June 11, 1957 C. S. MERTLER 2,795,678

SEALED ELECTRICAL SWITCHES

Filed June 16, 1953

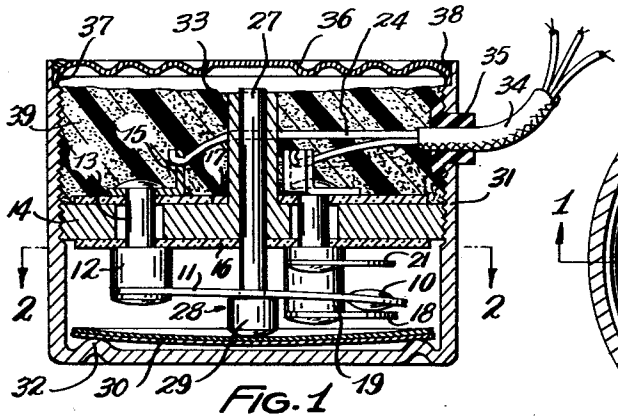


FIG. 1

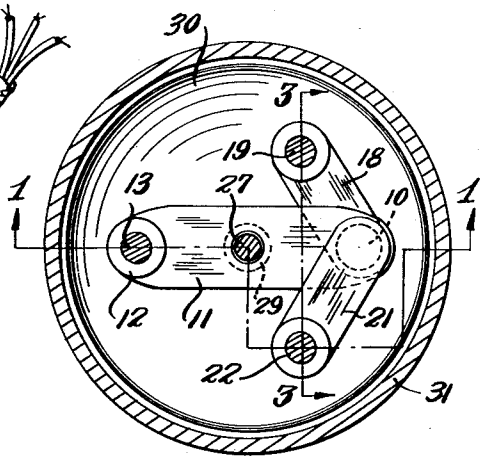


FIG. 2

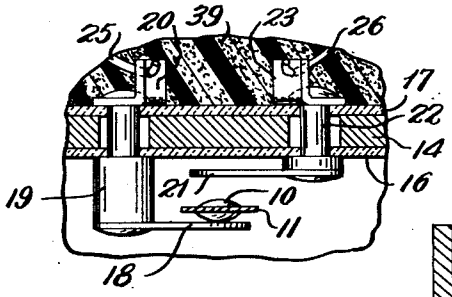


FIG. 3

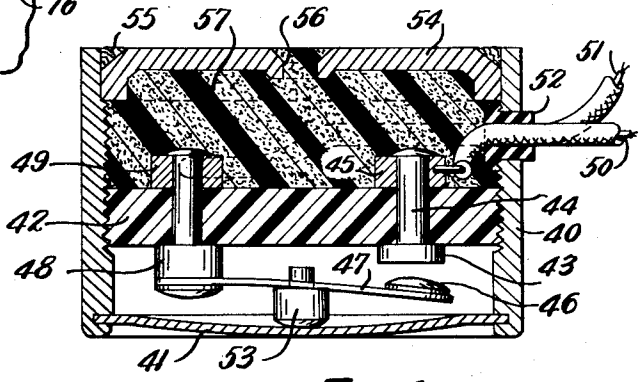


FIG. 4

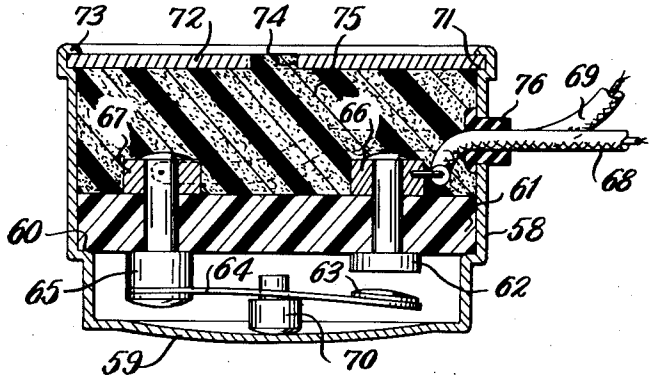


FIG. 5

INVENTOR.
CHARLES S. MERTLER
BY Hudson, Boughton, Williams, David & Hoffmann
ATTORNEYS

United States Patent Office 2,795,678 Patented June 11, 1957

2,795,678

SEALED ELECTRICAL SWITCHES

Charles S. Mertier, Mansfield, Ohio, assignor to Stevens Manufacturing Company, Inc., Mansfield, Ohio, a corporation of Ohio

Application June 16, 1953, Serial No. 361,898

5 Claims. (Cl. 200—168)

This invention relates to electrical switches and, more particularly, to a construction and procedure by which electrical switches may be sealed against the passage of air, moisture, gases, vapors or the like.

