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HERMETICALLY SEALED SWITCH

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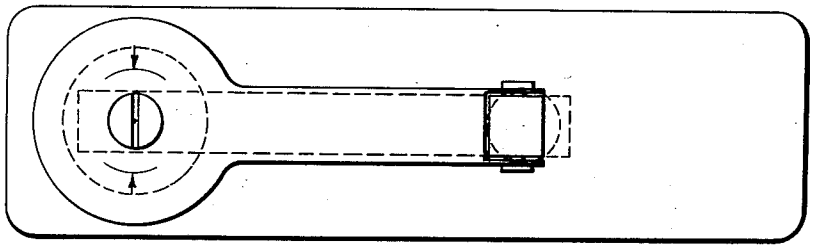


FIG. 2

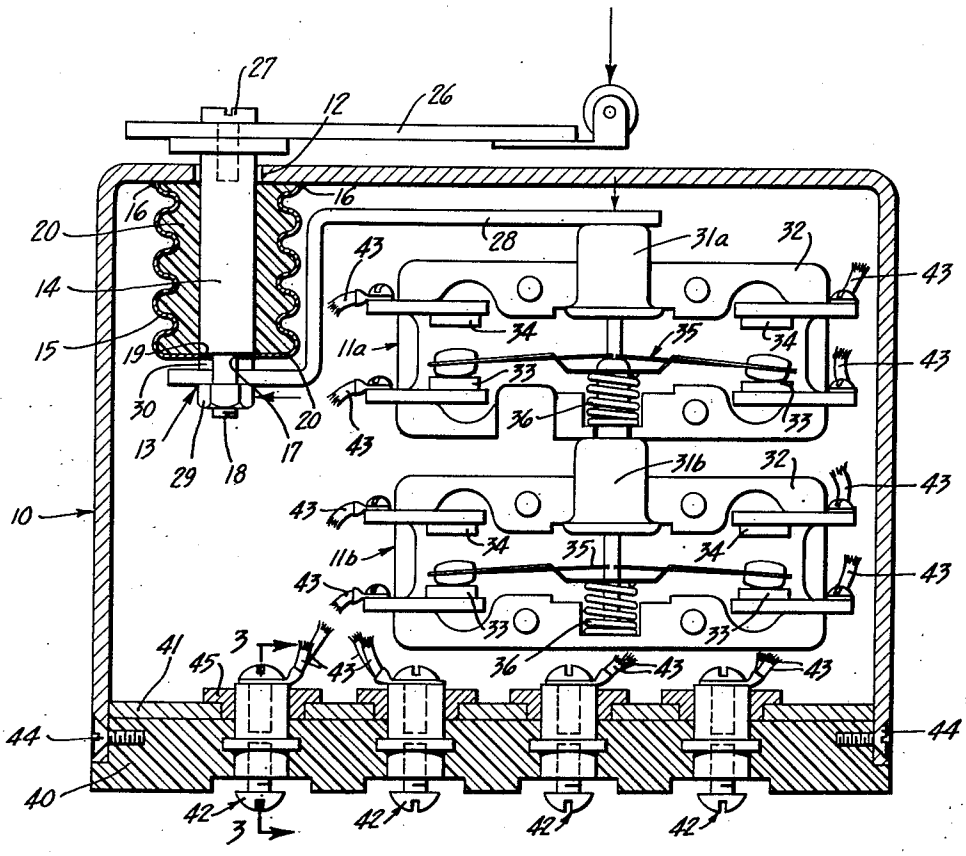


FIG. 1

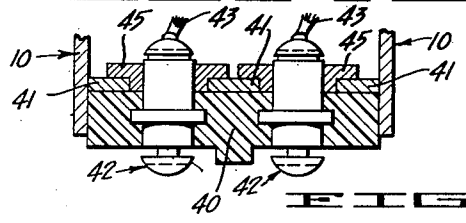


FIG. 3

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HERMETICALLY SEALED SWITCH

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1 Claim. (Cl. 200—168)

The present invention relates to electric switches and more particularly to certain new and useful improvements in hermetically sealed electric switching devices of the type particularly designed for use in high altitude aircraft.

Hermetically sealed electric switching devices are not broadly new and many such devices have been designed and constructed for use in high altitude aircraft where low temperatures will cause a condensation and icing problem which will adversely affect the operation of the device and the electrical contacts of the switch unit. In such devices a shaft is usually passed through or cooperates with a simple diaphragm or bellows in the wall of a casing in such a manner as to permit an electrical switch mounted and hermetically sealed in the casing to be actuated by movement of the shaft externally of the casing and flexion of the diaphragm or bellows.

