Jan. 11, 1955 C. E. ARMSTRONG 2,699,480

FIRE ALARM THERMOSTAT

Filed March 11, 1952

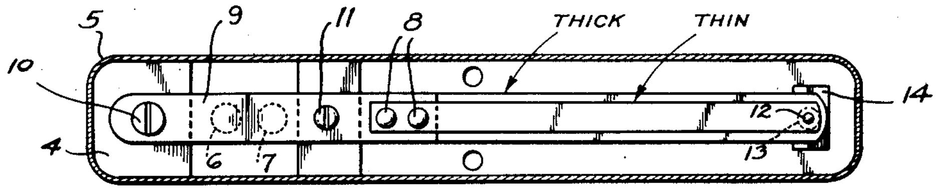

Fig. 2.

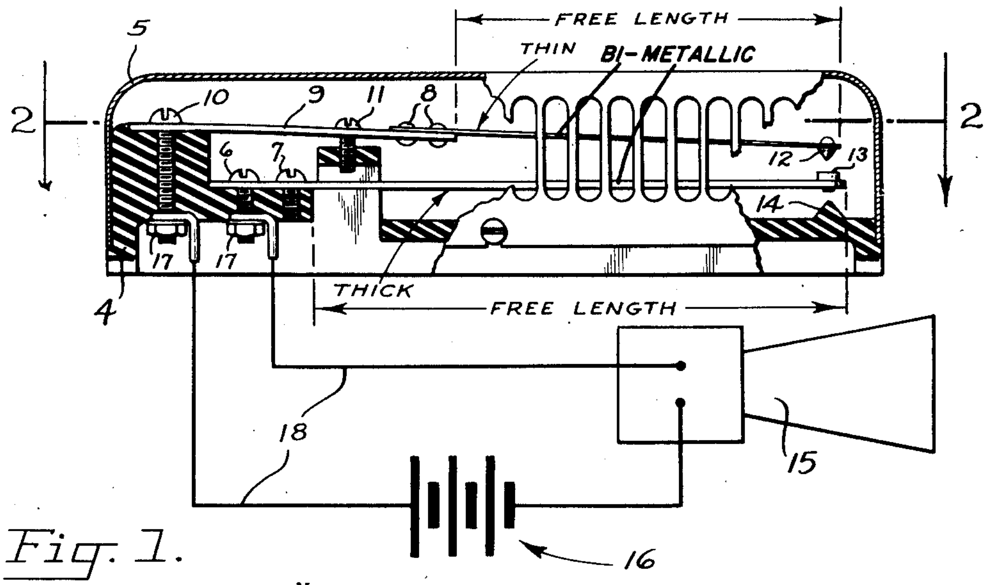

Fig. 1.

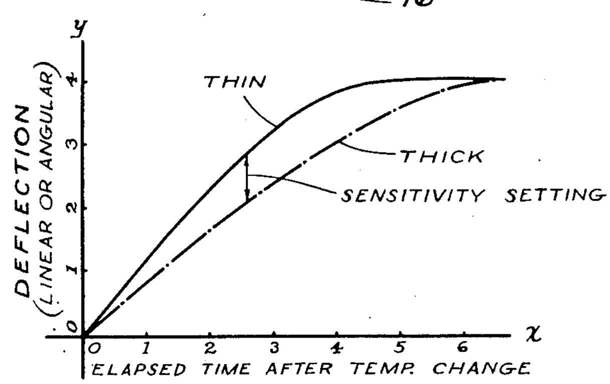

Fig. 3.

INVENTOR.
Charles E. Armstrong
BY [signature]
Atty.

United States Patent Office

2,699,480

Patented Jan. 11, 1955

1

2,699,480

FIRE ALARM THERMOSTAT

Charles E. Armstrong, Portland, Oreg., assignor to Electric Controls, Inc., Portland, Oreg., a corporation of Oregon

Application March 11, 1952, Serial No. 275,966

5 Claims. (Cl. 200—139)

My invention pertains to a dual element bimetal control which is responsive not only to a preselected maximum or minimum ambient temperature, but also to a preselected rate or speed of temperature change between such limits. Such a control, by way of example, is useful as a fire alarm thermostat or detector where the response to rate or speed of change assures a maximum sensitivity even when the upper limit of the control purposely is set at a high temperature in order to minimize false alarms.

