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Osheroff

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[54] **THERMOVALVE-ELECTRIC SWITCH APPARATUS**

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[58] **Field of Search** 337/3; 236/87, 101, 236/94; 137/625.18, 625.4; 251/368, 284

[56] **References Cited**

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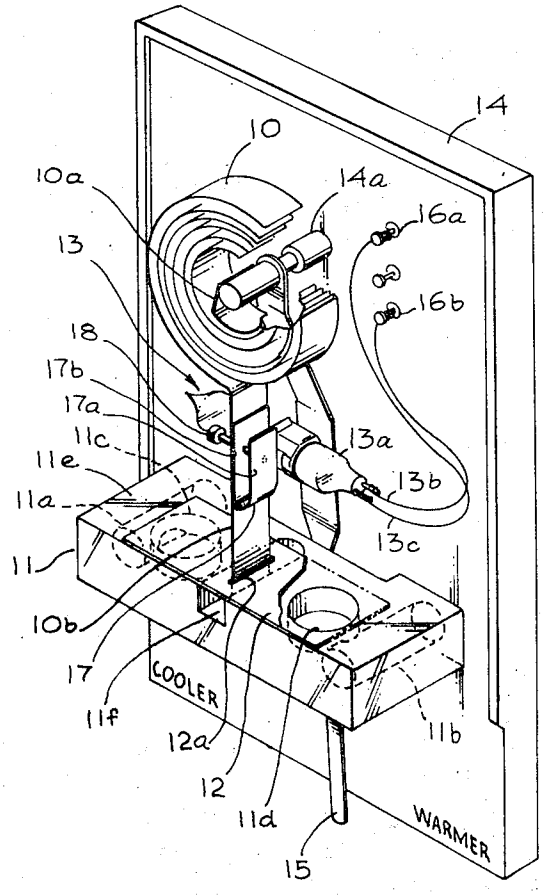
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[57] **ABSTRACT**

In the present invention, a pair of valves and an electric switch are controlled by the same bi-metallic strip, with the result that the operation of the switch and the operation of the valves are inter-related. The device basically comprises a coiled bi-metal strip fixed at one end and whose other end is coupled to a flat plate. The plate rests on a member containing the valve orifices, which are covered or uncovered by the plate as it moves horizontally in one direction or another as the bi-metal coil rotates in a clockwise or counterclockwise direction in response to changes in ambient temperature conditions. Mounted on the bi-metal strip is a mercury switch whose angular position is made adjustable so that it can be made to operate at specified temperatures.

9 Claims, 2 Drawing Figures



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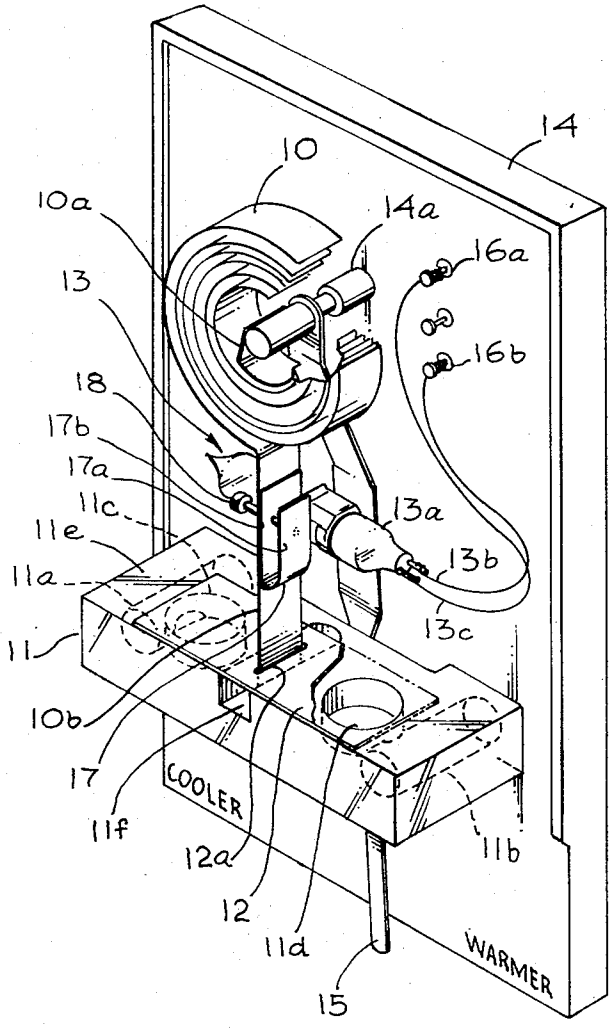