Hermetically sealed electric switching devices of the above type have not, however, proved generally satisfactory, particularly where the switching device is subject to numerous and repeated actuations. Under such conditions the devices have encountered fatigue problems after a relatively small number of operations with the result that the flexible bellows fails, breaking the hermetic seal provided thereby and permitting the entry of moisture or dirt into the housing.

The above noted defect of the prior art is remedied in accordance with the present invention wherein certain new and useful improvements are provided in an hermetically sealed electric switching device of the type described, which is of both simple and sturdy construction and is inexpensive to manufacture; and in which the electrical switching unit may be continuously and repeatedly actuated externally of the casing without encountering fatigue problems in the hermetic sealing means provided for the actuating mechanism.

More specifically, the present invention contemplates the provision in a hermetically sealed electric switching device, including a casing having an opening and an electric switch supported in the casing having a contact member and a movable member adapted to be moved into and out of electrical engagement with the contact member: of a novel actuating means cooperating through the opening in the casing for operating the electrical switch from the exterior of the casing and for hermetically sealing the opening.

In accordance with the preferred embodiment of the invention, the operating means comprises a rod having an inner portion which extends through the opening in the casing in spaced relation with respect thereto. Means are provided for rockably mounting the rod in and hermetically sealing the opening including a flexible bellows carried by the casing in surrounding relation with respect to a portion of the rod intermediate its end portions, one end of the bellows being secured to the wall of the casing in surrounding relation to the opening, and the other end of the bellows having an aperture therein through which an end portion of the rod is secured. A non-fluid semi-rigid plastic material is provided which is contained within the bellows and is adapted to hermetically seal the bellows both with respect to the casing and the portion of the rod extending therethrough, and, further, in cooperation with the bellows to provide a rockable pivot for the rod. The inner end of the rod is adapted, upon rocking movement of the rod in the aperture located in the casing, to operate through an actuating means the movable switch member to move the same into and out of electrical engagement with the electrical contact member.

The above, as well as other novel features of the hermetically sealed electric switching device, will be more readily understood from the following description of the accompanying drawings illustrating the invention in accordance with its preferred embodiment, in which drawings:

Figure 1 is a sectional view of a hermetically sealed electric switching device showing the novel actuating and sealing means according to the preferred embodiment of the invention;

Figure 2 is a top end view of the switching device shown in Figure 1; and

Figure 3 is a sectional view along line 3—3 of Figure 1.

As shown in Figure 1 of the drawings, the electric switching device includes a casing, generally designated as **10**, in which is mounted one or more conventional electric switch units, generally designated as **11***a* and **11***b*, respectively. The upper wall of the casing is provided with an opening or aperture **12** through which extends the actuating mechanism, generally designated as **13**, which serves both to operate the switch units **11***a* and **11***b* from the exterior of the casing and to seal hermetically the aperture **12**.

In accordance with the preferred embodiment of the present invention illustrated, the actuating mechanism **13** comprises a rod **14** extending in the manner shown through the aperture **12** in spaced relation with respect to the walls thereof. The rod **14** is rockably mounted in the aperture **12** by means of a flexible bellows **15** carried within the casing in surrounding relation with respect to the inner portion of the rod; one end of the bellows **15** being secured, as at **16**, by soldering or otherwise to the inner wall of the casing **10** in surrounding relation to the aperture **12**, and the other end of the bellows being provided with an opening or aperture **17**. The rod **14** is shown as provided with a threaded end portion **18** of lesser diameter than the central portion of the rod, which end portion extends through the bellows opening **17** with the shoulder **19** abutting the inner side of the end wall **20** of the bellows **15**. Contained within the bellows is a non-liquid flexible plastic material **20**, such as rubber or a silicone compound, which is poured into the bellows in liquid form and then sets to non-liquid form. It thus fills and hermetically seals the bellows **15** with respect to the rod **14** and casing **10** and serves to provide, in cooperation with the bellows **15**, a supporting means for the rod **14** in which there is no fixed physical pivot but which is such that the rod may be rocked within the aperture **12** as though the rod **14** were pivoted at approximately the point at which it passes through the casing.

The actuating mechanism **13** preferably includes an operating member such as lever **26** located exteriorly of the casing and secured at one end by means of the screw **27** to the outer end of the rod **14**, and a switch actuating member such as lever **28** located within the housing **10** and secured at one end to the threaded end portion **18** of the rod **14** by means of the nut **29**, said end of the actuating lever **28** being fixed in spaced relation from the outer side of the end wall **20** of the bellows **15** by means of the washer **30**. As will be observed from

Figure 1, both the operating member **26** and the actuating lever **28** extend in substantially parallel relation transversely to the longitudinal axis of the rod **14** with the actuating lever **28** being shaped to extend over the operating plunger **31** of the switch unit **11***a*. This arrangement is such that depression of the free end of the operating member **26** will cause the rod **14** to pivot at approximately the point where it passes through the casing **10**, as described hereinbefore, and the actuating lever **28** to be rocked to depress the plunger **31***a* of the switch unit **11***a*.

