Sept. 2, 1952 I. S. BLONDER 2,609,466

THERMORELAY ELEMENT

Filed June 12, 1951

Fig. 1.

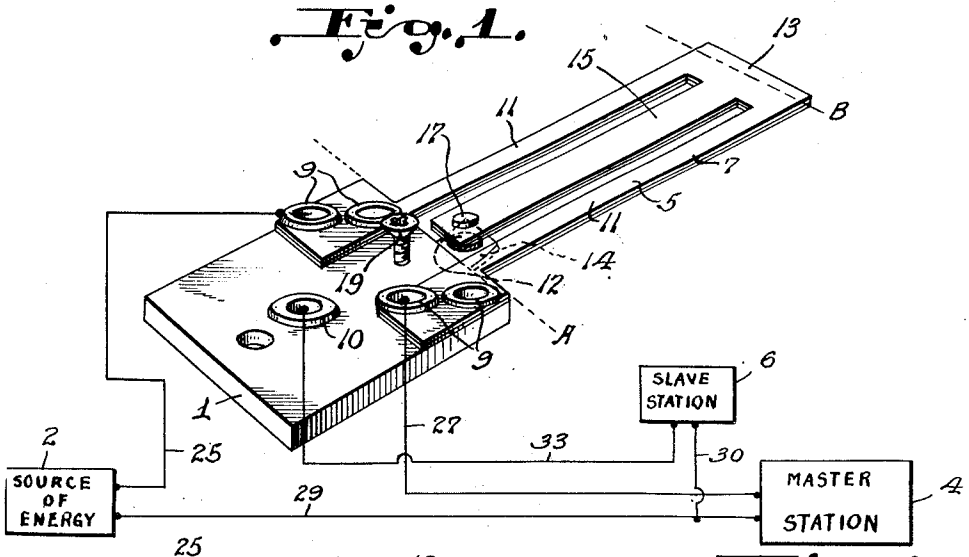


Fig. 2.

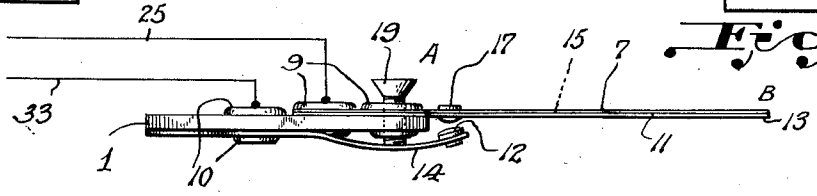
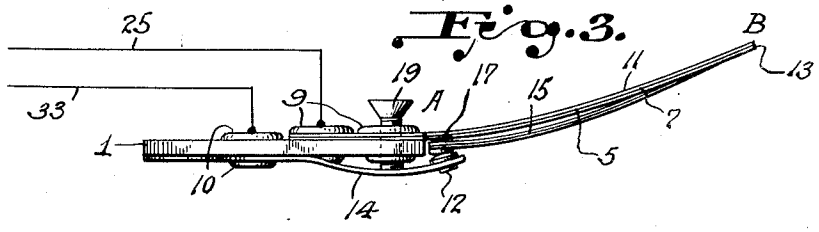


Fig. 3.



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THERMORELAY ELEMENT

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7 Claims. (Cl. 200—113)

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The present invention relates to thermo-relay elements and more particularly to bi-metallic thermo-relay elements.

An object of the present invention is to provide a new and improved thermo-relay element.

Thermo-relay elements have heretofore been constructed of adjacent layers of bi-metal materials in order to bend in response to temperature variations, such as those caused by the passage of electric current through the element, either in the direction of one of the bi-metal layers, or in the direction of the other layer, depending upon the different temperature coefficients of expansion of the layers. Such devices have been utilized for the opening or closing of electric circuits and similar apparatus. Among the difficulties attendant the use of such thermo-relay elements is the unstable performance of the elements when varying temperature effects are produced in the medium surrounding the elements. If, for example, a thermo-relay element is placed in an electric apparatus where there are vacuum tubes or other electrical components that generate heat into the surrounding air, non-uniform, varying temperature gradients are set up in the air surrounding the thermo-relay element. Whereas the bi-metal thermo-relay element may have initially been adjusted to close a pair of contacts spaced a predetermined distance apart in response to a particular threshold value of current in the element, these external temperature gradients will alter the intended performance of the element. Various temperature-compensating devices have heretofore been proposed to overcome this difficulty, such as temperature-controlled chambers or temperature-compensating bi-metal arms, but these add materially to the cost and/or size of the thermo-relay element.

Still an additional object of the present invention is to provide an extremely simple and inexpensive thermo-relay element that is not subject to the above-mentioned difficulties and that automatically is self-compensatory to ambient temperature changes in all planes with respect to the thermo-relay element.

