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J. GUTKOWSKI
HERMETICALLY SEALED PRESSURE SENSITIVE SWITCH
HAVING EXTERIORLY SUSPENDED ACTUATING MEANS
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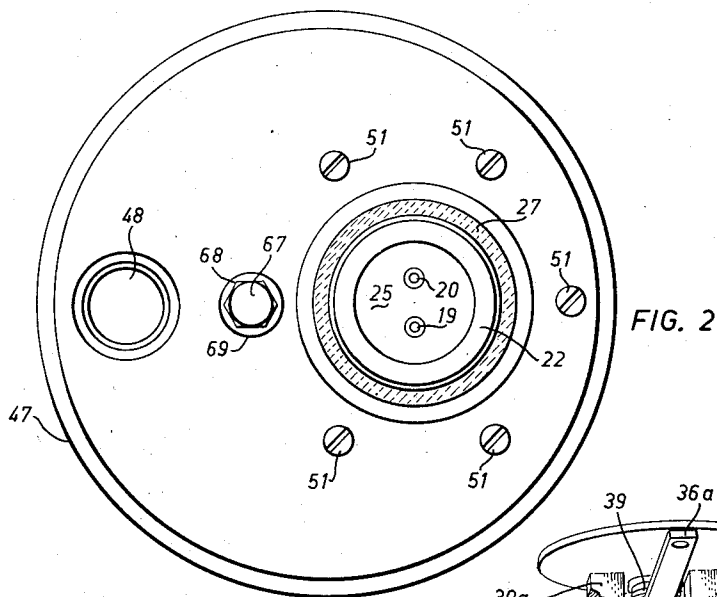


FIG. 2

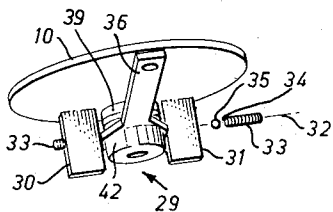


FIG. 3

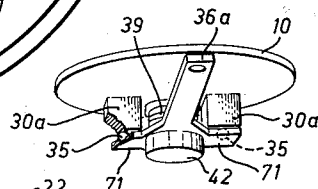


FIG. 4

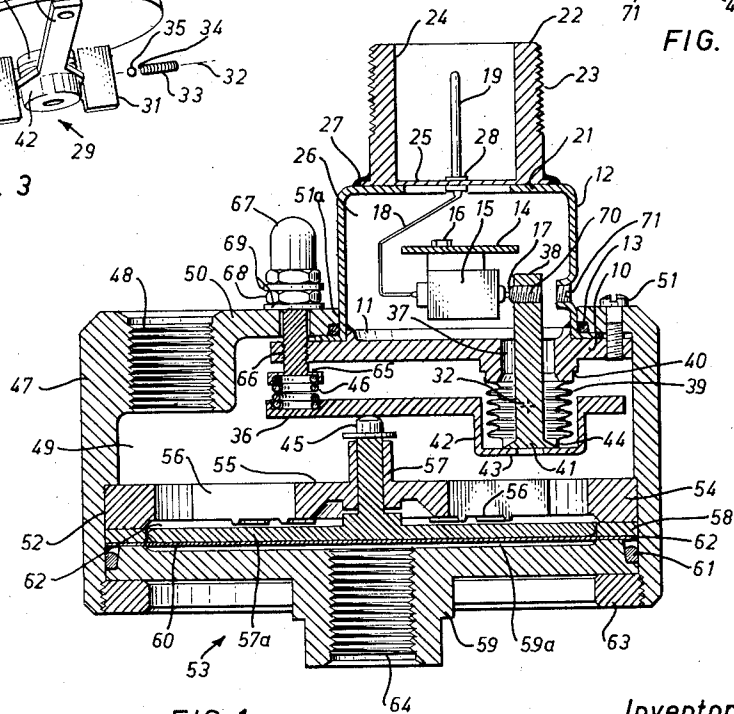


FIG. 1

Inventor
JANUSZ GUTKOWSKI

by: *J. Richard Cavanaugh*
Patent Agent

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HERMETICALLY SEALED PRESSURE SENSITIVE SWITCH HAVING EXTERIORLY SUSPENDED ACTUATING MEANS

Janusz Gutkowski, Owen Sound, Ontario, Canada, assignor to Parmatic Engineering Limited, Owen Sound, Ontario, Canada

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This invention relates to improvements in hermetically sealed pressure sensitive switches and more specifically to an hermetically sealed switch device having exteriorly suspended actuating means.

Heretofore, pressure sensitive switch constructions, particularly of the type adapted for response to fluid pressures, have been subject to random functional errors of relatively large magnitude. There is a need for pressure sensitive switches of much greater accuracy, especially for the indication of a change in low pressure fluid or gas pressures in aircraft instrumentation and equipment.

It is therefore the main object of the present invention to provide a pressure sensitive switch embodying a combination of elements adapted to function consistently under varying ambient pressure and temperature conditions.

It is a further object of the invention to provide a pressure sensitive switch device embodying an electrical switch component which is hermetically sealed but which is actuated by an exteriorly suspended actuating member.

