

July 8, 1958

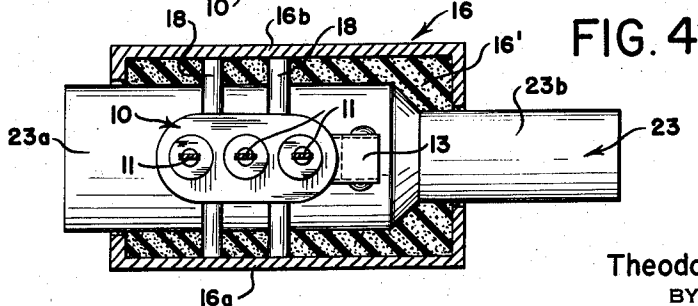
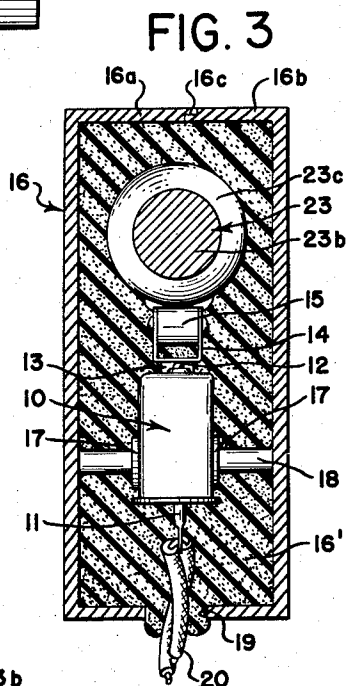
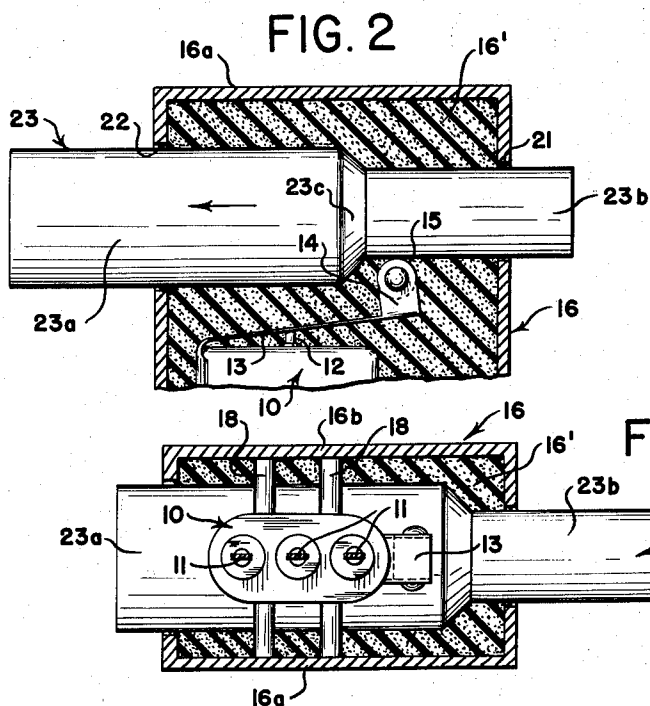
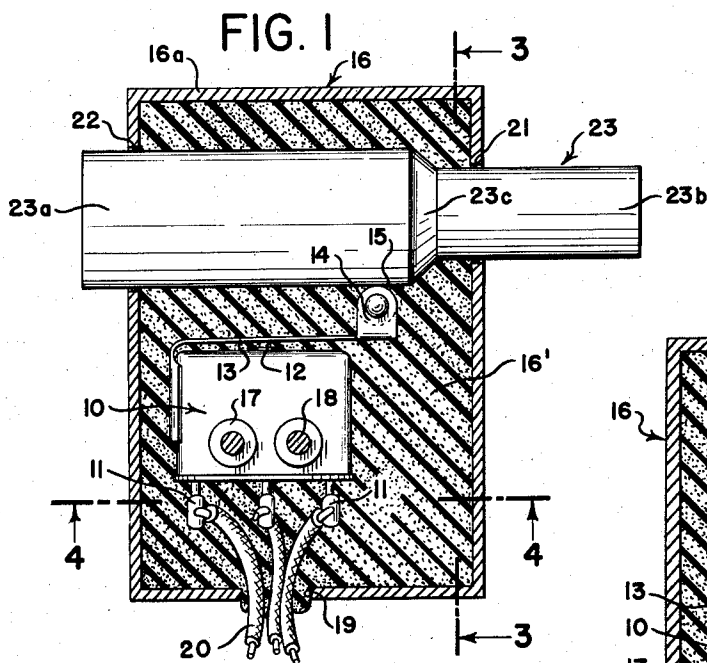
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2,842,644

