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HEAT ACTUATED DEVICE

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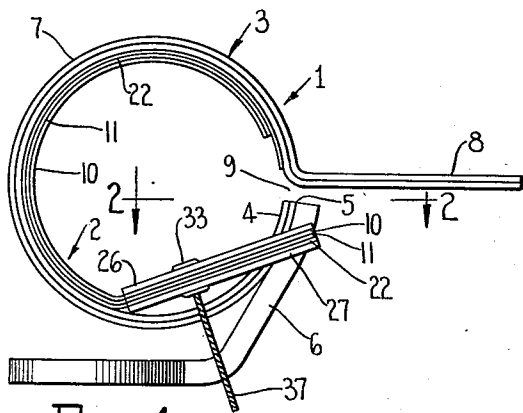


FIG-1

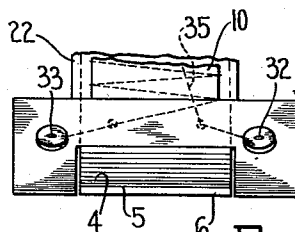


FIG-2

FIG-3

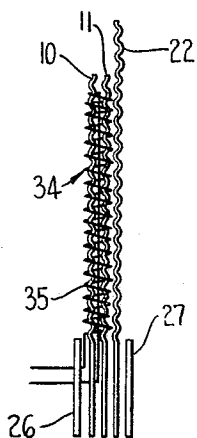
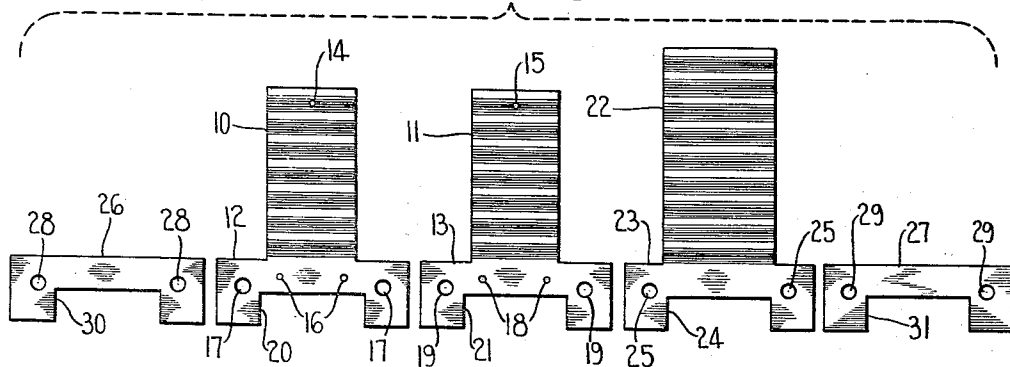


FIG-4

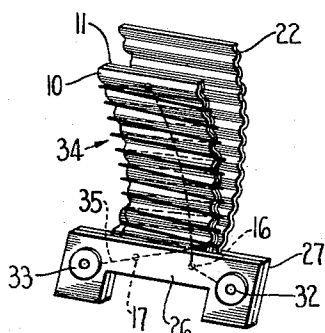


FIG-5

FIG-6

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HEAT ACTUATED DEVICE

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7 Claims. (Cl. 60—23)

This invention relates generally to heat actuated power elements and more particularly to a heater for actuating a bimetallic member.

An object of this invention is to provide a new and novel heater which will readily adjust itself to the contour of the heat actuated element.

A further object is to provide a construction for making the contour following heater flexible and resilient.

A further object is to provide a heater having a high rate of increase and decrease in temperature upon energization and deenergization.

A further object is to provide a new and novel heater which is easily and economically manufactured.

The invention consists in the improved construction and combination of parts, to be more fully described hereinafter, and the novelty of which will be particularly pointed out and distinctly claimed.

In the accompanying drawing, to be taken as a part of this specification, there is clearly and fully illustrated a preferred embodiment of this invention, in which drawing:

Figure 1 is a view in elevation of a heat actuated bimetallic power element embodying the invention;

Fig. 2 is a view substantially along the line 2—2 of Fig. 1 looking in the direction of the arrows;

Fig. 3 is a view of certain of the parts of the heater element separated from each other and each being in front elevation;

Fig. 4 is an exploded view of certain of the parts of the heater element in end elevation;

Fig. 5 is an enlarged sectional view showing the method of securing the parts together and of connecting the terminals of the resistance coil, and

Fig. 6 is a view in perspective of the assembled heater element.

Referring to the drawing by characters of reference, the numeral 1 designates generally the heat actuated bimetallic power element comprising a heater element 2, positioned within and conforming to the inside contour of a bimetallic element 3. The bimetallic element 3 comprises a strip of bimetal which has one end portion 4 rigidly secured, as at 5, to a suitable supporting member 6 and the bimetal is then bent into the shape of a cylinder 7 having its longitudinal axes extending perpendicular to the length of the bimetal and the end portion 8 opposite to the end portion 4 is bent to extend radially outward from the cylinder 7 which has a narrow slit or opening 9 formed between the end portion 4 and the

intersection of the end portion 8 and cylinder 7.

