Sept. 8, 1964 G. F. DALES 3,148,258

THERMOSTAT WITH BIMETAL SET IN PLASTIC

Filed Sept. 26, 1961

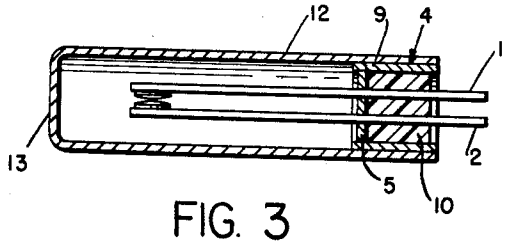

FIG. 3

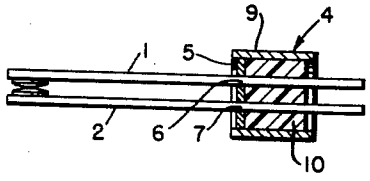

FIG. 1

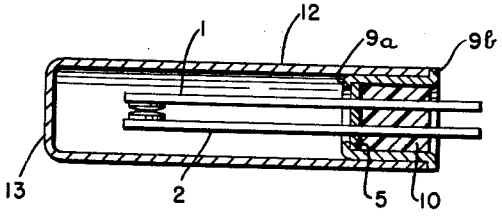

FIG. 4

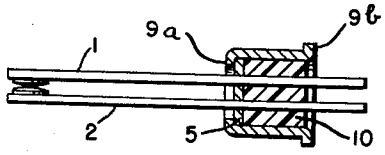

FIG. 2

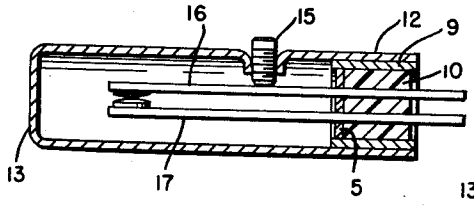

FIG. 5

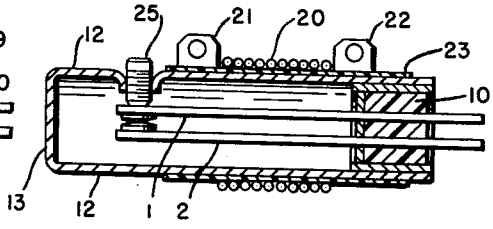

FIG. 6

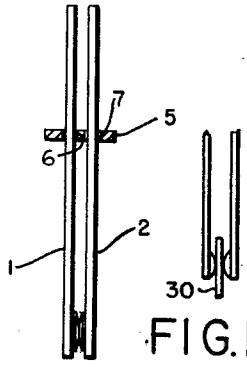

FIG. 7

FIG. 10

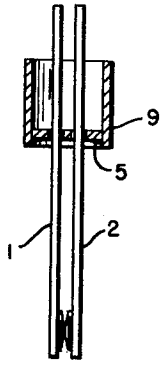

FIG. 8

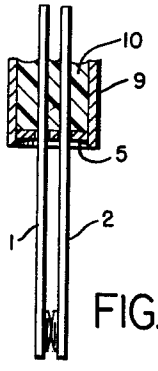

FIG. 9

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THERMOSTAT WITH BIMETAL SET IN PLASTIC

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5 Claims. (Cl. 200—138)

This invention relates to a thermostat which includes two electrodes adapted to make and break contact. At least one of these electrodes is bimetallic. The use of an electrode composed of a non-bimetallic member with a bimetallic member adjacent to it so that the bimetallic member moves the non-bimetallic member is the equivalent of a bimetallic electrode for the purpose of this patent.

The two electrodes are held in place by holding means which is composed at least in part of a set plastic. In use, the electrodes of this thermostat may be immersed in a liquid, or air, or other gas, and are heated thereby so that the contacts are brought together and separated as the medium in which they are immersed is heated or cooled, or vice versa. The electrodes are preferably enclosed in a casing of any structure and shape which protects them from dust and dirt, and then the operation of the thermostat is dependent upon the temperature within the casing. The casing may or may not be a dielectric.

