HERMETICALLY SEALED SWITCH WITH PRESSURE COMPENSATION MEANS

Filed Oct. 14, 1965 Sheet 1 of 3

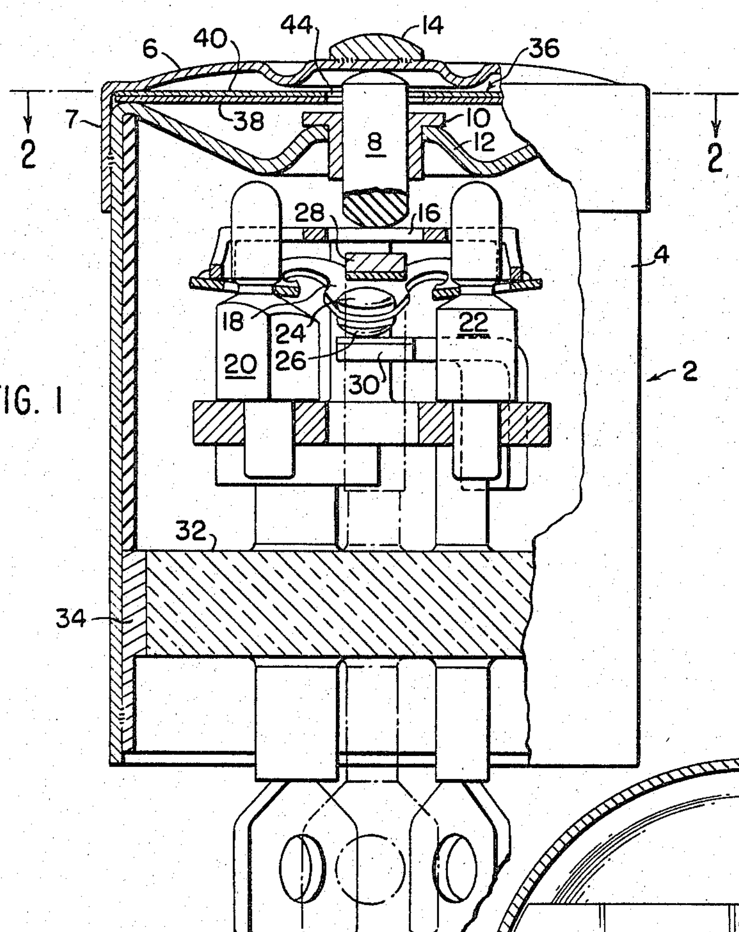

FIG. 1

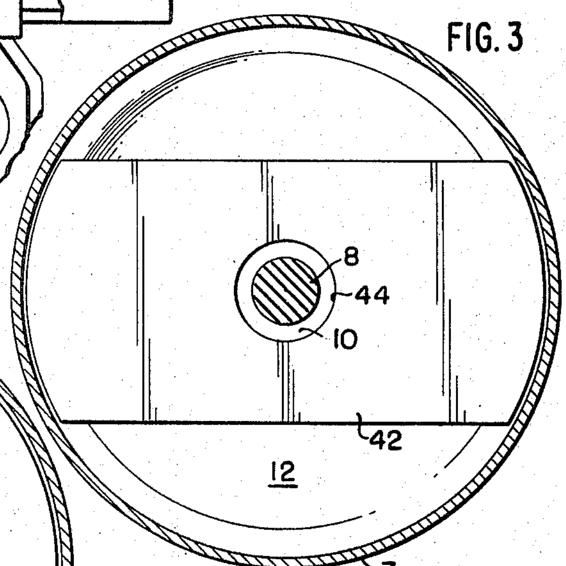

FIG. 3

FIG. 2

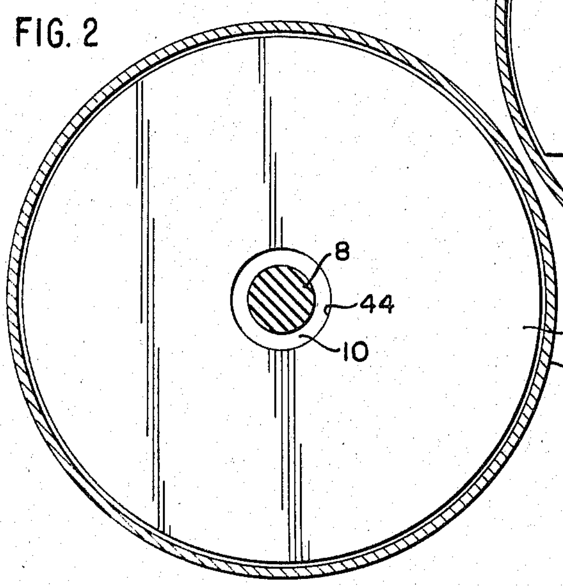

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FIG. 4

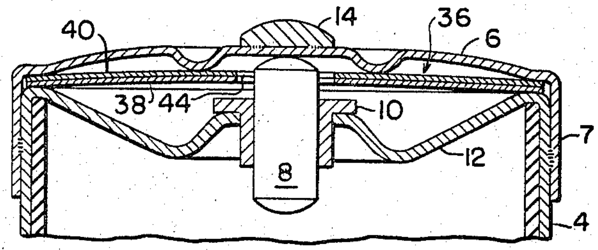

FIG. 5

