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LIQUID PRESSURE OPERATED ELECTRICAL SWITCH

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Fig. 1.

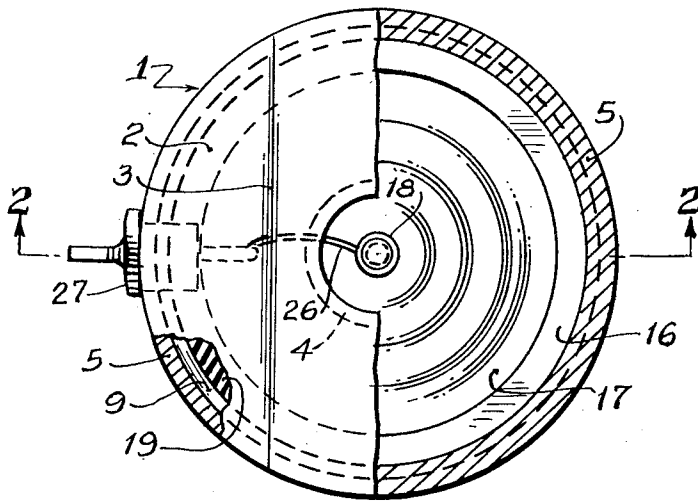
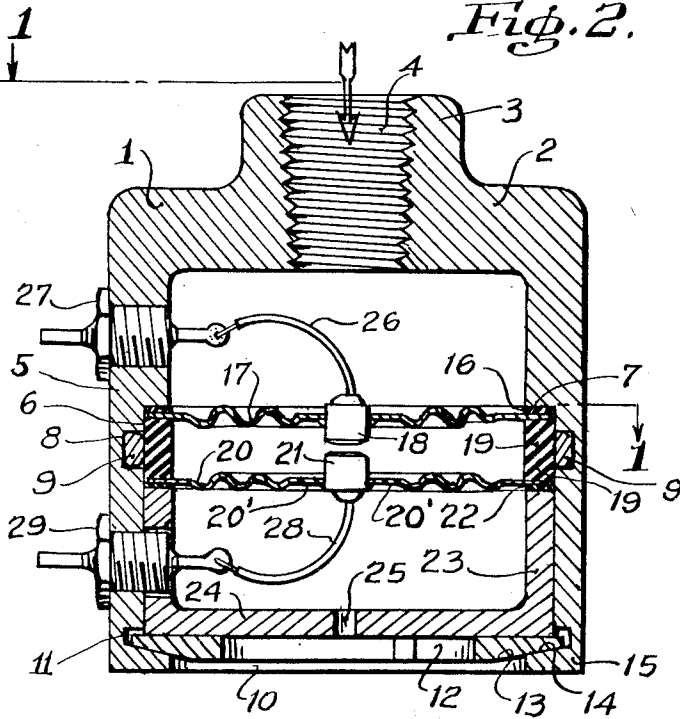


Fig. 2.



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LIQUID PRESSURE OPERATED ELECTRICAL SWITCH

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4 Claims. (Cl. 200—83)

This invention relates to an electrical switch mechanism which is substantially insensitive to acceleration.

For many purposes it is desirable to have sensitive switch mechanisms which will be insensitive to inertial forces generated when the switch is subjected to acceleration or deceleration.

Since a switch mechanism usually involves a moving part which has mass forces, the acceleration of the switch may cause a displacement of the switch parts in the same manner as if it were operated in its normal manner.

This is particularly true in switch mechanisms in which the switch parts are spring suspended, in which case they are essentially seismic systems.

For many uses, as in airplane or other vehicles which are subjected to large values of acceleration, the sensitivity of the switch parts to displacement upon acceleration introduces a possibility that the switch will close or open at such times and contrary to its real purpose.

