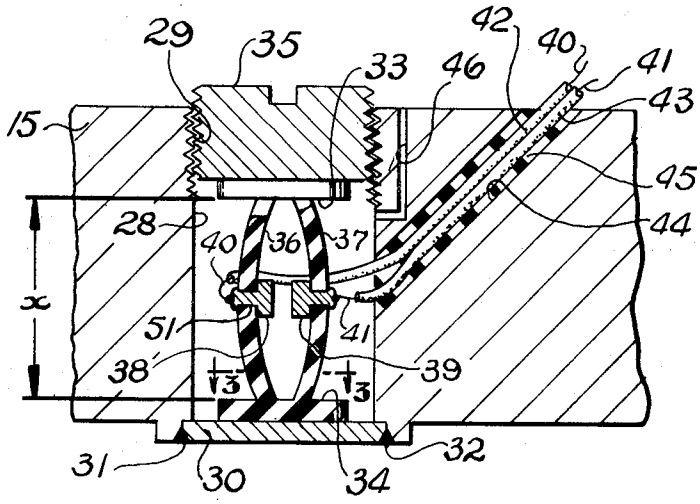
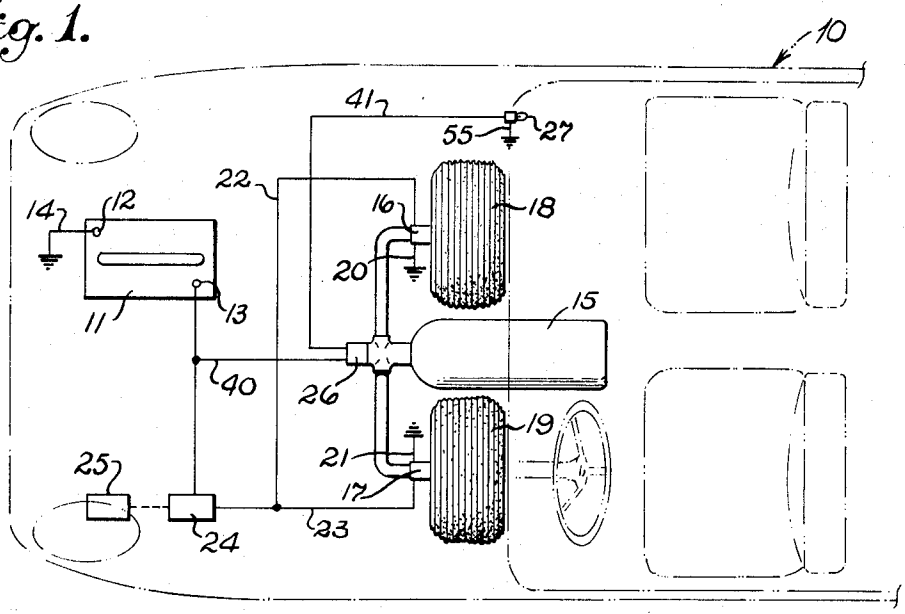


Fig. 1.



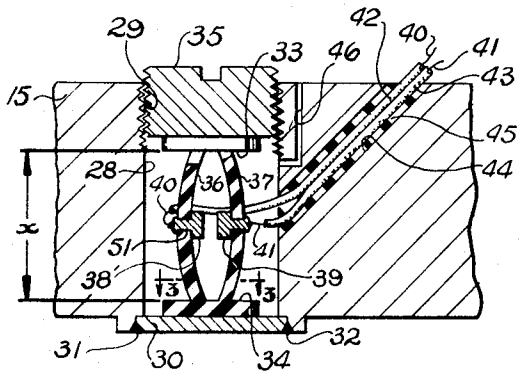


Fig. 2.

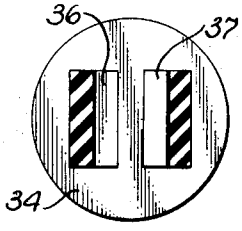


Fig. 3.

