United States Patent

[11] **3,609,618**

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[54] **THERMOSTAT WITH OVERLAPPED BIMETAL CONTROL STRIPS THEREIN**
8 Claims, 2 Drawing Figs.

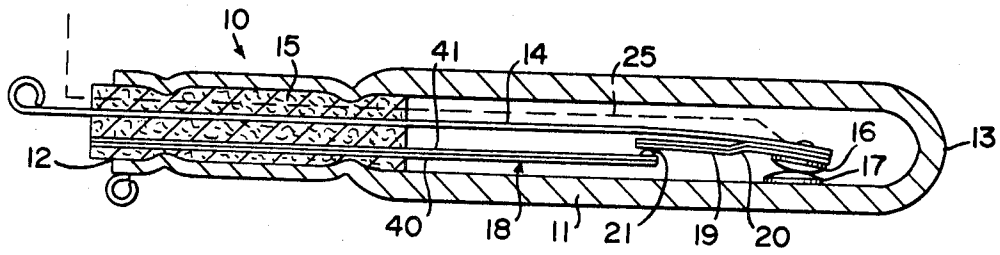
[52] **U.S. Cl.** **337/95,** 337/112
[51] **Int. Cl.** **H01h 37/52,** H01h 61/013, H01h 61/06
[50] **Field of Search** 337/38, 39, 40, 89, 92, 95, 96, 102, 103, 107, 112, 336, 337, 370, 371, 377, 380; 73/363.5

[56] **References Cited**
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ABSTRACT: A thermostat, thermal protector, or the like is provided including a shunt strip extending into the casing in cantilever form and where a pair of opposed contacts are usually carried by the free end of the shunt arm and the inside wall of the case in opposed relation. A bimetal strip is secured as a cantilever and its free end overlaps with the free end of a second bimetal strip secured to the shunt arm adjacent the free end thereof and extending towards the secured end of the first bimetal strip to overlap the first bimetal strip and normally have the free ends thereof in pressure contact.



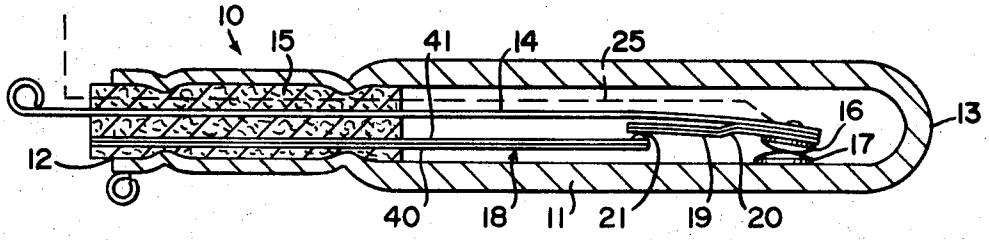


FIG. 1

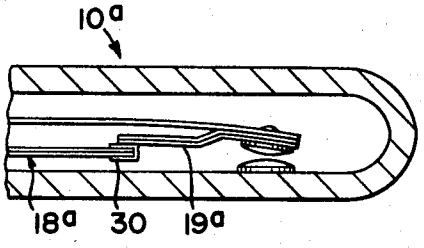


FIG. 2

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THERMOSTAT WITH OVERLAPPED BIMETAL CONTROL STRIPS THEREIN

Heretofore there have been many different types of thermostats, thermal protectors and the like provided. However, in all of such articles, there always is a demand to have a low price, relatively uncomplicated control provided which will function under varying types of circuit conditions. Particularly, where relatively heavy currents, such as up to and over 60 amps are present in the control circuit, most cantilever types of thermostats available heretofore have not been completely satisfactory for use in these relatively high-amperage power circuits for control action therein.

The general object of the present invention is to provide an improved thermostat or similar article wherein a shunt strip is provided as a current carrying element extending into the thermostat casing as a cantilever and wherein a pair of overlapped opposed bimetal strips are provided in the casing with only one of such bimetal strips being secured to the shunt arm adjacent the free end thereof.

Another object of the invention is to use a pair of overlapping but independent bimetal control strips in a thermostat or similar article and wherein such bimetal strips are heated by conduction from the contact and the shunt arm and by radiation from the shunt arm, and/or by heat flow through the insulating means positioning the shunt arm and bimetal strip in the thermostat.

