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2,587,551

THERMOSTATIC SWITCH

Original Filed Oct. 16, 1944

Fig. 1.

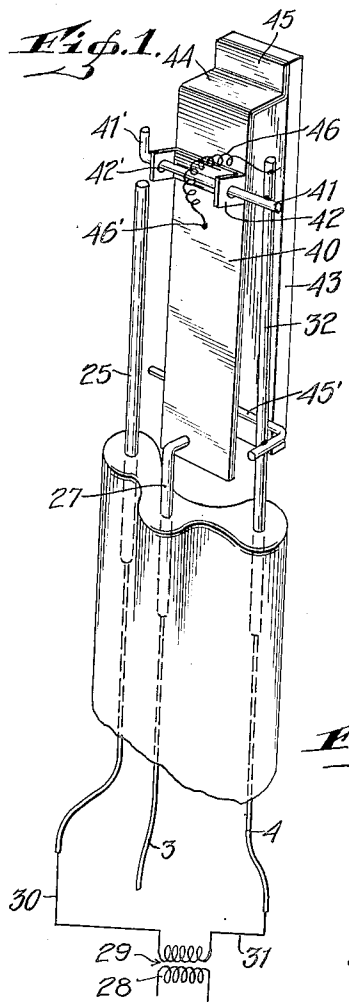


Fig. 2.

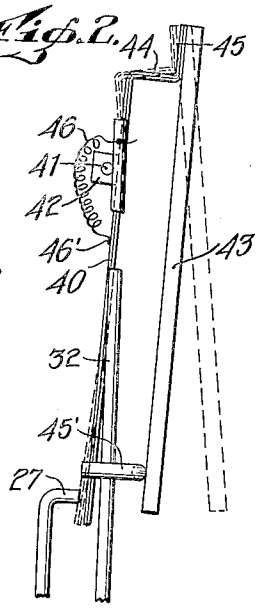


Fig. 3.

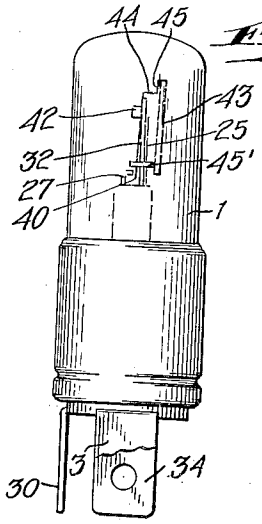


Fig. 4.

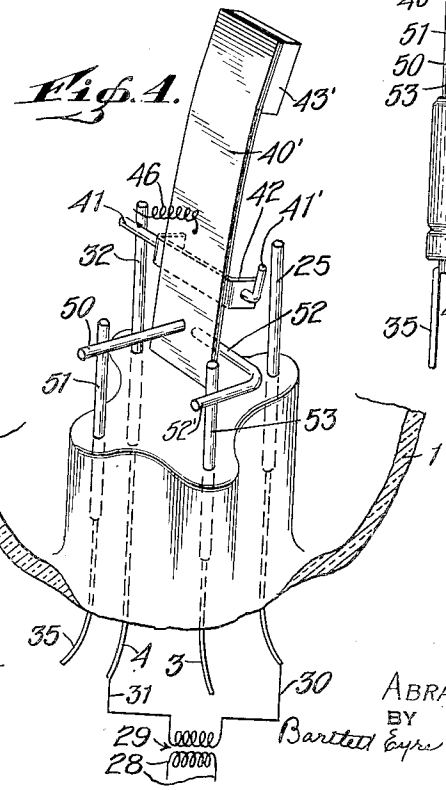


Fig. 5.

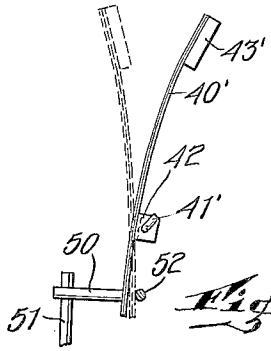
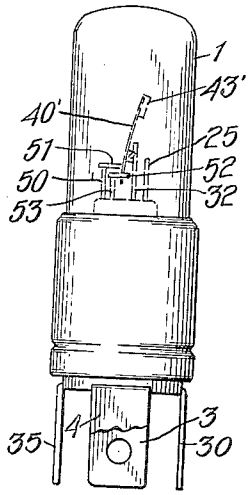


Fig. 6.