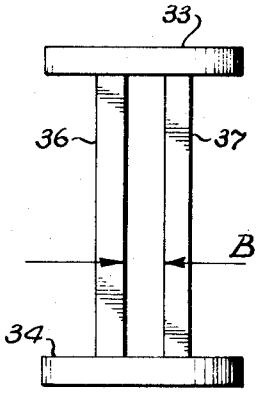


Fig. 4.

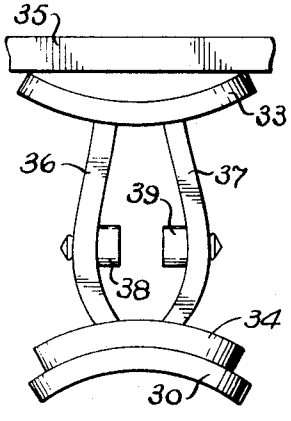
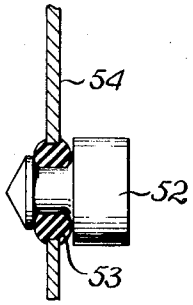


Fig. 6.

Fig. 7.



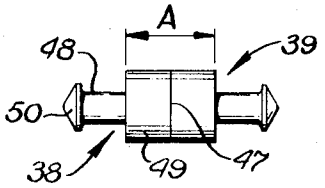


Fig. 5.

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PRESSURE RESPONSIVE SWITCH WITH PARALLEL CONTACT BLADES BENT APART BY AXIAL FORCE APPLIED BY DIAPHRAGM

BACKGROUND OF THE INVENTION

This invention relates to the switching art, and more particularly, to a switch which may be used for any purpose including, but not limited to, a fluid pressure indicating device for use in an automobile inflatable air bag safety buffer system.

In the said system, a tank is employed to supply air under pressure to inflatable bags upon impact of the vehicle with another or with any other body. The bags inflate in front of the passengers and act as cushions in the event of a collision. Thus, the air supply is a very important part of the system. If the air pressure falls below a predetermined level, the system will not operate.

SUMMARY OF THE INVENTION

In accordance with the device of the present invention, the above-described and other disadvantages of the prior art are overcome by providing a pressure switch for the air supply tank which turns on an instrument panel warning light when the tank pressure falls below the said predetermined level.

The above-described and other advantages of the present invention will be better understood from the following detailed description when considered in connection with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

In the drawings which are to be regarded as merely illustrative:

FIG. 1 is a diagrammatic view of an inflatable air bag system for an automobile;

FIG. 2 is a longitudinal sectional view of a pressure switch for use in the system of FIG. 1;

FIG. 3 is a transverse sectional view of a portion of the switch shown in FIG. 2;

FIG. 4 is a side elevational view of a portion of the switch;

FIG. 5 is a side elevational view of two engaging switch contacts;

FIG. 6 is a side elevational view of a portion of the switch shown in FIG. 2; and

FIG. 7 is a longitudinal sectional view of a portion of a switch illustrating an alternative embodiment of the present invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

In FIG. 1, an automobile is indicated at 10 having a battery 11 with terminals 12 and 13. Terminal 12 is grounded at 14. A tank of compressed air is provided at 15. Solenoid valves 16 and 17 are connected from tank 15 to deflated air bags 18 and 19, respectively. VAlve 16 has a lead 20 which is grounded. Solenoid 17 has a lead 21 which is grounded. Solenoids 16 and 17 have additional leads 22 and 23, respectively, which are both connected to a switch 24. Switch 24 is, in turn, connected to battery pole 13. Switch 24 is operated by an accelerometer 25. A pressure switch 26 illuminates a light 27 when the pressure in tank 15 drops to below a predetermined level.

Pressure switch 26 is shown in FIG. 2. The wall of tank 15 has a hole 28 therethrough which is threaded at 29 and is sealed at its other end by a diaphragm 30 which may be made of a flexible spring material including, but not limited to, steel. Diaphragm 30 may be fixed to the tank wall 15 by welding at 31 and 32, or by any other convenient means.

