

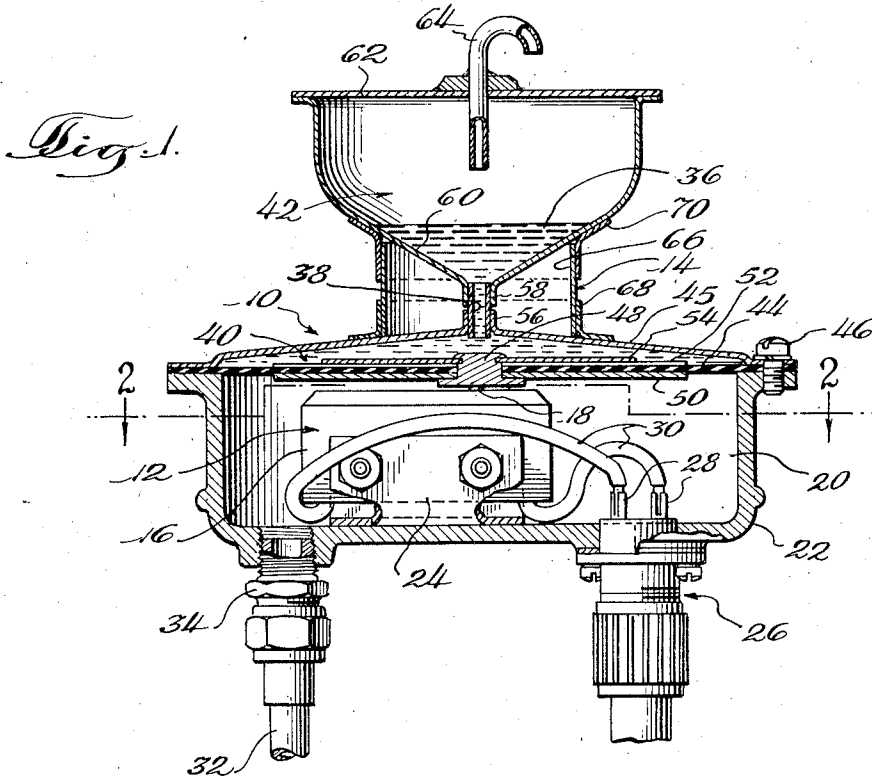
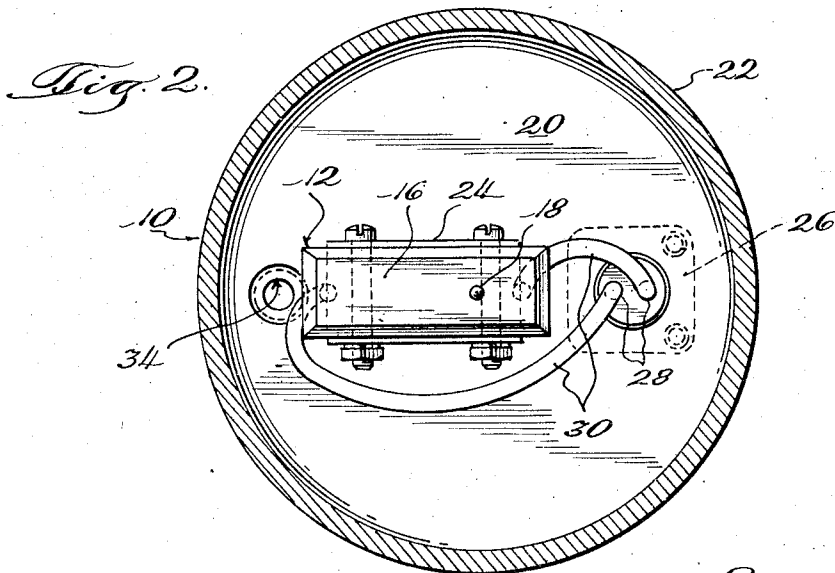
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ELECTRIC SWITCH

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ELECTRIC SWITCH

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The present invention relates to pressure actuated switches and particularly to very sensitive pressure actuated snap switches.