It is customary to provide electrical switches with housings or enclosures of various types. However, when an enclosed switch that is not completely sealed is exposed to different external atmospheric or gaseous pressures, or to changes of temperature, the device "breathes." That is, there is a transfer of air or other gas and/or vapors from the exterior to the interior of the switch housing and, when this is accompanied by a temperature change, vapors thus entering the housing are condensed and accumulate therein. For example, it has been found that enclosed switches employed in aircraft frequently accumulate considerable quantities of water. This results in corrosion and other difficulties. Similar difficulties are encountered with switches in other environments such as in refrigerated chambers or the like.

It is, therefore, imperative that enclosed switches be completely sealed against transfer of air, moisture, vapors, gas or the like, between the exterior and the interior of the switches. However, it has, heretofore, been expensive and difficult to completely seal such switches in the the region of the junction between the housing or enclosure and the base or supporting member on which the switch contacts and terminals are mounted. Difficulties in sealing are also encountered about the switch terminals and the conductors or leads connected thereto. This is due, at least in part, to the different coefficients of thermal expansion of the materials customarily employed for these parts and to lack of complete sealing between the lead wires and the insulation therefor thereby permitting passage of gases therebetween. The latter condition is accentuated when the lead wires are stranded since vapors, moisture and the like can travel to the switch between the strands of the wire.

An object of this invention is to provide an improved method of completely sealing electrical switches against the passage of moisture, vapor, or other gases, which method is inexpensive, is easily and rapidly performed and results in a rugged construction that is not damaged by shock, vibration, normally encountered temperature changes, or other operating conditions.

Another object of the invention is to provide an improved electrical switch construction and method of producing the same wherein the junction between the switch enclosure and the support for the moving parts of the switch, as well as the portions of the conductive members connected to the switch contacts, are all sealed against passage of gas, vapor or the like, by a foamed-in-place plastic.

A further object of the invention is to provide an improved electrical switch construction and method of producing the same as defined in the preceding paragraph wherein the foamed-in-place plastic is a solid formed by the reaction product of a mixture comprising an isocyanate and a resinous polymer.

A more specific object of the invention is to provide

an improved electrical switch construction and method of producing the same wherein the moving parts of the switch are enclosed in an impervious housing which, together with the portions of the conductive members connected to the switch contacts, are sealed from passage of vapors, gases and the like by the reaction product of a mixture comprising an isocyanate and a resinous polymer.

The invention further resides in certain novel features of switch constructions and in the method of producing the same, and further objects and advantages of the invention will be apparent to those skilled in the art to which the invention pertains from the following description of certain embodiments thereof which are described with reference to the accompanying drawing, forming a part of this application, and in which:

Fig. 1 is an enlarged vertical sectional view through the presently preferred embodiment of a switch constructed in accordance with this invention, the switch illustrated being of the manually reset thermal responsive type with the view being taken substantially on the irregular line 1—1 of Fig. 2;

Fig. 2 is a transverse sectional view through the switch shown in Fig. 1, the view being taken substantially as indicated by the line 2—2;

Fig. 3 is a detached, fragmentary view further illustrating the arrangement of the contacts of the switch shown in Figs. 1 and 2; the view being primarily in section taken along the line 3—3 of Fig. 2;

Fig. 4 is an enlarged vertical sectional view through a modified embodiment of the invention in which the switch contacts are operated by pressure applied to a part of the shell or housing of the switch; and

Fig. 5 is a view similar to Fig. 4 but showing another embodiment of the invention wherein the switch contacts are operated by pressure applied to a portion of the shell or housing.

