May 19, 1970 J. JULLIEN-DAVIN 3,513,274

ELECTRIC SWITCHING DEVICE

Filed Nov. 17, 1967 2 Sheets-Sheet 1

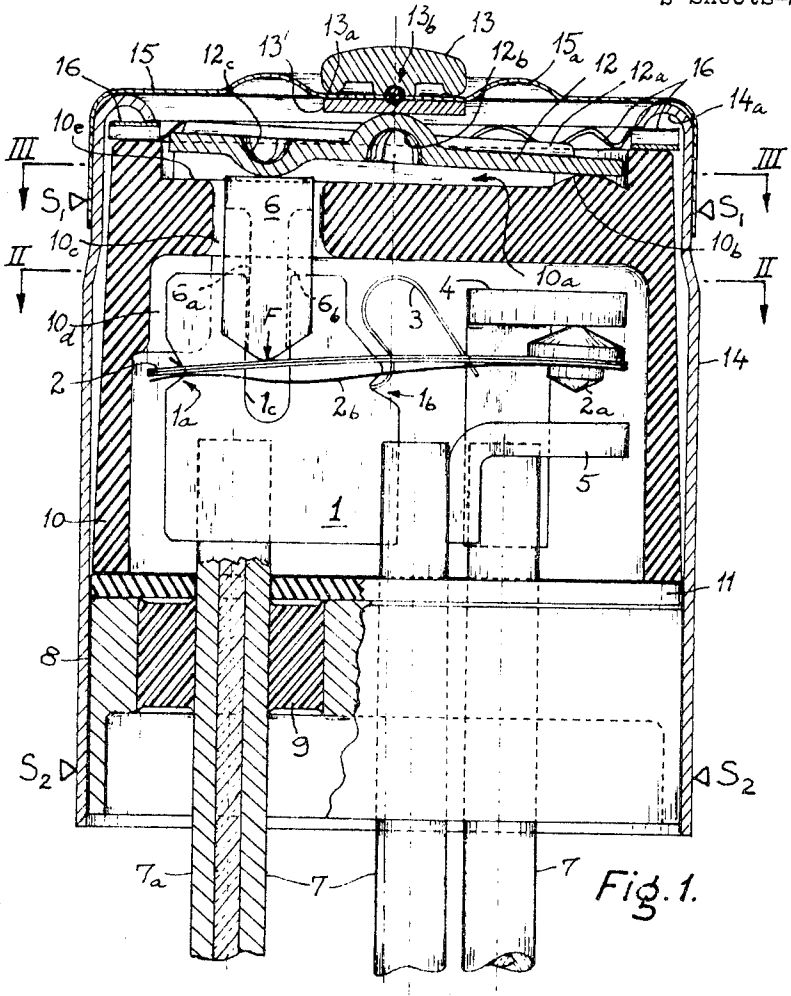


Fig. 1.

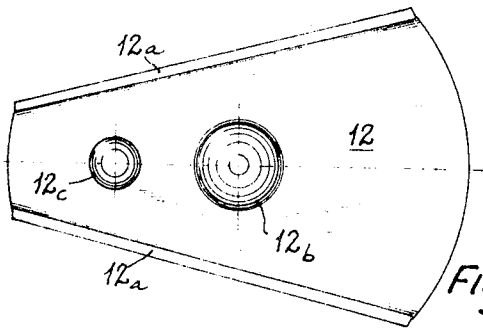


Fig. 4.

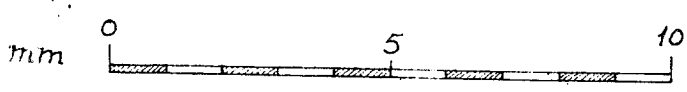


Fig. 5.