The heater element 2 comprises a pair of elongated corrugated flexible mica strips 10, 11 having at one end portion thereof portions 12, 13 respectively of increased width. The strips 10, 11 are congruent and have apertures 14, 15, respectively, at one end portion and have a plurality of apertures 16, 17 and 18, 19 through the end portions 12, 13. The strips 10, 11 at the end portions 12, 13 have recesses 20, 21, respectively, which are of a width substantially equal to the width of the bimetallic element 3 and which, when in cooperative position therewith, receive the element 3 and hold the element 2 in correct relative position. An elongated flexible mica strip 22 is similar to strips 10, 11 but has a width and length somewhat greater than strips 10, 11. The strip 22 also has a portion 23 of increased width similar to portions 12 and 13 and of equal size. The portion 23 also has a recess 24 and a pair of apertures 25 which are congruent with recesses 20, 21 and apertures 17 and 19. The strips 10, 11 and 22 are placed in juxtaposition with the apertures 17, 19 and 25 and recesses 20, 21 and 24 in alignment. A pair of relatively heavier non-flexible mica pieces 26, 27 which have apertures 28, 29, respectively, and recesses 30, 31, respectively, are congruent with the enlarged width portions 12, 13 and 23 and are placed so that piece 26 is against strip 10 and piece 27 is against strip 22. The recesses 20, 21, 24, 30 and 31 act to provide the strips 10, 11 and 22 and pieces 26 and 27 respectively with extending legs which are adapted to straddle the bimetallic strip of the heater element 2. Hollow rivets 32, 33 extend through the apertures 17, 19, 25, 28 and 29 and have their head portions riveted over tightly against pieces 26 and 27 so that the strips 10, 11 and 22 are held firmly together and to the pieces 26 and 27. The strips 10, 11 and 22 are preferably fabricated from corrugated mica but due to the tightness with which the portions 12, 13 and 23 are held together by the rivets and pieces 26 and 27 they may be relatively flat leaving only the normal width portions of strips 10, 11 and 22 corrugated.

The strips 10 and 11 serve to carry the resistance heater unit 34 which is made from a strip of resistance wire 35. One end of the wire 35 is secured tightly about the rivet 32. The wire then passes through one of the apertures 28, along the space intermediate the piece 26 and strip 10, through one of the apertures 16 up between strips 10 and 11 and then through aperture 15. After passing through aperture 15 the

wire 35 is wound helically downward around the strips 10 and 11 toward the portions 12 and 13 and when the wire 35 substantially reaches portions 12 and 13, the wire 35 is brought through the other of the apertures 18 and 16 after which it passes between piece 26 and strip 10 and then up through the other of the apertures 28 and the end is secured tightly to the rivet 33. Lead wires 36, 37 are secured within the hollow interior of rivets 32, 33, respectively, and serve to connect the ends of the resistance heating unit 34 to a suitable source of electrical energy.

After assembly of the heater element 2 it is placed within the cylinder 7 of the bimetallic element 3 with the strip 22 adjacent and substantially conforming to the contour of the bimetal, and the recesses 20, 21, 24, 30 and 31 receive a portion of the cylinder 7 adjacent the end portion 4. Prior to the initial bending of the corrugated strips 10, 11 and 22 they are relatively stiff and rigid. This is particularly advantageous for winding the unit 34 because the strips 10 and 11 are then innately strong enough to allow the wire 35 to be wound easily thereon. After initial bending of the mica, however, the rigidity of the strips changes and the strips 10, 11 and 22 become resiliently flexible so that after being positioned within the cylinder 7 the strips will adjust themselves to the inside contour of the cylinder and due to the resiliency will tend to open against the inside of the cylinder 7 and as the cylinder 7 flexes under the influence of the heater element 2 the flexible strips 10, 11 and 22 will continue to flex and remain in intimate contact therewith.

The operation of the heat actuated power element 1 is as follows: The lead wires 36, 37 are connected to a suitable source of electrical energy which is controlled in any desired manner, as by a switch (not shown), so that the heater unit 34 may be energized or deenergized as desired. Upon energization of the heater 34 the cylinder 7 of the bimetallic element 3 is heated which tends to open up the slit 9 or unwind the cylinder 7 so that the lip or end portion 8 of element 3 is moved upward thereby to actuate any desired reciprocally movable member (not shown). Upon opening of the switch (not shown), the heater unit 34 is deenergized and the bimetallic element 3 cools thereby moving portion 8 back to its original position and reciprocating said movable member (not shown) back to its original position.