The switch structure shown in Figs. 1 to 3 is of the manually resettable, snap acting, thermal responsive type. This switch comprises a movable double contact 10 supported on one end on a resilient spring arm 11, the other end of the latter being rigidly connected to a terminal post or stud 12. As here shown, the stud 12 has a reduced shank portion 13 passing, with clearance, through an opening in the base or supporting member 14. The end of this reduced diameter portion 13 has a terminal or connector member 15 secured thereon as by peening or otherwise upsetting the outer end of the shank. In the illustrated switch, the base member 14 is formed of metal and therefore sheets of mica or other insulating material are provided, as indicated at 16 and 17, on the opposite sides of the base member 14 and intermediate the latter and the adjacent surfaces of the stud 12 and the terminal member 15 to insulate these elements from the base member.

The resilient arm 11 is preferably formed of spring metal and is normally biased in a direction such that the contact 10 thereon engages a stationary contact 18. This contact is provided in the form of a substantially horizontally extending member that is supported upon a vertically extending terminal post or member 19. The post 19 is formed similarly to the terminal post 12 and is secured to a terminal member 20, see Fig. 3, the terminal post 19 and terminal member 20 being insulated from the base 14 by the aforementioned sheets of mica or the like, 16 and 17.

The arm 11 is adapted to move the contact 10 from engagement with the contact member 18 and into engagement with a second contact 21 which, like the contact 18, is provided in the form of a substantially horizontally extending arm. The contact member or arm 21 is secured to the base 14 by a terminal post or stud 22, the upper end of which is provided with a terminal member 23,

The post **22** and member **23** are formed and interconnected in the same manner as previously described for the post **12** and the terminal member **15**. Each of the terminal members **15**, **20** and **23** is adapted to receive a conductive member or means such as a lead wire, **24**, **25** and **26**, respectively, which may be either single or multiple strand. Each conductive member is secured to its terminal member by passing an end of the former through an opening in the terminal member and soldering or otherwise securing the parts together.

The spring arm **11**, intermediate its ends, is provided with an aperture through which passes the elongated shank **27** of a combined motion transmitting and reset means **28** for the switch. This motion transmitting and reset means **28** is preferably formed of insulating material such as synthetic resin, ceramic material such as porcelain, or other similar material and the lower portion **29** of the means **28**, beneath the spring arm **11**, is of larger diameter than the shank portion **27**. The lower surface of the portion **29** is curved or rounded while the upper surface thereof provides a planar surface upon which the spring arm **11** rests. The lower curved surface of the portion **29** is maintained in engagement with the central region of a snap acting, concave-convex bimetallic disc **30** due to the resiliency of the arm **11**. The disc **30**, which is of the type disclosed in U. S. Patent No. 1,697,886, is supported, adjacent its periphery, on an internal shoulder of a housing or shell **31** which is formed of impervious material. In the illustrated embodiment the housing or shell **31** is metal and the support for the bimetallic disc is provided by an annular ridge **32** formed integrally from the base of the shell or housing **31** as by a stamping, drawing or similar operation.

The housing or shell **31** is substantially cup-shaped and the upstanding sides thereof are internally threaded. The base member **14** has the periphery thereof provided with a mating thread and is screwed within the shell or housing so as to provide a transversely extending partition therein at a location spaced below the rim or upper edge of the shell or housing and with the contacts of the switch between this partition or base member and the closed end of the housing. The construction is such that by varying the position of the base member **14** relative to the shell or housing **31** the operation of the switch may be calibrated for response at a predetermined temperature.

Substantially centrally of the base member **14** is provided an upstanding tubular portion **33** which may be integral with the main body of the member **14** or formed separately therefrom and suitably attached thereto. This tubular portion **33** serves as a guide for the reduced diameter shank **27** of the motion transmitting and reset means **28** with the said shank slidable therein. The height of the tubular portion **33** is such that, when the curvature of the bimetal disc **30** is as shown in Fig. 1, the outer end of the shank **27** projects slightly above the portion **33**. Upon reversal of curvature of the disc **30** the end of the shank **27** will be elevated a corresponding amount. Hence, the upper end of the shank is available for ready application of a thrust thereto to effect resetting of the switch by restoring the curvature of the bimetal member **30** to the illustrated position when the temperature to which the switch is subjected has returned to a value permitting the member **30** to remain in its non-operated position.