It is an object of my invention to devise a switch mechanism which will be substantially insensitive to acceleration. I accomplish this object by mounting the pole pieces in such manner that they constitute two equivalent seismic systems, i. e., they will be displaced in space in phase. While not strictly necessary for the purpose of my invention, they may be made to displace equally in the same direction. Functionally, then, they will act as if they were separated by a rigid separator. This may be accomplished by mounting the pole pieces so that they will have substantially equal spring masses, i. e., mounted on resilient suspension. The masses or their spring rate may be made such that the suspended pole pieces will have substantially the same natural frequency. By proper design the amplitude of deflection of the pole pieces, as well as the damping coefficient of the resiliently suspended pole pieces, can be substantially the same. Thus, the pole pieces may be made to deflect in phase to the same degree and in the same direction.

It may not be necessary to make the deflection and natural frequency and phase ideally the same for both pole pieces of the switch so long as the deflection of each on any acceleration is such as to prevent the pole pieces from contacting when they are desired to remain open or to separate when it is desired that they remain closed. The parameters of design, mass, spring rate, and damping coefficient may be selected for the particular switch system, as those skilled in this art will understand from the description given herein.

In order to make the switch actuatable, I provide means for moving the pole pieces to contact or to separate at the will of the operator.

An electrical switch is actuated to close an electrical circuit upon the application of pressure from an external source. This pressure is transmitted to the interior of the switch casing, thereby imposing a strain upon a corrugated diaphragm which is provided at its center portion with pole pieces. A second corrugated diaphragm is mounted spaced from the first diaphragm which is also provided with a pole piece at its center portion. The pole

pieces are positioned in a predetermined spaced relationship to each other. The assembled diaphragms are preferably of the same form and weight and located within a suitable housing.

One of the diaphragms forms the bottom of a closed chamber and when it is subjected to a liquid pressure it is deflected from its normal position with no applied pressure to that where the two breaker points contact each other. The other diaphragm is unaffected by the applied pressure exerted on the first mentioned diaphragm. The second diaphragm is responsive to such motion or vibration as is transmitted to both diaphragms and to which both diaphragms respond.

Each of the pole pieces mounted on the spaced diaphragms is electrically connected to separate insulated wires leading from each of the breaker points to an individual threaded outlet plug in the wall of the casing to which is connected the lead-off wires.

When a liquid pressure is applied within the enclosed chamber above the diaphragm forming the bottom wall of the closed chamber, this diaphragm with its pole piece is deflected toward the other breaker point until the pressure of the predetermined force is reached and the pole pieces mounted on each of the diaphragms touch, thus closing the electrical circuit.

These and other objects of this invention will be more clearly understood by reference to the drawing, in which

Fig. 1 is a top view partly in section taken on the line 1—1 of Fig. 2; and

Fig. 2 is a view in section taken on the line 2—2 of Fig. 1.

As illustrated, the switch comprises the cylindrical housing 1 provided with top wall 2 which is increased in thickness at 3, and is bored and pipe tapped at 4 to receive the pipe fitting.

The wall 5 of the cylindrical housing is counterbored at 6 ending in the shoulder 7, and this counterbore is furnished with the groove 8 to receive the O ring 9. The housing at its open end 10 is provided with the groove 11 to receive the snap ring 12 having a beveled face 13 which, when resting on the bevel face 14 of the bottom internal flange 15, locks the interior parts in location in the casing. Within the counterbore 6 in the cylindrical wall 5 is progressively assembled, starting at the shoulder 7, first the insulating ring 16 nested against the shoulder 7 of the counterbore. The diaphragm 17 with its centrally located pole piece 18 is then inserted contacting the insulating ring 16; the insulating spacer ring 19 is then entered with the O ring 9 in place in the groove 8. Next the diaphragm 20 with its centrally located pole piece 21 is placed in position between the spacer ring 19 and the insulating ring 22 and held in spaced apart parallel relation to diaphragm 17. These units are backed up by the cap-shaped member 23, the bottom 24 of which is provided with vent hole 25. The diaphragm 20 is also provided with vent hole 20'.

The snap ring 13 is then inserted between the bottom 24 of the cup-shaped member 23 and the bevel 14 of the flange 15. The snap ring, by its wedging action, causes the diaphragms 17 and 20 to be tightly clamped in place between the insulating rings 7, 19, and 22.

