

UNITED STATES PATENT OFFICE

2,295,463

THERMOSTAT

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Application August 3, 1940, Serial No. 350,602

10 Claims. (Cl. 297—15)

The present invention relates to snap acting thermostats. It constitutes an improvement upon the invention of Malcolm W. Eaton, described and claimed in his copending application, Serial No. 277,436, filed June 5, 1939.

Objects of the invention include the provision of a new and improved snap acting thermostat, a new and improved thermally actuated electric switch, an improved snap acting bimetallic mechanism, and a highly sensitive thermostat. The invention resides in certain novel features of construction, combinations of parts, and arrangements of apparatus, particularly set forth in the claims, and is illustrated by the specific embodiments herein shown and described by way of example.

In the drawing:

Fig. 1 is a longitudinal sectional elevation of an embodiment of the invention;

Fig. 2 is a plan view, partly in section, of the same embodiment;

Figs. 3 and 4 are transverse sectional views of the same embodiment, taken along the lines 3—3 and 4—4 of Fig. 1;

Fig. 5 is an elevation, partly in section, of a different embodiment of the invention; and

Fig. 6 is a section taken along the line 6—6 in Fig. 5.

In the device of Figs. 1 to 4 inclusive, the various parts are mounted on a channel shaped metal base 10. Near the center of this base, a cutout tab 12 is turned up and notched on its two surfaces facing longitudinally of the base. A rocker 14 hanging above the aperture 13 from which the tab 12 is cutout, pivots on its own sharpened edge 16 fitting one of the notches 15 in the tab 12, and has a notch 18 on its outer edge to serve as a spring support. A curved arm 20 riveted through the rocker 14, extends down through the aperture 13 in the base and curves under the channel to extend to the left end thereof, as seen in Fig. 1. A wire spring 26 holds this arm 20 against an adjusting screw 22, pivoting the rocker 14 in the notch in the tab 12. An angle bracket 28 fastened by the riveted bushing 24 has a slit like aperture 30, the sides of which converge to a point at each end of the slit for firmly gripping the end of a bimetal strip 32.

The resilient strip 32 of composite thermostatic bimetal has an aperture 34, so that the bimetal strip comprises a broad tail 36, a pair of narrow arms 38, and an end strip 40. The tail portion 36 of this bimetal strip is wedged between one of the notches 37 in the tab 12 and the slit 30 in the bracket 28. The left hand end of this

bimetal strip is chamfered as shown in Fig. 2 so that it engages the slit 30 at the tapered end thereof for fitting snugly and firmly in place. The dimensions of the parts are such, and the bracket 28 is sufficiently resilient that the longitudinal compressive force exerted on the tail portion 36 of the bimetal strip 32 is not sufficient to buckle it. The longitudinal restraint imposed on the bimetal tail 36 by the angle bracket 28 is small compared to the stiffness of the bimetal so that the bracket 28 does not interfere with the flexing of the bimetal in the operation of the device. This tail 36 of the bimetal element is gripped only tight enough by its supports to insure that it will not be dislodged by the flexure thereof resulting from its changes of temperature, and by the resulting operation of the switch. A resilient spring strip 42 is fastened rigidly to the end strip 40 of the bimetal element 32 and, lying in the aperture 34 of the bimetal strip, extends to the notch 18 in the rocker 14 where it is supported. The resilient strip 42 is of such length that when so mounted it is bowed slightly in longitudinal compression. The compression spring 42, and the arms 38 of the bimetal strip constitute respectively thin leaf compression and tension members of a snap acting toggle which is movable at its unmounted right hand end. This movable end of the toggle carries a movable contact 44 which, in the uppermost position of the toggle engages a stationary contact 46 supported by an angle bracket 48 and terminal screw 50. The toggle stops in its lowermost position against an adjusting screw 52 threaded through the metal base 10. The external electrical connections to the switch are made to the terminal screw 50 which is insulated from the metal base by embossed insulating washers 54, and to a terminal screw 56 threaded into the metal of the base 10 itself. A metal plate 58 fastened against the top surface of the base 10 and overhanging the edges thereof supports a rubber protective covering 60 for the switch mechanism. This cover has a thin flexible wall 62 at its left end slitted for the tail of the bimetal strip 36. This covering is adapted to be slipped over the tail 36 of the bimetal strip before the bimetal is mounted. Since it is flexible, it can easily be held out of the way while the rest of the assembly is completed, and then it may finally be slipped into place by snapping the groove 62 in its lower bead 54 down over the edge of the overhanging plate 58.

The difference between the "turn on" and "turn off" temperatures of the complete thermostat may be changed by the setting of the adjusting screw

52 which regulates the total snap motion of the movable end of the toggle which carries the movable contact 44. These two operating temperatures may be raised and lowered together, without substantially changing the difference between them by means of the adjusting screw 22 which acts on the arm 20 to pivot the rocker 14 on its support in the tab 12 for raising and lowering the pivotal support of the compressions spring 42 of the toggle.

The entire bimetal strip contributes to the thermal action of the device, but the portion constituting the tail 36 is the most effective. In this particular embodiment, the bimetal strip has its high expansion side up, as seen in Fig. 1, so as to separate the contacts 44 and 46 in response to a rise of temperature, and so is suitable for controlling a heating system. When the temperature rises, the tail 36 tends to arch upwards in its center and because of this deflection, transmits a bending movement or rotational effort along the bimetal arms 38 to the movable end 40 tending to move the contacts down by rotating the tension arms 38 about the pivotal support in notch 37. This action is opposed by the toggle arrangement of the springs so that the temperature must rise to the "turn off" value before the bimetal develops sufficient force to overcome the toggle and snap the contacts to their lowermost position. Similarly the temperature must drop to the somewhat lower "turn on" value to snap the contacts back to their upper or closed position. This difference between "turn on" and "turn off" temperatures is characteristic of snap acting thermostats, but I have found that the present device is highly sensitive and that it can be adjusted to a very small difference in "turn on" and "turn off" temperatures, as for example to 1/2 degree F., and still be capable of controlling a substantial electrical load, as for example, 1000 watts on alternating current. This thermostat is suitable, for example, for responding to room temperatures in a building for controlling the heating system of the building, and in the case of a domestic heating system, generally is capable of handling the control without the use of relays.