There are many known types of sensitive switches. Most generally they are of a type which may be described as over-center snap switches and some are operable at low pressures and in response to small pressure differences.

Difficulties have been encountered in the use of the sensitive switches when they are installed in equipment such, for instance, as airplanes where considerable vibration is present. When the switches are subjected to a critical pressure, i. e., the approximate operating pressure, the vibrations produce an undesirable intermittent operation. This operation is sometimes called fluttering and it has an objectionable effect not only upon the switches but it also defeats the purpose of the control because the controlled apparatus is intermittently operated as a result of the intermittent operation of the switch.

For example, sensitive switches are utilized to control heaters in aircraft. The switches are intended to prevent operation of the heater unless a certain air pressure exists to create a minimum flow of air through the heating apparatus. The switches may be set to turn the heater on when the air pressure, which may be the air blast (propeller blast) from the propeller, has a pressure of one and one-half or two inches of water. At these pressures the vibration produces undesirable fluttering or intermittent operation of the switches.

The primary object of the present invention is to provide a new and improved sensitive pressure actuated switch.

Another object of the present invention is to provide a new and improved sensitive pressure actuated electrical switch which may be actuated at very low pressures and which is prevented from operating intermittently in response to vibrations.

A further object of the present invention is to provide a new and improved pressure actuated electrical switch having a hydraulic fluid providing a cushioning action preventing abnormal intermittent operation of the switch.

A still further object of the present invention is to provide a new and improved hydraulically cushioned electrical switch wherein the hydraulic cushioning means is effective throughout a wide range of angular positions of the switch. A switch of this character is particularly advantageous for use in certain types of apparatus, of which aircraft is an outstanding example.

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A still further object of the present invention is to provide a new and improved sensitive pressure actuated switch which may be readily constructed and arranged to operate at desired pressures.

Other objects and advantages of the present invention will become apparent from the ensuing description in the course of which reference is had to the accompanying drawing, in which—

Fig. 1 is a vertical cross sectional view through the switch of the present invention; and

Fig. 2 is a transverse cross sectional view taken along the line 2—2 of Fig. 1.

The switch of the present invention, which is indicated as a whole by reference character 10, includes two main parts. The first is a circuit controlling switch 12 and the second a hydraulic cushioning means 14 located in cooperative relationship with the switch actuating means and effective to prevent operation of the switch in response to vibrations over a wide range of angular positions of the device.

The switch 12 may be a snap switch of conventional construction except that it should be designed to operate at about one and one-half or two inches of water pressure, and with a pressure differential of about one-half inch. In other words, the switch should be a sensitive one. The circuit controlling contacts of the switch are not illustrated but they may be mounted within a suitable switch casing 16 and are operable through suitable switch operating means, such as a finger 18 projecting above the casing, so that the cushioning means may be readily brought into cooperative relationship therewith.

The switch 12 is mounted within a fluid-tight compartment 20 defined in part by a generally cup-shaped housing 22. The switch is secured inside the housing by any convenient means such as a U-shaped mounting bracket 24, the transverse portion of which is secured to the bottom of the housing 22 so that the switch may be secured between the upstanding arms of the bracket.

The circuit connections up to the switch extend through a suitable plug type fitting 26 secured in fluid-tight manner to the housing 22 and having a pair of terminals 28 located within the compartment 20. The terminals are connected as by conductors 30 to the switch.

In the instant embodiment of the invention the switch is operated in response to fluid pressures and specifically to air pressure. The source of air pressure is connected to the compartment 20 through a conduit 32 and a fitting 34 attached

to the bottom of the housing 22. As already indicated, the conduit 32 may lead to the propeller blast from an airplane propeller. It should be understood however that the device may be used in other installations and for other purposes.