HERMETICALLY SEALED SWITCH ASSEMBLY

Filed April 30, 1956

2 Sheets-Sheet 1



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FIG. 5

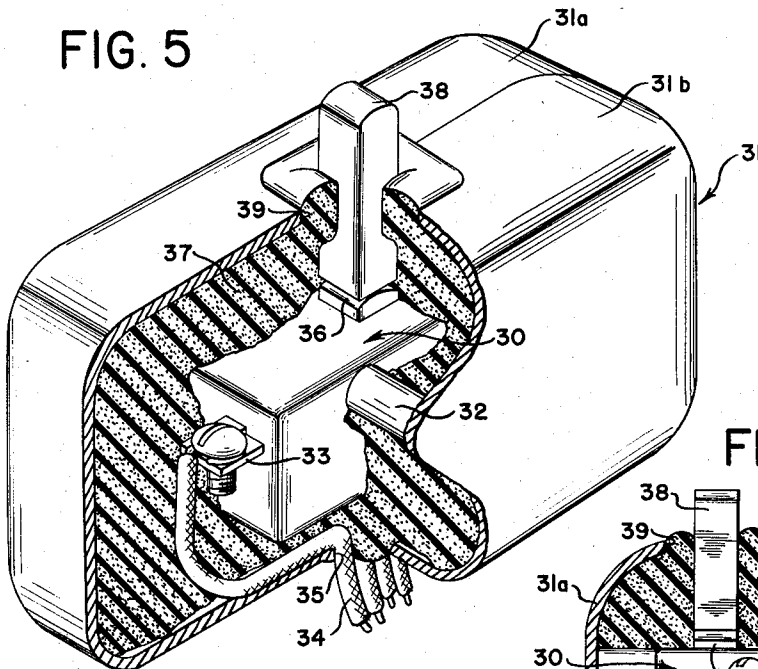


FIG. 7

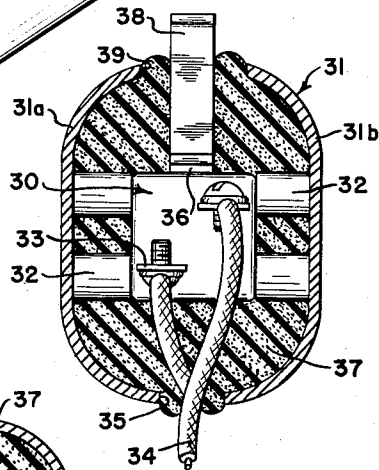
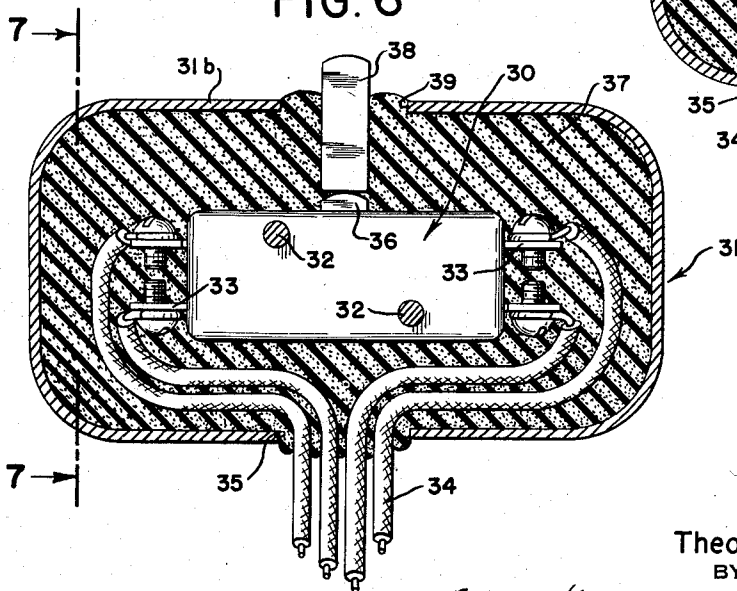


FIG. 6



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HERMETICALLY SEALED SWITCH ASSEMBLY

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10 Claims. (Cl. 200—168)

The present invention relates to switch assemblies and more particularly to switch assemblies including means to hermetically seal the switch, its contacts and terminals and the actuating mechanism for the switch. The invention also relates to a novel method of making hermetically sealed switch assemblies.