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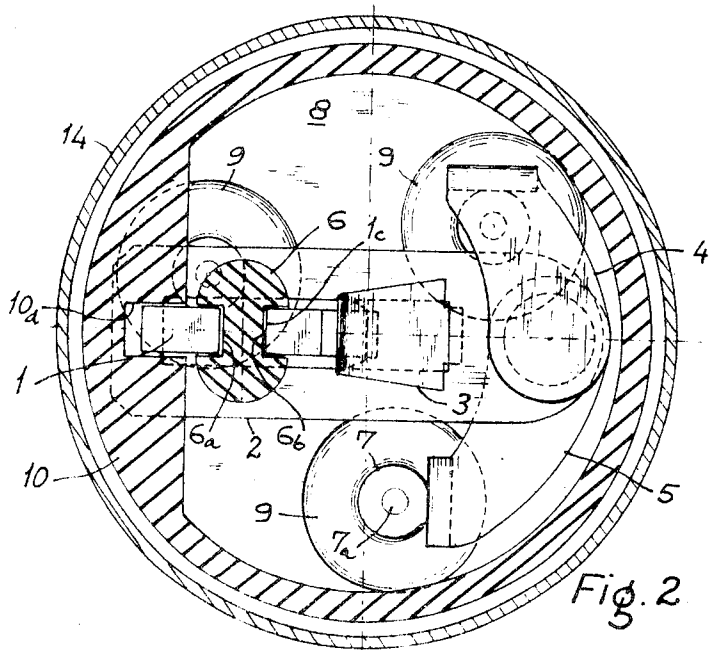


Fig. 2

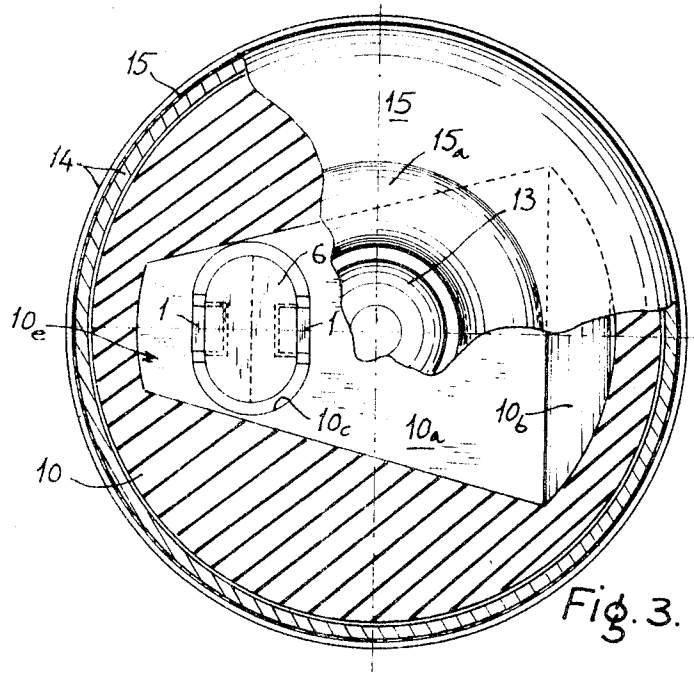


Fig. 3.

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ELECTRIC SWITCHING DEVICE

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Int. Cl. H01h 13/48
U.S. Cl. 200—67 8 Claims

ABSTRACT OF THE DISCLOSURE

A switching device comprising a metal casing in which is disposed a snap-action switching mechanism of the over-centre type. The switching mechanism comprises a common conducting support on which a flexible strip is pivotally mounted and provides a contact-carrying member which is capable of taking up one of two positions defined by two stationary contact members. A spring cooperates with the strip and to which the operating pressure is transmitted by means of an insulating push-rod provided with guide grooves permitting the push-rod to slide freely within a guide recess formed in the stationary conducting support for guiding the push-rod and the strip. The three conducting members are attached to conducting pins which traverse a circular metal base through openings filled with heat-resistant insulating material to form a hermetic seal.

This invention relates to an electric switching device which is closed in leak-tight manner and of small size, in particular a sealed microswitch with metallic casing of the type in which the snap-action mechanism operates on the over-center principle.

The object of the invention is to provide a switching device which is designed to afford high fidelity of electromechanical characteristics as well as a high degree of reliability and safety of operation under very difficult conditions of use as is the case, for example, in space vehicles or rockets.