The two electrodes may both be bimetallic. Alternatively, one may be bimetallic, and the other non-bimetallic. The electrodes referred to herein as bimetallic, may be bimetallic only in part. Thus the portion in and above the holding means may advantageously be made non-bimetallic so that it does not flex as the temperature changes; and all or part of the remainder may be bimetallic. For certain operations a stop, preferably adjustable, is provided for one or even both of the electrodes to establish the maximum distance that that electrode may be moved away from the other electrode. The preferred type of thermostat in which such an arrangement is used is one in which the holding means is sealed or otherwise held in one end of a tubular casing and a setscrew threaded through the wall of the casing applies pressure to an electrode. This casing may be cylindrical or of any other shape. It may be seamless. It is ordinarily metallic, but may be plastic or of other dielectric material. The end of the casing opposite that into which the holding means is sealed is preferably closed to keep out dust and dirt.

The thermostat is ordinarily small, the electrodes ordinarily not being over one inch, or two inches in length. If a casing is employed, the outside diameter of the casing need not be any greater than about ⅜ inch, but may be larger.

The thermostat is advantageously employed in a cycle switch or time-delay switch in which case it is preferably enclosed in a casing and the casing is provided with a resistance member which may be arranged in parallel with the line or load, or in series with the load as will be more particularly described in what follows.

The holding means in which the electrodes are held includes a rigid dielectric material which serves as a fulcrum. Ceramics, plastics, fiberboard or other rigid sheet materials may be employed, and whatever the composition of the sheet material, it forms a snug fit with the one or more electrodes. A limp paper or the like may be used if it is rigidified by the set plastic. This dielectric material is preferably held in one end of a short sleeve and the sleeve is filled with the plastic. The plastic may be supplied in a molten condition, or it may be in the form of solid particles, such as beads or powder, when incorporated in the thermostat, and then heated. If the plastic is chemically or thermally curable, the contact points of the electrodes are brought together or spaced to make and

break contact at any predetermined temperature and the plastic is heated to this temperature. If the plastic is not curable, but sets when cooled from being in the molten state, the temperature at which it sets is predetermined and the electrodes are set in it at this temperature with the contact points together, or spaced a predetermined distance so that they are brought together or separated (as the case may be) when the thermostat is heated to this temperature when in use.

The plastic may be one of those which sets at a predetermined temperature, described in Coates U.S. 2,745,924. The plastic may contain an inert filler. The gasket of Coates was actually a temporary silicone sponge which was removed in the final form of the thermostat shown in FIGURE 10 of the patent.

The invention will be further described in connection with the accompanying drawings, in which—

FIG. 1 is a side view of one form of thermostat;

FIG. 2 is a side view of a similar form of thermostat employing a slightly modified sleeve;

FIG. 3 is a view in section of the thermostat of FIG. 1 in a casing;

FIG. 4 is a view in section of the thermostat of FIG. 2 in a casing;

FIG. 5 is a view in section of a thermostat in a casing with a setscrew adjustably held in contact with one of the electrodes;

FIG. 6 is a view of a resistance wound casing containing an electrode with a setscrew bearing against a different portion of one of the electrodes;

FIGS. 7, 8 and 9 show schematically three views which illustrate the method of producing the thermostat; and

FIG. 10 illustrates the use of a spacer between two electrodes while the plastic sets.

In the thermostat of FIG. 1, the two electrodes 1 and 2 may both be bimetallic. Alternatively, one may be bimetallic and the other may be non-bimetallic. Either one or both may comprise a non-bimetallic member operated by the pressure of an adjacent bimetallic member. The two electrodes are held in the holding means 4. This comprises a rigid dielectric sheet material 5 which may be fiberboard or the like. There are two openings 6 and 7 in the sheet 5 in which the respective electrodes are held. The sheet makes a snug fit with the electrodes so that as the temperature of the thermostat is changed and the contact points move toward and away from one another, they fulcrum on at least one of the opposite edges of the openings 6 and 7 in the sheet. If the buttons are held together by pressure applied to the electrodes above the contact buttons when the plastic is set, the electrodes fulcrum on the edges of the narrow portion of the fulcrum between the openings 6 and 7. If the pressure is applied to the electrodes beyond the buttons, they fulcrum on the two outside edges of the openings 6 and 7.