For certain applications, such as in aircraft controls, electrical switch assemblies are subjected to wide variations in temperature and pressure, so that moisture condensation, freezing and other conditions are likely to arise. Furthermore clean operating conditions free from other foreign matter cannot always be maintained. Accordingly, it is common practice to hermetically seal at least the contacts of the switches used in such applications.

In the past, the hermetic sealing of switches while having involved considerable expense, has failed effectively to obviate some problems arising in connection with the use of such switches in aircraft, for example. Thus, while it is sometimes possible to seal the switch contacts effectively, the mechanism used in actuating the contact may be rendered inoperative by the formation of ice, so that the switch assembly is not useful for its intended purpose.

Accordingly, the present invention provides a novel and improved hermetically sealed switch assembly in which the actuating mechanism as well as the switch contacts are hermetically sealed and isolated from undesirable atmospheric or other conditions. In addition, the various terminals of the switch are sealed from the atmosphere and from each other to prevent the possibility of ice formations building up on the terminals and shorting out the switch.

More specifically, the invention provides an improved hermetically sealed switch assembly which comprises a switch and actuating mechanism which is positioned within a housing, and spaced from the side walls thereof, whereby to leave a space entirely surrounding the switch and actuating mechanism. The space surrounding the switch and actuating mechanism is then completely filled with a flexible, cellular foam material, advantageously lightweight and rubber-like, which completely seals the switch and actuating mechanism. The nature of the cellular rubber material is such that it will flex or give so that the actuating mechanism may freely move through its necessary operating range, even though the mechanism is completely imbedded in the cellular material. The housing surrounding the switch and actuating mechanism has openings therein, and through one of these openings are passed the wires or conductors leading to the switch terminals. The cellular sealing material completely surrounds the conductors and terminals and seals off the opening through which the conductors are passed. An actuating member projects through another opening in the housing and, advantageously, except for the projecting portion thereof, is completely imbedded in the sealing material. The switch may be actuated by engaging and

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moving the projecting portion of the actuator, and the sealing material is sufficiently resilient to permit the necessary movement of the actuating member without disturbing the seal between the member and the cellular material. The opening through which the actuating member projects is, of course, sealed off by the cellular material surrounding the actuating member.

In some forms of the invention, the switch which is mounted and hermetically sealed within the main housing may in itself be an hermetically sealed element. In other forms of the invention the switch is not a sealed unit, but is sealed by the cellular material surrounding it.

In all of its forms, the new switch is adapted for assembly in accordance with my improved method. The method involves positioning the switch assembly within the housing, in spaced relation to the side walls thereof, and introducing into the space surrounding the switch assembly a liquid composition of foamable material together with a foaming agent therefor. The foamable material, advantageously for example rubber, then foams within the housing, and if the quantity thereof and of the foaming agent is properly chosen, expands in volume until it occupies substantially the whole of the open space surrounding the switch assembly.

For a better understanding of the invention, reference should be made to the following description and accompanying drawings, in which:

Fig. 1 is a longitudinal cross-sectional view of an hermetically sealed switch assembly made in accordance with the invention;

Fig. 2 is a fragmentary, similar cross-sectional view of the switch of Fig. 1, showing the switch actuating mechanism thereof in another of its operative positions;

Fig. 3 is a cross-sectional view taken along line 3—3 of Fig. 1;

Fig. 4 is a cross-sectional view taken along line 4—4 of Fig. 1;

Fig. 5 is a perspective view, with parts broken away, of a second form of switch made in accordance with the invention;

Fig. 6 is a longitudinal cross-sectional view of the switch of Fig. 5; and

Fig. 7 is a cross-sectional view taken along line 7—7 of Fig. 6.

Referring initially to Figs. 1—4 the numeral 10 designates generally a switch unit having a plurality of terminals 11, a movable actuating plunger 12, and suitable switch contacts, not shown. The switch unit 10, in the illustrated form of the invention, may be an hermetically sealed unit. However, this is a matter of convenience, as the switch unit itself may equally as well be unsealed, and in this instance act merely to maintain the switch contacts therein free from the filler material hereinafter discussed.

Along one side of the casing of the switch 10 is secured a spring lever 13 having upwardly extending arms 14 at its free end between which is rotatably carried a cam follower 15. The spring lever 13 extends over the top of the plunger 12 and is adapted to effect the actuation of the switch 10 by depressing or releasing the plunger 12 in the usual manner.

