Aug. 7, 1945. C. V. ERICKSON 2,381,582

PRESSURE SWITCH

Filed May 8, 1944

Fig. 1.

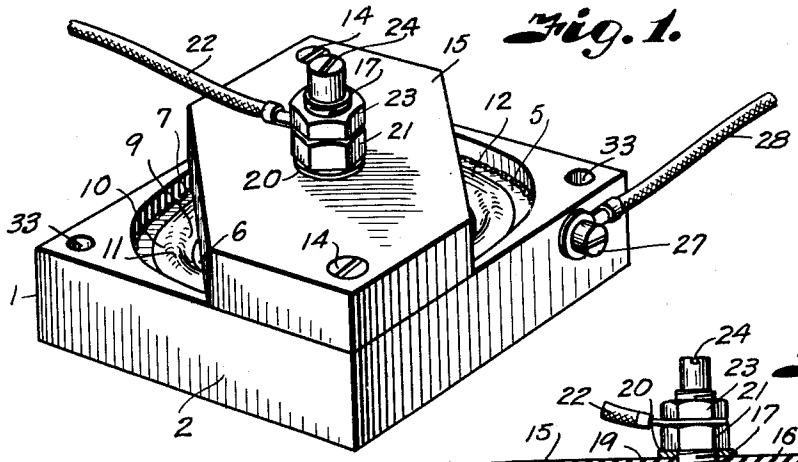



Fig. 2.

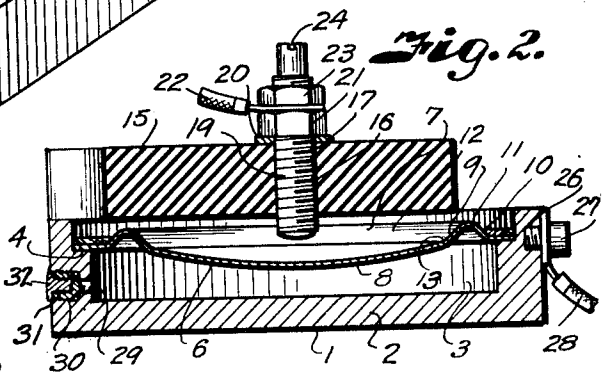



Fig. 3.

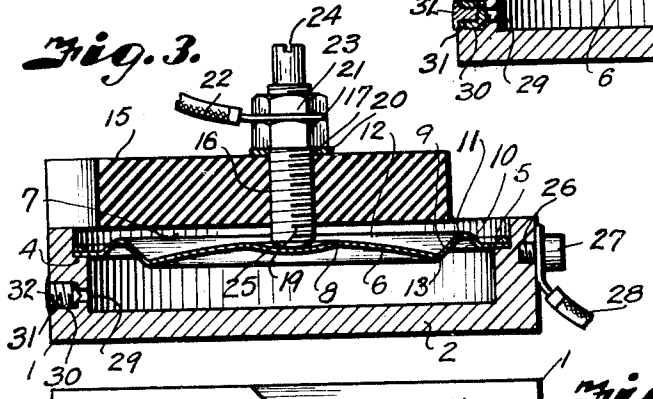



Fig. 4.

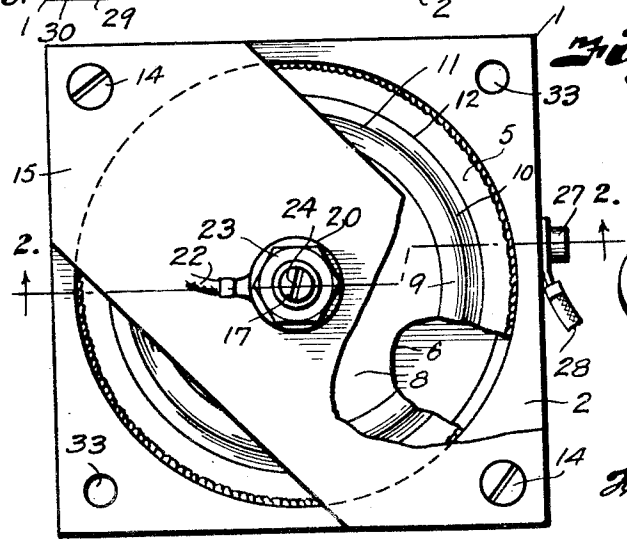
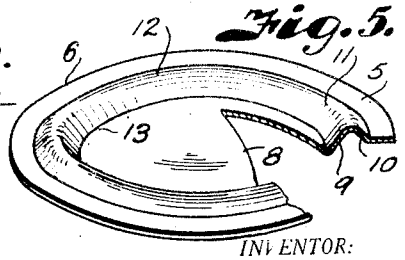



Fig. 5.