A further object is to provide a thermo-relay element that takes up very little space, that is light and compact, and that is extremely simple to manufacture.

Other and further objects will be explained hereinafter and will be more particularly pointed out in the appended claims.

In summary, the present invention relates to a bi-metal thermo-relay element having a base

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and two bimetal arms and an intermediately disposed bimetal tongue extending from the base. For best results, the width of the tongue is preferably greater than the width of each of the arms. The free ends of the arms are each provided with securing means for securing the relay at two points to permit the arms to bend about the two points in response to temperature variations in the element. The tongue is free to move at its free end and is there provided with a contact member, the tongue moving in a direction opposite to the direction of bend of the arms, in order to move the contact member in the opposite direction to the bending movement of the arms. A cooperating contact member is engaged by the tongue contact member to close a desired relay-operated circuit. Preferred constructional arrangements are hereinafter discussed in detail.

The invention will now be described in connection with the accompanying drawing Fig. 1 of which is a perspective view of a thermo-relay element constructed in accordance with the present invention, shown embodied in a typical electric circuit, and Figs. 2 and 3 are side elevations of the relay in different positions of operation.

A thermo-relay element constructed in accordance with a preferred embodiment of the invention may be die-stamped or otherwise formed from a flat planar sheet of superposed layers of bi-metal material the upper surface 7 of which may, for example, be constituted of sheet steel, and the bottom surface 5, of sheet brass. Other well known relay materials may, of course, also be employed. The relay comprises a substantially U-shaped member having a pair of co-planar, substantially parallel arms 11 connected at one end by the neck of the U—a preferably right-angularly oriented connecting portion or base 13. The arms 11 may be secured at their open ends to two points on the upper surface of a preferably planar insulating support 1, as of Bakelite, by two pairs of eyelets 9. The left-hand pair of eyelets 9 serves as a pair of electric terminals for connection, respectively, with conductors 25 and 27, connecting one side of a source of energy 2, such as the alternating-current mains, to an electric system to be energized, shown as a master station 4. The master station 4 may, as an illustration, be a television receiver that is energized from the source 2 through the conductor 25, the series-connected relay path comprising the left-hand arm 11, Fig. 1, the base 13 and the right-hand

arm 11, the conductor 27 and the further conductor 29. The pair of arms 11 are of substantially equal width and length in order that, in response to temperature variations caused by sending current from the source 2 through the arms 11, the arms 11 may bend symmetrically out of the plane of the insulating support 1, as shown in Fig. 3, about a fixed axis at the inner or right-hand edge of the insulating support 1, labelled A.

A bi-metal tongue 15, preferably formed integrally with the arms 11 and of the same bi-metal material, is connected to the base 13 midway between the arms 11, and extends therefrom between and preferably substantially in the plane of the pair of arms 11 toward their open ends. As the current from the source 2 flows through the arms 11 bending them upward about the previously described axis A of the insulating support 1, the tongue 15 is bent in the opposite direction, shown as downward in Fig. 3, about an axis B along the base 13, preferably disposed substantially parallel with the axis A. As the tongue 15 bends downward, a contact 17, such as a silver rivet mounted near its free end, is moved into electrical engagement with a further cooperating contact 12 carried at the end of a resilient tongue support 14 between, though below the plane of, the arms 11. To this end, the tongue support 14 is secured by an eyelet 10 to the lower surface of the insulating support 1. This permits current flowing from the source 2 through the conductor 25 and the left-hand arm 11 to pass along the tongue 15 and through the connected contacts 17 and 12 to the eyelet 10. The eyelet 10 may serve as an electric terminal for a further conductor 33 connected with a further electric system shown as a slave station G. The conductor 29—30 completes the connection of the source 2 to the slave station G. The slave station G, as an example, may be a television booster or pre-amplifier that it is desired to energize a predetermined interval of time, depending upon the speed of operation of the relay, after the master station television receiver 4 is energized. The relay operation may vary from substantially instantaneous closure of the contacts 17 and 12 to a few seconds delay before closure, as an illustration, depending upon the value of current passed through the relay, the relay dimensions and the initial spacing of the contacts 17 and 12. This initial spacing may be conveniently varied by means of a screw 19 threaded from the upper to the lower surface of the insulating support 1 and bearing upon the tongue support 14 at a point displaced from the eyelet 10, thereby controlling the adjustment of the distance between the contacts 17 and 12.