Surrounding the switch unit 10 is an enlarged housing 16 which is comprised of two housing sections 16a and 16b adapted to be fitted together and secured at 16c to form a complete enclosure. In accordance with the invention, the internal dimensions of the housing 16 are substantially greater than the external dimensions of the switch element 10, and the switch unit is supported within the housing in spaced relation to its walls.

As shown in Figs. 1 and 3, the switch unit 10 has a pair of washer-like members 17 mounted at each side and defining circular recesses. The side walls of the

housing 16 are provided with rigid inwardly projecting rod-like supports 18 which are of circular cross-section and are adapted to be received in the circular recesses defined by the washer-like members 17. The supports 18 are of such length that when the housing parts 16a and 16b are assembled together, the space between the ends of the supports 18 is equal to the width of the casing of the switch element 10. Accordingly, in the complete assembly, the switch unit 10 is rigidly supported in spaced relation to the walls of the housing 16 by the supports 18.

In the lower wall of the housing 16 is an opening 19 through which a plurality of conductors 20 are passed. The inner ends of the conductors 20 are soldered or otherwise connected to the terminals 11 in the usual manner to complete one or more current paths to the switch.

The end walls of the housing 16 are also provided with openings 21, 22 in which is slidably received a movable actuating member 23, which is generally in the form of a plunger having a large diameter portion 23a and a small diameter portion 23b. Between the large and small diameter portions 23a, 23b is an inclined cam surface 23c. The actuating member 23 is slidably mounted in the housing 16 directly above the switch unit 10, in position to be engaged by the cam follower 15 carried by the spring lever 13. When the actuating member 23 is in a position where the large diameter portion 23a thereof overlies the cam follower 15, the spring lever 13 is depressed, holding the switch actuating plunger 12 downwardly to either close or open the switch, as the case may be. When the actuating member 23 is moved to the left, the cam follower 15 rides along the cam surface 23c and bears against the small diameter portion 23b of the plunger. This permits the switch actuating plunger 12 to be raised, as shown in Fig. 2.

It will be observed that a substantial space is provided between the switch unit 10, with its associated actuating parts, and the enclosing walls of the housing 16. In accordance with the teachings of the invention, the space thus provided is completely filled with a flexible cellular material 16', substantially in the manner shown. This is accomplished by injecting a foamable composition in liquid form into the interior of the housing 16, along with a suitable foaming agent. Upon injection of the foamable composition and foaming agent into the housing, a foaming action takes place and a foamed cellular material seal is formed which in foaming expands and permeates the various crevices and openings about the switch unit 10 and its actuating mechanism. The quantity of foamable composition and foaming agent used is such that the foam formed just about tends to extrude through the openings in the housing, thereby filling the openings and sealing the interior of the housing from the atmosphere.

A silicone rubber composition manufactured by Dow Chemical Company of Midland, Michigan, and sold under the trade name "Dow Corning S2007 Silastic" I have found to be particularly useful. A suitable foaming agent for it, I have discovered, is petroleum ether. This silicone rubber composition retains its rubber-like properties at temperatures ranging from as low as -100° to upward of 500° F. Furthermore, it has excellent dielectric properties and good resistance to many chemicals (all of those to which it might be subjected in the uses to which I am putting it), to weathering and to oxidation.

In the completed switch assembly, the cellular foamed material is readily deformable, and provides for the free movement of the actuating member 23, as well as the spring lever 13 and switch actuating plunger 12. Accordingly, the switch unit 10 may be actuated in the usual manner by longitudinal movement of the actuating member 23 even though the critical parts of the assembly are at all times imbedded in the sealing material and adhering thereto. Thus, as shown in Fig. 2, when the actuating member 23 is moved to the left the spring lever 13 moves upwardly to release the switch actuating plunger

12 and the sealing material readily deforms to a sufficient extent to permit the necessary movement of the actuating parts.

In the form of the invention shown in Figs. 5-7, a switch 30, which may be of a non-sealed construction, is mounted within a housing 31, comprising parts 31a, 31b, and is supported in spaced relation to the walls thereof by means of rod-like supports 32 projecting inwardly from the side walls of the housing. The switch 30 has a plurality of terminals 33 to which are attached conductors 34 passing out of the housing 31 through a suitable opening 35 therein. The switch 30 also has an actuating plunger 36 projecting through its upper wall and adapted upon vertical movement to effect the actuation of the switch in the manner desired.

In accordance with the invention, the switch 30 and housing 31 are so dimensioned that a substantial space is provided between the walls of the switch and the walls of the housing, and this space is completely filled with a cellular foam rubber sealing material designated generally by the numeral 37.