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2,381,582

# UNITED STATES PATENT OFFICE

2,381,582

## PRESSURE SWITCH

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Application May 8, 1944, Serial No. 534,569

9 Claims. (Cl. 200—83)

This invention relates to a pressure-operated switch, and more particularly to a switch of this character adapted for automatic operation at predetermined atmospheric pressures for controlling current volume of radio equipment; for example, the circuit volume required in operating aircraft radio equipment must be increased at high altitudes and heretofore it has been necessary to operate manually-controlled switches when such aircraft reach high altitudes.

The principal objects of the present invention are, therefore, to provide for control of radio equipment responsive to predetermined atmospheric pressures so as to increase the volume necessary for operation at high altitudes; to provide a switch structure that is sufficiently sensitive to changes in atmospheric pressures occurring within a differential of approximately five hundred feet; to provide a switch structure with a diaphragm having a form to avoid fatigue and which is not affected by fatigue; to provide a switch structure capable of positive snap action at any predetermined altitude; and to provide a switch of simple and economic construction and efficient in operation.

In accomplishing these and other objects of the present invention I have provided improved details of structure, the preferred form of which is illustrated in the accompanying drawing wherein:

Fig. 1 is a perspective view of a pressure switch embodying the present invention.

Fig. 2 is a cross sectional view through the switch taken on the line 2—2, Fig. 4, showing the diaphragm in normal position.

Fig. 3 is a similar cross sectional view through the switch showing the diaphragm in flexed position and in contact with the electrical circuit.

Fig. 4 is a plan view of the switch with parts broken away to better illustrate the invention.

Fig. 5 is a fragmentary perspective view of the diaphragm forming part of the present invention.

Referring more in detail to the drawing:

1 designates a switch embodying my invention, having a housing 2, which may be of any suitable form although I have here shown it as substantially square, and is preferably made of brass, bronze or the like, although any suitable current conductive material may be used. Formed in the housing is a chamber 3 encompassed by an annular shoulder 4, inset within a face of the housing and providing a seat for the marginal edge 5 of a diaphragm 6 secured on the annular shoulder 4 by soldering or the like to completely close the chamber 3 and provide a space 7 in the housing above said diaphragm. The diaphragm is preferably made of electrical conducting material and shaped to provide a concavo-convex central portion 8 to take a shape substantially conforming to an elastic curve, terminating in an outwardly flared portion 9 merging through a radius 11 into an oppositely flaring portion 10 which carries the flat marginal edge 5. The portions 9 and 10, and the curvature 11 form an upwardly extending annular corrugation or ridge 12 on the diaphragm to render the outer portion relatively stiff so that flexure of the central portion 8 will not affect the seal around the edge of the diaphragm. The diaphragm is preferably overstressed around the base of the ridge 12 at 13 to aid in retaining the greatest possible flexure in the central portion 8.

The formation of the ridge portion 12 on the diaphragm will form a boundary so that the manner of holding the outer edges does not influence in any large degree the performance of the diaphragm, but also allows in this formation the establishment of stresses in the diaphragm against which a pressure must be applied to the diaphragm to cause its sudden displacement. In general, the bulge of the diaphragm determines the difference between the values of pressure required for displacement and that required for return. The stresses in the outer ridge determine the pressure which will be required for displacement. The stresses in the ridge are controlled by the different bending radii and linear lengths of the arcs employed in its formation. It is well known that after release of the forming forces of the die in making the diaphragm, a slight return from the bend occurs which may be given as a small angle of return for each unit length of the arc. The application of such a principle will allow the production of proper stresses for definite operation of the diaphragm.

Mounted on the housing 2 and held in place by fastening devices, such as screws 14, in opposite corners of the housing, is a plate 15 preferably made of insulating material and of a design to only partially cover the opening in said housing, thus leaving the diaphragm 6 exposed to atmospheric pressure. The plate 15 is provided with an aperture 16 adapted to receive an electric terminal 17 of a length to extend above and slightly below the plate 15 as shown in Fig. 2. In the illustrated instance, the aperture 16 is threaded and the terminal threaded as indicated at 19, Fig. 2, to adapt it to be screwed into the aperture. A washer 20 is provided for the terminal which rests on the plate 15. Turned on the terminal 17 is a nut 21

adapted to lock the terminal in selected position.

The terminal is connected in circuit by a conductor 22 fastened thereon with an ordinary nut 23. The outer end of the terminal 17 is adapted to receive a tool for adjustment of the terminal relative to the diaphragm. In the present device I have shown a slot 24 in the end of the terminal adapted to receive a tool, such as a screw driver (not shown) for adjustment of the terminal in the plate.