Another object of the invention is to provide an improved thermal control adapted to carry relatively high amperage and which will provide a definite "one time" for a circuit with a given amperage current flowing in the circuit.

The foregoing and other objects and advantages of the present invention will be made more apparent as the specification proceeds.

Reference is made to the accompanying drawings, which show:

FIG. 1 is a vertical section of a thermostat embodying the principles of the invention, as one illustration of an article of the invention, with the contacts closed; and

FIG. 2 is a similar vertical section with the contacts open of a modified embodiment of the invention.

Having particular reference to the details of the structure shown in the drawing, a thermostat **10** is indicated. This thermostat or equivalent article includes a substantially conventional metal or other type of case or casing **11** which normally has one initially open end **12** and a closed end **13** therein. A shunt arm or strip **14** is secured in the case **11** and extends thereinto as a cantilever, being positioned at the initially open end **12** of the case by being compressively engaged with conventional means such as an insulation sleeve **15** that can be made from a resin-impregnated fiberglass, or other equivalent material. A pair of opposed contacts **16** and **17** are secured, respectively, to the free end of the shunt arm **14** and to the inner wall of the case **11** in opposed relation, which contacts are of conventional design and construction.

As a feature of the present invention, the insulation means or sleeve **15** is also used to position the first bimetal strip **18** in insulated relation to both the case **11** and the shunt arm **14** so that the bimetal strip **18** extends into the case normally in substantially parallel relation to the shunt arm **14**. A further feature of the invention resides in a second bimetal strip **19** one end of which is secured in good thermal conductive relation to the shunt arm **14** adjacent or at the free end thereof, as by being welded thereto. Such second bimetal strip **19** has an offset or inclined section **20** formed therein whereby the second bimetal strip **19** is positioned for the major part of its length in offset relation to the shunt arm **14** but usually extending substantially parallel thereto. The free end of the second bimetal strip **19** extends towards the initially open end of the case **11** and overlaps the free end of the first bimetal strip **18**. Preferably, both of these bimetal strips **18** and **19** are of such a construction that they both curve upwardly from the secured portions thereof when heated and the free ends of these strips may be in contact or be spaced from each other depending upon the then specific phase of the operating cycle. The arm **18** engages the arm **19** to move it and contact **16** for circuit opening action.

It will be seen that the current flow in the thermostat **10** normally is through the casing **11** and through the shunt arm **14** and any suitable terminal means are provided for connecting power leads thereto. The initially open end of the case **11** can be processed in any suitable manner to compress such case end and enclose and seal the bimetal strip **18** and shunt arm **14** in the thermostat in operative positions.

It will be seen that the lengths of the bimetal strips **18** and **19** can be varied and the compositions of such bimetal strips can be varied whereby the curvature rates thereof and action when heated can be controlled and changed. Naturally it is the curvature action of the bimetal strips **18** and **19** in association with each other that serve to force the shunt arm **14** upwardly of the case **11** to open the contacts **16** and **17** and the circuit controlled thereby. The shunt arm **14** can be made either from a heat resistant material, as one which heats up rapidly under current carrying conditions (Inconel 320–7 for example), or the shunt arm can be made from a good electrical conductor with a minimum of heat being generated therein; and the heat created within the case **11** can be varied and thus the opening and closing characteristics of the thermostat **10** can be varied widely within desired limits. The shunt arm normally is not made from a bimetal material.

By the construction of the invention, the bimetal strips **18** and **19** normally relax or tend to straighten slowly after the contacts **16** and **17** have been opened and then the bimetals permit the shunt arm **14** to move down slowly to bring the contacts **16** and **17** into engagement again. Arcing between the contacts is avoided by a positive continued-closing action of the moving contact **16**, and no tendency to initiate an opening force is set up in the bimetal strips at the instant when current flow is resumed through the thermostat **10**. That is the strips **18** and **19** are still cooling and are not immediately heated by any initial current flow as such strips are nonconductive in the thermostat circuit. If the arcing should occur under high voltages, the action of the bimetals is such as to extinguish the arc, as by increasing the closing pressure. Hence, the contacts do not tend to chatter or arc on either the opening or the closing of circuit conditions. Of course, the shunt arm, or conductor **14** is so positioned in the thermostat as to have a normal position to engage contact **16** with contact **17**.