One object of my invention is to provide, in a temperature responsive control switch a pair of bimetal strips arranged in stacked relationship and having normally spaced electric contacts on the free ends thereof, said strips being arranged to deflect equal distances along the same path in response to a given change in temperature in order to maintain the normal spacing of said contacts. As an additional provision, one bimetal strip is thinner and shorter than the other. Thus, the thinner strip is more sensitive and is provided with a faster rate of response to the end that a sudden temperature change of preselected intensity will close the electric contacts and will complete an alarm circuit or the like when the faster strip catches up with the slower strip.

The conventional bimetal thermostat which today is used in conjunction with fire alarms and the like consists of a cantilever strip, helix, or spiral bimetal which is responsive to the ambient temperature in the area protected by the alarm and which moves an electric contact toward and away from a fixed contact as the ambient temperature varies. For example, a cantilever bimetal element may be arranged either to make or to break an appropriate type of electric circuit when the ambient temperature reaches a preselected maximum value, the electric circuit then functioning to sound an alarm, turn on a sprinkler system, or otherwise indicate the presence of an excessive temperature. Speaking generally, this type of bimetal control today is manufactured in a wide variety of styles and sizes, improvements and refinements thereon having occupied the attention of many manufacturers and inventors. However, in spite of the large amount of activity in this field, I have found certain basic protective functions to be wanting in all bimetal controls. Accordingly, it is toward the provision of a more adequate, a more sensitive, and a more versatile bimetal control that I have directed my inventive efforts.

Frequently, in a warehouse or other area protected with a conventional thermostatic bimetal alarm or control, a fire will originate either in material having a low combustion temperature or in material having a higher combustion temperature but under conditions which cause the fire to smolder and initially to burn at a slow rate. Under either of these conditions the ambient temperature of the protected area does not immediately rise above the temperature to which the bimetal control is set. Accordingly, a time lag is evident between origination and detection and the fire may do substantial damage before the bimetal control is actuated either to turn on the sprinklers or to sound the alarm. To take a concrete example, many bimetal fire alarm controls are set at 140° F. However, if the temperature of the protected area initially is quite low, as for example 40° F., a fire may break out and do substantial damage before the ambient temperature reaches 140° F. On the other hand, it is unwise to set the control at a temperature much less than 140° F., since experience has shown that natural heating, on a hot day or from causes other than an uncontrolled fire, will actuate the control and sound a false alarm. This example makes clear a problem which it is an object of my invention to solve, namely the problem of providing a maximum sensitivity in a bimetal control without, at the same time, setting the control at such a low temperature that false alarms will result.

To the above end, I have utilized the known physical properties of a bimetal element whereby the deflection of the free end of the element directly is proportional to the free length and inversely is proportional to the thickness. Further, I have utilized the known differences in rate of deflection between bimetal elements of differing thicknesses, a thinner element being more sensitive, more quick, and more rapid in response than a corresponding thick element. Correlating the above factors, I have provided a pair of mated bimetal elements, preferably formed of similar or identical bimetal materials, and having the free ends thereof mounted in stacked but normally spaced relationship. By correlating the physical dimensions of the elements, I have provided similar linear deflection characteristics and have arranged the elements so that one will follow the other along a preselected path and the spaced relationship of the free ends thereof will be maintained during normal changes in temperature. Thus, an exemplary range of temperatures between 0° F. and 140° F. may be provided and, within this range, the two bimetal elements will follow one another and will flex back and forth without coming into contact during normal temperature changes. That is to say, normal heating or cooling of the controlled area will not cause the elements to contact one another. In addition to the above factors, however, I have made the following one of said bimetal elements more thin than the leading element. Thus, while the elements will deflect equal distances under normal conditions, the following element is provided with a faster rate of response to temperature variations. That is to say, when the temperature varies suddenly a preselected amount, the thin following element will catch up with the thicker leading element. Thus, by arranging appropriate electric contacts on the free deflecting ends of these bimetal elements, I have provided a thermostatic control device which may be used as a fire alarm to actuate an electric circuit when a preselected rapid rise in temperature is evidenced. For example, even though the ambient temperature still may be within the critical 0° F. to 140° F. range, a rapid rise in temperature will cause the thin element to flex more rapidly, to catch up with the thick element and, thereby, to close the electric contacts and make the electric circuit.