The terminal 17 may be threaded into the plate to adjust the distance between the end thereof and the diaphragm when in circuit-interrupting position so that when contact is made, the screw will depress the central portion as indicated at 25, Fig. 3, and thereby reduce the differential pressure required to snap the diaphragm back in circuit-interrupting position. The return of the original position occurs with the release of the actuating fluid pressure through the actuating valve. The central portion is formed to take the shape substantially conforming to an elastic curve for the deflection of the flat plate rigidly held at the edges of the diaphragm, with a uniform pressure load.

The side of the housing 2 is provided, at substantially the level of the marginal edge 5 of the diaphragm with a threaded recess 26 adapted to receive a cap screw 27 for connecting a conductor 28 to said housing, forming a terminal for the opposite side of the circuit.

The chamber 7 is preferably evacuated by suitable means (not shown) through aperture 29 in the side of the housing 2, having an enlarged threaded recess 30 therein, adapted to receive a set screw 31, whereby the atmospheric pressure acting on the outside of the diaphragm forces the central portion 8 downwardly in the chamber 3. After the evacuation is completed the recess 30 is sealed with solder or other suitable material 32.

The switch may be mounted on the instrument panel of an airplane or other suitable place by ordinary means extending through apertures 33 in the housing 2.

Operation of the device constructed and assembled as described is as follows: After evacuation of the chamber the diaphragm will assume the concave open position as shown in Fig. 2. As higher altitudes are reached, change in pressures will cause the diaphragm to flex outwardly of the chamber and to assume an inverted curvature as shown in Fig. 3, and thus in its contacting position with the terminal 17 whereby current will pass through the wire 22, terminal 17, diaphragm 6, housing 2 and conductor 28 to complete the circuit. In other words, evacuation of the chamber 7 permits the center of the diaphragm to be forced inwardly under external atmospheric pressure at low altitudes. Reduction in atmospheric pressure causes the diaphragm to flex outwardly, and after passing the central point, the action is quite rapid to provide a snap action which is effective in operating the switch. At the proper balance between the fluid pressure and stresses in the diaphragm, the diaphragm suddenly moves to a new fixed position retaining this position until a reversal of pressure application has occurred, at which time the diaphragm reassumes its first position. This snap movement of the diaphragm is employed to definitely control electrical contacts.

A switch constructed in accordance with my invention is of light, simple and inexpensive construction which may be mounted on the panel or back of the housing of an airplane in a suitable manner so that there may be no danger of loss of current through the mounting.

What I claim and desire to secure by Letters Patent is:

1. A snap action switch for opening and closing a control circuit to a mechanism to be operated in response to change in atmospheric pressure including, a substantially rigid base member having a recess opening from a side thereof and provided with an inset shoulder encircling the recess, a snap action diaphragm having a rim portion sealed on the shoulder cooperating with the base member to form a closed chamber for containing an inert fluid medium under pressure less than atmospheric pressure, said snap action diaphragm being shaped to provide a concave-convex central portion therein, a terminal support bridging said recess, and an electrical terminal carried by the terminal support and having a contact portion coaxially of the diaphragm and adapted to be engaged thereby upon reversal of position of the central portion of said diaphragm.

2. A snap action switch for opening and closing a control circuit to a mechanism to be operated in response to change in atmospheric pressure including, a substantially rigid base member having a recess opening from a side thereof and provided with an inset shoulder encircling the recess, a snap action diaphragm having a rim portion sealed on the shoulder cooperating with the base member to form a closed chamber for containing an inert fluid medium under pressure less than atmospheric pressure, said snap action diaphragm being shaped to provide a concave-convex central portion and having an annular ridge between said central portion and said rim portion, a terminal support bridging said recess, and an electrical terminal carried by the terminal support and having a contact portion coaxially of the diaphragm and adapted to be engaged thereby upon reversal of position of the central portion of said diaphragm.

3. A snap action switch for opening and closing a control circuit to a mechanism to be operated in response to change in atmospheric pressure including, a substantially rigid base member having a recess opening from a side thereof and provided with an inset shoulder encircling the recess, a snap action diaphragm having a rim portion sealed on the shoulder cooperating with the base member to form a closed chamber for containing an inert fluid medium under pressure less than atmospheric pressure, said snap action diaphragm being shaped to provide a concave-convex central portion and having an annular ridge between said central portion and said rim portion and an overstressed portion between said ridge and said central portion to increase the snap action of said central portion, a terminal support bridging said recess, and an electrical terminal carried by the terminal support and having a contact portion coaxially of the diaphragm and adapted to be engaged thereby upon reversal of position of the central portion of said diaphragm.