The side wall of the shell or housing **31** is provided with an opening through which the conductive members or lead wires **24**, **25** and **26** of the switch pass for connection with a circuit that is to be controlled thereby. In the illustrated embodiment, these conductive members or wires are enclosed in insulating material **34** which may be molded or otherwise formed about all three of the conductive members to unite the latter in one envelope. In the region where the insulating material **34** passes through the shell **31**, a rubber sleeve or grommet **35** is sleeved thereover and fits within the opening of the housing, the grommet or member **35** preferably having an enlarged portion within the housing which engages the side wall of the latter about the opening therethrough.

The construction of the switch thus far described is such that when the bimetallic disc **30** is in position shown in the drawing, a circuit is completed from the conductor **24** to the conductor **25** through the engagement of contacts **10** and **18**. Upon a predetermined change in temperature, however, the bimetallic disc **30** will reverse its curvature with a snap action. This motion is transmitted through the portion **29** of the means **28** to the arm **11** thus moving the contact **10** from engagement with contact **18** and into engagement with contact **21**. This breaks the circuit between the wires **24** and **25** and completes a circuit between the wires **24** and **26** since the contact **10** is now in engagement with contact **21**. This movement of the bimetallic disc has also resulted in the reduced diameter shank **27** of the means **28** being projected above the tubular portion **33** as above described.

As mentioned heretofore, the bimetallic disc **30** of the switch disclosed in Figs. 1 to 3 does not automatically reverse its direction of curvature when the temperature returns to a value less than that which caused switch operation. The switch may however be manually reset, when temperature conditions permit, by manually pressing inwardly upon the end of the shank **27**. This will snap the bimetallic disc back to its initial position as shown in Fig. 1, and the resiliency of the arm **11** will return the contact **10** to engagement with the contact **18** so that the switch is again prepared for a new operation.

The enclosing of the switch illustrated in Figs. 1 to 3, may be completed by providing the outer or open end of the housing or shell **31** with a cover or closure member **36** which has at least a portion thereof flexible so that the reset means **28** may be operated therethrough. For this purpose, the cover member **36** is here shown as formed of relatively thin material and provided with a plurality of concentric alternate grooves and ridges as will be readily understood in the art. The periphery of the cover member **36** has an axially extending flange or rim **37** which is adapted to rest upon an internal shoulder provided adjacent the outer end of the housing or shell **31**. The cover or closure member **36** is secured in place by a rim or bead of solder or the like **38** provided between the shell or housing and the cover member, the latter being recessed or beveled slightly adjacent the periphery to receive this solder or other connecting material.

Although the switch as thus far described has the operating parts entirely enclosed, it would, nevertheless, be subject to "breathing" or transfer of air, vapor or gases between the exterior and interior thereof as the result of changes of temperature, atmospheric pressure and the like. This is due to the fact that it is substantially impossible to completely seal the threaded joint between the base and enclosure and the openings in the base through which the terminal members pass simply by maintaining close manufacturing tolerances of the parts or like expedients. Moreover, the conductive members secured to the terminals are frequently of stranded material and it has been found that "breathing" can occur through such conductors as, for example, between the strands thereof or between the strands and insulating covering. Furthermore, simply providing a grommet or the like such as **35** at the place where the conductors pass from the enclosure or housing, will not normally prevent such breathing through the conductors nor passage of vapors, gases or the like between the grommet and the adjacent portion of the enclosure or housing.

It has been found, however, that effective sealing against breathing or transfer of gases, vapors or the like through the conductive members or through passages between the latter and the housing or enclosure may be provided by employing a substance of the type known as a foamed-in-place plastic to enclose the inner ends of the conductive members and exert pressure on the grommet or sleeve **35**.

Such sealing is described and claimed in the copending application of Robert J. Cassidy, Serial Number 363,773, and which was filed concurrently with this application. As disclosed therein, the foamed-in-place plastic is provided in the form of a mixture of two liquids which are commercially available, one of these liquids being an isocyanate and the other a resinous polymer. These liquids when mixed and introduced into the enclosure where the conductive members are to be sealed, react to form a solid and release carbon dioxide. The resulting solid occupies a much greater volume than the mixed liquids and has a multitude of small cells or voids which are substantially not interconnected so that the solid is not absorbent or permeable to gases or liquids. In addition, the solid reaction product has good thermal stability, and does not shrink or separate from the surfaces with which it is in contact, but rather sticks or bonds thereto.