In the switch assembly of Figs. 5-7, an actuating member 38 projects out of the housing 31 through an opening 39 therein and is in abutting engagement at one end with the actuating plunger 36 for the switch 30. The actuating member 38 is surrounded and supported by the cellular rubber filler material 37, and is held in place by the sealing connection between the side walls of the actuating member 38 and the rubber sealing material 37.

In the assembly of the switch of Figs. 5-7, the switch unit 30 is first properly positioned within the housing 31, the conductors 34 having been previously connected to the terminals 33, and arranged to extend through the opening 35 in the bottom wall of the housing. The actuating member 38 is then positioned with its inner end against the actuating plunger 36 of the switch and held in this position by suitable means, not shown. The foamable liquid rubber composition and foaming agent are then injected into the housing through one or both of the openings 35, 39 in a sufficient amount to cause the foamed rubber to completely fill the open space in the interior of the housing 31 and to partly project through the openings 35, 39. As the rubber composition foams it surrounds and bonds itself to the actuating member 38 and to the conductors 34 so that the same are properly held in position. The rubber filler is of course sufficiently resilient to permit longitudinal movements of the actuating member 38 to the extent required to actuate the switch 30.

One of the contemplated uses for the new switch assembly is in the bomb bay of an aircraft. The switch is so positioned that the actuating member projecting therefrom is moved upon release of a bomb from the aircraft to energize a suitable signal device, indicating to the aircraft crew that the bomb or bombs have been satisfactorily released. In such application, the switch assemblies are exposed to the atmosphere and subjected to widely varying conditions of temperature, pressure, etc. However, since the switch and its actuating parts are wholly enclosed by the cellular foam rubber material, the operation of the switch is unaffected by changes in surrounding atmospheric conditions.

In addition to providing an improved and simplified hermetically sealed switch assembly the invention further provides an improved method of hermetically sealing switch assemblies, involving first assembling the switch and actuating parts within an enlarged housing and then injecting into the housing a foamable liquid rubber-like composition together with a suitable foaming agent to fill up the entire open space within the housing and surround the switch and actuating parts with the cellular sealing filler material, which will effectively exclude moisture or other undesirable matter from the switch and its actuating parts.

It should be understood that the specific switch assem-

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blies herein shown and described are intended to be illustrative only. Reference should therefore be made to the following appended claims in determining the full scope of the invention.

I claim:

1. An hermetically sealed switch assembly comprising a housing having an opening therein, a switch mounted within said housing and spaced from the side walls thereof, means to actuate said switch including a movable member projecting through said opening, and a sealing filler of flexible cellular material disposed in and filling the space between said switch and the walls of said housing and surrounding said switch and movable member, said movable member being sealingly engaged with and movable in said sealing filler for actuating said switch.

2. The switch assembly of claim 1, characterized by a member pivoted on said switch and imbedded in said sealing filler, said movable member engaging said pivotally mounted member.

3. The switch assembly of claim 2, further characterized by said movable member comprising a cam, and said pivotally mounted member having a follower engaging said cam.

4. The switch assembly of claim 1, further characterized by said sealing filler comprising a silicone rubber compound mixed with a petroleum ether foaming agent.

5. The switch assembly of claim 1, characterized by said sealing filler comprising a foamable composition mixed with a foaming agent, said foamable composition being one which when foamed is flexible.

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6. An hermetically sealed switch assembly comprising a main housing having an opening therein, a switch mounted in said housing and spaced from the side walls thereof, movable means projecting through said opening for actuating said switch, and a sealing filler of flexible cellular rubber material disposed in and filling the space about said switch and surrounding at least a substantial portion of the part of said movable means normally within said housing.

7. The switch assembly of claim 6, characterized by an inner housing surrounding the switch and maintaining the space between contacts thereof free of filler, said main housing having support means therein projecting inwardly from certain of its walls and engaging said switch to support said switch in spaced relation to said walls.

8. The switch assembly of claim 6, in which the sealing filler and movable means, in combination, completely surround and form an hermetic seal about said switch, the sealing filler is continuous throughout the body thereof and the sealing filler is in intimate contact with the portions of said switch surrounded thereby.

9. The switch assembly of claim 6, in which the sealing filler substantially completely surrounds said switch and is continuous throughout the body thereof, and said sealing filler is in intimate contact with the portions of said switch surrounded thereby.

10. The switch assembly of claim 9, in which the sealing filler is sealingly engaged with the portions of the switch surrounded thereby.

No references cited.