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UNITED STATES PATENT OFFICE

2,587,551

THERMOSTATIC SWITCH

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Continuation of application Serial No. 558,795, October 16, 1944. This application May 20, 1950, Serial No. 163,129

7 Claims. (Cl. 200—138)

1

This invention relates to electrically operated relays and more particularly to thermostatic relay devices and is a continuation of my application, Serial No. 558,795, filed October 16, 1944, now abandoned.

One object of the invention is an improved thermostatic relay structure embodying means for regulating or limiting the stresses on the thermostatic element while at the same time insuring good contact pressure.

Another object is to impart rapid make and break action to the contacts of a thermostatically controlled device that would otherwise react slowly to changes in temperature.

The above and other objects will become more apparent in the following description and drawings forming part of the invention.

In the drawings,

Fig. 1 is a view of a relay mechanism embodying the invention;

Fig. 2 is another view of a part of the mechanism thereof;

Fig. 3 is a view of the relay mechanism of Figs. 1 and 2 sealed in its envelope;

Fig. 4 is a view of a modification of the invention;

Fig. 5 is a view of a part of the mechanism thereof; and

Fig. 6 is a view of the complete unit embodying the mechanism of Figs. 4 and 5.

Referring to the modification of Figs. 1 to 3, I have illustrated my relay as including a sealed tube 1 containing a suitable gas filling such as argon, neon, helium and the like, and my improved thermostatic mechanism mounted therein and controlled by the ionization of the contained gas. Fig. 1 is an enlarged exaggerated view of the mechanism mounted on a press having lead-in wires or terminals 3, 4 and 30.

The thermostatic element is a bimetallic element 40 and is in the form of a strip mounted on a rod 41 which is welded or otherwise rigidly fastened to the support wire 32 at a point near the upper end thereof and disposed at an angle thereto, in the particular embodiment shown the rod 41 being disposed at right angles to the support wire 32. The bimetallic element is mounted on rod 41 in hinge-like fashion by means of a U-shaped bracket 42 welded or otherwise rigidly fastened to one side of the bimetallic strip 40, this bracket 42 having openings 42' in its legs through which the rod 41 passes. By this means the bimetallic member 40 is free to pivot about the rod 41 as the hinge axis. The rod 41 is provided with a bent arm 41' to prevent the slipping of the bracket 42 off of the rod. The bimetallic element 40 is counterweighted by an elongated metal strip 43 which is welded or otherwise rigidly fastened to one end of the bimetallic element. This mounting is effected by bending one end 44 of the bimetallic element 40 at right angles to the main body and then bending back the extreme end 45 at right angles again to assume a substantially parallel relation with the main body of the element 40 and the counterweight 43 is secured at one end flat against this part 45 so that the element 40 and the counterweight 43 are disposed substantially parallel to each other. The unit 40, 43 thus pivots freely about the rod 41 limited only by a stop wire 45' which projects between the ends of the elements 40 and 43 which are opposite to the end 44. In the particular embodiment shown this limiting stop is a wire of substantially L shape with one leg of the L fastened as by welding to the support wire 32. A jump wire 46 is electrically fastened at one end to the support wire 32 and at its other end to the bimetallic member at 46' so as to assure electrical contact between the support wire 32 and the bimetallic element 40.

2

In this embodiment the relay is of the normally open type, namely when the bimetallic element 40 is cool it is in a position out of contact with the contact rod 27, the end of the latter being bent over to a position slightly spaced from one end of the bimetallic element 40 when the latter is cool, this contact being disposed in the particular embodiment shown on the opposite side of the bimetallic element 40 from the counterweight 43. In this embodiment the ionizing electrode 25 is inside of the envelope 1 and the gaseous atmosphere inside the envelope is ionized by supplying electrical energy to the electrodes 25 and the supporting wire 32, as for example, by connecting these elements to the secondary of the transformer 29 through the leads 30 and 31. The lead wires 3 and 4 are in the circuit to be controlled, the lead wire 3 being electrically connected with the stationary contact member 27 and the lead wire 4 being connected with the supporting post wire 32. The closing action of the circuit is illustrated in Fig. 2, the position of the bimetallic hinged unit being illustrated in full lines in the open position of the circuit and in dotted lines in the closed position of the circuit. This structure is characterized by a floating member, namely the hinge unit which is easily operable and largely removes any strain condition on the bimetallic member. The latter can self-adjust itself to any

temperature condition without exceeding fatigue strain.