With these and other objects in view, the invention generally comprises an electrical switch having an actuating member, an hermetically sealed housing for said switch, a flexible bellows forming a part of said housing and extending therefrom to connect at its exterior end to a movable armature, an actuating member extending from the armature within said bellows to the interior of said housing for engaging said actuating member of said switch, exterior suspension means for said armature, and means for actuating said armature responsive to pressure.

Other objects of the invention will be appreciated by a study of the following specification taken in conjunction with the accompanying drawings.

In the drawings:

Figure 1 is a sectional view of a pressure sensitive switch according to the invention;

Figure 2 is a plan view of the switch of Figure 1;

Figure 3 is an underside perspective view of the exteriorly mounted armature and mounting plate therefor; and

Figure 4 is an underside perspective view similar to Figure 3 but showing a modified armature suspension.

Referring to the drawings and particularly Figure 1, the switch mounting plate 10 embodies an upwardly projecting annular lip 11 adapted to tightly receive thereabout, the lower end of a housing 12 which is soldered thereto by flange 13 to form an hermetic seal. A supporting bar 14 extends between the walls of the housing 12 in the interior thereof and forms a rigid mounting for a sensitive electrical switch 15 of conventional construction fastened thereto by means of suitable screws 16. Sensitive switch 15 embodies an actuating member 17 adapted upon actuation thereof to close switch contacts (not shown) within the switch 15 thereby completing the electrical connection between electrical leads 18 leading to the contact prongs 19 and 20.

The inwardly directed flange 21 of housing 12 sup-

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ports the electrical connector fitting 22 having thread means 23 thereon adapted to accept a conventional electrical lead connector fastening device (not shown) and embodies a socket 24 adapted to receive a conventional insulated socket plug body having female connectors (not shown) for engaging the contact prongs 19 and 20. The fitting 22 incorporates an end wall 25 preventing communication between the switch chamber 26 and socket 24. An hermetic seal is formed by soldering the fitting 22 to the housing at 27. The contact prongs 19 and 20 are mounted in the end wall 25 by a conventional glass-to-metal sealing means 28, providing electrical insulation and an effective hermetic seal.

Exteriorly suspended switch actuating armature means 29 are pivotally suspended on the spaced apart depending exterior posts 30 and 31 extending downwardly from rigid connection to mounting plate 10, as shown in Figure 3. Each of the posts has a threaded bore aligned on a pivotal axis 32 adapted to receive pivot screws 33 each having a socket 34 at its inward end adapted to accommodate a small hardened pivot ball 35. A pivot arm 36 forming a part of armature 29 embodies pivot axis recesses (not shown) adapted to accept the pivot balls 35 to thereby provide a low friction exterior pivot suspension for the pivot arm 36.

As shown in Figure 1, an enlarged bore 37 is provided in the mounting plate 10 to accommodate therethrough, a rigid lever arm 38 extending from rigid connection to the pivot arm 36. The bore 37 and lever arm 38 are so located that the pivotal axis 32 passes through the lever arm 38 and the latter effectively rocks about the pivotal axis during rocking motion of the pivotable arm 36. A relatively small flexible metal bellows structure 39 of effectively minimum diameter having regard to the diameter of arm 38 is soldered at its upper end to form a sealed anchorage about annular shoulder 40 depending from the mounting plate 10. The bellows structure 39 is coaxially aligned with the bore 37 to suspend therefrom for an hermetically sealed connection about the lower end 41 of the lever arm 38 exterior of the housing 12. The axis 32 is preferably a transverse centroidal axis of the bellows 39 and is located substantially midway between the upper and lower ends thereof. Accordingly, the pivotal arm 36 in the region of the axis 32 embodies a bellows receptacle or housing in the form of a dish-like recess or cavity 42, to the end or bottom wall 43 of which is soldered the lower end 44 of bellows 39 and to which the lower end 41 of lever 38 is concentrically fixed by soldering or other metal sealing means. The pivotal arm 36 is therefore adapted for rocking motion about the axis 32 in such manner as to effect corresponding rocking motion of the lever arm 38 which projects into the hermetically sealed housing 12, which latter effectively includes the downwardly projecting bellows structure 39 adapted to be flexed or distorted about the central axis; that is, the pivotal axis 32 extending therethrough.

The hermetically sealed switch device and actuating armature therefor embodying the exterior suspension means set forth herein may be actuated by pressure responsive mechanism in a number of ways. Thus, in one type of preferred construction illustrated in Figure 1, the pivot arm 36 is disposed to be actuated by a pressure sensitive piston stem 45 against the adjustable force of the biasing spring 46. The device shown is used to indicate when pressure difference between two points in a fluid system departs from a predetermined value. Thus, the hollow case body 47 embodies an inlet threaded bore 48 for attachment of a suitable fitting communicating exterior lower pressure to the reference pressure chamber 49. The mounting plate 10 carrying hermetically sealed switch components thereon is fastened to the top wall

50 of the body 47 such as by means of screws 51 in such manner that housing 12 projects through an opening 51a in the top wall to extend exteriorly of the casing 47 for accessibility of the connecting fitting 22 thereof.

