Nov. 8, 1949 A. A. ZUEHLKE 2,487,686

THERMOSENSITIVE BULB

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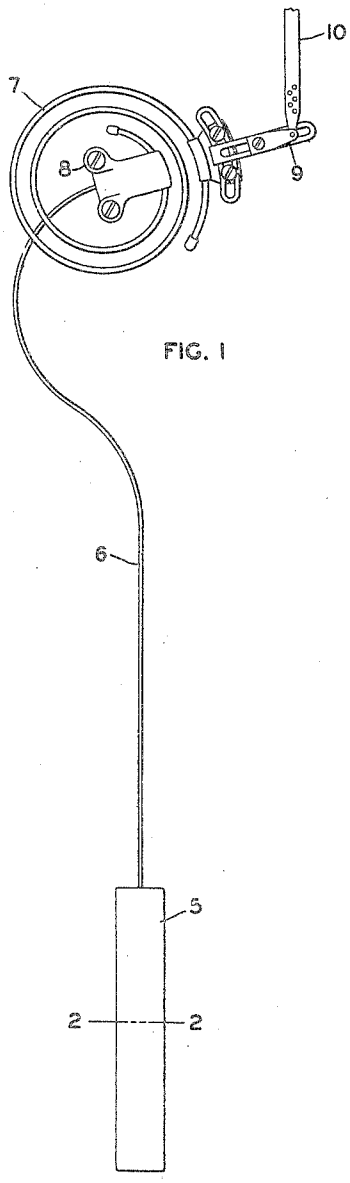

FIG. 1

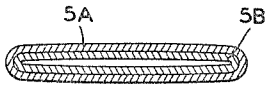

FIG. 3

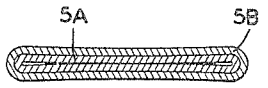

FIG. 4

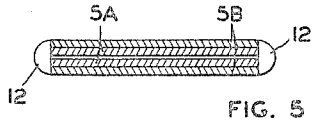

FIG. 5

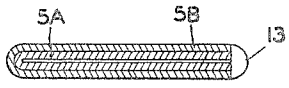

FIG. 6

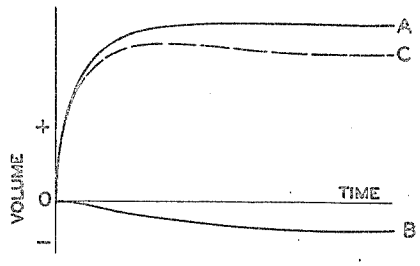

FIG. 7

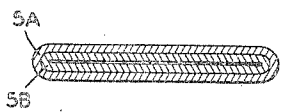

FIG. 2

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THERMOSENSITIVE BULB

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8 Claims. (Cl. 297—3)

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This invention relates to a thermosensitive device and more particularly to a bulb for use in such a device.

In many installations, it is highly desirable that the bulbs of such devices have exceedingly fast speeds of response so that any deviation from a required temperature can be promptly detected.

The present invention has for its purpose a novel construction of thermosensitive bulb having a greatly improved speed of response as compared with conventional types.

The main feature of the invention relates to a thermosensitive bulb in which the walls thereof consist of bimetallic material, that is layers of dissimilar metals bonded together and having different coefficients of expansion.

Various other features and advantages of the invention will appear from the detailed description and claims when taken with the drawin in which:

Fig. 1 discloses the bulb of the present invention incorporated in a thermosensitive tube system;

Fig. 2 is a cross-section of the bulb of Fig. 1 taken on the line 2—2 thereof;

Figs. 3, 4, 5 and 6 are cross-sections similar to that of Fig. 2 but showing various modified forms of construction; and

Fig. 7 is a chart useful in describing the invention.

Referring first to Fig. 1, there is illustrated a thermosensitive tube system comprising the bulb 5 of the present invention which communicates through a capillary tube 6 with a pressure responsive element such as a conventional Bourdon spring 7. The inner end of the Bourdon spring is mounted on a fixed support 8 while the outer or free end of this spring is provided with a suitable take-off arm 9. This arm has pivoted thereto a link 10 connectible to a movable index or control element (not shown). The tube system may be filled with any of the well-known fluid filling mediums so that this fluid causes the Bourdon spring 7 to wind-up or to unwind, as the case may be when the temperature at the bulb 5 changes.

In accordance with the present invention, the bulb 5 is made of bimetallic sheet material consisting of two layers of metal 5A and 5B bonded together, the metal layers having two different coefficients of expansion. This bulb can conveniently be made from a short piece of bimetallic tubing by flattening the piece and suitably sealing its ends, preferably the space between the opposed inner surfaces of flattened bulb being somewhat thinner than the thickness of one of the layers 5A and 5B. The capillary tube 6 will of course be sealed to one end of the sealed piece in communication with the interior thereof. It will be understood that when these layers are subjected to a change in temperature, they will expand differentially to change promptly the volume of the bulb so that the fluid in the tube system will cause the Bourdon spring to wind-up or unwind as the case may be.

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In the construction of Fig. 3, the layer of metal having the greater coefficient of expansion is located at the outer surface of the bulb with the metal layer having a lower coefficient of expansion at the inner surface thereof. In this construction, the volume of the bulb expands on an increase in temperature as shown by the convex shape of its sides. Similarly, the volume of the bulb contracts on a decrease in temperature.