In order to prevent the tongue 15 from heating as much as the arms 11, thereby to insure that it does not reach such a high temperature that it tends to curl or bend upward in the same direction as the arms 11, destroying the contact between the tongue contact member 17 and the contact member 12, the tongue 15 is made wider than the arms 11. As an illustration, the tongue 15 may be two or three times as wide as each arm 11. The current passing through the tongue 15 is thus distributed along a surface two or three times greater than the surface of the arms 11, insuring that the tongue does not heat as much as the arms. Furthermore, since the left-hand arm 11 passes additional current not also passed along the right-hand arm 11, in the circuit comprising the left-hand arm 11 and the tongue 15, the tongue 15 should be wider than the arm 11 in order to insure that its tendency to curl upward in response to the current passed therethrough shall be less than that of the left-hand arm 11, thereby causing the tongue contact member 17 to exert greater pressure upon the contact member 12.

The relay construction of the present invention is entirely self-compensatory for variations in the temperature of the medium surrounding the relay. Considering, first, temperature changes in planes of the medium normal to the plane of the arms 11 and the tongue 15, whatever temperature variations may occur, these variations act both upon the arms 11 and the tongue 15; and because the lengths are substantially the same, they produce substantially the same cumulative effect upon the arms 11 and the tongue 15. The bending action of the arms 11 about the axis A and the oppositely directioned bending action of the tongue 15 about the axis B, therefore, are equally affected by the temperature changes so that the relay will effect closure of the contacts 17 and 12 in response to substantially precisely the same threshold value of current from the source 2 irrespective of such ambient temperature fluctuations. As for variations in the temperature gradient of the medium in the plane of the arms 11 and the tongue 15, since the arms 11 straddle the tongue 15, the cumulative effect therein is substantially the same as the effect upon the intermediate tongue 15. Such temperature variations, therefore, also do not affect the reliable and reproducible operation of the relay.

A typical bi-metal relay of sheet brass and sheet steel, or other bi-metallic combinations known to the art for use as temperature sensitive devices, a few thousandths of an inch thick, for operation with conventional alternating-current 110-volt mains may have the following dimensions. The arms 11 may be about an inch long between their end-connecting or base portion 13 and the axis A of the insulating support 1; the tongue 15, just under an inch in length in order just to clear the edge of the support 1 at the axis A; the width of the arms 11, about one sixteenth of an inch; the width of the tongue 15, about three sixteenths of an inch, spaced at each edge about one sixteenth of an inch from the adjacent arms 11; and the width of the connecting or base portion 13, about three sixteenths of an inch. The spacing between the contacts 17 and 12 may be of the order of a sixteenth of an inch.

While the relay of the present invention has been described as applied to master-slave electric circuits, it is to be understood that it is equally applicable to any circuit requiring a current- or temperature-controlled relay, such as plate-voltage relays in vacuum-tube circuits or automobile left-right indicator circuits, to mention but a few. The invention finds particular application where light weight, limited space and low cost are important factors, and where temperature-compensating features are required. Though the U-shaped relay is shown provided with a rectangular contour, it may be of somewhat different shape, such as of semi-circular contour, though the rectangular configuration has the advantages of easy and reliable die-stamping and the provision of a bending axis B disposed substantially parallel to the axis A for producing optimum bending leverage for the tongue.

Further modifications will occur to those skilled in the art and all such are considered to fall within the spirit and scope of the present invention as defined in the appended claims.

What is claimed is:

1. A thermal relay having a base and two bimetal arms and an intermediately disposed bimetal tongue extending from the base, the width of the tongue being about two to three times the width of each of the arms, an insulating support to two points of which are secured, along an edge thereof, the free ends of the arms to permit the arms to bend about the edge away from the support in response to temperature variations, the securing means being provided with electric terminals for connecting the arms in series circuit with a source of energy to effect the said temperature variations in the relay, and the tongue having a contact member at its free end and being free to move at its free end past the said edge in order that the tongue may move in a direction opposite to the direction of bend of the arms, a further contact member disposed between the said two points for cooperating with the tongue contact member, and electrical terminal means connected with the further contact member for connecting one of the arms and the tongue in series circuit with the source of energy when the tongue contact member and the further contact member are in engagement.

2. A thermal relay having a base and two bimetal arms and an intermediately disposed bimetal tongue extending from the base, an insulating support, means for securing the free ends of the arms at two points on one surface of the support, along an edge thereof, in order to permit the arms to bend about the edge away from the support in response to temperature variations in the relay, the securing means being provided with electric terminals for connecting the arms in series circuit with a source of energy to effect the said temperature variations in the relay, the tongue having a contact member at its free end and being free to move at its free end in order that the tongue may move in a direction opposite to the direction of bend of the arms, a further contact member supported upon the oppositely disposed surface of the insulating support between though out of the plane of the arms for cooperating with the tongue contact member, and electric terminal means connected with the further contact member for connecting one of the arms and the tongue in series circuit with the source of energy when the tongue contact member and the further contact member are in engagement.