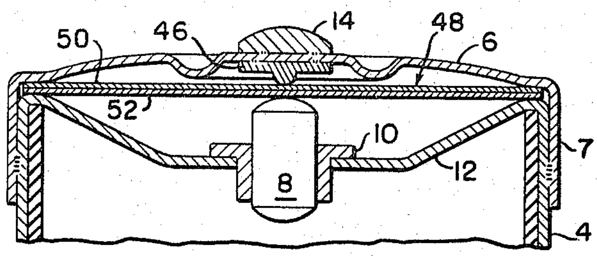

FIG. 6

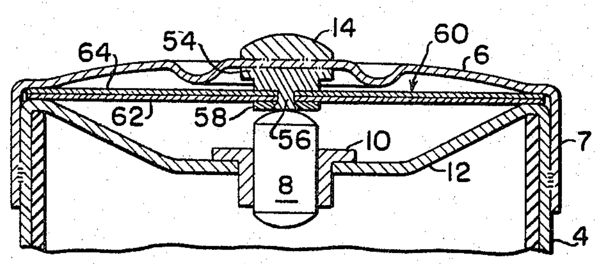

FIG. 7

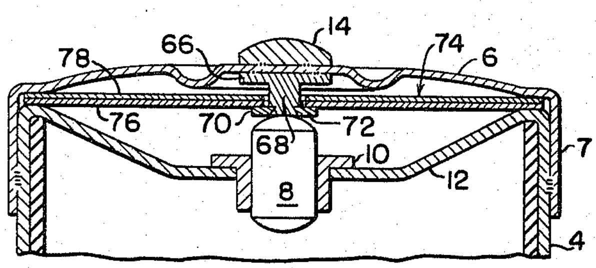

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FIG. 8

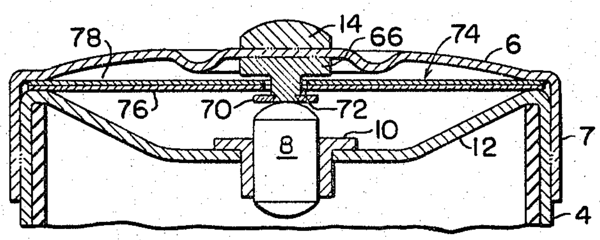


FIG. 9

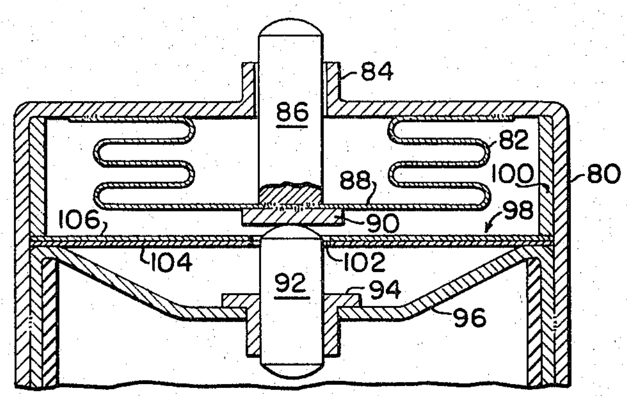


FIG. 10

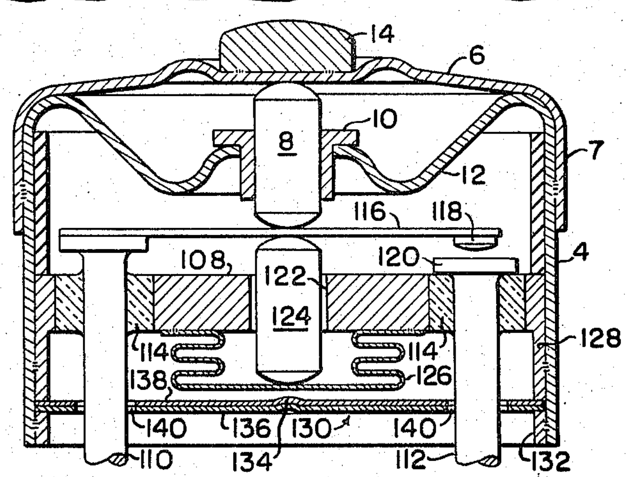
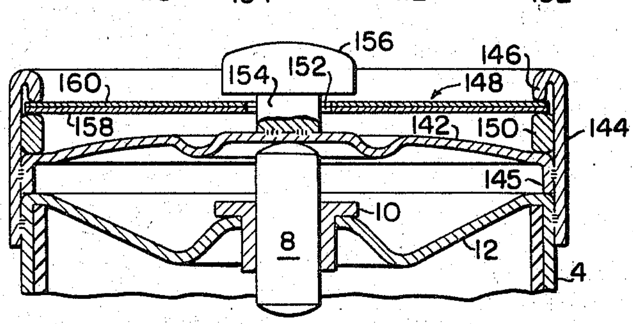