By increasing the length of the bimetal strip **19** in relation to the length of the bimetal strip **18**, the "hot one" and cycle times are increased and vice verse. The bimetals **18** and **19** need only sufficient overlap to insure contact therebetween for circuit opening action. The bimetal arm **18** for example may be about 1½ to 3 times as long as the bimetal arm **19**, and usually is about twice as long as such arm **19** to provide the major contact opening force.

The thermal protector **10** usually is used where the casing **13** is subject to high environmental heating which casing transmits heat to the strips **18** and **19** by radiation. In use, the bimetal strip **18** is heated slowly primarily by external heat flow to the casing **13** for radiating heat to the strip **18**. The strip **19** is heated more rapidly by being in additional heat conducting contact with the current carrying shunt arm **14**. Therefore the action to create an opening force on the arm **14** is delayed by the bimetal arms in combination until the upwardly movable bimetal arm **18** is extensively heated and moves substantially to overtake and control the upward moving arm **19** and thus the shunt arm **14** secured thereto. As the bimetal arm **19** cools, it straightens and exerts pressure on the lower arm **18** and reaction pressure on the shunt arm **14** to urge it upwardly and open the contact further. Hence the cooling of the bimetal arm **19** tends to maintain the contacts open and maintain a cooling action on the environment to which the thermal protector **10** is subjected, Of course the free end of the arm is offset further from the shunt arm **14** than the distance that such arm **19** will curve upwardly when heated. Usually it is desirable that no appreciably heat flow

occurs between the bimetal strips when in contact and one bimetal strip may have a suitable insulation means secured thereto at the area that would engage the other bimetal arm to minimize heat flow therebetween. Or, a small end area of one bimetal strip can be embossed to protrude towards the other bimetal strip in the overlapped portions thereof to provide a small nubbin, or dimple **21** for contact with the other bimetal strip. Such dimple **21** is usually a section of a sphere and protrudes from the adjacent flat strip at least 0.004, preferably 0.006 to 0.008 inch. If the thermal protector **10** is to operate at two different voltages such as about 110 to 120 or 220 to 240 volts, then an insulated lead **25** has an end thereof secured, usually welded, to the shunt arm **14** at its free end. The lead **25** extends through and is sealed by the insulation material **15** for connection to the alternate high-voltage circuit. For high currents, it is not desirable to have the bimetal strip or strips in the circuits because of the sensitivity of bimetals to the rapid current heating action thereof. Likewise the shunt arm **14** would be heated rapidly by its currents under the elevated voltage and hence action of the thermal protector is slowed down by use of the lead **25** as shown.

The casing **11** may be conductive or not, as desired, and the contact **17** may have a lead extending therefrom to and through the open end of the casing. Both ends of the casing may be open, if desired and the thermostat may have a second conventional bimetal arm extending thereinto from the opposite end, as shown, for example, in U.S. Pat. No. 2,586,309. Such second arm would carry a contact for engaging the contact **16** on the shunt arm **14** and would move away from such arm **14** when heated. The thermal protectors may be calibrated as disclosed in U.S. Pat. Nos. 2,497,397 and 2,586,309. The sealed end or ends of the thermal protector may be of the construction disclosed in U.S. Pat. No. 3,209,107.

Any conventional bimetal strips may be used with the bimetal strip **18** normally having, for example, a layer **40** of high-expansion metal such as a nickel-crome-steel alloy, and a layer **41** of a low-expansion metal, such as a nickel-iron alloy therein. W.M. Chace Company of Detroit, Michigan makes a number of known types of bimetals and its No. 2,400 is typical of the bimetal strips in use today. The bimetal strip **19** normally is made from the same material as the strip **18** with the same positioning of the high and low-expansion metals.

FIG. **2** shows a modified thermostat **10***a* similar to the thermostat **10** but with an insulation sleeve **30** secured suitably to the free end of a bimetal strip **18***a*. In this instance, the thermostat is shown with the contacts open but where cooling of the thermostat has started and a bimetal strip **19***a* has started to curve downwardly.

The thermostats or motor protectors of the invention may have a differential in temperature of opening and closing action in the range, for example, of 5° to 30° F. in thermal controls designed to open in the range, for example, of 165° to 190° F. The thermostats are described as normally positioned horizontally in the manner shown in FIG. **1**. In the thermostat **10***a* of FIG. **2**, the bimetal strip **18***a* would curve upwardly when the contacts are open and FIG. **2** shows the strip **18***a* when it has cooled down almost to circuit closing position. Any suitable insulation means **30** is positioned intermediate the ends of the strips **18***a* and **19***a*.