The switch includes upper and lower bases 33 and 34 which abut a set screw 35 and diaphragm 30, respectively.

Flexible leaf spring members 36 and 37 connect the bases 33 and 34. Contacts 38 and 39 are snap fit through members 36 and 37, respectively. Conductive leads 40 and 41 are conductively bonded by any conventional means to contacts 38 and 39.

Lead 40 has insulation 42, and lead 41 has insulation 43. Leads 40 and 41 with insulation 42 and 43 are fixed in the wall of tank 15 through a hole 44 therethrough by surrounding the same with an epoxy or potting compound to seal the same as indicated at 45.

A vent passage 46 may be provided from the interior of hole 28 to the atmosphere, if desired.

Set screw 35 is an adjustment screw which may be employed for calibration.

The pressure inside tank 15 may, for example, be as high as 3,500 pounds per square inch.

Although bases 33 and 34 need not be integral with members 36 and 37, they may easily and economically be made integral, as shown. Further, neither bases 33 and 34, nor members 36 and 37, need be made of plastic or of any certain material. Molded nylon will be found to be satisfactory. However, preferably molded nylon or beryllium copper leaf springs may be set in bases 33 and 34 made of a phenolic resin.

So that the switch 26, shown in FIG. 2, will not fail to operate by an "on center" action, bases 33 and 34 with members 36 and 37 may appear as shown in FIG. 4 when members 36 and 37 are unstressed, and contacts 38 and 39 have been removed from members 36 and 37, respectively. Note that the spacing between members 36 and 37 may be uniform and be equal to the dimension, B.

Bases 33 and 34 may be identical. Only base 33 will thus be described in greater detail. Base 33 may be simply a right cylinder having parallel upper and lower circular faces perpendicular to the outer small cylindrical surface thereof.

Members 36 and 37 may also be identical except for their particular locations laterally between bases 33 and 34. For this reason, only member 36 will be described. Member 36 is a longitudinal member such that it is a right prism having a rectangular cross section uniform throughout its entire length.

As shown in FIG. 5, contacts 38 and 39 may be identical. Thus, only contact 38 is described in greater detail. The contacts 38 and 39 are shown in FIG. 5 with their contacting faces in abutting relation at a line 47.

Contact 38 may be made entirely of metal, any conventional metal of which electrical contacts are normally made, and includes a shaft 48 having enlargements 49 and 50 thereon. Enlargement 49 is provided for engagement with contact 39. Member 36 has a hole 51 therethrough, as shown in FIG. 2, through which enlargement 50 passes, during assembly. That is, hole 51 has a cylindrical surface defining the same, and contact

38 is completely symmetrical about the axis of cylindrical shaft 48, thus, the maximum outside diameter of enlargement 50 is slightly greater than the inside diameter of member hole 57. Thus, in assembly, contact enlargement 50 may simply be pressed through hole 51 until enlargement 50 snaps into place in the location shown in FIG. 2. As viewed in FIG. 2, contact enlargement 50 would be pressed into hole 51 first into the right end thereof. Contact 39 may be similarly assembled with member 37.

When the dimension A, shown in FIG. 5, is greater than the dimension B, shown in FIG. 4, there will be no "on center" action, and the switch will not fail. Moreover, in the event of failure of pressure in tank 15, contacts 38 and 39 will be pressed together with a greater pressure the more that dimension A exceeds the dimension B.

One of the several outstanding features of the invention resides in the use of diaphragm 30 to actuate or deactuate the switch.

Diaphragm 30 is shown in FIG. 6 taking a greatly exaggerated deflection. However, FIG. 6 shows that members 36 and 37 are spread apart to keep contacts 38 and 39 apart due to two different stressing mechanisms produced by diaphragm 30. In the first place, the simple upward deflection of diaphragm 30 causes members 36 and 37 to bow outwardly. However, the curvature which diaphragm 30 takes also tends to bow base 34 and to spread at least the bottom portions of members 36 and 37 still farther apart.