However, in the switch constructions disclosed in the above mentioned copending application, the housings for the operative portions of the switches have a plurality of interconnected parts welded together and hence may be subject to leakage into the region of the switch contacts even though the terminals or lead wires be sealed. In accordance with this invention the entire switch structure is effectively sealed against the entrance of air, gas, vapors or the like. This is made possible by the fact that the housing or shell **31** is substantially cup-shaped and the contacts of the switch are disposed between the base member or partition **14** and the closed end of the switch housing while the open end of the housing is closed by the single flexible cover or member **36** which may be effectively sealed to the housing by soldering or brazing. Moreover, the terminal members and the lead wires are sealed against breathing or any other entrance of air, vapors or the like therethrough or thereabout by forming a foamed-in-place plastic **39** within the housing or shell **31** of the switch above the base or partition member **14**.

The plastic sealing is effected by introducing into the housing **31** a mixture of the type mentioned above which reacts to expand by creating a non-absorbent cellular solid through the release of carbon dioxide or other gas. In the preferred embodiment the mixture comprises an isocyanate and a resinous polymer which is introduced into the housing **31** before the cover member **36** is secured thereon, the mixture being deposited in the annular space between the tubular portion **33** and the side walls of the shell **31** above the base or partition member **14**. A temporary cover is then provided for the open end of the shell **31** so that the mixture in reacting and expanding cannot escape from the housing. The quantity of the mixture thus introduced is such that the resulting solid reaction product fills the region of the shell between the base member **14** and the temporary cover, which may rest upon the upper end of the tubular portion **33** and the internal flange of the shell.

The terminal members and posts as well as the conductive members connected thereto are thus completely enclosed and sealed. Moreover, the pressure developed by the material as it expands and solidifies compresses or deforms the grommet **35** so that the latter completely seals the opening through the housing **31** and the insulating material **34** is forced into such firm engagement with the conductive members **24**, **25** and **26** that there can be no "breathing" therethrough or therealong. In addition, the foamed-in-place plastic also seals the edges of the base **14** where the latter unites with the shell **31** and consequently, even if there should be any entrance of vapors or gases between the strands of the conductive members **24**, these cannot penetrate to the region of the switch where the contacts are disposed.

After the foamed-in-place plastic **39** has been provided as described, the temporary cover is removed and the permanent cover member **36** is then united with the shell **31** thus sealing the latter from entrance of any air, vapors, or the like through the tubular member **33**. As mentioned above, sealing by means of soldering a disc or cover such as **36** can be readily achieved at this location since the materials to be united are both metals the compositions of which are such that solder readily unites therewith. Moreover, since the solder has a relatively low melting point and is provided in appreciable quantity, it will flow into thorough sealing engagement with the parts. Consequently, the switch of this invention is completely sealed against entrance of any air, vapors, or the like.

The switch construction shown in Figs. 1, 2 and 3 is disclosed as having the manual reset effected from the opposite end of the housing from that in which the thermal responsive member is located. Should, however, the bimetallic disc **30** be such that it automatically snaps back to its initial position after the temperature has dropped below the operating value, no manual reset is required. In this event, the base member **14** would not be provided with a tubular portion **33** and the shank **27** of the motion transmitting means is only sufficient to be received in the arm or member **11** and retained therein. Consequently, the entire switch construction is then sealed by the foamed-in-place plastic and there is no need for a separate cover or member **36**.

The switch shown in Figs. 1 to 3 has been indicated as having the partition member **14** formed of metal and hence, it is necessary to provide insulating sheets **16**, **17** of mica or the like and to have the terminal posts or studs such as **12**, **19** and **22** formed with reduced diameter portions where they pass through the base member. It will be apparent however that it is not necessary that the base **14** be formed of metal since it may be formed of an insulating material in which event the separate insulating sheets or plates **16** and **17** may be omitted and there need be no clearance between the base member and the terminal posts. Moreover, it is not necessary that the cover or shell **31** and the base **14** be threaded since the former may simply be provided with a shoulder or the equivalent on which the base member **14** rests since the base member and shell will be held in firm engagement by the foamed-in-place plastic **39**. The threads upon the base member and shell are, however, advantageous to facilitate initial calibration.

