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3,238,780

AMBIENT COMPENSATED BIMETAL ELEMENTS

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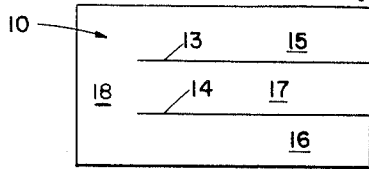


FIG. 2

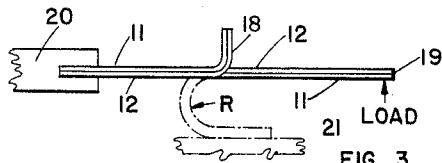


FIG. 3

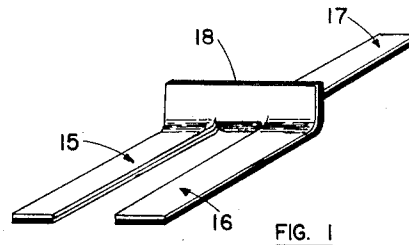


FIG. 1

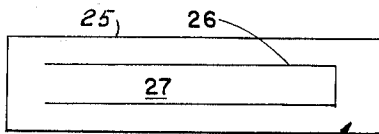


FIG. 5

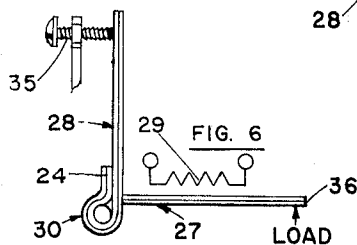


FIG. 6

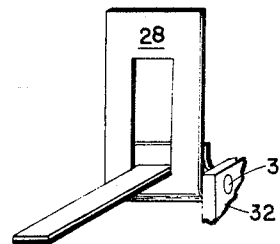


FIG. 4

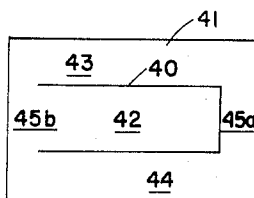


FIG. 8

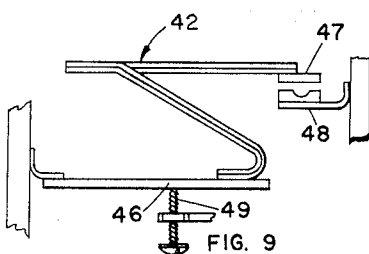


FIG. 9

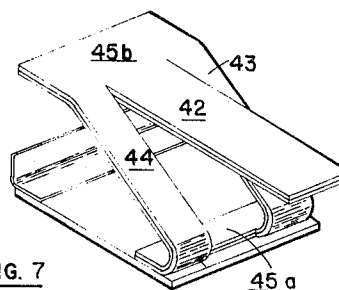


FIG. 7

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AMBIENT COMPENSATED BIMETAL ELEMENTS
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The present invention relates to improved bimetal elements and, more particularly, to bimetal elements which are substantially insensitive to changes of the ambient temperature.

Bimetal elements are widely used as temperature sensing means. These elements, for example, are used for making and breaking electrical switch contacts and for opening and closing fluid control valves. The electrical switch or the valve may in turn control the flow of fuel to a furnace or like heat source. A particular application involves heating the bimetal element in accordance with the flow of electrical current through a given electrical circuit such as an electrical resistance heating element wound upon or proximately located with respect to the bimetal element. This application requires that the bimetal element be sensitive only to the temperature change caused by the resistance heater, or stated in another manner, the element must be insensitive to changes in ambient temperature. Such components are said to be ambient temperature compensated.

The present invention relates to improvements over the ambient compensated bimetal element described and claimed in the copending application of Denis G. Wolfe entitled "Ambient Compensated Bimetal Element and Method for Making Same," Serial No. 260,014, filed February 20, 1963 and assigned to Robertshaw-Fulton Controls Co., assignee of the present invention.

An object of the present invention is to provide an ambient compensated bimetal element which, while being easily and quickly fabricated, retains substantial physical rigidity.

It is a further object of the present invention to provide an ambient compensated bimetal element fabricated by ordinary sheet metal stamping methods which resists twisting about its longitudinal axis.

Other and further objects, features and advantages of the invention will become apparent as the description proceeds.

Briefly, in accordance with a preferred form of the present invention, there is provided an ambient temperature compensated bimetal element comprising a unitary bimetal sheet having two longitudinally extending slits therein to form two outer legs and an inner leg connected by a narrow web. The outer legs are then bent in opposite directions to the inner leg to thereby form a single inner segment reversed from the two outer segments. Anchoring the two outer segments supports the reversed inner segment in cantilever fashion and substantially obviates twisting of the inner member about its longitudinal axis.