A further object of my invention is to provide a dual element bimetal control device which is movable to a closed position in response either to a preselected temperature change or to a preselected rate of change, whichever change occurs first in point of time. In service of this object, I provide an abutment stop means which is mounted adjacent the free end of the thick bimetal element at a preselected point along the deflection path thereof. During operation, this abutment stop will engage and hold the free end of the thick strip to allow the thin strip to mate therewith at the preselected maximum temperature.

A further object of my invention is to provide an electric circuit means which is joined in series with the electric contacts on the above described bimetal control device in order that an indicator, such as a sprinkler system or an alarm, will be actuated in response either to a maximum ambient temperature or to a preselected rate of temperature change.

These and other objects and advantages of my invention will be set forth in the following detained description, taken in conjunction with the accompanying drawing, therein:

Fig. 1 is a side view, partially broken away, of a thermostatic bimetal control constructed in accord with my invention and joined, electrically, to an indicator whereby either a preselected temperature change or a preselected rate of temperature change will actuate the indicator;

Fig. 2 is a section view, taken substantially on the line 2—2 of Fig. 1, better illustrating the relative lengths and the stacked relationship of the thin following bimetal element and the thick leading bimetal element; and

Fig. 3 is a graph in which the deflection of the thin bimetal element and the thick bimetal element are plotted against the elapsed time after a temperature change, this graph serving to indicate the variation in rate or speed of response between the thin and thick elements.

As is known to those skilled in the art, the function of a bimetal element follows definite physical laws, the deflection of the free end thereof depending upon several factors which include (1) the type of bimetal, (2) the length of the bimetal strip, (3) the thickness of the bimetal strip, and, (4) the temperature change or range over which the performance is calculated. Utilizing these variable factors, mathematical formulae have been developed by which the thermal action of various shapes, such as straight strips, coils, spirals, helixes, U-shapes, disks, and compound elements may be calculated. The particular formula to be employed will vary somewhat with the shape or configuration of the bimetal element under consideration. However, those factors which are critical in the performance of all bimetal elements can be illustrated with reference to the simple cantilever type. Accordingly, while the scope of the instant invention is inclusive of shapes other than cantilevers, the following disclosure will be made with particular reference to an exemplary cantilever type bimetal element.

To this end, the mathematical formula for the deflection of a cantilever may be expressed

$$D=\frac{K(T_2-T_1)L^2}{t}$$

In this formula, D is the deflection of the free end of the element in inches, K is a constant which is calculated for the particular type of bimetal utilized, (T_2-T_1) is the temperature difference in degrees F, L is the active free length of the bimetal element in inches, and t is the thickness of the element in inches. An inspection of this formula will reveal that the free end deflection of the cantilever-type bimetal element is directly proportional to the square of the free length thereof and is inversely proportional to the thickness of the element. Further, if all factors in the formula, except the factor of thickness, are held constant, the formula may be differentiated (in accord with the laws of calculus) to arrive at a second formula in which the rate of change of deflection is correlated to the thickness t. Such a rate of change formula reveals that the speed of deflection is inversely proportional to the square of the thickness. It is the mathematic and physical conclusions following from the above discussion of the deflection of an exemplary cantilever bimetal element which I have utilized in the construction of the instant invention.

Having in mind the above interrelated factors of length and thickness, reference should be had to Figs. 1 and 2 wherein my exemplary cantilever type control is shown. In these figures, I have shown a base member **4** which is provided with a removable apertured cover member **5**. Additionally, two elongated bimetal strips or elements are shown operatively mounted upon the base member **4**. The first of these bimetal strips is indicated by the legend "thin" and the second by the legend "thick," these legends corresponding to the physical dimensions of the elements. Further as can be seen by the arrowed dimension lines in Fig. 1, the thin bimetal element has a "free length" which is less than the "free length" of the thick bimetal element, these physical dimensions being correlated one to another in accord with an important feature of my invention and by solving the previously mentioned deflection formula.

In detail, the thick bimetal element is secured to the base member 4 by means of two mounting screws **6** and **7**. The thin element, on the other hand, is riveted, as at **8**, to an elongated mounting bar **9**. In function, the mounting bar **9** should be flexible and electrically conductive but should be uneffected, to any appreciable degree, by temperature changes within the range of temperatures to which the bimetal elements are responsive. Accordingly, in my preferred embodiment, the mounting bar **9** is formed of spring Phosphor bronze and is secured, as by the metal mounting screw **10**, to the base member **4**. The flexibility of this mounting bar is important in order that the relative position of the thin bimetal element initially may be set. To this end, an adjustment screw **11** interconnects an intermediate portion of the bar **9** and the base member **4**. When this adjustment screw is tightened, the entire length of the thin bimetal element is moved down toward the base member **4**. Conversely, when the adjustment screw **11** is backed off, the thin element is moved away from the base member **4**.