FIG. 11



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HERMETICALLY SEALED SWITCH WITH PRESSURE COMPENSATION MEANS

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U.S. Cl. 337—348 6 Claims
Int. Cl. H01h 37/70; H01h 37/74; H01h 35/40

ABSTRACT OF THE DISCLOSURE

A hermetically sealed switch with pressure compensation means to offset pressure changes due to changes in ambient temperature. The thermally responsive means employs sheets of thermostatic metal either circular or rectangular in shape, mounted adjacent a flexible diaphragm with the low coefficient of expansion mounted toward the diaphragm to offset the force exerted by the diaphragm upon a drop in temperature. Compensation for rising temperature can be accomplished by prebiasing the thermostatic element against the diaphragm upon assembly.

This invention relates to electrical switches, and particularly electrical switches which are hermetically sealed but actuable from outside the switch.

Hermetically sealed switches are well-known, and if they are of the kind which can be actuated from outside the switch through a flexible closure element which forms a part of the switch container, then a problem arises when such switches are used at either very low or very high temperatures. Such use, for example, can occur in the application of such switches for controlling the circuits of missiles which reach very high altitudes, and at these altitudes the temperatures of the switches may drop to exteremly low values. Since the volume of the container of the switch is a constant, the resulting drop in temperature of the gas which is enclosed by the container results in a pressure drop within the container. This pressure drop affects the closure element by exerting a force on it in the direction that the closure element would normally be used in order to actuate the switch within the container, and the pressure drop can be so great as to interfere with the proper functioning of the switch.

It is the purpose of this invention to provide a solution for the above problem, and the invention does so by compensating the switch against any such pressure change due to a change in the ambient temperature surrounding the switch. Compensation is provided by a thermally responsive means.

It is to be noted that interference with the proper operation of the switch also may occur because of an increase in the ambient temperature surrounding the switch with resulting increase in the interior gas pressure. Also, there may be occasion where it is also desired to operate the switch on a given temperature change, independently of any operation of the flexible closure element. Furthermore, it may be desired to have no compensation of the switch for a temperature change in either direction, or only in one direction, and thereafter to attain a compensation either partial or total. It is also the purpose of this invention to provide structures for accomplishing these additional desired features.

In solving the above problems, other desiderata are that the method of compensation should not add very much weight to the switch, particularly where such switches are used where weight is at a premium such as in missiles. Similarly, there should not be any large increase in the size of the switch, particularly where the end use of the switch requires a switch in miniaturized

form. The switch must withstand cycling, and in many instances the method of compensation must be such as not to interfere with the normal operation of the switch through the flexible closure means.

Among the several objects of the invention, therefore, may be noted the provision of a hermetically sealed electrical switch compensated against temperature changes thereof; the provision of a hermetically sealed switch which is compensated against internal gas or air pressure changes due to a temperature change of the gas or air; the provision of a hermetically sealed switch of the above classes in which compensation can be readily changed during manufacture by a predetermined amount; the provision of a switch of any of the above classes in which provision is made for no compensation for a given temperature change, but thereafter compensation will take place; the provision of electrical switches of the above classes in which the temperature compensation will occur for either direction of temperature change; the provision of a hermetically sealed switch of the last named class which has a predeterminably shiftable point at which compensation takes place; the provision of a hermetically sealed switch which is compensated for a temperature change in one direction but not in the other; the provision of an electrical switch of the hermetically sealed kind having a temperature compensation, the switch being adapted for miniaturization; the provision of a hermetically sealed electrical switch which is temperature compensated but is of minimum weight; and the provision of switches of the above classes which are simple and inexpensive to make, and are adapted for mass production. Other objects and advantages will be in part obvious and in part pointed out hereinafter.

The invention accordingly comprises the elements and combinations of elements, features of construction, and arrangement of parts which will be exemplified in the structures hereinafter described, and the scope of the application of which will be indicated in the following claims.