A more thorough understanding of the invention may be obtained by a study of the following detailed description taken in connection with the accompanying drawing in which:

FIG. 1 is a perspective view of an ambient temperature compensated bimetal element constructed in accordance with the present invention;

FIG. 2 illustrates the bimetal sheet used in constructing the element of FIG. 1, the sheet being shown after being split but before bending thereof;

FIG. 3 is a side elevation of the element shown in FIG. 1;

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FIG. 4 is a perspective view of another embodiment of the invention;

FIG. 5 illustrates the bimetal sheet used for forming the element of FIG. 4, the sheet being shown after being slit but before bending thereof;

FIG. 6 is a side elevation of the embodiment of FIG. 4;

FIG. 7 is a perspective view of still another embodiment of the invention;

FIG. 8 illustrates the bimetal sheet used to form the embodiment of FIG. 7, the sheet being shown after being slit but before bending thereof; and

FIG. 9 is a side elevation view of the embodiment shown in FIG. 7.

Referring now to the embodiment shown in FIGS. 1 through 3, a flat sheet of bimetal material 10 normally includes two continuous sheets of metal 11, 12 having widely different coefficients of heat expansion joined together face-to-face. One of these metals is ordinarily Invar steel and the other an alloy including, for example, nickel or manganese. This sheet is cut as shown in FIG. 1 to form parallel longitudinally extending slits 13, 14 extending from one end of the sheet to near the other end thereof. Respective outer legs 15, 16 and inner leg 17 joined by a narrow web 18 are thereby formed as shown in FIG. 2. Legs 15, 16 are bent in the same direction to an angle of 90° so as to form the element shown in FIG. 1 wherein each of the legs lie in a common plane with outer legs 15, 16 being mutually reversed from inner leg 17. Thus, metal 11 is on the upper surface of segments 15, 16 whereas it is on the lower surface of segment 17.

Representative mountings for the element of FIG. 1 are shown in FIG. 3 wherein the legs 15, 16 are anchored in a bifurcated support member 20 to support the element in cantilever fashion. Alternatively, the segments 15, 16 can be arcuately bent and supported upon the horizontal base 21 as shown by the dotted lines of FIG. 3. The proportionate lengths of the legs, or the proportion of the radius R to the length of leg 17, will determine the desired movement ratio for ambient compensation of the end 19 of the segment 17.

There is thus formed by the simple expedient of cutting and folding a single bimetal sheet, a bimetal element having reversed segments and further affording a means for supporting the element to resist twisting about its longitudinal axis. This construction also allows the cross-sectional area of segment 17 to be made substantially smaller than that of the combined areas of segments 15, 16. The segment 17 may then be preferentially heated over segments 15, 16 by allowing current to pass through the entire structure; the smaller area segment 17, because of its higher electrical resistance, will be subjected to a higher power dissipation and heating than the segments 15, 16. Furthermore, regardless of the mode of preferential heating or cooling utilized, a substantial heat barrier is provided since all of the heat must flow through the narrow web 18 in order to be conducted from the inner segment to the outer segments.

Another advantage of the present invention is that thermal changes of the upstanding web 18 does not cause lateral movement of segment 17. Such movement will occur if, for example, only one of the legs 16 was secured to support 20 and the temperature of the web changed. This web, being a bimetal, tends to flex about an axis perpendicular to the longitudinal axis of legs 15, 16 and 17 when subjected to a temperature change. By rigidly mounting both of the legs 15, 16 to support 20, such flexure is prevented and segment 17 remains in a preset lateral position during changes in either the ambient or control temperatures.

Another embodiment of the invention as shown in FIGS. 4 through 6 comprises forming slit 26 in the bi-

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metal sheet 25. This slit preferably has a generally U-shape with straight parallel sides perpendicular to a straight line base to form bimetal tongue 27 and a bimetal U-shaped segment 28. The resultant rectangular tongue 27 is bent at approximately 90° with respect to the segment 28 to form a generally L-shaped element. Web 24 is bent in a generally cylindrical form with the outer edge of the web joined by welding or like means to an inner portion of the segment 28. The resulting cylinder 30 is conveniently pivoted on an axle 31 affixed to support 32 when the bimetal element is utilized as a thermal actuator. The position of the U-shaped segment 28 may be varied by an adjustment screw 35 and a load is actuated by preferential heating or cooling of the reverse tongue 27 by, for example, an electrical resistance heater 29 wound upon or mounted adjacent this member. By making segment 28 substantially equal in length to segment 27, flexure of segment 27, caused by a change in the ambient temperature, will be compensated for by an equal but opposite flexure of segment 28 so that the end 36 of segment 27 will remain substantially stationary. As a result, the load is unaffected by changes in ambient temperature. Also, it will be seen that this type of mounting permits movement only about the longitudinal axis of axle 31; accordingly, a force applied to the end 36 of inner segment 27 does not produce an undesired twisting of the element about another axis.