Fig. 1

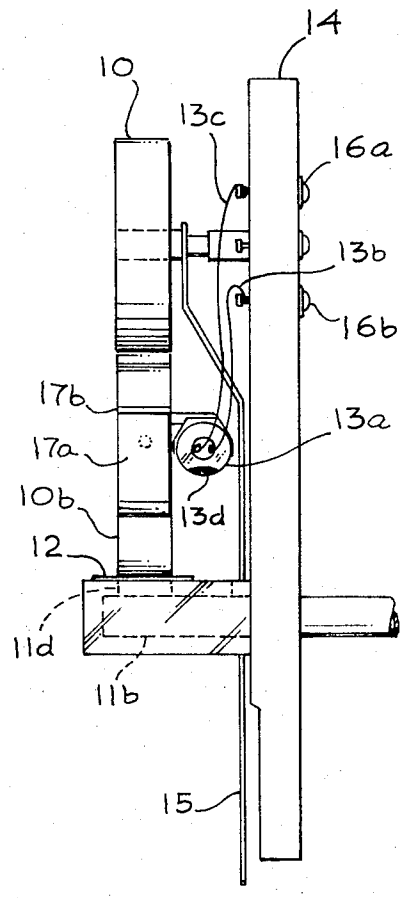


Fig. 2

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THERMOVALVE-ELECTRIC SWITCH APPARATUS

The present invention relates to thermoelectric switch devices in general and more particularly relates to a thermovalve-electric switch apparatus.

In co-pending United States patent application Ser. No. 159,626, there is disclosed a thermovalve in which one or the other of a pair of valves is opened or closed by the rotation of a bi-metallic strip in response to changing ambient temperature conditions. However, as disclosed therein, the operation of the thermovalve is limited only to the opening and closing of these valves, and there may be times when it is desirable, and even necessary, to operate an electric switch as a function of the operation of the thermovalve.

Accordingly, it is an object of the present invention to provide a thermovalve of the type mentioned that is combined with an electric switch mechanism whose operation is a function of the operation of the thermovalve.

It is another object of the present invention to provide a thermovalve - electric switch type of apparatus in which the electric switch is adjustable to function at predetermined points in the operative cycle of the thermovalve.

It is a further object of the present invention to provide a thermovalve - electric switch type of apparatus in which the electric switch is operable in response to the same temperature fluctuations that affect the operation of the thermovalve.

The novel features which are believed to be characteristic of the invention, both as to its organization and method of operation, together with further objects and advantages thereof, will be better understood from the following description considered in connection with the accompanying drawing in which an embodiment of the invention is illustrated by way of example. It is to be expressly understood, however, that the drawing is for the purpose of illustration and description only and is not intended as a definition of the limits of the invention.

FIG. 1 is a perspective view of a preferred embodiment of a thermovalve-electric switch apparatus according to the present invention; and

FIG. 2 is a side view of the FIG. 1 embodiment.