In the construction of Fig. 4, the layer of metal having the greater coefficient of expansion is located at the inner surface of the bulb, while the metal layer having the lower coefficient of expansion is located at the outer surface of the bulb. In this construction, the bulb will contract on a rise in temperature so that its sides will be concave, as illustrated. A drop in temperature will cause the bulb to expand with its sides convex.

As shown in Fig. 5, the bulb can be made of two bimetal strips each comprising the layers 5A and 5B having different coefficients of expansion. The edges and ends of these strips can be welded directly together or they can be welded to a metal bead 12.

The bulb can also be made from a single bimetallic strip bent into the U-shaped cross-section of Fig. 6, with the free edges thereof welded together or to a bead 13.

The operation of the several bulbs, herein shown, will best be understood by reference to the chart designated Fig. 7. When a temperature change is impressed on the bulb 5, the two sides of the bulb change in shape and thereby change the internal volume of the bulb. The change in volume due to the change in shape of the bulb will be larger than the change in internal volume of the liquid due to its expansion with temperature. A typical ratio of these two volume changes is ten to one.

That the bulb of the present invention is much faster in response than the conventional bulb is due to the fact that the majority of the response is controlled by the relatively thin shell comprising the metallic part of the bulb. In

other words, when the metallic layers are heated through, the largest portion of the response has taken place. This is in contrast to a conventional bulb in which the speed of response is controlled for the most part by the rate of heating of the liquid volume inside the bulb.

It is the nature of this particular invention that the volume change due to the metallic portion of the bulb (see curve A of Fig. 7) and the volume change due to the liquid expansion within the bulb (see curve B) influences the Bourdon spring or other pressure responsive element in opposing directions, that is, the resultant magnitude of response of the Bourdon spring is equal to the difference between the two mentioned volumetric effects (see curve C). It will be noted that the resulting response curve C is different from conventional responses in that the response first reaches a maximum and then declines a small degree.

While the Bourdon spring type of pressure responsive element has been disclosed, it will be understood that other pressure responsive elements such as bellows, diaphragms and capsular chambers may be substituted therefore.

Although any type of bimetallic material may be used, it is convenient to use that type wherein one of the metal layers thereof has substantially zero coefficient of expansion.

What I claim is:

1. A sealed bulb for use in a thermoresponsive tube system wherein the bulb is sealed in communication with a capillary tube in turn communicating with a pressure responsive element, the tube system being filled with a transmitting fluid, said sealed bulb comprising two opposing walls, each made of two layers bonded together throughout their entire area, said layers having different coefficients of expansion, the space between the inner surfaces of said opposing walls being thinner than the thickness of one of said layers whereby the volume change of the bulb in response to a given temperature change is substantially greater than the volume change of the fluid therein in response to said given temperature change.

2. A thin, flat bulb adapted to be filled with a thermoresponsive fluid for communication with the capillary tube of a thermoresponsive device, said bulb comprising an elongated tube flattened into strip form with sealed ends except for an opening in one end in communication with the capillary tube and having opposed walls, each wall being made of bimetallic layers bonded together throughout a substantial area thereof.

3. A thin, flat, strip-type bulb adapted to be filled with a thermoresponsive fluid for communication with the capillary tube of a fluid filled thermoresponsive device, said bulb comprising an elongated tube made entirely of two layers of dissimilar metals bonded together and flattened into band-like form with sealed ends except for an opening in one end for communication with said capillary tube.

4. A flat, strip-type bulb filled with a thermoresponsive fluid for communication with the capillary tube of a fluid-filled thermoresponsive device, said bulb comprising two elongated, opposed, strip-like walls each made of bimetallic layers with a thin space between them, said layers having different coefficients of expansion, one of which is substantially zero, whereby the change in volume of the bulb due to a change in ambient temperature is several times greater than the change in volume of the fluid therein, due to said ambient temperature change.

5. A flat, strip-type bulb adapted to be filled with a thermoresponsive fluid for communication with the capillary tube of a fluid-filled thermoresponsive device, said bulb comprising two opposed walls each made of bimetallic layers with a thin space between them, said layers having different coefficients of expansion, the layer having the greater coefficient of expansion being located at the outer surface of the bulb.

6. A flat strip-type bulb filled with a thermoresponsive fluid for communication with a capillary tube of a fluid-filled thermoresponsive device comprising a bimetallic strip, U-shaped in cross section and having its edges joined together in sealed relation.

7. A flat strip-type bulb adapted to be filled with a thermoresponsive fluid for communication with a capillary tube of a fluid-filled thermoresponsive device, said bulb comprising two opposing bimetallic strips connected together at two adjacent edges sealed at their ends except for an opening in one end in communication with the capillary tube and a bead to which the remaining adjacent edges of said strips are welded in sealed relation.

8. A sealed bulb for use in a thermoresponsive tube system wherein the bulb is sealed in communication with a capillary tube in turn communicating with a pressure responsive element, the tube system being filled with a transmitting fluid, said sealed bulb comprising two strip-like opposing walls, each made of two layers bonded together throughout their entire area, said layers having different coefficients of expansion, the space between the inner surfaces of said opposing walls being thinner than the thickness of one of said layers whereby the volume change of the bulb in response to a given temperature change is substantially greater than the volume change of the fluid therein in response to said given temperature change.

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