A further embodiment of the invention is shown in FIGS. 7, 8 and 9. This embodiment comprises a generally Z-shaped bimetal element formed by cutting a generally U-shaped slit 40 in a bimetal sheet 41 (FIG. 8). This slit provides a generally rectangular inner tongue or leg 42 and outer legs 43, 44 connected at their respective ends by webs 45a and 45b. Leg 42 and web 45b are bent at an acute angle with respect to outer legs 43, 44, and web 45a is bent through an obtuse angle to form a supporting base for the bimetal element. A typical application is shown in FIG. 9 wherein the web 45a is fixedly mounted to a spring pivoted base member 46. An electrical contact 47 is affixed to the end of tongue 42 and is juxtaposed stationary electrical contact 48. The position of the contact 47 relative to contact 48 may be varied by adjustment screw 49.

It will be seen that webs 45a and 45b prevent any twisting of the bimetal component about any longitudinal axis of the body, i.e. an axis generally parallel to segment 42 or segments 43, 44.

The bimetal element shown in FIGS. 7-9 provides ambient compensation in the following manner: Assuming that the lower side of inner leg 42 and outer legs 43, 44 is the greater expansion side, an increase in ambient temperature will cause the outer legs 43, 44 to bow clockwise and thereby tend to bend the outer end of inner leg 42 toward the fixed contact 48. However, the inner leg also bows and in so doing raises the outer end of leg 42. Consequently, by suitably proportioning the leg members, the position of contact 47 will remain fixed with respect to stationary contact 48 for changing ambient temperatures. Contrarywise, a preferential heating of either inner leg 42 or outer legs 43, 44 has a minimum effect upon the other since the only heat conduction occurs through the narrow web 45b.

Although exemplary embodiments of the invention have been disclosed and discussed, it will be understood that other applications of the invention are possible and that the embodiments disclosed may be subject to various changes, modifications and substitutions without necessarily departing from the spirit of the invention.

I claim:

1. An ambient compensated bimetal element for detecting temperature changes adjacent one part of the element comprising:

a unitary bimetal sheet having two longitudinally ex-

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tending slits therein to form two outer legs and an inner leg connected by a relatively narrow web; said inner leg being bent relative to said outer legs to form mutually reversed inner and outer segments, selected portions of which remain in fixed relation to each other irrespective of change in the ambient temperature;

said reversed segments being spatially separated from each other such that the placing of either one of said segments in the proximity of a local source of heat or cold will produce a non-compensated relative movement between said selected segment portions indicative of the temperature of such local source.

2. The ambient compensated bimetal element defined in claim 1 wherein:

said longitudinally extending slits extend from one end of said sheet to near the opposite end thereof to form said web at said latter end.

3. The ambient compensated bimetal element defined in claim 2 wherein:

said mutually reversed inner and outer segments are substantially co-planar.

4. The ambient compensated bimetal element defined in claim 1 wherein:

said longitudinally extending cuts have their respective ends lying within the confines of said bimetal sheet whereby said outer legs are joined by said web at one end thereof and by an additional web at the other end thereof.

5. The ambient compensated bimetal element defined in claim 4 wherein:

said longitudinally extending slits lie parallel to each other and perpendicular to another slit forming a straight line base thereby forming a generally rectangular inner leg.

6. The ambient compensated bimetal element defined in claim 4 wherein:

said web connecting the inner segment to said outer segment is bent into a generally cylindrical shape with the outer edge of said web joined to an inner portion of said bimetal sheet.

7. The ambient compensated bimetal element defined in claim 4 wherein:

said inner leg is bent at an acute angle with respect to said outer legs.

8. The ambient compensated bimetal element defined in claim 4 wherein:

said additional web joining said outer legs is bent through an obtuse angle with respect to said outer legs so as to lie in a plane substantially parallel to the plane of said inner leg.

9. The ambient compensated bimetal element defined in claim 4 wherein:

said inner leg is bent with respect to said outer legs to form a generally L-shaped element.

10. The ambient compensated bimetal element defined in claim 4 wherein:

said inner leg and said additional web are bent with respect to said outer legs to form a generally Z-shaped element.

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