For a consideration of the invention in detail, reference is now made to the drawing wherein, in FIGS. 1 and 2, an embodiment of the invention is shown to basically include a coiled bi-metallic strip **10** that forms the thermal or temperature-sensitive portion of the device, a valve member **11** and a plate **12** that together constitute the valve portion of the device, and a mercury switch **13** that constitutes the electric switch portion of the device. Coil **10** is mounted on a wall, designated **14**, of the structure that houses the embodiment and this is accomplished by rigidly fixing one end of the strip, namely, end **10***a* located at the center of the coil, to a rod or shaft **14***a* protruding from the wall, the other or free end of the bi-metallic strip, hereinafter occasionally referred to as tongue **10***b*, extending downwardly from the body of the coil. Coiled bi-metallic strip **10** is of the kind found in many thermostatic or temperature-sensitive devices in the market place and, hence, is a standard type of element.

Member **11** is a solid block of material having a pair of channels **11***a* and **11***b* extending partially through it

that respectively connect with a pair of orifices or ports **11***c* and **11***d* in the surface of the block that is nearest or closest to coil **10**. This surface is designated **11***e* and it has a slot **11**f therein that is preferably located just midway between the two ports. Channels **11***a* and **11***b*, as well as their entrance ports **11***c* and **11***d*, are preferably identical to one another and slot **11***f* is preferably of *s* symmetrical configuration. Member **11** is also mounted on wall **14**, the spacing between it and the coil above it being such as to permit tongue **10***b* to extend downwardly into slot **11***f*.

With respect to plate **12**, plate **12** is a thin, light plate that slidably rests on surface **11***e* and, as may be seen in FIG. **1**, the plate has a narrow slit **12***a* in it through which tongue **10***b* extends into slot **11***f*. Thus, plate **12** is coupled to bi-metallic strip **10** but not integrally joined to it. Needless to say, as a result of the aforedescribed coupling, plate **12** is also prevented from falling off the surface of member **11**. As for the dimensions of plate **12**, its length and width are sufficient to cover entrance ports **11***c* and **11***d* when tongue **10***b* is centered in slot **11***f*. However, in order to increase the sensitivity of the thermovalve to a maximum and thereby decrease its reaction or response time to a minimum, it is preferable to have the plate just barely cover the entrance ports when the free end of the bi-metallic strip is centered in the slot. In this way, as will be seen later, the slightest movement of the plate will partially uncover one or the other of the entrance ports. For the purpose of further enhancing the rapidity with which an embodiment of the present invention responds to changes in ambient temperature conditions, the thermovalve preferably further includes means to reduce the friction between member **11** and plate **12**. One way in which this can be done is to coat the bottom side of the plate with a layer of material that has a low coefficient of friction, such as teflon. Another way is to fabricate member **11** out of such a material or, at the very least, coat surface **11**e with it. Of course, if it is desirable, a combination of both ways may be employed.

Last but not least, the thermovalve portion of the device also includes the usual temperature-setting lever **15** by means of which the coil can be biased so as to set the temperature of the thermovalve above or below the ambient temperature for the control of whatever equipment may be coupled to it, such as an air-conditioning system. As shown in the figures, lever **15** is coupled to coil **10** at end **10***a* and extends downwardly between member **11** and wall **14**, the bottom end of the lever extending below the level of the wall to provide easy manual access to the user. Finally, although the materials from which member **11** and plate **12** are made are really a matter of design and economics rather than invention, it is nevertheless deemed worthwhile to mention that both member **11** and plate **12** can be made from any one of a number of suitable materials. Thus, for example, member **11** can be mouled out of any sturdy and inexpensive plastic, whereas plate **12** can be made of a plastic or a metal. Aluminum has already been used in the manufacture of plate **12** and found to be satisfactory.