In the accompanying drawings, in which several of the various possible embodiments of the invention are illustrated;

FIG. 1 is a sectional elevation of one embodiment of this invention;

FIG. 2 is a sectional top view of the FIG. 1 embodiment, taken in the direction of sight lines 2—2 thereon;

FIG. 3 is a sectional view like FIG. 2, but showing another embodiment of the invention;

FIG. 4 is a sectional elevation of a portion of the FIG. 1 embodiment, showing a second position of the compensating element thereof;

FIGS. 5, 6, 7, 8, 9 each shows a different embodiment of the invention, the illustration in each case being a sectional elevation of a portion of the respective embodiment.

FIG. 10 is a sectional elevation of another embodiment of the invention, in which the compensating element is exterior of the sealed enclosure; and

FIG. 11 is a sectional elevation of a portion of yet another embodiment, but having the compensating element again outside of the sealed enclosure.

Similar reference characters indicate corresponding parts throughout the several views of the drawing. Dimensions of certain of the parts as shown in the drawings may have been modified and/or exaggerated for the purposes of clarity of illustration.

Referring now to FIG. 1 for a description of one embodiment of the invention, a hermetically-sealed switch indicated generally by numeral **2** is shown which is similar in most of its respects to the switch shown and described in United States Patent 3,146,329, dated Aug. 25, 1964, and as to such similar details, the teachings of said patent are incorporated herein by reference. Briefly, the switch comprises a container 4 made of metal such as brass or steel and having at one end thereof the flexible closure element 6 which in this instance is shown as a flexible diaphragm. Diaphragm 6 is in the form of a cap having the skirt 7 and is hermetically sealed to the top end of container 4 as by seam-welding the skirt to the container. As thus attached, the flexible diaphragm becomes a closure element for the entire switch. Within the enclosure or envelope thus formed, there is mounted a thrust pin 8 which is guided in a bearing sleeve 10 which in turn is held by an interior support 12 within the container. Thrust pin 8 is actuable by flexing the diaphragm 6, and for convenience, a push button 14 is fastened to the outside of the diaphragm for this purpose.

When actuated, thrust pin 8 bears against the actuator bar 16 of the switch to cause it to bear, in turn, against the extremities of a snap-acting element 18 which, as described in said patent, is a three-legged structure having its outer legs confined by the supporting posts 20 and 22, the post 20 being inwardly and outwardly adjustable in order to calibrate the snap spring forces of the blade 18. The center leg of blade 18 carries movable electrical contacts 24 and 26 which cooperate with the stationary contacts 28 and 30 to make and break electrical circuits. Suitable connections to the snap-acting blade 18 and to the stationary contacts 28 and 30 are provided by means of the respective mounting posts and terminals, all as explained in said patent. The container 4 is hermetically sealed at its other end by means of the mounting plate 32 which is in the form of a glass header plate having the metallic rim 34, the rim being seam welded to the can or container 4 to provide a hermetic seal.

The switch thus described is not the invention herein, but only a part thereof. Other switch structures inside the container 4 can be provided, and other means of hermetically sealing the switch 2 may also be provided.

With the switch as thus far described, it will be noted that if there is a gas such as air in the container (and it is often the practice to hermetically-seal these switches at room temperature and at normal atmospheric pressures), then if the gas inside the container 4 drops in temperature, there will occur a drop in the gas pressure since the volume of the enclosed gas is a constant. When this happens, the drop in gas pressure will result in a force being exerted on the flexible diaphragm 6 to urge the diaphragm inwardly of the casing. The amount of force will depend on the change in gas pressure, and the inward flexure of the diaphragm will of course depend on the spring forces thereof, etc. This inward force will affect the calibration of the switch as to the mechanical forces required to actuate the switch. If the inward flexure is enough, then the diaphragm may even cause the thrust pin 8 to actuate the switch structure in an unwanted manner or time. In view of the fact that switches of this kind are carefully calibrated as to the amount of force required to actuate them, and also the release force, it can be seen that this drop in gas pressure inside the container 4 results in a shift in the calibration of the switch which is entirely unwanted, and in some cases such an operation of the switch may be hazardous.

In order to compensate against these effects of the change of the temperature of the gas inside the container, a means of compensation is provided. This means takes the form of a sheet or plate of thermostat metal 36 of any of the well known kinds which have the desired thermoflexity at the temperatures at which it is desired to compensate the switch as a whole, and in this instance the thermostat metal is shown as having a high coefficient expansion side 38 and a low coefficient side 40. An exemplary material may be one having a high expansion side of the alloy 22% nickel, 3% chromium, balance iron; and a low expansion side of 36% nickel balance iron. Member 36 is mounted inside the container by its periphery which is held between the inside peripheral surface of

diaphragm 6 and the rim of the support member 12, the low expansion side 40 being mounted adjacent the flexible diaphragm 6, and the high coefficient of expansion side 38 being mounted inwardly of the casing.