In the modification of Figs. 5 and 6, an insulating base 70 carries a threaded bushing 72 which in turn carries an adjustable supporting screw 74 having a circumferential notch 76 near its upper end for fitting into an aperture 78 in bimetal strip 80 for supporting it. A bracket 82 includes a pair of upwardly extending tabs 84 having notches for pivotally supporting a pair of compression springs 86 which constitute the two legs of a single thin leaf spring member. One end of the bimetal strip 80 is fastened to the unmounted end 88 of these compression springs 86 to form a spring toggle. The bimetal strip 80 pivotally supported at the screw 74 constitutes the tension member of the toggle and springs 86, pivoted at 84 constitute compression members. This movable end 88 carries a pair of movable contacts 90 which engage stationary contacts 92 and 94 carried by terminal members 96 and 98 respectively. The other end or tail 81 of the bimetal strip 80 loops over the top of the mechanism just described as shown in Fig. 5 and is firmly held between the spring 102 and the head 104 of adjusting screw 106 which threads into the bushing 108 carried by the base 70.

Like the device of Figs. 1 to 4, this device of Figs. 5 and 6 operates its moving contacts with a snap action in response to changes of temperature of the bimetal strip. The temperature at

which it operates may be raised or lowered by adjusting the screw 106 for deflecting the tail 81 of the bimetal strip.

The bimetal element 80 has its high expansion side on the inside of the loop 83, that is on the lower face of the tail 81 as seen in Fig. 5. Upon a rise of temperature the tail 81 bends down in its center and transmits a bending moment or rotational effort along the curve 83 and past the pivot support at 74 to the toggle for snapping the contacts 90 to their lower position. The temperature at which the device operates may be raised by turning screw head 104 up as seen in Fig. 5 and lowered by turning the screw head 104 down. The resilience at the loop 83 in the bimetal strip prevents the longitudinal restraint imposed on the bimetal tail by adjusting screw 104 from buckling the bimetal or otherwise interfering with its reliable and sensitive action.

It will be readily apparent that the invention is capable of various modifications within the scope of the claims.

I claim:

1. In combination in a thermostatic device, a snap acting toggle having a tension strip and a compression strip connected together, the connection between them being rigid to permit the transmission of bending moments there through from one strip to the other, one of said strips consisting of resilient thermostatic bimetal, a toggle support for said bimetal strip intermediate its ends and so constructed as to permit bending moments to be transmitted along said bimetal strip past said toggle support, a toggle support for the other strip, each of said toggle supports imposing longitudinal stresses on the strip that it supports, and an outer support for restraining motion of the extended outer end of said bimetal strip, said outer support being spaced out far enough from the toggle support of said bimetal strip that said portion between said toggle and outer supports supplies a substantial part of the driving effort imposed by said bimetal strip on said toggle.

2. In combination in a thermostatic device, a snap acting toggle including a tension member and a cooperating compression member, a support for each of said members, said compression member having a shorter radius of action about its support than said tension member, one of said members consisting of a resilient strip of thermostatic bimetal extending beyond its toggle support, a second support for restraining motion of the outer extended portion of said bimetal strip, said second support being spaced sufficiently far from said toggle support of said bimetal strip compared to the length of said bimetal strip and the restraint imposed upon its motion by its said toggle support, that said extended part of said bimetal strip, between said two supports thereof, exerts the major part of the temperature responsive driving effort exerted by said bimetal strip on said snap acting toggle.

3. The combination of claim 1 wherein said resilient strip of thermostatic bimetal constitutes the tension member of said toggle.

4. The combination of claim 1 wherein there is included a sealed enclosure for all of said mechanism except said extended bimetal strip, and wherein said bimetal strip extends out of said enclosure through a close fitting flexible diaphragm located close to its inner support.

5. The combination of claim 2 wherein there is included means for adjusting the position of one

of the supports for changing the operating temperature of said device.

6. The combination of claim 2 wherein said extended part of said bimetal strip is substantially flat and otherwise is substantially the same as the toggle portion of said bimetal strip.

7. The combination of claim 2 wherein said extended portion of said bimetal strip has a substantial curve between its two supports.

8. The combination of claim 2 wherein said extended portion of said bimetal strip is U shaped and so has its extended end doubled back to lie along side its toggle portion.

9. The combination of claim 2 wherein said resilient strip or thermostatic bimetal constitutes a tension member of said toggle, and wherein the portion of said bimetal strip extending beyond said toggle support is held in compression by said toggle support and said second support thereof.

10. In combination in a thermostatic device, two fixed supports, a bimetal strip between them, pivoted to each, a strut pivoted on one of those supports, a bowed thin leaf compression spring pivoted on the movable end of said strut, said bimetal strip having an extension extending past said one support, lying alongside said strut and compression spring, and connected to said compression spring and held in tension thereby, whereby said extended portion of said bimetal and said compression member together constitute an over-center toggle, stops for the said over-center toggle and a means for swinging said strut in its pivot and for holding it in its adjusted position, so as to adjust the operating temperature of said device.

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