A further object of the invention is to provide a switching device having a simple mechanism of very small overall size which ensures high performance and is of very rugged construction.

Further objects of the invention consist in providing a switching device in which:

Insulation is particularly effective, taking account of the fact that the device under consideration is of the miniature type having a metallic casing and designed to operate under severe environmental conditions (such as temperature and the like);

The device for transmitting the control movement of the switching mechanism is so designed as to guarantee functional accuracy and fidelity;

The metallic casing is such as to permit the transmission of the control movement while guaranteeing total leak-tightness under the most exacting operating conditions.

The features referred to above as well as other properties and advantages of the invention will become apparent from the following detailed description which is given in connection with one non-limitative example of construction of the novel switching device, said example being shown diagrammatically in the accompanying drawings, in which:

FIG. 1 is a view in elevation and in fragmentary cross-section along different plane which, for the sake of enhanced clarity, have been brought back into the plane of the drawing;

FIG. 2 is a view in cross-section taken along the line II—II of FIG. 1;

FIG. 3 is a plan view in fragmentary cross-section taken along the line III—III of FIG. 1;

FIG. 4 is a plan view of the control movement transmission lever, said lever being shown in cross-section in FIG. 1;

FIG. 5 is a millimetric scale which makes it possible to appreciate the order of magnitude of the dimensions of the switch in accordance with the invention.

The switching mechanism which is fitted in the microswitch in accordance with the invention is essentially composed of a stationary main conducting support **1** on which a longitudinally-hollowed strip **2** of spring metal and a spring **3** are pivotally mounted by means of V-shaped recesses **1***a* and **1***b* respectively. Said spring **3** is adapted to cooperate with the strip **2** which is fitted with a moving contact **2***a* so that, when the surface of the strip reaches the line of junction of the recesses **1***a* and **1***b*, the moving contact **2***a* is caused to move rapidly onto either one or the other of two stationary contact members **4** and **5** under the action of a driving force F exerted on the strip **2** by means of an insulating push-rod **6** which is permitted to slide within a guide **1***c* formed in the support **1** by virtue of longitudinal grooves **6***a* and **6***b*. Particular emphasis should be laid on the high precision and fidelity of the mechanical characteristics obtained in the control operation by virtue of the arrangement last mentioned in which the two associated moving members, namely the push-rod **6** and contact-carrier strip **2**, are adapted to move respectively in translation within the guide **1***c* and in pivotal motion in the V-shaped slot **1***a* while being continuously applied against the common stationary support **1**.

The push-rod **6** is advantageously fabricated by molding a heat-resistant insulating material (sintered glass or preferably the product designated by the trade name "Micaver" or any other similar product having the same mechanical or dielectric properties).

In order to improve the electrical and mechanical properties of the switching device, the single strip **2** can be replaced by a composite strip formed by superposing at least two thin strips of the same resilient alloy having low resistivity (usually beryllium-bronze) so that the combined assembly is capable of tolerating a substantially higher current density while retaining the same characteristics of elasticity which are necessary for its operation. In the case in which the switching device is intended to operate under particularly severe temperature conditions (for example −55° C. to +200° C. or more), use can be made of a simple or composite strip **2** which is cut-out (as in the case of the spring **3**) from a metal having high resilience (such as, for example, the stainless steel which is known commercially as "Atominphy AR2"), said strip being associated with an electric shunt **2***b* of non-resilient metal having a suitable thickness and low resistivity (copper or silver, for example).

The connections of the switching device consist of three pins **7** which are rigidly maintained in a metallic base **8** by means of a seal **9** of heat-resistant insulating material. The pins **7** comprise a metal core **7***a* of low resistivity and a casing formed of the same metal alloy as that of the base **8**, the coefficient of expansion of which is matched with that of the insulating material employed for sealing the pins **7**, said material being commonly designated as "pressed glass."

The three pins **7** are adapted to support the stationary contact members **4** and **65** which are preferably fixed by welding as well as the common conducting support **1**.