An alternative embodiment of the invention is shown in FIG. 7 wherein a contact 52, which may be identical to contact 38 is snap fit, as before, through a resilient insulator grommet 53 that is located around a hole in a thin spring metal strip 54 which serves as one of the members 36 and 37. If desired, both of the members 36 and 37 thus may be provided with thin spring metal strips such as strip 54, each being provided with a contact identical to contact 52 and a grommet such as grommet 53.

From the foregoing, it will be appreciated that, in FIG. 2, when the pressure in tank 15 is adequate, diaphragm 30 will take a deflection such that members 36 and 37 will be column loaded and spread apart, as shown in FIG. 2. If the pressure in tank 15 fails, diaphragm 30 will not take a deflection, and contacts 38 and 39 will be held together by the spring action of members 36 and 37 to engaging relation, shown in FIG. 5, so that they thereby will electrically connect the leads 40 and 41 together.

As shown in FIG. 1, lead 40 is connected to battery pole 13, and lead 41 is connected to lamp 27. Lamp 27 is grounded at 55. When contacts 38 and 39 make, lamp 27 will, therefore, be illuminated. This will tell the occupant of the automobile 10 that the pressure system has failed. Lamp 27 thus acts as a warning light so that the pressure system may be repaired for safe driving.

The pressure at which actuation is required is set by adjusting the position of screw 35.

The calibration adjusting screw 35 is screwed down until the contacts separate.

The pressure vessel 15 is put into normal operation and from then on, whenever the pressure drops below the calibrated pressure, the contacts 38, 39 will touch and energize the lamp 27.

The length of beam being x and diaphragm movement being y, then beam amplification, a, is given by

$$a = 2\sqrt{(x/2)^2 - (y/2)^2} \simeq 2\sqrt{(yx/2)}$$

For high pressure sensing, the calibration would be reversed, and the electric circuit would be deenergized.

What is claimed is:

1. A switch comprising: first and second end plates; first and second members, each of said members having first and second ends, said first ends being fixed relative to said first plate, said second ends being fixed relative to said second plate, said plates being approximately parallel to each other with one located over the other, said members being approximately parallel to each other and approximately perpendicular to said plates, said plates having approximately parallel facing surfaces, all of said member ends being joined to said plates at said facing surfaces; a first contact fixed to said first member in a position between said members and approximately at the midpoint of said first member; a second contact fixed to said second member in a position between said members and approximately at the midpoint of said second member to engage said first contact when said members are brought toward each other; and releasable means actuable to push one of said plates toward the other to cause said members to bow outwardly of each other and to move said contacts out of engagement with each other, said members both being made of a spring material which will bring said contacts into engagement with each other when said releasable means is deactuated to allow said members to recover their shapes, said contacts being insulated from each other except when they are brought into mutual engagement as aforesaid; a container having a wall to hold a fluid under an absolute pressure greater than atmospheric, said container having a hole completely through said wall thereof, one end of said hole adjacent the outer surface of said wall being internally threaded, a set screw threaded into the said one end of said hole, a circular diaphragm sealed around the other end of said hole, said diaphragm being made of a flexible spring material, means to vent the space between said screw and said diaphragm to the atmosphere, an electrical lead connected to each contact and extending outwardly of said space, and means to insulate said leads from each other, each of said plates being a solid right cylinder, said cylinders having a common axis, said members being spaced equidistant from said axis on opposite sides thereof, each member being integral with both of said plates, both of said members and both of said plates being made of plastic, said contacts being snap fit through corresponding holes in said members, both said members having the same shape and dimensions, each of said members being a right prism having a rectangular cross section, the heights of said members between said plates being greater than the lengths and widths of said cross sectional rectangles, said lengths being greater than said widths, said members having parallel facing surfaces whose dimensions are said heights and said lengths, said plates, said contacts and said members being located in said space with said first and second plates abutting the facing surfaces of said screw and said diaphragm, respectively.

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