It is to be noted here, by reference to FIG. 2, that as thus described, the thermostat metal member 36 is a circular disc corresponding in cross-sectional shape to the inside of container 4. Instead of using a circular disc, the thermostat metal member can be made as shown as in FIG. 3, in which the thermostat metal member 42 is a rectangular-shaped strip of thermostat metal of the proper characteristics, again supported at its outer edges between the flexible diaphragm 6 and the support member 12.

The operation of the device as thus described is as follows. The device is assembled at room temperature and at normal atmospheric pressures. If, now, the device is subjected to a drop in temperature, the above described forces due to the gas pressure drop inside container 4 will tend to pull the flexible diaphragm 6 inwardly and give the above described unwanted operational characteristics. However, because of the change in the temperature, the thermostat metal member 36 will bow upwardly (due to the high expansion side being positioned as shown), and the resulting shape and position of the thermostat member 36 will be that illustrated in FIG. 4. In this position, it will be noted that the bowing of the element 36 has extended upwardly far enough so that its center portion engages the flexible diaphragm 6 to resist any such inward pull of the diaphragm due to the drop in gas pressure. The amount of force exerted by the thermostat metal member 36 is a function of its temperature change, the thermostat member exerting more force outwardly (as drawn) as the temperature becomes lower.

Since the gas pressure-temperature relationship in the container 4 basically follows the well-known laws governing such relationships, the pressure in the container will be proportional to the Kelvin temperature of the gas (the volume of the container 4 being a constant). Therefore, by the application of known mathematical relationships, it is within the skill of the art to select thermostat metal for the compensating element 36 whose thermoflexivity, thickness and other characteristics are such as to produce an outward thrust on diaphragm 6 at a given temperature which will counterbalance the inward pull on the diaphragm due to the drop in gas pressure.

It is also to be noted that in the FIG. 1 embodiment, there is a slight gap between the thermostat member 36 and the diaphragm 6. This means that the temperature surrounding the switch 2 will drop a predetermined amount before the thermostat member 36 comes in contact with the diaphragm 6 to begin to compensate the same for the pressure changes. It will also be noted in the FIG. 1 embodiment that because of this lack of contact, and in view of the fact that the thermostat metal member 36 is provided with a clearance hole 44 through which the thrust pin 8 passes freely, the diaphragm 6 can be acuated without any restraining force thereon by the thermostat metal 36, at the temperature at which the device is made, and at some variation therefrom.

Turning now to FIG. 5, there is shown another embodiment of the invention, in which an inner button 46 is attached to the diaphragm to provide a centralized point against which the thermostat element or member 48 can press. In this instance, the thermostat element 48 has its high and low expansion sides 50 and 52 respectively positioned as in the FIG. 1 embodiment, but the relationship between the button 46 and the thrust pin 8 in respect to thermostat metal member 48 is such that the thermostat metal member is already in contact (at the temperature at which the switch is assembled) with the button 46. Thus, in this embodiment, there is no lost motion between the thermostat element 48 and the diaphragm 6, with the result that the thermostat element begins to compensate for the drop in gas pressure immediately on a change in temperature. In this embodiment, the switch structure used is the same as in the FIG. 1 embodiment, or any other switch structure desired. Thermostat element **48** is again held by its rim as in the FIG. 1 embodiment.

In the above two embodiments, it will be noted that since the thermostat element is normally flat when the switch is constructed, any temperature rise which would increase the gas pressure in the container **4** will cause the thermostat elements **36** and **48** to bow downwardly (as drawn), with the result that they have no effect on the diaphragm **6** upon such temperature rise. However, if it is desired to have the thermostat element affect the operation of the diaphragm **6** upon a rise in temperature, then the thermostat elements **36** and **48** can be prebiased against the diaphragm at the temperature at which the device is assembled. In the FIG. 1 embodiment, this prebiasing can be done, for example, by giving the thermostat element **36** a pre-curvature upwardly so that when assembled in the switch, it will press against the diaphragm **6** with an initial predetermined force. This same means can be used in the FIG. 5 embodiment. In the latter embodiment, prebiasing can also be done with a normally flat thermostat element by making the inner button **46**, for example, longer, so that when the parts are assembled there is a predetermined pressure being exerted by the thermostatic element against the diaphragm.

In such prebiased embodiments, upon a drop in the temperature of the gas in the container, the effect described above for both the FIG. 1 and FIG. 5 embodiments will be obtained. However, because of the prebiasing, an increase in the temperature of the thermostat element **48** has the result that the thermostat element will now bow downwardly (as drawn) and thus less the prebiasing force. This lessening of the prebiasing force, with concomitant lessening of the force on the diaphragm **6**, will compensate the diaphragm against increases in gas pressure in the container.