I have found by experience that this method of mounting the bimetallic element avoids some of the permanent strain that is apt to develop in continuous operation. In the fixed mounting models the excessive heat which is developed sometimes causes permanent deformation of the bimetallic element. In this particular embodiment the distortion is distributed over a wider area and by being hinged is free to move sufficiently to compensate for the excess distortion of the bimetallic member. This unit can be used either with the envelope in a position so that the hinged unit is vertically disposed, or horizontally disposed with the counterweight on top. In both positions the mass of counterweight tends to hold the bimetallic member in correct central position, the small stop functioning to prevent excessive hinge action and also to accurately control the gap between the bimetallic element and contact rod in initial position. This hinge action provides a considerable degree of cushioning and, as indicated, largely prevents undue strain being exerted on the bimetallic member. The entire strip of the member **40** is of bimetallic material and the distortion is distributed throughout the entire length. The counterweight **43** acts as an adjusting weight and in conjunction with the small stop **45**[1] establishes the initial position.

In the embodiment of Figs. 4 to 6 the bimetallic element **40'** is hingedly mounted similarly to the mounting in Fig. 1 through a bracket **42** rigidly fastened to one side of the bimetallic element and freely hinged to a rod **41** fastened to the support wire or post **32**. In this embodiment the bimetallic element **40'** in the cool condition is slightly bent to form a concave side on which the hinge **42** is fastened and a counterweight **43'** in the form of a metallic block is fastened at one end of the bimetallic element and on the concave side thereof. The end of the bimetallic element opposite to the end on which the counterweight **43'** is mounted is maintained by the counterweight in contact with one end of an elongated finger **50** which is welded or otherwise rigidly fastened to a support wire or post **51** mounted in the press.

Fig. 5 shows both the cool and the hot positions of the hinged bimetallic unit. The dotted position indicates the hot condition or position and it is observed that in this position the end of the bimetallic element **40'** is in contact with a finger contact **52** which is mounted on the opposite side of the end of the bimetallic element from the contact element **50**. This contact **52** is electrically connected with a support wire or post **53** mounted in the press and in the particular embodiment shown the contact finger **52** is the bent arm of a wire **52'** which is welded or otherwise rigidly fastened to the support wire **53**. The ionizing electrode **25** in this embodiment is also disposed inside the envelope **1** and the ionizing of the gas is effected by supplying electrical energy to the post **32** and the post **25** as, for example, by connecting them across a transformer **29** through the leads **30** and **31**.

This embodiment has two controlled circuits, one a normally closed circuit and one a normally open circuit. The normally closed circuit is through the leads **4** and **35** leading respectively to the post **32** and bimetallic member, and to the contact **50** which circuit is normally closed, as shown in the drawings when the bimetallic element **40'** is cool. The normally open circuit is through the leads **3** and **4** leading respectively

to the contacts **52** and the post **32** and hinged unit. A short length coil spring **46** similar to that shown in Figs. 1 to 3 is connected to the hinged member at one end and with the post **32** or hinge rod **41** at the other end, thereby acting as a jumper and maintaining a secure circuit across the hinge. This very light spring has very little or no effect on the device but merely acts as an electrical jumper during the interval of movement in the hinge. Thus this embodiment operates both to open and to close circuits in sequence. It starts with a closed circuit which automatically opens when the gas is ionized and in so doing automatically closes the second circuit. This therefore becomes a sequence relay switch. Thus a single relay may be used for normally open or normally closed circuit requirements.

Argon gas is quite satisfactory in the tube for facilitating ionization but neon, helium, hydrogen or various combinations of gases may be employed here, as in the other modification. The pressure of the fill is instrumental in the control and also the type, size and shape of the bimetallic strip offers a quite satisfactory control of functioning. I have obtained quite satisfactory results by using a bimetal strip of .010 Baker No. 360. The performance obtained is definitely within a close controlled range and this can be adjusted nicely by proper manufacturing procedures. Silver contacts in the form of wire welded to the bimetal strip and also to the contact lead stem may be used to good advantage. I have found that sufficient ionization of the gas and resultant heating of the bimetallic element can be obtained by the voltage supplied by the ballast choke unit from conventional fluorescent lighting fixtures, that is, satisfactory tube operation may be obtained within the working range of 90 to 180 volts depending on the gas condition and other variables for the ionization circuit while the control circuit would be regulated entirely by the capacity of the contacts used limited only by other elements in the circuit. The bimetallic strip can be formed to close with definite, positive pressure.