In view of the foregoing, it is believed that the objects of the invention have been achieved.

While one complete embodiment of the invention has been disclosed herein, it will be appreciated that modification of this particular embodiment of the invention may be resorted to without departed from the scope of the invention.

What is claimed is:

1. A thermostat, thermal protector or the like comprising a casing having at least one open end, a bimetal strip extending into the casing as a cantilever, insulation means securing said strip at the initially open end of said casing and sealing said open end and around said bimetal strip, a shunt strip secured as a cantilever extending into said casing and insulated from both said bimetal strip and said casing at the secured end of said shunt strip, opposed contact means on said casing and the free end of said shunt strip and said shunt strip and said casing being adapted to have power leads secured thereto operatively connecting to said contact means, characterized by

said bimetal strip being below and shorter than said hunt strip,

a second bimetal strip secured at one end to the free end of said shunt strip and extending towards the initially open end of said casing, said second bimetal strip being offset from said shunt strip except for a short distance adjacent is secured end, said second bimetal strip having a free end overlying the free end of said first bimetal strip.

2. A thermostat, thermal protector or the like as in claim **1** where both of said bimetal strips move upwardly when heated, and where the cycle rate of the thermostat can be varied by changing the respective lengths and compositions of said bimetal strips.

3. A thermostat, thermal protector or the like as in claim **1** where said second bimetal strip is shorter than said first bimetal strip.

4. A thermostat, thermal protector or the like as in claim **1** where a current conducting lead extends into said casing and is secured to said shunt strip immediately adjacent to a said contact means.

5. A thermostat, thermal protector or the like comprising a casing having at least one end, a bimetal strip extending into the casing as a cantilever, insulation means securing said strip at the initially open end of said casing and sealing said open end and around said bimetal strip, a shunt strip secured as a cantilever extending into said casing and insulated from both said bimetal strip and said casing at the secured end of said shunt strip, opposed contact means being provided within said casing with one of said contact means being operatively secured to the free end of said shunt strip, and said shunt strip being adapted to have a power lead secured thereto characterized by

said bimetal strip being spaced from and shorter than said shunt strip but movable towards said shunt strip when heated,

a second bimetal strip secured at one end to the free end of said shunt strip and extending towards said initially open end of said casing, said second bimetal strip normally being offset from said shunt strip except for a short distance adjacent is secured end, said second bimetal strip having a free end positioned intermediate the free end of said bimetal strip and said shunt strip when considering the positions in a direction perpendicular to the longitudinal axis of said casing

6. A thermostat, thermal protector or the like as in claim **5** comprising a

said bimetal strip being spaced from a shorter than said shunt strip but movable towards said shunt strip when heated, and

said second bimetal strip which is above said bimetal strip moving toward said shunt strip when heated,

the action of said bimetals resulting in a closing action of the contacts at a significantly lower temperature than the temperature at the opening action of the contacts.

7. A thermostat, thermal protector, or the like as in claim **5** where insulation means are operatively positioned intermediate the free ends of said bimetal strips.

8. A thermostat, thermal protector or the like as in claim **5** and including

a power lead extending into said casing from said open end thereof, said insulation means insulating said power lead from said shunt strip, and an end of said power lead being secured to said shunt strip in the area of the free end thereof.

UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,609,618 Dated September 28, 1971

Inventor(s) Alton R. Wells

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

Col. 1, line 29, "one time" should read -- on time --.
Col. 2, line 47, " 'hot one' " should read -- "hot on" --.
Col. 2, line 48, "vice Verse" should read -- vice versa --.
Col. 2, line 75, "appreciably" should read -- appreciable --.
Col. 3, line 67, "departed" should read -- departing --.
Col. 4, line 8, Claim 1, "hunt" should read -- shunt --.
Col. 4, line 14, Claim 1, "is" should read -- its --.
Col. 4, line 29, Claim 5, after "one" insert -- open --.
Col. 4, line 47, Claim 5, "is" should read -- its --.
Col. 4, Claim 5, line 51, after "casing", insert -- . --.
Col. 4, line 54, Claim 6, "a" should read -- and --.

Signed and sealed this 28th day of March 1972.

(SEAL)
Attest:

EDWARD M.FLETCHER,JR.
Attesting Officer

ROBERT GOTTSCHALK
Commissioner of Patents

FORM PO-1050 (10-69)

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