Referring now to FIG. 6 for a further embodiment, the embodiment is the same as those already described, except that in this instance the inner button **46** of the FIG. 5 embodiment has been changed to link **54** which is attached to the diaphragm **6**, button **54** being provided with an extension **56** and a washer **58**, the extension and washer being riveted together to clamp the thermostat element **60** therebetween. In this embodiment, the thermostat element **60** will compensate in both directions of temperature change; that is, an increase in temperature or a decrease in temperature, because any force or motion of the thermostat metal element **60** due to temperature change is transferred immediately to the diaphragm **6**. Again, as in the previous embodiments, element **60** has a high expansion side **62** and a low expansion side **64**, these sides being positioned as shown in FIG. 6.

Turning now to FIG. 7 for a still further embodiment of the invention, in this instance the aforesaid diaphragm **6**, push-button **14**, container **4**, guide sleeve **10** and sleeve support **12** are provided, along with the thrust pin **8**. An inner link **66** is provided, having the extension **68** and a washer **70** riveted to the end thereof. Extension **68** passes freely through a hole **72** in the thermal element **74**. With this construction, and by suitably adjusting the space between the top surface of element **74** and the diaphragm **6**, the thermostat element **74** will compensate for a drop in gas pressure as in the FIG. 1 embodiment; but with a rise in temperature with consequent rise in gas pressure in the container **4**, the thermostat element **74** immediately bears against the washer **70** to exert a force downwardly (as drawn) against the diaphragm **6** in order to compensate the latter against the rise in gas pressure. In this embodiment, the thermal element **74** has its high expansion side **76** downward, as drawn, and the low expansion side **78** is adjacent the diaphragm. Element **74** is held in position as in the FIG. 1 embodiment.

Turning now to the FIG. 8 embodiment, the construction is the same as in the FIG. 7 embodiment except that in this instance the thermal element **74** is positioned midway between the inner face of link **66** and the washer **70**. In this embodiment, it will be noticed that there is a lost motion in each direction between the thermal element **74** and, in essence, the diaphragm **6**. Thus, no compensation will take place for the initial temperature changes in either direction. Thereafter, the thermostat element **72** will have bowed in the respective direction sufficient to either push outwardly on the diaphragm **6** or to pull the diaphragm inwardly to give the correct compensation for the pressure change in container **4**.

Referring now to FIG. 9 for a still further embodiment of the invention, there is shown a container **80** having as a flexible closure element therefore the bellows **82**. A neck portion **84** is provided as a guide for the push pin **86**, the inner end of pin **86** being welded to the bottom **88** of the bellows. A bearing plate **90** is provided on the other side of the bottom **88**, against which bears the switch actuating thrust pin **92**. Thrust pin **92** slides in the bearing sleeve **94** which in turn is supported by a support member **96** as in the FIG. 1 embodiment. Bellows **82** is hermetically fastened to the under surface of the top of the container **80**, and thus becomes a flexible closure element for the container **80**. A thermostat element **98** is provided, element **98** being mounted between the top edge or rim of the support member **96** and a spacing ring **100** as shown. A hole **102** is provided in thermostat element **98** of sufficient size to permit the passage freely therethrough of the thrust pin **92**, as in the FIG. 1 embodiment. Thermostat element **98** has its high coefficient of expansion layer **104** on the bottom, as shown, and its low expansion side **106** on the top. The operation of this embodiment is the same as the operation of the FIG. 1 embodiment, the only difference between the two embodiments being the substitution of the bellows **82** for the flexible diaphragm **6**.

In all of the above embodiments, it will be noted that the thermostatic compensating element is positioned within the container. In this position, because of its interior location, it may not respond rapidly enough to a rapid change in the temperature outside the container. Therefore, it may be desired to mount the thermostatic compensating element so that it will be on the outside of the hermetically sealed container in order to get a faster response.

Referring now to FIG. 10 for an embodiment which shows a construction to accomplish this purpose, a container **4**, a flexible diaphragm **6**, push-button **14**, thrust pin **8**, bearing sleeve **10**, sleeve guide **12**, are all supplied as in the FIG. 1 embodiment and as shown in said United States patent.

In this instance, a simplified switch structure is illustrated, and consists of a base such as a header plate **108** having the terminals **110** and **112** fused therein in conventional manner by means of the glass seals **114**. Mounted on the terminal post **110** on the inside of the container is the movable contact arm **116** which carries at one end thereof the electrical contact **118**. A stationary electrical contact **120** is provided at the inner end of terminal post **112** for cooperative engagement with the contact **118**. A bore **122** is provided in the header plate **108** of sufficient size to pass freely therethrough the pin **124**. In order to hermetically seal the inside of the case (there being otherwise a leakage path to the outside via the hole or bore **122**) a bellows **126** has its open end hermetically sealed or fastened (such as by seam welding) to the header plate **108** in conventional manner. The header plate **108** is hermetically sealed to the inside of the container **4** such as by seam welding the rim or skirt **128** to the container **4**.