The pole piece 18 is electrically connected by the insulated wire 26 to the terminal 27 in the side wall 5 of the case. The breaker point 21 is connected by the insulated wire 28 to the terminal 29 which is also located in the wall 5 of the case. A closed chamber is formed by the top 2 of the case, the side wall 5, and the diaphragm 17 into which fluid under pressure is introduced through the opening 4.

When the pressure in this closed chamber is impressed

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on the diaphragm 17, the diaphragm is deflected from its normal position, causing the pole piece 18 to approach the pole piece 21 until the pole pieces are pressed together, thus closing the circuit.

It will be observed that air compressed between diaphragm 17 and 20 by deflection of the diaphragm 17 is vented through holes 20' to atmospheric pressure through the bore 25 in case 1.

By making the sum of the mass of the diaphragm 17 and the masses supported thereby substantially equal to the sum of the mass of 20 and the masses supported thereby, and by making the spring rate of 17 and 20 substantially equal, upon any acceleration of the case 1, the pole pieces 18 and 21 will move together and maintain their separation so that they will not contact each other. However, when fluid pressure is imposed on 17, the breaker point 18 will approach the breaker point 21 and close contact. Obviously, of course, a similar result will be obtained when a vacuum is imposed via 25, atmospheric pressure being exerted via 4 in such case.

Similarly, if the initial position of 18 and 21 were to be in contact, vacuum exerted on 4, atmospheric pressure being exerted via 25, the switch would open by separation of 18 and 21. However, unless so actuated the switch would remain closed on acceleration of the case.

It will be understood that instead of diaphragms, I may employ bellows or any other type of spring suspension and also employ mechanical or pneumatic means for deflecting one of the pole-pieces where the parameters of design as described above are employed.

While I have described a particular embodiment of my invention for the purpose of illustration, it should be understood that various modifications and adaptations thereof may be made within the spirit of the invention as set forth in the appended claims.

I claim:

1. An acceleration insensitive switch, comprising a case having therein a switch pole-piece, a second switch pole-piece, a resilient support for the first switch pole-piece, a resilient support for the second switch pole-piece, said pole pieces being held in spaced apart relationship on said resilient suspensions, one of said resilient supports being apertured, the space between said supports communicating through said apertured support with the atmosphere exteriorly of said case, and means to deflect one of said pole-pieces on its resilient suspension to actuate said switch.

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2. An acceleration insensitive switch, comprising a switch pole-piece, a second switch pole-piece, a resilient support for the first switch pole-piece, a resilient support for the second switch pole-piece, said resilient supports forming a chamber therebetween, said pole pieces being held in spaced apart relationship on said resilient suspensions, one of said resilient supports being apertured, and means to deflect one of said pole-pieces on its resilient suspension to actuate said switch, the masses of said resiliently supported pole-pieces being substantially equal and the spring rate of said resilient supports being substantially equal.

3. A switch comprising a case, a fluid pressure chamber in said case, a flexible diaphragm closure for said chamber, a fluid pressure inlet to said chamber, a second diaphragm mounted in said case and spaced from said first diaphragm, said diaphragms forming a chamber therebetween, said second diaphragm being apertured, a switch pole-piece mounted on each of said diaphragms, the masses of said pole-pieces and the spring rate of said diaphragms being substantially equal, respectively, and an electrical connection to each of said pole pieces.

4. An acceleration insensitive switch, comprising a case having therein a switch pole-piece, a second switch pole-piece, a resilient support for the first switch pole-piece, a resilient support for the second switch pole-piece, said pole pieces being held in spaced apart relationship on said resilient suspensions, one of said resilient supports being apertured, the space between said supports communicating through said apertured support with the atmosphere exteriorly of said case, and means to deflect one of said pole-pieces on its resilient suspension to actuate said switch, the masses of said resiliently supported pole-pieces being substantially equal and the spring rate of said resilient supports being substantially equal.

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