The outside periphery of the sheet material 5 conforms to the inside periphery of the sleeve 9. This sleeve may be circular, square, octagonal, or any shape. The sleeve is filled with a set plastic material 10. Preferably the sleeve is held upright with the sheet material 5 at the bottom and then filled with plastic which may be molten or in a finely divided solid state. The electrodes are held in any predetermined relation with one another so that they will make or break contact at a given temperature. They are held in this position while the plastic sets, and thereafter the thermostat will function at the predetermined temperature. Any means may be employed for holding the electrodes while the plastic is setting. These electrodes may be straight or of any desired shape, and they need not necessarily be parallel as illustrated in FIG. 1.

If a curable resin is used, it is preferably supplied to the holding means 4 as a liquid or a solution, but it may

be supplied in a finely divided solid state and then be melted or dissolved before being set chemically or thermally. A preferred curable resin is an epoxide which is supplied as a liquid containing an activator which catalyzes polymerization when the mixture is heated to any temperature within a wide range. When polymerized the resin sets as a solid. A cold setting resin may be used if the thermostat is to be actuated at a low temperature. The thermostat is heated and maintained at a predetermined temperature while the resin becomes solid. It is prearranged that either (1) the electrode buttons are in contact at this temperature (in which case the thermostat is operable at this temperature later when put to use), or (2) the electrode buttons are spaced a predetermined distance at this temperature, as by insertion of a spacer of predetermined thickness between them (in which case the thermostat is thereafter operable at a predetermined temperature above or below this temperature depending (*a*) upon how far the electrodes are spaced when the resin is set and (*b*) upon whether the electrodes are arranged to come into contact or separate when heated).

If the resin is a thermoplastic which has no cold flow, such as a glass, it will have a known solidification temperature. For instance, the composition of certain glasses is kept so constant that the solidification point does not vary more than two degrees from batch to batch. If the plastic solidifies at the temperature at which the thermostat is to be actuated, the buttons are held together while the plastic solidifies. If the thermostat is to operate at a temperature different from that at which the plastic solidifies, the buttons are spaced a predetermined distance while the plastic solidifies, such that the buttons will thereafter be in contact at the desired operating temperature.

If the dielectric sheet 5 is porous (whether a fiberboard, glass fiber sheeting or other composition), it may be flexible or even limp in its original condition, and become impregnated by the liquid plastic above it. The sheet will then become rigid enough to serve as a fulcrum when the plastic sets.

The thermostat of FIG. 1 may be used in the condition shown, or it may be encased in any suitable casing to keep out dust and dirt. It may be held in an opening in an engine block. It may be spot welded in position or held by any other means.

The electrode of FIG. 2 is identical in design except that when the electrode is erect, the dielectric sheet 5 is supported by the inturned flange 9*a* of the sleeve. The opposite end of the flange is turned outwardly at 9*b*. It may thus be supported in an opening and held in place as by screwing a setscrew or cap screw into a threaded opening adjacent to it so that the head of the screw is brought into pressure contact with the metal of the holding means. The flange 9*b* might be turned inwardly over the plastic content of the holding means, if desired.

The thermostat is preferably held in a casing 12 (FIG. 4) and the casing may have a circular, square or octagonal section, or be of any other desired shape. It may be of metal or plastic, or of any other desired composition. It may be closed at the end 13, but this is not necessary. The holding means 4 is fastened in the casing, preferably at one end. If the sleeve 9 and casing 12 are both metallic the holding means 4 may be held in position by spot welding. Other means for holding the thermostat in the casing may be employed, and if the casing is of metal and the sleeve is plastic, other means than spot welding will be required as will be evident to the man skilled in the art.