As in the previous embodiments, compensation for a change in the pressure within the container **4** is provided by means of a thermostatic metal member **130**. Member **130** is supported at its rim between the rim of the skirt

128, and a short cylinder 132 which may be welded to the container 4. Element 130 is provided with a small inwardly extending deformation 134 approximately at the center thereof, to act as a thrust point against the bottom of the bellows 126 when the thermal element 130 moves for compensation. Thermostatic element 130 has its high expansion side 136 downwardly, as drawn, and its low expansion side 138 adjacent the bellows 126. Suitable holes 140 are provided in the thermostat element 130 to permit the terminals 110 and 112 to pass therethrough without touching, in order to provide electrical clearance.

In operation, when the temperature external to the container drops, the internal pressure also drops. However, thermostat element 130 will bow upwardly to push against the bottom of bellows 126. The latter in turn pushes against thrust pin 124 and its motion is transferred through the contact arm 116 and the thrust pin 8 to the flexible diaphragm 6 for compensation.

Referring now to FIG. 11 for another embodiment in which the thermostatic compensating element is mounted on the outside of the hermetically sealed container, the container in this instance constitutes the envelope 4 on the top of which are mounted the flexible diaphragm 142 and a surrounding cylindrical member 144. Member 144 is hermetically sealed (as by seam welding) to the rim or skirt 145 of the diaphragm 142 and to the end of the envelope 4, thus providing a hermetically sealed enclosure for the switch parts. As before, a thrust pin 8 is provided, a bearing sleeve 10 therefor, and a sleeve guide 12, all as described in the FIG. 1 embodiment.

The outside rim of member 144 is turned over, as shown, to provide a bearing seat 146 for the thermal element 148. The periphery of element 148 is held between seat 146 and a spacing ring 150 which may be of metal or a relatively hard molded plastic. A hole 152 is provided in the thermal element 148 through which passes freely the stem 154 of the push-button 156. The inner end of stem 154 is welded or otherwise hermetically fastened to the center of the diaphragm 142.

In this construction, the high expansion side 158 of thermal element 148 is on the bottom (as drawn) and the low expansion side is on the top.

As drawn, a clearance is shown between the thermal element 148 and the inner face of the push-button 156. In operation, if there is a temperature drop which would reduce the gas pressure inside the container, the thermostat element will bow upwardly (as drawn) to contact the inner face of the push-button 156 and thus provide the desired compensation, as has been set forth as to the other embodiments. If desired, there can be no space provided between the top surface of the element 148 and the underside of push-button 156, in which event compensation takes place immediately upon a change in the temperature of the thermostat element 148. In the embodiment as drawn, it is possible to have the push-button actuate the switch mechanism in the container without any hindrance by the thermal element 148 if there is no temperature change.

Throughout the several embodiments of this invention, conventional practices are to be followed in obtaining hermetic seals for the container. Also, conventional practices are to be followed in regard to the mounting of the several thermostat elements so that the latter will not bind during its operation. As indicated above, the exact form of the switch used within the sealed envelope is not a part of this invention, and as examples only thereof two forms are shown, viz the snap-acting switch of the FIG. 1 embodiment and the creep type switch of the FIG. 10 embodiment. It will be noted that with the construction shown, there are many possibilities of the kinds of compensation that can be accomplished. In several of the embodiments shown, the thermostat element has been mounted to have lost motion between it and the diaphragm. In others, the thermostat metal element is connected physically to the diaphragm. As to each form of construction, many kinds of compensation can be provided within the scope of the invention, and the variations are even more when prebiasing is used.

On the other hand, still further variations in kinds of performance can be obtained if the thermostat element is reversed and, for example in the FIG. 1 embodiment, the high expansion side lies toward the flexible diaphragm or flexible enclosure means and the low expansion side lies toward the interior of the container. If such a construction is followed, upon a drop in temperature of the thermostat element which drop lowers the gas pressure within the sealed container, the thermostat element 40 will bow away from the diaphragm 6. This, then, would leave the drop in internal pressure fully effective to urge the diaphragm 6 inwardly with the result that the diaphragm itself (without any external force being applied thereto) would actuate the switch. There are situations in which such an occurrence would be desirable in the event of a very low drop in the temperature of the atmosphere surrounding the switch. (Of course, this would not, strictly speaking, be compensation.) With such a configuration, the use of lost motion and prebiasing also presents many combinations of operating characteristics.

In view of the above, it will be seen that the several objects of the invention are achieved, and other advantageous results attained.