As shown in Figs. 1 and 2, the thick and thin bimetal elements are mounted in stacked relationship, one over the other, upon the base member **4** and the free deflecting ends thereof carry the mated electric contacts **12** and **13**. These electric contacts normally are spaced one from the other as shown in the drawing and, by virtue of the stacked relationship of the free ends of the bimetal elements, the contacts are mounted to traverse the same path of flexure as the bimetal elements respond to temperature changes. Further, as shown in Fig. 1, an abutment stop **14** is positioned beneath the free end of the thick bimetal element adjacent the under side of the electric contact **13**. This stop, as hereinafter will be explained, is positioned at a preselected point along the deflection path of the bimetal free ends in order to engage and to hold the thick element so the thin element may continue to deflect and, eventually to catch up to the thick element. Further, in the commercial model of my invention, the base member **4** and abutment stop **14** are molded as an integral piece from a thermosetting phenolic plastic so the height and effective position of the stop **14** may be set by filing off the protruding point of the stop.

To illustrate a typical use of my dual element bimetal control, an electric circuit has been shown in series therewith in Fig. 1. Thus, the thick and the thin bimetal elements are arranged to deflect in the same direction in response to a temperature change (the high expansion sides both being on top) and, as is known in the art, the bimetal material itself is electrically conductive. As additional factors in the electric circuit, the mounting bar **9**, the screws **6** and **10** and the electric wires **18** which are joined thereto all are electrically conductive. The base member **4**, on the other hand, is a non-conductive insulator. The numeral **15** identifies an indicator element for the electric circuit. In the exemplary structure, this indicator **15** is shown as an electric horn or the like and it is joined in series with the bimetal elements, the electric contacts **12** and **13**, a storage battery **16**, and a pair of electric connectors **17** which join the screws **6** and **10** to the bimetal elements. Accordingly, when the two electric contacts **12** and **13** define a closed or make position, an electric circuit is completed from the battery **16**, through the wires **18**, the screw **10**, and the thin bimetal element, to the contact **12**. From this contact the circuit travels back via the contact **13**, the thick bimetal, the screw **6**, and the indicator **15** to actuate the latter and sound an alarm. Such a closure of the contacts **12** and **13** and such an actuation of the indicator may be effected in either of two ways as now will be explained.

It is an important feature of my invention that the electric contacts **12** and **13** will be closed in response either to a preselected temperature change or to a preselected rate of temperature change, whichever change occurs first in point of time. To this end, the formula

$$D=\frac{K(T_2-T_1)L^2}{t}$$

has been shown to indicate that the linear deflection of a cantilever type bimetal element is directly proportional to the square of the free length of the element (L) and is inversely proportional to the thickness of the element (t). In the drawings it will be noted that the thin bimetal element is shorter than the thick bimetal element. Further, by following the relationships evident in the formula, an appropriate interrelationship of length and thickness in the two bimetal elements has been developed to the end that both bimetal elements will deflect equal linear distances at the free ends thereof. That is to say, the electric contacts **12** and **13** are mounted upon the free ends of the bimetal elements. Normally, these contacts are spaced one from another as shown in the drawings. Further, as the bimetal elements deflect in normal operation, this spacing is maintained and the electric circuit is not made.