The electric switch unit or units to be operated by the actuating lever **28** may be of any suitable type in which a movable member is adapted to be moved into and out of electrical contact with a contact member. As shown in Figure 1, the two electric switch units (**11***a* and **11***b*, respectively) presently illustrated, are of the type generally referred to as double acting microswitches, requiring relatively small actuating movements for operation. Each of the switches includes a supporting frame or housing **32** secured to the back wall of the casing **10**, stationary contact members **33—33** and **34—34**, a movable double-acting resilient snap blade **35** adapted to engage at its end portions the stationary contact members **33—33** and **34—34**, respectively, an operating plunger **31***a* and **31***b*, and a spring **36** adapted to normally urge and maintain the operating plunger and snap blade in the position shown. As will be observed, switch unit **11***b* is so positioned below switch unit **11***a* that downward movement of the plunger **31***a* of switch unit **11***a* will be transmitted directly to plunger **31***b* of switch unit **11***b* and the two plungers **31***a* and **31***b* will, therefore, operate simultaneously upon rocking movement of the actuating lever **28** to effect an upward snapping action of the snap blades **35** which breaks electrical contact between contact members **33—33** and establishes electrical contact between contact members **34—34**.

As shown in Figures 2 and 3, the bottom of the casing is provided with inner and outer insulating plates **40** and **41** which serve to close the casing and to provide a supporting means for the electrical terminals, generally designated as **42**, the inner ends of which terminals are connected by means of lead wires **43** to the stationary contact members **34—34** and **35—35** of the microswitches **11***a* and **11***b*, respectively. In order to seal hermetrically the insulating plates with respect to the casing **10** and the terminals **42**, the lower edge portion of the casing **10** is tightly secured to the outer insulating plate **40** by means of screws **44** and a resilient bushing **45** is provided between the inner end of each of the terminals **43** and the inner insulating plate **41**. As will be observed, each of the terminals **42** is secured in the outer insulating plate **40** by means of their flange portion **46** which is engaged in a corresponding circumferal groove located in the wall of the hole formed in the outer insulating plate **40** for reception of the terminal **42**.

As is apparent from the foregoing, the switching device according to the preferred embodiment of the invention as described is of both simple and sturdy construtction and is distinguished by the fact that the switch units

11*a* and **11***b* may be repeatedly actuated by movement of the rod **14** externally of the casing without occasioning a failure in the hermetically sealing means provided for the actuating mechanism. If, after repeated actuation and flexing of the bellows **15**, an opening should develop in the wall of the bellows, the plastic material contained within the bellows will continue to provide a hermetic seal between the rod **14** and the casing **10**. As will also be apparent, the plastic material **20** in cooperation with the bellows **15** provides a supporting means for the rod **14** in which there is no necessity for any fixed physical pivot but which is such that the rod may be rocked within the aperture **12** as though the rod were pivoted at approximately the point at which it passes through the casing. The plastic material also serves to prevent any water or moisture from entering into the bellows **15** where it might freeze or otherwise cause damage or trouble.

What is claimed is:

An hermetically sealed switch unit of the character described including a casing forming an envelope from which air may be excluded; said casing having an end wall provided with an aperture, electrical switching means mounted within said casing and having an actuating plunger, means for operating said plunger from the exterior of said casing comprising a rod rockably carried by said casing and extending through said casing aperture, an operating arm fixed to said rod exteriorly of said casing and extending from said rod in such spaced relationship to the apertured end wall of said casing as to constitute said wall a limit stop for arresting movement of said arm and rod in one direction, a switch actuating arm fixed to said rod interiorly of said casing; said switch actuating arm having the major portion of its length disposed parallel to the major portion of said operating arm and the end portion thereof remote from said rod disposed in contiguous relation with said switch plunger, and flexible means for maintaining an hermetic seal between said rod and said casing where said rod extends through said casing aperture, comprising a flexible bellows carried by the interior of said casing wall in surrounding relation with respect to a portion of said rod intermediate its end portions; one end of said bellows being secured to the interior of said casing wall in surrounding relation to said aperture and the opposite end of said bellows having an opening through which an end portion of said rod passes, and a non-fluid semi-rigid plastic material cast in situ within said bellows in contact with the inner wall thereof, with a portion of the interior wall of said casing, and with a portion of the surface of said rod.

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