March 2, 1948. I. W. EISENBERG 2,436,958

SWITCH

Filed Jan. 31, 1944

Fig.1

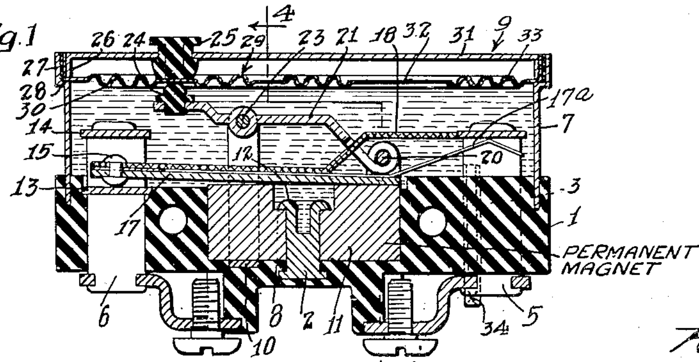


Fig.2

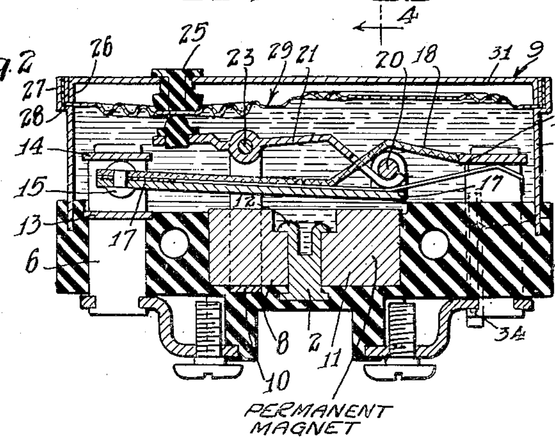


Fig.4

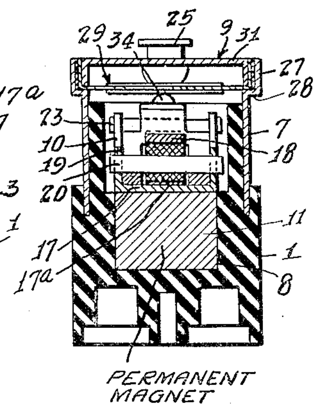


Fig.3

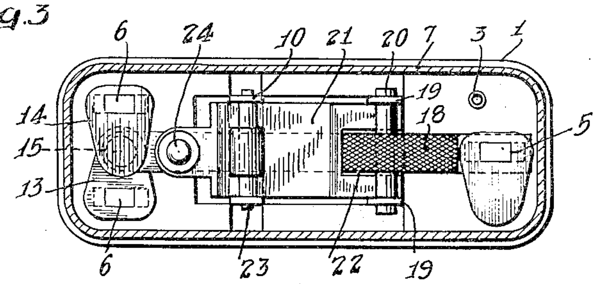
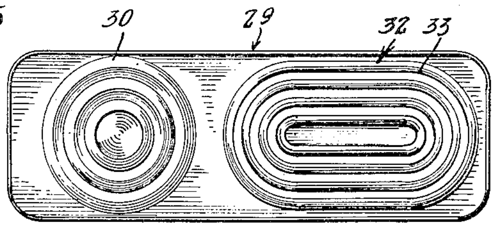


Fig.5



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SWITCH

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1 Claim. (Cl. 200—168)

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This invention relates to switches for the making and breaking of electrical circuits and is more particularly directed to a switch of the fully enclosed, sealed and oil-filled type.

It is an object of this invention to produce a fully enclosed and sealed switch of the oil-filled type applicable for use in the making and breaking of electrical circuits under conditions of wide temperature variations.

It is another object of this invention to produce a switch relay member or the like applicable for opening or closing electrical circuits and particularly adapted for use in installations subject to wide temperature variations.

Another object of this invention is to produce a switch of the fully sealed and enclosed type which includes a movable contact member, means for actuating the contact member to a closed position, and means incorporating a flexible diaphragm operable from the exterior of the switch for actuating the switch bar to another position.

A further object of this invention is to produce a switch of the fully enclosed type which includes a base member within which the pole pieces of the switch are embedded, a cover or enclosure member for housing and sealing a removable contact bar upon the base member and which closure member includes a flexible diaphragm means capable of compensating for expansion or contraction and also including diaphragm means operable for shifting the position of the contact member within the enclosure.