To examine a typical cycle of operation, let it be assumed that the bimetal control device is used as the fire detector. For the purposes of this particular use, the thick and thin bimetal elements both will be arranged to deflect toward the base member **4** as the ambient temperature increases. Further, in accord with the previously mentioned correlation of length and thickness, a given slow or normal temperature rise will produce equal deflections and equal movements of the contacts **12** and **13** within that range of temperatures for which the device is set. To be more specific, let it be assumed that the fire detector is installed in an unheated warehouse where the operative range is 0° F. to 140° F., the upper limit of 140° F. being defined by the position of the abutment stop **14**. In this instance, as the ambient temperature rises or falls slowly within the effective range of the control, the two electric contacts **12** and **13** will be moved back and forth in leading and following relationship without touching. However, should the temperature reach 120° F. or 130° F., depending upon the setting of the adjustment **11** and the stop **14**, the thick element will be moved into contact with the abutment stop and further deflection thereof will be halted. Thereafter, if the temperature continues to climb, the thin bimetal element will continue to deflect and, eventually, the preselected temperature of 140° F. will be reached. At that point, the electric contact **12** will have moved into contact with its mate **13** and the electric circuit will be completed through the indicator **15** to sound an alarm. In this function, the control device is somewhat similar to a conventional bimetal thermostat in that actuation has been effected at a preselected maximum temperature. However, because of the critical relationship of length and thickness previously set forth, my control device also is capable of a second function. To this end, it previously has been explained that the rate or speed of deflection of a bimetal element is inversely proportional to the square of the thickness thereof. Accordingly, the thin bimetal element of my invention will deflect at a much greater rate or speed than the thick element. Under normal conditions of slowly rising and falling temperatures, this difference in rate of deflection is of little consequence since the contacts **12** and **13** are spaced sufficiently to allow a margin of safety. Expressed in different words, the thin bimetal element is more sensitive or more responsive but this sensitivity will be evidenced by a closure of the contacts **12** and **13** only when there is a sudden change in the ambient temperature.

Referring to Fig. 3, this difference in rate of response has been illustrated by means of a graph. In this graph, the X axis represents elapsed time after a given temperature change and the Y axis represents either linear or angular deflection of the free end of a bimetal element. The deflection curves of a thick (dashed line) and a thin (solid line) bimetal element both are plotted upon this graph. Thus, because the ultimate deflection of both bimetal elements is equal, the curves will be seen to intersect adjacent the upper right hand margin of the graph. At the same time, however, it will be noted that the deflection curve for the thin element climbs toward this ultimate deflection at a greater "rate" or slope than the comparable thick element deflection curve, the ultimate deflection of the thin element being reached much sooner on the time axis than that of the thick element. Thus, while this graph is not plotted with mathematical precision and the representation thereon is only approximate, it does serve to indicate the critical factor in my invention whereby the control device is responsive to a preselected rate of temperature change. Further, the double ended arrow labeled "sensitivity setting" is a graphical representation of the setting of the adjustment screw **11**, this Y axis distance between curves being inversely proportional to the spacing of the elements as hereinafter will be described.

Assuming now that the thick and thin bimetal elements in Figs. 1 and 2 are preselected and set to have an accurate deflection constant within a temperature range of 0° F. to 140° F., the adjustment screw **11** initially is set to define a normal spacing of the electric contacts **12** and **13**. After this initial setting, the spacing between the free ends of the elements will be maintained, during slow or normal temperature changes, since the deflection characteristics of the two bimetals are similar. In response to a sudden temperature change, however, the bimetal elements will move together and the contacts will close as the thin element catches the thick element. By way of example, such a sudden change of temperature will be evident when a fire breaks out and, in accord with

one important feature of my invention, it is immaterial whether such a fire has a high or a low combustion rate. That is to say, a relatively rapid rise of 20° F. or so is sufficient to cause the thin bimetal element to deflect with such speed that the electric contact **12** will catch up with the contact **13** and make the electric circuit. Thus, even though the ambient temperature has not risen sufficiently to cause the thick element to contact the abutment stop **14**, the greater velocity or sensitivity of the thin element will cause the contacts to close and to make the electric circuit through the indicator **15**. Further, in accord with another important feature of my invention, the magnitude of that temperature rise which will cause such a "rate" response can be preselected, such preselection being effected by the adjustment screw **11**. Thus, it is the normal spacing of the contacts **12** and **13** and the relative thicknesses of the bimetal elements which determines the magnitude and rate of temperature rise which will cause the thin element to catch the thick element. One of these factors, namely the normal spacing of the contacts, can be preselected by tightening or backing off the adjustment screw **11**. This adjustment will effect a sensitivity setting as indicated on the graph in Fig. 3. For example, if the control device is to be set to a very fine rate of change sensitivity, the contacts **12** and **13** should be made to travel in close proximity during all normal deflections of the bimetal elements. Such a close proximity can be effected merely by tightening the adjustment screw **11** and, thereby, shortening the gap or spacing between the contacts. Thereafter, the thin element will catch up with the thick element at a point on the graph of Fig. 3 where the two deflection curves are spaced but a short distance (after a small time interval). On the other hand, less sensitivity may be incorporated in the device by backing off the adjustment screw **11** so the thin element will not catch up with the thick element until the point on the graph where the curves are spaced a maximum distance (after a larger time interval or in response to a greater change in temperature).