The argon, neon or other gas or mixture of gases used in the envelope may be incorporated at any suitable pressure and I have found a pressure of from 10 to 30 mms. satisfactory, since this provides suitable current density on the electrodes to provide quick and adequate heating. A soft glow produced by a lower pressure is not as satisfactory for our purpose as the glow produced by the higher pressure.

While certain features of the applicant's relay are of broader application the invention is illustrated as being applied to a gaseous tube relay wherein the three elements are all contained in the envelope. The location of the third lead or ionizing electrode inside the envelope closely adjacent the bimetallic element as the other ionizing electrode provides an efficient means for obtaining the desired potential at the point of breakdown for the ionization of the gas, and also provides for accurate relay controls. This allows close spacing of the parts thereby making possible low striking voltages and more satisfactory control conditions.

I claim:

1. In a thermal switch, an elongated bimetallic element carrying on one end thereof an elongated counterweight disposed substantially parallel therewith and pivotally mounted at a point spaced from one end for limited free pivotal movement

and a fixed contact element disposed in the vicinity of the other end of said bimetallic element and engaged by said pivotally mounted bimetallic element is flexed by heat, said counterweight functioning to maintain a firm contact between the elements.

2. In a thermal switch, an elongated bimetallic member pivotally mounted at a point spaced from one end for limited free pivoting movements, said bimetallic element having a counterweight fastened near the other end of the bimetallic element, a contact element engaged by the end of said bimetallic element on the opposite side of the pivotal axis from the counterweight, said counterweight determining the contacting pressure between the contact element and the bimetallic element.

3. The combination according to claim 2 including a second contact element positioned for engagement by said one end of the bimetallic element, said one end of said bimetallic element engaging one of said contact elements upon pivotal movement of said bimetallic element in one direction and engaging the other of said contact elements upon pivotal movement in the other direction.

4. A thermostatic switch comprising a bimetallic element disposed in a vertical plane and pivoted between its ends for movement about a horizontal axis, parallel to the plane of said element, fixedly mounted contact means cooperating with the lower end of said element, electrical contact means on the lower end of said element to electrically contact the fixed contact when the bimetallic element is flexed, a counterweight fixed to the upper end of the element and extending downwardly in a plane parallel to and spaced from the plane of said element and movable from its vertical position by said element in response to a predetermined temperature change, said counterweight acting to rotate the element about the pivot and hold the contacts in the closed position, thereby minimizing the strain on said element and insuring good contact pressure.

5. A thermostatic switch comprising a bimetallic element pivotally mounted and downwardly depending from said pivotal mounting for pivotal movements about the mounting, a contact disposed below the pivotal mounting and engageable

by the downwardly depending portion of said bimetallic element when the latter buckles under the influence of heat, an elongated counterweight fastened at its upper end to said bimetallic element at a point above the level of the pivotal mounting, the upper portion of said bimetallic element to which the counterweight is fastened moving the counterweight to a position under the influence of heat to apply through the influence of gravity a greater pressure between the lower portion of the bimetallic element and the contact.

6. A thermostatic switch comprising a bimetallic element pivotally mounted and depending downwardly from said pivotal mounting for movement about the pivot, a contact disposed below the pivotal mounting and engageable by the downwardly depending portion of said bimetallic element when the latter buckles under the influence of heat, an elongated counterweight fastened at its upper end to said bimetallic element at a point above the level of the pivotal mounting, the element upon buckling and engaging the contacts moving the depending counterweight outwardly to produce a moment about the pivot urging the contacts together, and a stop for limiting the movement of the counterweight in the opposite direction.

7. A thermostatic switch comprising a bimetallic temperature responsive element adapted to flex with a change in temperature, a pair of cooperating contacts with one of said contacts fixed to one end of the temperature responsive element, said contacts closing when said element is flexed, said element including counterweighting means and movable upon flexure of said element to hold the contacts in the closed position with the contact pressure determined by mass of said counterweighting means.

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The following references are of record in the file of this patent:

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