Focusing now on the electric switch portion of the device, mercury switch **13** is of the usual or commercially available variety and, therefore, includes the usual envelope **13***a*, wire ends **13***b* and **13***c*, and supply of mercury **13***d*. As may be seen from the figures, wire ends **13***b* and **13***c* protrude through envelope **13***a* and

respectively connect to a pair of terminals 16*a* and 16*b* mounted on wall 14. Mercury switch 13 is mounted in a horizontal direction on one end of a U-shaped bracket 17, the other end of the bracket being coupled or affixed to tongue 10*b* by means of a screw 18 that passes through both the tongue and the bracket end. The end of the bracket on which the mercury switch is mounted is designated 17*a* and the end of the bracket that is linked to tongue 10*b* is designated 17*b*, the screw extending across the gap between the bracket ends so that the tip of the screw is in contact with bracket end 17*a*. Thus, by turning screw 18 in one direction or the other, the position of bracket end 17*a* relative to bracket end 17*b* can be adjusted slightly, with the result that mercury switch 13 can thereby be tilted somewhat from the horizontal. As will be recognized by those skilled in the art and as will become clearer during the discussion of the operation hereinbelow, this ability to tilt the mercury switch adds a certain amount of flexibility to the operation of the apparatus since it makes it possible to change or adjust the temperature at which the switch closes, that is to say, at which the mercury comes into contact with wire ends 13*b* and 13*c*.

Considering now the operation of the thermovalve-electric switch apparatus shown and described herein, when bi-metallic coil 10 is in what may be called its quiescent position, that is to say, when its free end 10*b* is centered in slot 11f, ports 11c and 11d are both covered by plate 12, with the result that no air, or any other gas for that matter, can enter and pass through channels 11*a* and 11*b*. The valve is then totally closed. FIG. 1 illustrates this kind of condition, which occurs when the temperature at which the thermovalve is set is the same as the ambient temperature.

However, when the thermovalve is set at a temperature that is higher than the ambient temperature as, for example, by moving lever 15 to the warmer temperature markings, the coil and, therefore, tongue 10*b* rotates in either a clockwise or counterclockwise direction depending on how the thermovalve is designed. Assuming that tongue 10*b* moves in a counterclockwise direction, then in that event plate 12 moves linearly along surface 11*e* to the right, thereby partially opening or uncovering port 11*c*. Plate 12 continues to move to the right in response to the motion of tongue 10*b* until the tongue abuts against the side or wall of slot 11*f*, at which point tongue 10*b* and plate 12 coupled to it can move no further and, therefore, port 11*c* is now open to the maximum extent. The reverse process takes place as the ambient termperature rises toward the temperature setting of the thermovalve. Thus, as the ambient temperature rises, tongue 10*b* moves more and more toward the center of slot 11*f* and, correspondingly, plate 12 ever increasingly covers over port 11*c*. It will be recognized that when the ambient temperature reaches the temperature setting of the thermovalve, tongue 10*b* will again be at the center of slot 11*f* and port 11c will again be completely covered by plate 12. The thermovalve is now once again in its quiescent position.

On the other hand, when the thermovalve is set at a temperature that is lower than the ambient temperature, as by moving lever 15 to the cooler temperature settings, coil 10 and, therefore, tongue 10*b* moves in a clockwise direction. When this occurs, plate 12 moves linearly along surface 11*e* to the left, thereby partially opening port 11*d*. As before, plate 12 will continue to move in this direction until tongue 10*b* abuts against the opposite wall or side of slot 11*f*, at which point port 11*d* is opened to the maximum extent. Needless to say, as the ambient temperature approaches the temperature setting of the thermovalve, tongue 10*b* moves ever further away from the wall of the slot until, when the temperatures are equal, it will have reached the center of the slot. At this point, the thermovalve is again in its quiescent position, which means that both ports are again completely covered by plate 12.

It will be recognized by those skilled in the art that the maximum extent to which ports 11*c* and 11*d* are opened or uncovered by plate 12 depends not only on the size or dimensions of these openings but on the width of slot 11*f* as well. It will also be recognized that the rotational motion of coil 10 and, therefore, of tongue 10*b* has been converted or translated into a rectilinear motion of plate 12.