The complete mechanism is covered with an insulating bell **10** of molded material (of the "Micaver" type previously mentioned) which is supported on the base **8** by means of a thin insulating plate **11** formed of the same material and pierced with holes so as to permit the insertion of the pins **7**. The first useful function of this virtually hermetic sealing enclosure which is formed by the bell **10** and the plate **11** is to protect the switch against

any accidental arcing which might arise between the current-carrying parts and the metal casing which will be referred-to again below (arcing of this nature being due to molten metal particles produced during operation of contacts. Such particles build up at points at which they are liable to reduce to a dangerous extent either the spacing or the leakage paths which are initially provided for maintaining insulation). The insultating bell **10** also forms a mechanical support for the transmission lever **12** of the control mechanism. As can be seen from the drawings, the lever **12** is cut out from thin sheet metal and is provided with two lateral ribs **12***a* for endowing it with rigidity and two die-stamped bosses **12***b* and **12***c*, the former being intended to define the point of action of the control push-button **13** whilst the latter is intended to define the point of action on the push-rod **6**.

The lever **12** is housed within a recess **10***a* formed in the base of the bell **10** in which said lever is adapted to pivot by virtue of a boss **10***b* which is molded in one piece with said base. By virtue of its boss **12***c*, said lever is supported on the push-rod **6** which comes level with the base of the bell **10** through the opening **10**c. The insulating bell **10** is rotationally keyed relative to the mechanism by virtue of the radial groove **10***d* which is freely engaged at the time of assembly on the rear end of the stationary conducting support **1**. The essential advantage of this arrangement lies in the fact that a very positive and sturdy abutment is defined on the surface **10***e* at the end of travel of the lever **12** and that the thrust is finally exerted on the base **8**.

The complete mechanism as hereinabove described is enclosed within a sealed metal casing which is particularly simple and advantageous both to construct and to assemble. The casing referred-to consists of a stainless steel tube **14**, one end of which is rolled-down so as to form a semi-toric collar **14***a* and covered by a diaphragm **15**. Said diaphragm is produced by die-stamping from a thin stainless steel sheet having high resilience and is provided for the purpose of increasing its axial range of deformation with one or a number of undulations **15***a* (as shown in FIGS. 1 and 3) which reduce the rate of fatigue of the metal.

The diaphragm **15** is also provided at its center with the operating button **13** which is joined to said diaphragm in leak-tight manner either by electric arc welding or resistance welding by means of a backing plate **13'** which serves to transmit the operating pressure to the boss **12***b* of the transmission lever **12**. In order not to reduce the properties of resilience of the diaphragm **15** in the immediate vicinity of the operating button **13**, this latter is provided on the periphery of its bearing face with a circular projection **13***a* and a central nipple **13***b* which, on the one hand, serve to lock the diaphragm between the operating button **13** and its backing plate **13'** and, on the other hand, limit solely in the zone of the diaphragm which is located beneath the nipple **13***b* the zone which is elastically modified by welding.

The leak-tight connection between the tube **14** and the diaphragm **15** is preferably formed by resistance welding along one or a number of peripheral circles located at S1 by means of a known welding process which consists in making use of a stationary cylindrical electrode within the casing and a rotating electrode (welding wheel) outside the casing.

The same welding process could usefully be employed for the purpose of forming the final seal (at S2) between the casing **14** and the base **8** of the switching device.

Combined with the simplicity of handling operations entailed at the time of assembly, the above-mentioned welding process facilitates to a considerable extent the operation which consists in filling the switch with a neutral gas (such as nitrogen, helium and the like). This filling operation can be carried out, for example, by carrying out the final assembly in a glove box provided with a lock-chamber in which a relatively large number of switches to be assembled can be introduced at the same time, thereby resulting in a minimum loss of neutral gas conained in the glove box which, as is apparent, only contains the electrodes of the seam-welding machine. Furthermore, this method of manufacture avoids the use of a filling tube or stem. In fact, since the heating which is necesary for welding is very localized, there is no accidental expansion of the gaseous mass which is trapped in the switch casing, thereby preventing any incipient leakage during hardening of the weld seam.