The hydraulic cushioning means 14 is located above the switch 12, as is readily apparent from Fig. 1. The cushioning action is provided by a hydraulic fluid, indicated by reference character 36, which is located within a structure bearing against the switch actuating finger 18 and moved in response to the pressures existing within compartment 20. The movement of the cushioning fluid is constrained or restricted by a relatively small orifice 38 located between the two main parts of the cushioning means, which, for convenience, are termed a variable volume chamber 40 and a reservoir chamber 42.

The variable volume chamber 40 comprises a diaphragm 44 made of some flexible material such as rubber. It is preferred that the diaphragm be substantially untensioned in order that it will not exert any influence upon the operation of the switch. The diaphragm is circular in shape and is secured over the open top of the cup-shaped housing 22 to define with the latter the fluid compartment 20. It is secured to the flanged top of the housing in a suitable manner as by a plurality of screws 46 which serve also to secure to the housing a generally conical top 45.

The movements of the diaphragm are utilized to operate the switch 12. For this purpose a switch operating button or stud 48 is secured substantially centrally of the diaphragm so that it is located above and in cooperative relationship with the switch operating finger 18.

The pressure setting at which the switch will operate may be readily varied, in accordance with another feature of the invention, by varying the weight of the diaphragm assembly. This is conveniently done by utilizing different numbers of metallic plates preferably located at opposite sides of the diaphragm and secured to it by the switch operating button 48. In the instant embodiment one plate 50 is disposed underneath and two plates 52 and 54 are disposed above the diaphragm. Not only may different numbers of plates be used but also different sizes may be used. The plates may be of different diameters but preferably are somewhat less in diameter than the effective diameter of the diaphragm 44 so as to enable the diaphragm readily to move in response to pressure of the character for which the device is intended to be used.

The variable volume change 40 is constituted by the diaphragm and the previously referred to generally conical top 45. The latter is provided with a central opening defined by an upwardly extending flange 50 adapted to receive a short tube 58 defining the previously referred to fluid flow restricting orifice 38. The top is quite closely spaced to the diaphragm assembly and limits movement of the latter so that it will not be injured when subjected to higher pressures.

The fluid reservoir 42 is constituted by a generally cup-shaped receptacle having an inclined bottom 60 and having its upper end closed by a closure plate 62 suitably secured to the flanged top of the receptacle. In order that the movement of the fluid within the reservoir, in response to variations in volume of the chamber 40, will not be impeded, a vent tube 64 extending

into the upper part of the reservoir is mounted substantially centrally of the closure plate 62.

Added rigidity is given the cushioning means 14 by an annular bracing structure located between the top 44 and the bottom 60 of the reservoir. This structure includes a short piece of tubing 66 and a pair of annular flanges 68 and 70 securing the tube to the top 44 and bottom 60, respectively.

It should be noted, in accordance with one of the features of the present invention, that the hydraulic cushioning means 14 is constructed and arranged to be effective throughout a wide range of angular positions of the device. This is of importance in connection with certain installations such as aircraft. This desirable attribute of the device is obtained by making the dual chamber construction generally hour-glass shaped and by making the variable volume chamber relatively large in diameter but short in length, and having the flow-restricting orifice located substantially centrally of the chamber. Furthermore, flow of the cushioning fluid from the reservoir is prevented from escaping by extending the venting tube 64 a substantial distance within the reservoir and locating it centrally thereof. The amount of fluid should be limited so as not to rise above the inner end of the venting tube even if the device should be in an inverted position.

The switch of the present invention may be constructed readily and economically. It is also extremely sensitive to variations in the control pressure but will not operate in response to vibrations. In operation, the compartment 20 is connected to the source of control pressure through the conduit 32, which may be the propeller blast of an airplane. The switch 12 may be either of the normally closed or normally open type. In this description it is assumed to be of the normally open type. The diaphragm and amount of fluid are so arranged that the switch remains in its open position until the pressure in chamber 20 rises to some predetermined value. This value may be as low as one and one-half or two inches of water. Furthermore, the switch itself may be of a character to operate with a pressure differential of one-half inch. For example, if the switch closes at a pressure of two inches of water, at which time the diaphragm 44 moves upwardly to relieve the pressure on the switch operating finger 18 and then if the pressure decreases to one and one-half inches of water, the switch would be opened by the downward movement of the diaphragm and finger 18.