The principles of this invention may be applied in sealing switch constructions other than those employing thermally responsive members. For example, Fig. 4 shows an embodiment of the invention wherein the switch is operated by pressure applied to a flexible portion of the enclosing shell or housing. This housing or shell is here shown formed as a cylindrical member **40** one end of which has a counterbore of larger diameter than the internal diameter of the main body of the housing or shell thereby providing an axially extending flange which is bent or spun over the peripheral edge of a flexible disc **41**. This provides a sealed connection between the disc and tubular portion **40** and results in a substantially cup-shaped member. If desired, the union between the edge of the disc **41** and the member **40** may be further sealed by soldering, brazing or the like. The disc **41** is preferably slightly convexo-concave and may be readily flexed inwardly of the housing by pressure exerted thereagainst, as for example, by fluid pressure, thrust member, the finger of an operator, or the like. The disc, however, does not snap through center but returns to its initial position when the pressure applied thereto is released.

The interior of the housing member **40** is threaded and a peripherally threaded base or partition member **42** is screwed therein, this member being formed of insulating material in the illustrated embodiment. The member **42** is provided with a stationary contact **43** which may be the enlarged end of a terminal stud or post **44** extending through the base and having a terminal or connector member **45** secured thereon. A movable contact **46** is adapted to engage the stationary contact **43** but is normally biased from contact therewith. This is effected by

providing the contact 46 upon a resilient arm or member 47 adjacent one end of the latter, the arm or member 47 being preferably formed of spring metal. The other end of the arm 47 is secured to the base 42 by a terminal member or stud 48, the reduced diameter shank of which extends through the base and is provided with a connector or terminal member 49. The terminal or connector members 45 and 49 are each provided with a flexible lead or conductive member 50, 51 respectively, which enters the housing member 40 through a suitable opening provided with a rubber grommet 52, the inner ends of the leads or conductive members being connected to the connector members 45 and 49 as by insertion in appropriate openings in the latter and/or by soldering thereto.

The spring arm 47 is provided, intermediate its ends, with a motion transmitting member 53, which may be formed of synthetic resin, porcelain or other ceramic material, or the like, and has the lower end thereof maintained in engagement with the flexible disc or portion 41 of the housing by virtue of the resiliency of the arm 47. The upper portion of the force transmitting member 53 is of reduced diameter and extends through an opening in the arm 47 in the manner similar to the member 28 in Fig. 1. The construction is such that, when pressure is applied to the disc or flexible portion 41 of the housing, the member 53 transmits the movement of the portion 41 to the arm 47 thus engaging the contact 46 with the contact 43. When pressure is released from the member 41, the latter returns to its initial position as does the arm 47 so that the contact 46 is moved from engagement with the contact 43.

The portion of the housing member 40 adjacent the open end thereof above the base or partition member 42, has the threads omitted and is counterbored to provide a shoulder on which a cover member 54 is positioned. As shown, the cover member has an axially extending flange resting on the flange of the shell or housing and the outer face of the cover member is beveled or otherwise shaped adjacent its periphery to provide an annular groove in which solder, brazing material, or the like 55 is provided to secure the cover member to the housing or shell. The cover member 44 is also provided with an opening 56 through which a mixture of an isocyanate and a resinous polymer is introduced. This mixture reacts, after introduction, to provide a foamed-in-place cellular plastic 57 which, by its expansion in setting, completely seals the switch construction against transfer of air, vapors, or other gases between the exterior and the interior of the switch. Thus, the ends of the conductors or lead wires 50, 51, the ends of the terminal posts 44 and 48, and the terminal or connector members 45 and 49 are embedded in the material 57. Also, the grommet 52 is forced into sealing engagement with the shell 40 and the conductors while the junction of the base with the shell is also sealed by the foamed-in-place plastic.