Finally, it should be mentioned that a compressible device consisting of a simple corrugated washer **16** of resilient steel is interposed during assembly between the upper end of the insulating bell **10** and the collar **14***a* of the tube **14**. This arrangement makes it possible to ensure that the bell **10** is rigidily fixed in position, especially in the event of vibrations, shocks and so forth.

What I claim is:

1. An electric switch wherein a snap-action switching mechanism of the over-center type is placed within a sealed casing and comprises a base, two stationary contact members mounted on said base, a conducting support mounted on said base and provided with an oblong recess which forms a guide, a strip of spring metal pivotally mounted on said support and constituting the moving contact-carrier member, a moving contact carried by the flexible strip and so disposed as to be capable of taking up one of two positions in which it is in contact with one or the other of the two stationary contact members, a spring pivotally mounted on said support and adapted to cooperate with said flexible strip in order to produce a rapid switching action, an insulating push-rod provided with guide grooves in order to slide freely within the recess formed in said support, an insulating bell-housing for containing all of the components aforesaid and the free edge of which is in contact with the edge of the base whilst an opening is formed in the end-wall of said bell-housing so as to provide a passageway for the insulating push-rod, a transmission lever external to the bell-housing and one end of said lever being applied against the end-wall of said bell-housing whilst the other end is applied against that portion of the push-rod which passes through said opening, an outer metallic casing which surrounds the insulating bell-housing and has a flexible end-wall whilst the skirt of said outer casing is joined to the base in leak-tight manner, and operating means mounted on the flexible end-wall of said outer casing and adapted to bear on the transmission lever at a point located between its ends and to actuate said lever and the push-rod which is associated therewith.

2. A switch as defined in claim **1**, wherein the base comprises on the side adjacent to the insulating bell-housing an insulating plate of heat-resistant material and a metallic plate which is adapted to support said insulating plate.

3. A switch as defined in claim **2**, wherein the conducting support and the two stationary contact members are each attached to a conducting pin which passes without play through the insulating plate of the base and which traverses the metallic plate of said base through an opening which is filled with heat-resistant insulating material and provides a hermetic seal.

4. A switch as defined in claim **1**, wherein the insulating bell-housing comprises an internal groove which, by engaging with a projection of the conducting support, keys said bell-housing rotationally with respect to the switch mechanism.

5. A switch as defined in claim **1**, wherein the metallic outer casing consists of a rigid metal tube which forms the skirt of said outer casing and of a deformable metallic diaphragm which forms the end-wall of the casing and the periphery of which is welded to one end of said tube.

6. A switch as defined in claim **5**, wherein the operating means are formed of two members disposed on each

side of the metallic diaphragm, said members being pressed together so as to form an operating button, at least one of said members being provided on the periphery of its bearing face with a peripheral projection of substantially semi-toric shape and with a central nipple in order that the leak-tight connection between the operating button and the diaphragm can be formed by resistance welding in a zone which is limited solely to said nipple without entailing any risk of alteration of the resilient properties of the diaphragm in the circular region immediately surrounding said operating button.

7. A switch as defined in claim **5**, wherein the leak-tight connection between the diaphragm and the casing tube on the one hand and between said casing tube and the base on the other hand is provided in the form of one or a plurality of weld seams formed by the seam-weld method of resistance welding in order to permit filling of the switch casing with a neutral gas.

8. A switch as defined in claim **7**, wherein, in order to provide anti-vibrational and anti-shock fixation of the insulating bell-housing, the metallic casing tube is provided at the end adjacent to the diaphragm with an inwardly-

rolled peripheral annular flange whilst a thin metal washer provided with radial corrugations which endows said washer with axial flexibility is interposed between the free edge of said annular flange and the end-wall of the insulating bell-housing.

References Cited

UNITED STATES PATENTS

2,854,536	9/1958	Beer.
3,030,465	4/1962	Roeser.
3,106,886	10/1963	Burch et al.
3,210,507	10/1965	Kadisevskis.
3,238,344	3/1966	Machon.
3,288,963	11/1966	Mondy.

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