As tongue 10*b* moves in one direction or the other from its quiescent position, bracket 17 and, therefore, mercury switch 13 moves along with it, with the result that envelope 13*a* correspondingly tilts more and more from the horizontal in one direction or the other, the tilt angle at any one moment depending both on the displacement of the tongue at that time from its above defined quiescent position and the initial tilt or bias imposed upon the switch by means of screw 18. The tilting of envelope 13*a*, in turn, causes the blob of mercury therein to move toward or away from wire ends 13*b* and 13*c* depending on which way the envelope is tilted. Assuming that the envelope is being tilted so that the mercury moves toward the wire ends, at a certain angle or tilt the mercury will make contact with the wire ends and thereby close the switch. Thus, the mercury switch is temperature responsive and, as previously mentioned, can be adjusted to close over a range of temperatures.

Although a particular arrangement of the invention has been illustrated above by way of example, it is not intended that the invention be limited thereto. Accordingly, the invention should be considered to include any and all modifications, alterations or equivalent arrangements falling within the scope of the annexed claims.

Having thus described the invention, what is claimed is:

1. A thermovalve-electric switch apparatus comprising: a housing wall; a member having a pair of valving orifices therethrough mounted on one surface of said wall, the top surface of said member being flat with the entrance ports to said orifices lying in said top surface, said member including a slot located between said entrance ports that extends downward from said top surface only partially through said member, said wall including means for coupling the exit ports of said orifices through said wall to the other side thereof; a plate slidably resting on said top surface, the dimensions of said plate being sufficient to just completely cover both said entrance ports when said plate is centered therebetween, said plate having a slit therethrough between the ends thereof; a coiled bi-metallic temperature-sensitive element mounted in the space above said plate, the center of said coil being fixedly coupled to said wall and the other end thereof being free and extending linearly downward through the slit in said plate and into said slot, the space between said plate and said element containing no other parts; and a mercury switch, posi-

tioned in a substantially horizontal direction, coupled to said temperature-sensitive element and movable therewith.

2. The apparatus defined in claim 1 wherein the width of said slot is substantially equal to the sum of the widths of said entrance ports and wherein said apparatus further includes additional means for tilting said mercury switch from the horizontal for adjustment thereof.

3. The apparatus defined in claim 1 wherein said apparatus further includes means for increasing the sensitivity of the apparatus to changes in ambient temperature conditions, said means including friction-reducing means mounted between said plate and top surface.

4. The apparatus defined in claim 1 wherein the location and dimensions of said slot are such that one of said entrance ports is covered and a predetermined portion of the other of said entrance ports is uncovered by said plate when the end of said temperature-sensitive element that extends into said slot abuts against one side thereof, and such that said other entrance port is covered and a predetermined portion of said one entrance port is uncovered by said plate when the end of said temperature-setting element that extends into said slot abuts against the other side thereof.

5. The apparatus defined in claim 1 wherein the thermovalve further includes a mechanism mounted between said housing wall and said member for biasing said coiled bi-metallic element to pre-set the temperature of the thermovalve.

6. The apparatus defined in claim 3 wherein said plate is coated with a friction-reducing substance on the side thereof facing said member.

7. The apparatus defined in claim 4 wherein said entrance ports are of equal size and said slot is located midway therebetween, wherein said plate covers both said entrance ports when said other end of said bi-metallic strip is positioned midway between the sides of said slot, and wherein said plate just fully uncovers one or the other of said entrance ports as said other end of the bi-metallic strip respectively abuts against one or the other of the sides of said slot.

8. The apparatus defined in claim 2 wherein said additional means includes a generally U-shaped bracket, one side thereof being coupled to the free end of said coil and said mercury switch being mounted on the other side thereof, and a device for varying the spacing between said bracket sides.

9. The apparatus defined in claim 8 wherein said device is a screw extending through said coil end and the bracket side coupled thereto to the other of said bracket sides.

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