The lower portion of the body 47 is annularly recessed as at 52 to accept a piston supporting structure 53 comprising an annular ring 54 spaced concentrically from a piston guide member 55 and connected thereto by spider arms 56. The guide member 55 has a central bore 57 adapted slidably to accommodate the piston stem 45 extending upwardly from the enlarged piston element 57a. The spacer ring 58 extends freely about the piston 57a and is held in assembly with the annular ring 54 by the fitting 59 having a recess 59a spaced from flexible diaphragm 60. A sealing ring 61 and diaphragm 60 provide an effective sealing for the piston chamber 62, the fitting 59 being held in assembly within the body 47 by the threaded retaining ring 63. Fitting 59 embodies a threaded bore 64 to which a pressure fitting connection may be made to provide communication of the higher pressure side of a fluid system to diaphragm 60 and hence piston element 57a moveable thereby having regard to reference pressure in chamber 49.

Spring 46 is adjustable in its biasing force by an adjusting screw 65 extending freely through the top wall 50 but threadably as at 66 through the mounting plate 10. Screw 65 is capable of exterior adjustment upon removal of the thread sealing cap 67 and loosening of the lock nut 63 relieving the sealing washers 69. Accordingly, by suitable adjustment of the biasing spring 46, a differential pressure adjustment can be made whereby motion of the pivotable arm 36 will be effected by piston 57a when the pressure difference between the lower reference pressure chamber 49 and high pressure chamber 60 changes from a predetermined value. Such motion effects a pivoting of the arm 36 providing a corresponding swing of lever arm 38 causing the actuating screw 70 thereof either to engage or disengage from the actuating member 17 or switch 15, as the case may be. The actuating screw 70 is adjustable by removing the sealing screw 71 of housing 12 being coaxially aligned therewith. However, as soon as the necessary adjustments are made, the screw 71 is preferably sealed with solder.

A modified armature suspension is illustrated in Figure 4 in which like numerals indicate like components. The pivotal arm 36a embodies transversely extending fulcrum arms 71 each having a shallow socket for retaining the fulcrum ball 35. Posts 30a provide a transverse surface having a corresponding ball retaining socket 72 therein. The assembly of pivotal arm 36a, bellows 39 and mounting plate 10 is first accomplished without balls 35 whereby later insertion of the latter will be resisted only by the mild tensioning of the bellows 39. By this means the balls 35 may be retained in assembly. If desired, the fulcrum balls 35 may be inserted in the respective sockets at such time as the hermetically sealed switch device of the invention is mounted in a utilizing and actuating device such as in Figure 1.

It will be observed that both forms of armature suspension shown in Figures 3 and 4 so place the pivotal fulcrum axis 32 that the pivotal arm in each case utilized as a part of the switch actuating lever is effectively pivoted about a pivotal axis substantially midway between the ends of the bellows 39. In addition, however, the pivotal axis is directed substantially along a diameter line of said bellows so that the latter effectively flexes about a transverse centroidal axis thus provided.

While there has been described what is at present

considered a preferred embodiment of the present invention, it will be appreciated by those skilled in the art that various changes and modifications can be made therein without departing from the essence of the invention and it is intended to cover herein all such changes and modifications as come within the true spirit and scope of the appended claims.

What I claim as my invention is:

1. An hermetically sealed electrical switch device comprising, in combination: an electrical switch having an actuating member adapted when engaged to actuate said switch; a housing including means rigidly supporting said electrical switch therein, said housing having an opening; a switch actuating lever having one end engageable with said switch actuating member and extending freely through said opening exteriorly of said housing; a flexible bellows extending about a portion of said lever and having one end sealed about the other end of said lever; means hermetically sealing said bellows about said housing opening effecting entire hermetic sealing of said switch and the actuating lever therefor from the atmosphere; means effectively pivoting said lever about a pivotal axis exterior of said housing substantially midway between the ends of said bellows to maintain a constant volume within said housing during flexing of said bellows upon actuation of said lever; a casing having a reference pressure chamber; means supporting said housing to dispose said other end of said lever within said reference pressure chamber; and adjustable means biasing said lever arm for motion at a predetermined pressure difference relative to the pressure in said reference pressure chamber.

2. An hermetically sealed electrical switch device comprising, in combination: an electrical switch having an actuating member adapted when engaged to actuate said switch; a housing including means rigidly supporting said electrical switch therein, said housing having an opening; a switch actuating lever having one end engageable with said switch actuating member and extending freely through said opening exteriorly of said housing; a flexible bellows extending about a portion of said lever and having one end sealed about the other end of said lever; means hermetically sealing said bellows about said housing opening effecting entire hermetic sealing of said switch and the actuating lever therefor from the atmosphere; means pivoting said lever about a pivotal axis exterior of said housing substantially and effectively forming a transverse centroidal axis for said bellows to maintain a constant volume within said housing during flexing of said bellows upon actuation of said lever; differential pressure responsive means for effecting pivotal motion of said lever; and means biasing said lever for motion at a predetermined differential pressure.

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