4. A snap action switch for opening and closing a control circuit to a mechanism to be operated in response to change in atmospheric pressure including, a substantially rigid base member having a recess opening from a side thereof and provided with an inset shoulder encircling the recess, a snap action diaphragm having a rim portion sealed on the shoulder cooperating with the base member to form a closed chamber for containing an inert fluid medium under pressure less than atmospheric pressure, said snap action

diaphragm being shaped to provide a concave-convex central portion and having an annular ridge between said central portion and said rim portion and an overstressed portion between said ridge and said central portion to increase the snap action of said central portion, a terminal support bridging said recess, and an electrical terminal carried by the terminal support and having a contact portion coaxially of the diaphragm and adapted to be engaged thereby when the pressure in the closed chamber is greater than the atmospheric pressure.

5. A snap action switch for opening and closing a control circuit to a mechanism to be operated in response to change in atmospheric pressure including, a substantially rigid base member having a recess opening from a side thereof and provided with an inset shoulder encircling the recess, a snap action diaphragm having a rim portion sealed on the shoulder cooperating with the base member to form a closed chamber for containing an inert fluid medium under pressure less than atmospheric pressure, said snap action diaphragm being shaped to provide a concave-convex central portion and having an annular ridge between said central portion and said rim portion and an overstressed portion between said ridge and said central portion to increase the snap action of said central portion, a terminal support bridging said recess, an electrical terminal carried by the terminal support and having a contact portion coaxially of the diaphragm and adapted to be engaged thereby when the pressure in the closed chamber is greater than the atmospheric pressure, and an electrical terminal attached to said base member.

6. A snap action switch for opening and closing a control circuit to a mechanism to be operated in response to change in atmospheric pressure including, a substantially rigid base member having a recess opening from a side thereof and provided with an inset shoulder encircling the recess, a snap action diaphragm having a rim portion sealed on the shoulder cooperating with the base member to form a closed chamber for containing an inert fluid medium under pressure less than atmospheric pressure, said snap action diaphragm being shaped to provide a concave-convex central portion and having an annular ridge between said central portion and said rim portion and an overstressed portion between said ridge and said central portion to increase the snap action of said central portion, a terminal support bridging said recess, and an electrical terminal carried by the terminal support and having a contact portion coaxially of the diaphragm whereby differential in pressure on the outside of said diaphragm will cause the concave-convex portion to snap back and forth to open and close said circuit.

7. A device for controlling a mechanism in response to change in atmospheric pressure including, a base member having a recess opening from a side thereof and provided with an inset shoulder encircling the recess, a diaphragm having a rim portion sealed on said shoulder cooperating with the base member to form a closed chamber for containing fluid medium under pressure less than atmospheric pressure, a terminal support bridging a part of said recess so that the side of said diaphragm opposite said chamber is open to atmosphere, and an electrical terminal carried by said support and having a contact portion coaxially of the diaphragm adapted to be engaged thereby when the atmospheric pressure on the outside of said diaphragm is less than the pressure in said closed chamber.

8. A device for controlling a mechanism in response to change in atmospheric pressure including, a base member having a recess opening from a side thereof and provided with an inset shoulder encircling the recess, a diaphragm having a rim portion sealed on said shoulder cooperating with the base member to form a closed chamber for containing fluid medium, means for evacuating said chamber so that the fluid medium therein will be less than atmospheric pressure, a terminal support bridging a part of said recess so that the side of said diaphragm opposite said chamber is open to atmosphere, and an electrical terminal carried by said support and having a contact portion coaxially of the diaphragm adapted to be engaged thereby when the atmospheric pressure on the outside of said diaphragm is less than the pressure in said closed chamber.

9. A device for controlling a mechanism in response to change in atmospheric pressure including, a base member having a recess opening from a side thereof and provided with an inset shoulder encircling the recess, a diaphragm having a rim portion sealed on said shoulder cooperating with the base member to form a closed chamber for containing fluid medium, means for evacuating said chamber so that the fluid medium therein will be less than atmospheric pressure, said diaphragm having a concave-convex central portion, a terminal support bridging a part of said recess so that the side of said diaphragm opposite said chamber is open to atmosphere, and an electrical terminal carried by said support and having a contact portion coaxially of the diaphragm adapted to be engaged by said concave-convex central portion when the atmospheric pressure on the outside of said diaphragm is less than the pressure in said closed chamber.

CARL V. ERICKSON.