It may now be seen that there is set forth and fully disclosed herein a heat actuated element which is simple and economical of construction and suitable for manufacture in large quantities. The heater unit 34 is amply protected from "shorting" against the bimetal of cylinder 7 and is so constructed that it stays in intimate heat transfer relationship with the cylinder 7 irrespective of the movement of cylinder 7 due to change in its temperature, and the mass of the heater element 2 is small so that immediately subsequent to deenergization of the unit 34, the element 2 will cool thereby allowing the cylinder 7 to quickly cool and move end portion 8 to its original or cold position. The particular construction in which the heater 34 is wound helically along the longitudinal axes of the strips 10 and 11 provides a heater in which the resistance wires are flexed as little as possible, there being in the present construction a single wire, that portion of the wire 35 running longitudinally intermediate the strips 10 and 11, which flexes any ap-

preciable amount and this portion is not drawn tightly between the apertures 15 and 16.

What I claim and desire to secure by Letters Patent of the United States is:

1. A flexible electric heating element comprising a pair of corrugated mica strips in opposed facing relation, and a resistance wire having one portion extending transverse to said corrugations and between said strips and having another portion binding said strips to each other by a multiplicity of spaced turns wound around both of said strips together and substantially parallel to the corrugations so that said strips hold said one portion frictionally in position therebetween.

2. A flexible electric heating element comprising a pair of corrugated mica strips in opposed facing relation, a resistance wire having one portion extending transverse to said corrugations and between said strips and having another portion binding said strips to each other by a multiplicity of spaced turns wound around both of said strips together and substantially parallel to the corrugations so that said strips hold said one portion frictionally in position therebetween, and a corrugated mica strip having its corrugations parallel to the corrugations of said strips, said strip being secured at one end to one end of and overlying one face of said strips and having a width greater than said strips thereby to protect the ends of said turns.

3. A heat actuated power means comprising a bimetallic power element having a substantially cylindrical portion, a flexible resilient supporting member of electric insulating sheet material positioned within and held solely by friction against circumferential movement relative to said cylindrical portion, said member conforming automatically by its innate resiliency to the contour of said element portion irrespective of contraction or expansion thereof due to temperature change, and a resistance wire wound upon and bodily removable with said member and acting upon the passage of an electric current there-through to heat said power element.

4. A heat actuated power means comprising a bimetallic power element having a substantially cylindrical portion, a flexible resilient supporting member of electric insulating sheet material positioned within and held solely by friction against circumferential movement relative to said cylindrical portion, said member conforming automatically by its innate resiliency to the contour of said element portion irrespective of contraction or expansion thereof due to temperature change, a resistance wire wound upon and bodily removable with said member and acting upon the passage of an electric current there-through to heat said power element, and spaced legs on one end portion of said supporting member and laterally engageable with the side edges of said cylindrical portion to hold said supporting member against unintentional lateral displacement.

5. A heat actuated power means comprising, a bimetallic power element having a substantially cylindrical portion, an electric insulating sheet material positioned in and substantially conforming to the contour of said portion, said material being transversely corrugated for flexibility and acting due to its innate resiliency to conform with the contour of said portion irrespective of contraction or expansion thereof due to temperature change, a resistance wire on said member and having its turns running substantially longitudinally of the corrugations, a back-

ing member of electric insulating sheet material positioned intermediate said portion and said sheet material and secured to one side of said member and overlying said wire, and projecting portions on said sheet material for receiving therebetween said element thereby to position said material within said cylindrical portion.

6. A heat actuated power means comprising, a bimetallic power element having a substantially cylindrical portion, an electric insulating sheet material positioned in and substantially conforming to the contour of said portion, said material being transversely corrugated for flexibility and acting due to its innate resiliency to conform with the contour of said portion irrespective of contraction or expansion thereof due to temperature change, a resistance wire on said member and having its turns running substantially longitudinally of the corrugations, and a backing member of electric insulating sheet material positioned intermediate said portion and said sheet material and secured to one side of said member and overlying said wire, said material having at one end portion a portion of increased width, said increased width portion having a recess therein for receiving said element thereby to position said material within said portion.

7. A heat actuated power element comprising a first elongated flexible strip, said strip having an aperture therethrough at one end portion thereof and having a plurality of apertures there-

through at the other end portion thereof, a second elongated flexible strip, said second strip having an aperture therethrough at one end portion thereof and having a plurality of apertures therethrough at the other end portion thereof, said strips being placed in juxtaposition with the apertures of said one strip in alignment with the apertures of said second strip, a resistance wire passing through one of said plurality of apertures in one of said strips, said wire passing longitudinally between said strips and through said one end aperture in one of said strips, said wire being wound in a spiral about said strips from said one end to said other end, said wire then passing through the other of said plurality of apertures, a third elongated flexible strip placed in juxtaposition with one of said strips, means tightly securing together said third strip and said other end of said first and said second strips, said securing means also acting as terminals for the ends of said resistance wire, and a heat actuated power element having a cylindrical portion, said strips having at said other end a slot equal in width to the longitudinal dimension of said cylindrical portion, said strips being positioned within and conforming to the inside contour of said cylindrical portion and positioned with said third strip adjacent said element, said slot receiving said cylindrical portion for positioning of said strips.

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