FIGURE 4 shows the thermostat of FIG. 2 in the casing 12 with the flange 9*b* of the sleeve over the open end of the casing. If the sleeve and casing are of metal, the flange may be welded to the end of the casing. The thermostat may be held in the casing by an desired means.

FIGURE 5 shows a thermostat located in a casing with an adjusting screw 15 threaded into one wall of the casing and bearing against one of the electrodes 16. Both electrodes may be bimetallic, although the electrode 16 may be non-bimetallic and the electrode 17 bimetallic. (As previously stated, an electrode composed of a bimetallic member pressing against a non-bimetallic member is the equivalent of the bimetallic electrodes to which reference is made in this specification.)

A setscrew may be utilized to adjust the temperature at which the thermostat will operate temporarily. After the temporary period has passed the setscrew can be screwed out of contact with the electrode so that the thermostat will again operate at the predetermined temperature.

The position of the setscrew 15 in the casing may be varied, and the pitch of the threads may be varied. A setscrew provided with a dial head with temperature markings, without indicating whether the scale is centigrade or Fahrenheit, can be used for adjustments on both scales by locating the setscrew nearer or farther from the holding means. The setscrew 15 is preferably made of non-conducting material or, if of conducting material, it may be held in a non-conducting bushing held in the opening in the casing. Alternatively, the setscrew 15 may be composed of conducting material with a dielectric end in contact with the electrode 16. There may be situations where the setscrew may be of conducting material connecting the casing electrically with the electrode 16.

Any of the electrodes previously described may be employed as a switch as illustrated in FIG. 6. Here the casing is wound with a resistance which is parallel to the line, or parallel to the load, or in series with the load as will be explained in what follows. The thermostat need not be in a casing to operate as a switch, and the resistance need not encircle the thermostat. The two may be side by side, provided heat from the resistance is adequate to open and break the contacts of the thermostat.

In FIG. 6 the casing 12 is wound by the resistance wire 20, and the terminals of the resistance wire are connected with the electrical connections 21 and 22. If the casing 12 is made of metal a layer of insulating material 23 separates the resistance from the casing. The resistance may be a coil of wire, a tape, or the like. This resistance may be connected into the thermostat circuit in ways known to the art.

FIGURE 6 shows a setscrew 25 located to contact one of the electrodes at the contact points. It is not necessary that the thermostat used as a switch include any setscrew. The setscrew is shown to illustrate the location of the setscrew in a different position from that shown in FIG. 5. A setscrew may be used with a thermostat employed as a switch when located in any position, but the use of a setscrew is not necessary. Two setscrews may be employed, each limiting the distance one of the electrodes may move away from the other electrode, but the use of two such setscrews will not be usual.

FIGURES 7, 8 and 9 illustrate schematically the method of forming the thermostat. Reference will be had more particularly to the thermostat shown in FIG. 1, but it is to be understood that this is illustrative and that other types of electrodes may be used and other holding means may be formed about the electrodes.

FIGURE 7 shows the first step of the process in which the electrodes 1 and 2 are arranged side by side with the contact points opposite one another. They are held in this manner by any suitable dielectric means. FIGURE 7 shows the dielectric sheet 5 which may be fiberboard, a phenol-formaldehyde resin, asbestos, or other dielectric which is preferably rigid enough to support itself and serve as a fulcrum, although it is quite satisfactory to use a sheet which is less rigid and then stiffen it by impregnation with the plastic. FIGURE 8 shows the sheet 5 in the sleeve 9. It may first be inserted in the sleeve, before or after placing the electrodes in the openings in

it. The openings are preferably of just the same shape and size as the section of the electrodes so that the electrodes fit snugly in the openings. (In FIGS. 7–9 the size of the openings is exaggerated to illustrate the operation.)