Operation of the switch in response to vibrations occurring even at critical operating pressures is prevented by the hydraulic fluid 36, the movement of which is restricted by the orifice 38. The vibrations tending to operate the switch tend also to move the diaphragm 44, but such movement is prevented by the fluid 36 which cannot move rapidly because of the restriction offered by the orifice. Consequently the switch of the present invention is not only sensitive but it is free of fluttering in response to vibrations.

The switch of the present invention is also effective over a wide range of angular positions. It is normally mounted vertically, i. e., in the position in which it is shown in Fig. 1. Should the angular position of the device change, the fluid in the reservoir moves, but the fluid in the variable volume chamber 40 does not move, at least until the angular position has been considerably

shifted. Furthermore, some of the fluid in the chamber may drain to the liquid reservoir without affecting the operation of the device.

In the instant embodiment of the invention, wherein the diaphragm is moved away from the switch operating finger at higher pressures the variation in angular position does not pose much of a problem because the variations in angular position are not likely to occur until the airplane is in flight. When in flight the air pressure existing in chamber 20 may be above six or seven inches of water and as high as fifteen inches of water pressure so that there is then no danger of undesired operation of the switch. The drainage of fluid from the variable volume chamber to the reservoir at this time would not affect the operation of the switch because such drainage would merely mean that the diaphragm may relieve further the pressure applied to the operating finger. Movement of the diaphragm beyond a predetermined safe point is prevented by the top 44 which is located relatively close to the diaphragm.

The foregoing detailed description of the present invention is intended to be illustrative and not limitative of the invention, except insofar as particularly set forth in the accompanying claims.

Having thus described my invention, what I claim as new and desire to secure by United States Letters Patent is:

1. A pressure actuated switch of the type including movable switch operating means, including in combination, a fluid-tight compartment for said switch, a diaphragm closing said compartment located in cooperative relation to and adapted to move said operating means, and means for opposing movement of the diaphragm, said last mentioned means including a variable volume chamber comprising said diaphragm, and a generally conical top spaced a short distance from the diaphragm to limit movement of the latter, a reservoir defining chamber, a flow-restricting orifice located centrally of and interconnecting said chambers, and a vent-defining tube located centrally of and extending into said reservoir.

2. A switch as claimed in claim 1, wherein the chamber and orifice have a generally hour-glass

shape and means including annular bracing structure engaging both chambers and surrounding the orifice are provided to give added strength.

3. A pressure actuated switch, including in combination, a fluid-tight compartment, a switch having a switch actuating element mounted in said compartment with the actuating element located near the upper end of the compartment, a flexible diaphragm closing the upper end of the compartment, means mounted upon said diaphragm adapted to engage said switch actuating element, means forming a variable volume chamber located at the upper side of the diaphragm and constituted in part by the diaphragm, a fluid reservoir located above said chamber and open to atmospheric pressure, and means including a flow-restricting orifice interconnecting the chamber and reservoir.

4. A pressure actuated switch, including in combination, a fluid-tight compartment, a switch having a switch actuating element mounted in said compartment with the actuating element located near the upper end of the compartment, a flexible diaphragm closing the upper end of the compartment, means mounted upon said diaphragm adapted to engage said switch actuating element, means forming a variable volume chamber located at the upper side of the diaphragm and constituted in part by the diaphragm, a fluid reservoir located above said chamber and open to atmospheric pressure, means including a flow-restricting orifice interconnecting the chamber and reservoir, and a weight attached to said diaphragm for resisting vibration thereof and determining the pressure at which the switch operates.

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