Other objects and advantages of this invention it is believed will be apparent from the following detailed description of a preferred embodiment thereof as illustrated in the accompanying drawings.

In the drawings:

Figure 1 is a side elevation mainly in vertical mid-section of the switch embodying my invention illustrating the switch in closed position.

Figure 2 is a view similar to Figure 1 with the switch in open position.

Figure 3 is a top plan view partly in horizontal section with the cover and diaphragm actuating member removed.

Figure 4 is a sectional end view taken substantially on the line 4—4 of Figure 1.

Figure 5 is a top plan view of the diaphragm cover embodied in the sketch incorporating my invention.

In the preferred embodiment of my invention as illustrated in the accompanying drawings, I have shown my invention as adapted within a switch or relay member of the magnetically actuated form. It will be apparent, however, that my invention is not limited in its field of use to this particular adaptation.

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In this modification I employ a base member 1 which may be molded Bakelite or other similar material. The base 1 is molded to incorporate therein a magnet rivet 2, a sealing tube 3, contact inserts 5 and 6, and a metallic or other suitable material case 7. The base 1 is molded to form a magnet recess 8.

The switch is assembled upon the base 1 and within the enclosure formed by the metal case 7. A diaphragm cover assembly 9 is provided for the case 7 and this cover is of the hereinafter set forth construction.

In assembling the switch upon the base 1, a U-shaped actuating arm bracket 10 is first mounted within the recess 8 and then the permanent magnet 11 is positioned within the recess 8 with the rivet 2 extending through a central aperture of the magnet and the head of the rivet is then spun or peened as indicated at 12 to permanently secure the magnet within the recess.

In this illustration of my invention there are two inserts 6 which provide vertically spaced contacts 13 and 14 which are insulated from each other. Between the contacts there is positioned the contact button 15 supported upon the free end of an armature plate 17. The armature plate 17 is attached to a spring 17a and a current conductor or pigtail 18. The current conductor 18 is secured to the upper end of the contact insert 5 within the case 7. The armature plate 17 is normally supported at one end on the contact button 15 which rests on the contact 13 and on the magnet 11 at the other end, as shown in Figure 1, while the spring 17a is secured by the button 15 between the current conductor 18 and the plate 17 and has a slot shown in dotted lines in Figure 3 at an end opposite the contact button 15 which slot receives the insert 5 below the point of the pigtail 18 connection to the insert 5. Formed upon, or secured to the armature plate 17 are a pair of spaced ears 19 between which there is extended a pivot pin 20.

The switch actuating arm 21 is carried by the pin 20 to rotate within the ears 19. The actuating arm 21 has a cutout recess 22 through which the pigtail 18 is extended. The actuating bar 21 is also pivotally supported upon a pin 23 carried in the U-shaped bracket 10. At its free end the actuating bar 21 supports an actuating button 24 of insulating material which is moved to actuate the switch by movement of a push button 25 as hereinafter described.

The diaphragm cover assembly 9 embodying my invention is herein illustrated as including a cover plate 31 having its marginal edges turned downward to form a flange 26, and a diaphragm plate 29 having an upturned marginal flange 28. The flange 26 fits within the flange 28 and the cover assembly fits within an offset flange 27 provided around the case 7 and rests on a shoulder 28. The cover plate and diaphragm plate are suitably sealed together and to the case 7 by means of solder, welding or other permanent type of connecting and sealing arrangement.

The diaphragm plate is provided with concentrically positioned ripples or corrugations 30 centered with respect to the push button 25. The ripples 30 form a switch actuating diaphragm the center of which upon flexing of the diaphragm may be pressed against the push button 25 to cause the actuating arm 21 to rotate on its pivot 23 and lift upwardly the ears 19 of the plate 17.

This action results in moving the spring 17*a* and plate 17 upwardly to shift the position of the contact 15 from the position indicated in Figure 1 to the position indicated in Figure 2, which may be from a position of closing the circuit to a position opening the circuit or from a position of opening the circuit established between the insert 5 and one of the inserts 6 as illustrated in Figure 1 to a position of closing a second circuit between the insert 5 and the second insert 6 lying immediately to the rear of the insert 6 as indicated in Figure 1.