The electrodes are then embedded in a plastic **10**, and unless the electrodes are insulated, this plastic is a dielectric. The sleeve **9** serves as a retaining wall and the plastic is built up toward the outer ends of the electrodes, but in the final product, as illustrated in the drawings, these ends project from the plastic. Although reference is made herein to the electrodes projecting from the plastic, it is to be understood that leads or terminals may be welded to the electrodes, or otherwise attached thereto, and the leads or terminals alone may project from the plastic.

FIGURE 10 illustrates the use of a spacer **30** between two electrodes, which may be any two of the electrodes shown in the drawings. If the electrodes are arranged to separate on heating, a spacer of predetermined width is used during calibration to separate the buttons on the electrodes if the plastic sets at a temperature above that at which the thermostat is to operate; and if the bimetal or bimetals are arranged so that the buttons come together on heating, a spacer of predetermined width is used during calibration to separate the buttons on the electrodes if the plastic sets at a temperature below that at which the thermostat is to operate.

The plastic is a settable plastic. It is liquid when it is formed around the electrode, and thereafter it is allowed to set and harden. It may be a thermosetting resin of which there are many on the market, or it may merely be a molten plastic which sets to a solid on cooling. It preferably is not a brittle type. It may be an asphaltic or resinous material, and if resinous it may be synthetic. It may include chemicals which cause it to set. Ordinarily the plastic will be of an organic composition, but inorganic cements, etc. may be employed.

The electrodes are held gently in contact with one another or spaced a predetermined distance by a suitable fixture while the plastic is setting. Any suitable means for heating the electrodes to the temperature of the plastic may be employed.

For purposes of illustration, it is to be understood that in the various views the plates **5** which hold the electrodes have a circular outline, and the sleeves are cylindrical, although it is to be understood that the shape of the plate and sleeve is not a feature of the invention, and they may be of any desired shape.

These small thermostats, whether encased or not, are well adapted for use in the automatic control of the operation of various appliances such as ovens, waffle irons, electric ions, etc. They are particularly adapted for use

in appliances where a circuit is to be interrupted, temporarily or permanently.

They may be used in connection with electrical heating means such as resistances which are located in heat-transferring relation with the thermostat. These resistances are advantageously placed around a thermostat located within a casing much as illustrated in FIG. 6, although other means of associating the resistance with the thermostat may be employed. Different types of resistances may be used.

The drawings and descriptive matter are illustrative, and the invention is covered in the claims which follow.

The invention is a continuation-in-part of my applications Serial No. 728,484, filed April 14, 1958 (now abandoned), and Serial No. 31,962, filed May 26, 1960.

What I claim is:

1. A thermostat which comprises at least one bimetal electrode held in a set plastic with one end of the bimetal projecting from one surface of the plastic, which end is adapted to make and break contact with another portion of the thermostat on change in its temperature, a rigid fulcrum plate having constant dimensions within the expected ambient temperature range, said plate being in intimate contact with said surface of the plastic, and a hole in the plate with the electrode fulcrumed against one edge of the hole.

2. A thermostat which comprises at least one bimetal electrode held in a set plastic, a rigid impregnatable fulcrum plate having constant dimensions within the expected ambient temperature range, at least one surface of which plate is impregnated with the plastic, and a hole in the plate with the electrode fulcrumed against one edge of the hole.

3. The thermostat of claim 1 which includes holding means and a casing, the plastic and fulcrum plate being within the holding means, and the holding means being held in one end of the casing.

4. The thermostat of claim 1 which includes holding means and a casing, the plastic and fulcrum plate being within the holding means with the fulcrum plate at one end thereof, the end of the holding means farthest from the fulcrum plate being flared out, and the casing being around the holding means with the flared-out end thereof against one end of the casing.

5. The thermostat of claim 1 in which the plastic is glass which has no cold flow.

References Cited in the file of this patent

UNITED STATES PATENTS

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205,079 Australia ---------- Aug. 18, 1955