It will be apparent that the manner in which the housing or shell is made may be varied without departing from the basic principles of the invention and, as a further example of the invention, another embodiment of a pressure operated switch is shown in Fig. 5. In this construction, the shell or housing 58 is formed in one integral piece by stamping and/or drawing operations with the closed end 59 of the housing bowed or dished outwardly and sufficiently flexible so that it may be moved inwardly by the application of pressure thereto in the manner of the disc 41 in the embodiment previously described in conjunction with Fig. 4. The shell 58 has a radially offset portion spaced from the end 59 providing an internal shoulder or seat 60 upon which a base or partition member 61 is received. This member is shown as formed of insulating material and provided with a stationary contact 62 in the manner described with respect to the embodiment shown in Fig. 4. A movable contact 63 is adapted to engage with the stationary contact 62 and for this purpose the contact 63 is mounted at one end of a resilient or spring arm 64, the other end of which is supported upon the base or partition member 61 by the stud or terminal post 65 as will now be apparent.

The stud or terminal post which provides the contact 62 and the stud or post 65 extend through the base or partition member 61 and are provided with terminal or connector members 66 and 67, respectively, to which flexible connectors or leads 68 and 69 are connected in the manner described with respect to the embodiments shown in Fig. 4. Likewise, the spring arm 64 is provided, intermediate its ends, with a motion or force transmitting member 70, similar in construction and operation to the member 53.

The outer end or open end of the shell or housing 58 has a radially offset portion providing an internal shoulder 71 on which is received a disc-shaped cover member 72, the latter being secured in place by turning inwardly the outer edge of the shell or cover member as indicated at 73. The cover member 72 is provided with an opening 74 through which the mixed isocyanate and resinous polymer are introduced, as will now be apparent, which mixture thereafter reacts to provide the foamed-in-place plastic 75 thereby sealing the switch against transfer of air, gases, vapors, or the like, between the exterior and the interior of the switch. The sealing of the conductors or leads 68 and 69 is preferably ensured by disposing a grommet 76 thereabout which is compressed upon the expansion of the plastic in its reaction or setting operation. The switch shown in Fig. 5 may be operated in the same manner as has been described for the switch shown in Fig. 4.

The switch constructions illustrated in Figs. 1 and 4 may be readily calibrated, as mentioned above, by virtue of the threaded connection between the base and shell. Where it is not necessary to provide for such calibration, the screw threads in the housing and on the base or partition member of the switches shown in Figs. 1 and 4, may be omitted, as mentioned above, and the base received upon an internal shoulder in a manner indicated in Fig. 3. It will also be apparent that a resettable switch of the type disclosed in Fig. 1 could be enclosed in a housing or shell similar to that indicated in Fig. 5 by providing a sufficient recess in the bottom or closed end of the housing to accommodate the flexing of the bimetallic disc 30. In such a construction the bimetal disc 30 could be normally curved in the reverse direction to that shown in Fig. 1 so that contact 10 normally engages contact 21. Then upon attaining the operating temperature the disc 30 would reverse its curvature to a position as now shown in Fig. 1. The side wall of the housing could be provided with a plurality of inwardly projecting portions or a continuous rib, as by effecting an indenting or spinning operation on the exterior of the housing, upon which the peripheral portion of the bimetallic disc 30 rests in its reversed position. Consequently, resetting could be effected simply by pressing inwardly on the flexible bottom of the housing, such as 58, so that the member 28 would be made like the member 70 and the tubular member or portion 33 eliminated. In such a construction, the foamed-in-place plastic completely seals the switch and no cover 36 is needed.

The foamed-in-place material such as 39, 57 and 75 is rugged and non-frangible and consequently is not broken or separated from the base or shell by vibration, shocks or other mechanical forces to which the switch is normally subjected, nor is the material softened or physically changed by normal temperature variations. Furthermore, the material is an electrical insulator and is not deteriorated by moisture or fumes such as are encountered in aircraft, refrigeration, or similar installations. Therefore, sealing of switches by this method not only provides an effective barrier against vapors or gases about the terminals that is more durable than the conventional glass seals heretofore employed, but in addition seals the junction between the switch base and housing so that complete sealing

of the switches is effected thereby. Furthermore, this improved method of sealing is readily adapted to mass production techniques and greatly reduces the cost of manufacture of sealed switches.