Returning now to the formula which expresses the deflection of a cantilever type bimetal element in terms of the length and thickness thereof, the manner of constructing my invention will be explained. This formula is

$$D=\frac{K(T_2-T_1)L^2}{t}$$

and, as explained previously, K is a dimensionless constant which may be calculated for the particular type of bimetal element selected. For example, a bimetal strip in which the low expansion side is invar, a nickel iron alloy having a nickel component of approximately 35%, and the high expansion strip is brass, is conventional. Accurate physical tests of such a bimetal will yield an average value for the constant K which is accurate over the desired range of temperatures. After selecting a bimetal and calculating the constant thereof, the first step in fabricating a control is to select a length and thickness for the thick bimetal element. These dimensions generally will depend upon the space available in the contemplated installation. Further, since it is known that the thin bimetal element must deflect with more rapidity than the thick element, the factor of thickness for the thin bimetal element also may be preselected.

Continuing, it will be remembered that the free ends of the two bimetal elements must deflect the same linear distance for a given temperature change throughout the operative range of the control device. Accordingly, the known factors of length and thickness for the thick element are substituted in one formula as above set forth and the known factor of thickness is substituted in a second formula. Thereafter, these two formulae are made equal to each other (equal deflections for equal temperature changes) and an equation is established in which, after the constant K and the temperature change (T_2-T_1) are substituted, the only unknown is the length L of the thin bimetal element. Solving this equation will give a numerical value for the length of the thin bimetal element and the control then is ready for assembly.

During assembly, the known physical dimensions of the thick and thin elements are correlated one to another. That is to say, the two bimetal elements are mounted upon the base member **4** so their free ends are in stacked relationship. Thereafter, these ends will deflect equal linear distances throughout the operative range of the control and the normal spacing of the electric contacts **12** and **13** will be maintained. However, also in accord with the above calculations, the thin bimetal element will be somewhat shorter than the thick element so the bar **9** is employed to match the free ends. Also the thin element is more sensitive and it has a faster response to temperature changes so the contacts **12** and **13** will close in response to a preselected "rate" of temperature change as has been explained with reference to the graph in Fig. 3.

In summary, I have provided a dual element bimetal control which is responsive not only to a preselected maximum or minimum ambient temperature, but also to a preselected rate or speed of temperature change within such limits. Accordingly, the control device will be found to have many diverse uses in addition to the exemplary fire alarm use. For example, the control is very effective when used to detect a minimum temperature in conjunction with a rate of temperature fall. For such a use, of course, two bimetal elements must be set in the same relative position on the base member but the high and low expansion sides thereof must be inverted so as to deflect toward the base member when the temperature drops. In an Alaskan warehouse, by way of example, the control device may be set to respond either to a preselected minimum temperature (to prevent freezing of foodstuffs or machinery) or to a preselected rate of temperature drop (such as might be evident when a door was left open or a window was broken) whichever contingency occurred first in point of time. This exemplary use, however, is but one of many that will present themselves to those skilled in the art and each such use, it will be evident, is dependent upon the correlation of the two bimetal elements so that both deflect equal distances yet one deflects at a greater rate or speed. Thus, the invention itself is inclusive of all normally spaced dual element bimetal controls in which a rate of temperature change is utilized to effect an actuation.

I claim:

1. A temperature responsive bimetal control device, comprising a first relatively uncoiled bimetal element operatively carrying a first electric contact at the free end thereof, a second relatively uncoiled bimetal element operatively carrying a second electric contact at the free end thereof, said first and second elements being arranged with said free end electric contacts in stacked but normally spaced relationship and with the high expansion sides of the bimetal elements on correlated, corresponding sides so one element will follow the other during expansion and contraction movements, means operatively engaging said first element for adjusting the amount of spacing between said electric contacts, the linear deflection of each bimetal element free end being directly proportional to the free length of the element and inversely proportional to the thickness of the element, said first bimetal element being thinner and shorter than said second bimetal element and being mounted to define the following one of the elements, the thickness and free lengths of said elements being preselected and correlated one to another to produce substantially equal linear deflections of said free ends and thereby to maintain the normal spacing of said electric contacts, the less thick first element, however, having a faster time rate of response to temperature changes thereby to narrow said normal spacing and close said electric contacts in response to a preselected fast rate of temperature change.