In order to provide for actuation of the switch through the diaphragm plate 29 in a fully enclosed and sealed type of switch filled with liquid oil, and in order to provide for expansion and contraction of the oil contained within the case under widely varying changes of temperature, I provide a second expansion or compensating diaphragm or bellows portion 32 in the diaphragm plate 29 which has a greater freedom of expansion than does the switch actuating diaphragm 30. I may accomplish this by forming a diaphragm portion 32 of larger area as indicated in Figure 5 or by forming a series of these diaphragm portions or by forming the metal at this section of the cover 9 of less thickness. As illustrated, I may form a larger compensating diaphragm portion 32 by forming a plurality of concentric ripples 33 which are of greater length than the ripples of the switch actuating diaphragm 30.

The areas of the diaphragm plate 29 between and around the switch actuating diaphragm 30 and the compensating diaphragm 32 is relatively flat, and aided by the flange 29 is relatively stiff so that movement of one diaphragm is not mechanically transmitted to the other. However, when the case 7 is filled with oil, movement of the switch actuating diaphragm is transmitted hydraulically, that is by pressure of the oil, to the compensating diaphragm as shown in Figure 2 to compensate for the oil which must be displaced to permit movement of the switch actuating diaphragm.

The volume of oil varies with temperature change. The compensating diaphragm also compensates for this change without appreciably affecting the switch actuating diaphragm; that is, the compensating diaphragm by reason of its greater flexibility, responds to pressure differentials due to change in volume of the oil before the switch actuating diaphragm is affected, and under such conditions moves independently of the switch actuating diaphragm. The range of movement or displacement of the compensating diaphragm is sufficient to include both the displacement of the switch actuating diaphragm and the volumetric change of the oil due to temperature change.

In other words, when the liquid contained in the switch expands, the compensating diaphragm moving before the force is sufficient to move the switch actuating diaphragm. Conversely, when the liquid contracts the compensating diaphragm moves before a force which is developed sufficiently to move the switch actuating diaphragm.

In order to fill the switch with oil I employ the sealing tube 3 which is molded within the molded base 1 and extends therethrough. I connect the extended end of the tube 3 with a suitable source of vacuum and evacuate the case to a very high degree of vacuum; that is, to an absolute pressure of a few millimeters of mercury. I then, by suitable cross connections connect the tube 3 to a source of oil so that the oil is drawn into the case 7 to fill the same completely. The end of the tube 3 is then sealed to retain the oil within the case 7 by any suitable means as by pinching the end of the tube 3 as indicated at 34.

The oil employed in this switch is of a special type which will remain liquid throughout a large temperature range and at very low degrees of temperature, thereby permitting the switch embodying my invention to be used as a relay or switch member in the electrical installations in aircraft or other installations which pass through regions of very widely ranging temperatures.

The magnet 11 operates upon the plate 17 to hold this plate in the position indicated in Figure 1. Pressure exerted against the button 25 bows the spring 17*a* upwardly until the spring force is sufficient to overcome the magnetic force of the armature plate 17 and the plate then moves upwardly to thereby break the contact of the contact button 15 with the contact plate 13. On release of the pressure on the button 25, the magnet 11 moves the plate 17 upwardly to again reestablish the contact.

The conjoint action of the magnet and spring produces a switch of the snap-over type. It will hold the armature in position to maintain the contact button 15 in contact with the contact 13 until sufficient force is exerted on the actuating button 25 to raise the plate 17 away from the magnet 11. When the force exerted by the spring due to pressure on the push button 25 is sufficient to move the plate 17 away from the magnet 11 the spring 17*a* will snap the plate 17 upwardly causing the button 15 to break from the contact 13 and make contact with the contact 14. This is caused by the fact that the magnetic force on the plate 17 decreases at a greater rate than the spring force as the plate moves away from the magnet. As the push button 25 is released the spring force is reduced until the magnetic force on the plate 17 is sufficient to overcome the force of the spring 17*a* whereby the magnet 17 snaps the armature 16 back into its original position. The magnetic force on the plate 17 increases at a greater rate than the spring force as the plate 17 moves toward the magnet.

Having fully described my invention, it is to be understood that I do not wish to be limited to the details herein set forth, but my invention is of the full scope of the appended claim.

I claim:

In a device of the class described, a closed liquid filled casing having a switch member therein mounted for movement in response to a predetermined force, said casing having an actuating diaphragm portion, means operatively connecting said diaphragm portion with the said switch member to move the same upon flexing of the said diaphragm portion, a second diaphragm portion being so positioned that flexing thereof will not directly effect movement of said switch member and being sufficiently flexible to flex under a force less than said predetermined force whereby it will flex under forces induced by contraction of said liquid before sufficient force is induced to move said switch member.

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