The ruggedness and inertness of the foamed-in-place plastic sealing material is sufficient to render unnecessary the provision of a permanent cap or cover thereover for protective purposes. Hence, the cover members such as 54 and 74 may be omitted and the forming of the cellular solid 57 and 75 effected while a temporary cover is in place as explained above in conjunction with the formation of the plastic seal in the embodiment illustrated in Fig. 1. Moreover, the insulating characteristics of the plastic permits use of non-insulated conductor wires and elimination of sleeves or grommets since embedding the conductors and terminal members in the plastic provides sufficient insulation thereof.

Other changes in the housings and/or switch elements may be readily effected while retaining the novel features of the manner in which the switch constructions are sealed within a housing or shell to prevent passage of air, gases, vapors, or the like. Consequently, the invention is not to be construed as restricted to the specific steps of procedure or to the details of construction here shown and described except as may be required by the spirit and scope of the appended claims.

Having thus described my invention, I claim:

1. A sealed electrical switch comprising an impervious substantially cup-shaped housing, a partition member extending transversely of said housing and spaced inwardly from the open end thereof and defining with said housing and the closed end thereof a first space, a closure for the open end of said housing and defining with said housing and said partition member a second space, stationary electrical contact means supported by said partition member and located within said first space, a movable contact means supported by said partition member and located in said first space for movement to and from engagement with said stationary contact means and resiliently biased for movement in one direction, both of said contact means having terminal portions extending through said partition member and into said second space, force transmitting means within said first space and engaging said movable contact means to effect movement of the latter in a direction opposite to that in which it is resilently biased when a force is exerted on the said transmitting means, means engaging said force transmitting means to move the latter in response to a predetermined condition, conductive members connected in said second space to said terminal portions of said contact means and extending externally of said housing through said second space, and a solid foamed-in-place plastic within said second space sealingly engaging the interior of said housing and sealing the conductive means within said housing, said terminal portions of said contact means and the junction of the housing with said partition member.

2. A sealed electrical switch as defined in claim 1 and wherein the means engaging said force transmitting means to move the latter in response to a predetermined condition is a thermally responsive bimetallic member.

3. A sealed electrical switch as defined in claim 1 and wherein the means engaging said force transmitting means to move the latter in response to a predetermined condition is a metallic flexible part of said housing and forms the closed end of the latter.

4. A sealed electrical switch comprising an impervious substantially cup-shaped housing, a partition member extending transversely of said housing and spaced inwardly from the open end thereof and defining with said housing and the closed end thereof a first space, a closure for the open end of said housing and defining with said housing and said partition member a second space, stationary electrical contact means supported by said partition member and located within said first space, a movable contact means supported by said partition member and located in said first space for movement to and from engagement with said stationary contact means and resiliently biased for movement in one direction, both of said contact means having terminal portions extending through said partition member and into said second space, force transmitting means within said first space and engaging said movable contact means to effect movement of the latter when a force is exerted on the said transmitting means, means engaging said force transmitting means to move the latter in response to a predetermined condition, conductive means connected in said second space to said terminal portions of said contact means and extending externally of said housing through said second space, and a solid foamed-in-place plastic within said second space sealingly engaging the interior of said housing and sealing the conductive means within said housing, said terminal portions of said contact means and the junction of the housing with said partition member; said closure for the open end of said housing being a flexible disk sealed in said open end of said housing while said partition member is provided with a tubular extension in said second space and terminating adjacent the inner side of said closure, said force transmitting means having an extension passing through said tubular extension and engageable by said closure when the latter is flexed in one direction.

5. A sealed electrical switch as defined in claim 1 and wherein said closure for the open end of said housing is a rigid member provided with an opening therein while said solid foamed-in-place plastic completely fills said second space and the opening in said closure.

References Cited in the file of this patent

UNITED STATES PATENTS

2,345,757	Lester	Apr. 4, 1944
2,431,945	Little et al.	Dec. 2, 1947
2,488,049	Bolesky	Nov. 15, 1949
2,667,553	Moorhead et al.	Jan. 26, 1954
2,679,566	Clark	May 25, 1954