3. A thermal relay having a base and two bimetal arms and an intermediately disposed bimetal tongue extending from the base, a planar insulating support, means for securing the free ends of the arms upon one surface of the insulating support, along an edge thereof, to permit the arms to bend about the edge away from the said one surface of the support in response to temperature variations in the relay, the securing means being provided with electric terminals for connecting the arms in series circuit with a source of energy to effect the said temperature variations in the relay, the tongue having a contact member at its free end and being free to move at its free end in order that the tongue may move in a direction opposite to the direction of bend of the arms, a further contact member supported upon the oppositely disposed surface of the planar support between

though out of the plane of the arms for cooperating with the tongue contact member, means for varying the distance between the contact members, and electric terminal means connected with the further contact member for connecting one of the arms and the tongue in series circuit with the source of energy when the tongue contact member and the further contact member are in engagement.

4. A thermal relay having a base and two bimetal arms of substantially equal length and an intermediately disposed bimetal tongue extending from the base, a planar insulating support, means for securing the free ends of the arms upon one surface of the insulating support, along an edge thereof, to permit the arms to bend about the edge away from the said one surface of the support in response to temperature variations in the relay, the securing means being provided with electric terminals for connecting the arms in series circuit with a source of energy to effect the said temperature variations in the relay, the tongue having a contact member at its free end and being free to move at its free end in order that the tongue may move in a direction opposite to the direction of bend of the arms, a further contact member, a support for supporting the further contact member upon the oppositely disposed surface of the planar support between though out of the plane of the arms for cooperating with the tongue contact member, means comprising an adjustable screw threaded through the planar support for bearing upon the further-contact-member support in order to vary the distance between the contact members, and electric terminal means connected with the further contact member for connecting one of the arms and the tongue in series circuit with the source of energy when the tongue contact member and the further contact member are in engagement.

5. A thermal relay having a base and two coplanar bimetal arms constructed of superposed planar strips of different metals of substantially equal length and an intermediately disposed planar bimetal tongue of the same bimetal construction extending from the base, a planar insulating support, means for securing the free ends of the arms upon one surface of the insulating support, along an edge thereof, to permit the arms to bend about the edge of the support out of the plane of the support in response to temperature variations in the relay, the securing means being provided with electric terminals for connecting the arms in series circuit with a source of energy to effect the said temperature variations in the relay, the tongue having a contact member at its free end and being free to move at its free end in order that the tongue may move along an axis substantially parallel to the said edge of the support in a direction opposite to the direction of bend of the arms, a further contact member, means comprising a further tongue carried upon the oppositely disposed surface of the insulating support for supporting the further contact member between though out of the plane of the arms for cooperating with the bimetal tongue contact member, and electric terminal means connected with the further tongue for connecting one of the arms and the bimetal tongue in series circuit with the source of energy when the bimetal tongue contact member and the further contact member are in engagement.

6. A thermal relay having a base and two co-

planar bimetal arms constructed of superposed planar strips of different metals of substantially equal length and an intermediately disposed planar bimetal tongue of the same bimetal construction extending from the base, the width of the tongue being greater than the width of each of the arms, means for securing the free ends of the arms upon one surface of the insulating support, along an edge thereof, to permit the arms to bend about the edge of the support out of the plane of the support in response to temperature variations in the relay, the securing means being provided with electric terminals for connecting the arms in series circuit with a source of energy to effect the said temperature variations in the relay, the tongue being free to move at its free end in order that the tongue may move along an axis substantially parallel to the said edge of the support in a direction opposite to the direction of bend of the arms, a further contact member, means comprising a further tongue carried upon the oppositely disposed surface of the insulating support for supporting the further contact member between though out of the plane of the arms for cooperating with the bimetal tongue contact member, means for varying the position of the further-contact-member supporting means from the said oppositely disposed surface of the insulating support in order to vary the distance between the contact members, and electric terminal means connected with the further tongue for connecting one of the arms and the bimetal tongue in series circuit with the source of energy when the bimetal tongue contact member and the further contact member are in engagement.

7. A thermal relay having a base and a bi-

metal arm and a bimetal tongue extending from the base, the width of the tongue being greater than the width of the arm, the free end of the arm being provided with securing means for securing the relay at a point to permit the arm to bend about the point in response to temperature variations, means connected to the securing means for initially passing current from a source of energy through the arm but not through the tongue in order to effect the said temperature variations in the arm, the tongue having a contact member at its free end and being free to move at its free end in order that the tongue may move in a direction opposite to the direction of bend of the arm, a further contact member disposed near the said point for cooperating with the tongue contact member and electric terminal means connected with the further contact member for connecting the arm and the tongue in series circuit with the source of energy when the tongue contact member and the further contact member are in engagement.

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