2. A temperature responsive control, comprising a base member, a first relatively uncoiled elongated bimetal element operatively mounted upon said base member and carrying a first electric contact at the free end thereof, a second relatively uncoiled elongated bimetal element operatively mounted upon said base member and carrying a second electric contact at the free end thereof, said first and second elements being arranged with said free and electric contacts in stacked but normally spaced relationship and with the high expansion sides of the bimetal elements on correlated, corresponding sides so one element will follow the other during expansion and contraction movements, the linear deflection of each bimetal element free end being directly proportional to the free length of the element and inversely proportional to the thickness of the element, said first bimetal element being thinner and shorter than said second bimetal element and being mounted to define the following one of the elements, the thickness and free lengths of said elements being preselected and correlated one to another to produce substantially equal lineal deflections of said free ends and thereby to maintain the normal spacing of said electric contacts, the less thick first element, however, having a faster time rate of response to temperature changes thereby to narrow said normal spacing and close said electric contacts in response to a preselected increased rate of temperature change, a stop means carried by said base member and positioned in the path of said second bimetal element to engage and hold the same while the first element continues to flex.

3. In a dual-element bimetal control device responsive either to a preselected end temperature or to a preselected rate of temperature change whichever occurs first in point of time, a base member, first and second relatively uncoiled elongated bimetal strips mounted in stacked relationship upon said base member and arranged to deflect in the same direction in response to a change in temperature, the free deflecting ends of said bimetal strips being mated one to another and being arranged to deflect along the same path in normally spaced, leading and following relationship, adjustment means operatively engaging the fixed end of said first bimetal strip initially to preselect the amount of spacing between said free ends, the thickness and free lengths of said bimetal strips being correlated to produce substantially equal linear deflections of said free ends and thereby normally to maintain the spacing thereof, said first bimetal strip defining the following one of the elements and being thinner than, yet having a shorter free length than said first bimetal strip in accord with said preselected rate of temperature change, and an abutment stop means mounted adjacent the free end of said second strip but remote from the free end of said first strip at a preselected point along the deflection path therefore to engage and hold the free end of the second strip in accord with the spacing between said free ends and said preselected end temperature.

4. In a dual-element bimetal switch movable to a closed position in response either to a preselected temperature change or to a preselected rate of temperature change whichever change occurs first in point of time, a base member, first and second relatively uncoiled elongated bimetal strips mounted in stacked relationship upon said base member and arranged to deflect in the same direction in response to a change in temperature, the free deflecting ends of said bimetal strips carrying mated and normally spaced electric contacts arranged to deflect along the same path in normally spaced, leading and following relationship, adjustment means operatively engaging the fixed end of said first bimetal strip initially to preselect the amount of spacing between said electric contacts, the thickness and free lengths of said bimetal strips being correlated to produce substantially equal linear deflections of said free ends and thereby normally to maintain the spacing thereof, said first bimetal strip defining the following one of the elements and being thinner than, yet having a shorter free length than said first bimetal strip in accord with said preselected rate of temperature change.

5. In a dual-element bimetal switch movable to a closed position in response either to a preselected temperature change or to a preselected rate of temperature change whichever change occurs first in point of time, a base member, first and second relatively uncoiled elongated bimetal strips mounted in stacked relationship upon said base member and arranged to deflect in the same direction in response to a change in temperature, the free deflecting ends of said bimetal strips carrying mated and normally spaced electric contacts arranged to deflect along the same path in normally spaced, leading and following relationship, both of said bimetal strips being electrically conductive, adjustment means operatively engaging the fixed end of said first bimetal strip initially to preselect the amount of spacing between said electric contacts, the thickness and free lengths of said bimetal strips being correlated to produce substantially equal linear deflections of said free ends and thereby normally to maintain the spacing of said electric contacts, said first bimetal strip defining the following one of the elements and being thinner than, yet having a shorter free length than said first bimetal strip in accord

with said preselected rate of temperature change, an abutment stop means mounted adjacent the free end of said second strip but remote from the free end of said first strip at a preselected point along the deflection path therefore to engage and hold the free end of the second strip in accord with said preselected temperature change.

References Cited in the file of this patent

UNITED STATES PATENTS

578,345	Maxim	Mar. 9, 1897
1,544,549	Barnett	July 7, 1925
2,101,637	Davis	Dec. 7, 1937
2,187,975	Kuhn et al.	Jan. 23, 1940
2,526,992	Biermann et al.	Oct. 24, 1950