It is to be understod that the invention is not limited in its application to the details of construction and arrangement of parts illustrated in the accompanying drawings, since the invention is capable of other embodiments and of being practiced or carried out in various ways. Also, it is to be understood that the phraseology or terminology employed herein is for the purpose of description and not of limitation.

As many changes could be made in the above constructions without departing from the scope of the invention, it is intended that all matter contained in the above description or shown in the accompanying drawings, shall be interpreted as illustrative and not in a limiting sense, and it is also intended that the appended claims shall cover all such equivalent variations as come within the true spirit and scope of the invention.

Having thus described my invention, what I claim as new and desire to secure by Letters Patent of the United States is:

1. A switch comprising an hermetically sealed container; flexible means attached to said container and constituting a closure element therefor, at least a portion of said flexible means being movable for transmitting a force applied thereto externally of the container to the interior of the container; a first contact mounted within said container; a second contact movably mounted within said container and adapted to cooperate with said first contact for making and breaking an electrical circuit; means between said flexible means and said movable contact to move the latter upon motion of said flexible means; and thermally responsive means supported by said container prestressed to exert a force on said flexible means at room temperature to compensate for an internal pressure change in said container for a temperature change in one direction, said thermally responsive means also being free to move to exert a force on said flexible means to compensate for an internal pressure change in the container for a temperature change in the other direction.

2. A switch comprising an hermetically sealed container; flexible means attached to said container and constituting a closure element therefor, at least a portion of said flexible means being movable for transmitting a force applied thereto externally of the container to the interior of the container; a first contact mounted within said container; a second contact movably mounted within said container and adapted to cooperate with said

first contact for making and breaking an electrical circuit; means between said flexible means and said movable contact to move the latter upon motion of said flexible means; and a thermostat metal element supported by said container and having a portion thereof being free to move upon a temperature change thereof, said portion of said thermostat metal element attached to said flexible means and adapted, upon said temperature change, to exert a force on said flexible means thereby compensating for a concomitant internal pressure change in the container.

3. The switch of claim 2 in which the portion of the thermally responsive means which is free to move is adapted to move a predetermined distance on a temperature change thereof without exerting a force on said flexible means.

4. A switch comprising an hermetically sealed container; flexible means attached to said container and constituting a closure element therefor, at least a portion of said flexible means being movable for transmitting a force applied thereto externally of the container to the interior of the container; a first contact mounted within said container; a second contact movably mounted within said container and adapted to cooperate with said first contact for making and breaking an electrical circuit; means between said flexible means and said movable contact to move the latter upon motion of said flexible means; and a thermostat metal element supported by said container with a portion thereof being free to move upon a temperature change thereof, said thermostat metal element adapted upon said temperature change to exert a force on said flexible means, and said portion of the thermostat metal element adapted to move a predetermined distance on a temperature change thereof in one direction without exerting a force on said flexible means, said thermostat metal element is prestressed to exert a force on said flexible means at room temperature to compensate for an internal pressure change in the container concomitant with said temperature change in the other direction.

5. A switch comprising an hermetically sealed container; a flexible diaphragm attached to said container and constituting a closure element therefor, at least a portion of said diaphragm being movable for transmitting a force applied thereto externally of the container to the interior of the container; a base mounted within said container; a stationary contact mounted on said base; a snap-acting switch element mounted on said base and carrying a second contact adapted to cooperate with said first contact for making and breaking an electrical circuit; a thrust pin guided between said diaphragm and said snap-

acting element and adapted to transfer motion of said diaphragm to said snap-acting element; and a thermostat metal element supported by said container with a portion thereof free to move upon a temperature change thereof, said thermostat metal element is adapted upon said temperature change to exert a force on said flexible means, said thermostat metal element is prestressed to exert a force on said diaphragm in one direction at room temperature, and said thermostat metal element is adapted to move a predetermined distance in the opposite direction without applying a force on said diaphragm.

6. A switch comprising an hermetically sealed container; flexible means attached to said container and constituting a closure element therefor, at least a portion of said flexible means being movable in directions toward and away from the interior of said container for transmitting a force applied thereto externally of the container to the interior of the container; a first contact mounted within said container; a second contact movably mounted within said container and adapted to cooperate with said first contact for making and breaking an electrical circuit; means between said flexible means and said movable contact to move the latter upon motion of said flexible means; thermally responsive means supported by said container with a portion thereof free to move upon a temperature change thereof, the movable portion of said flexible means operatively connected to the movable portion of said thermally responsive means, the thermally responsive means adapted upon said temperature change to exert a force on said flexible means, whereby said thermally responsive means upon a temperature change thereof opposes in each of said directions motion of said flexible means due to a change in the gas pressure in said container.

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200—83; 337—354, 378