

April 7, 1959

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2,881,294

TEMPERATURE RESPONSIVE RESISTOR

Filed March 30, 1955

FIG. 2.

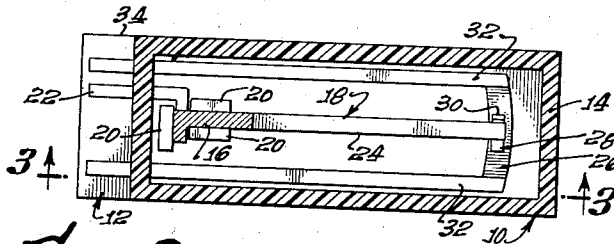


FIG. 10.

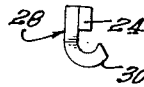


FIG. 3.

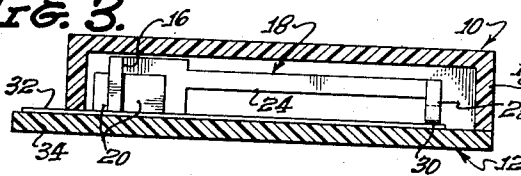


FIG. 1.

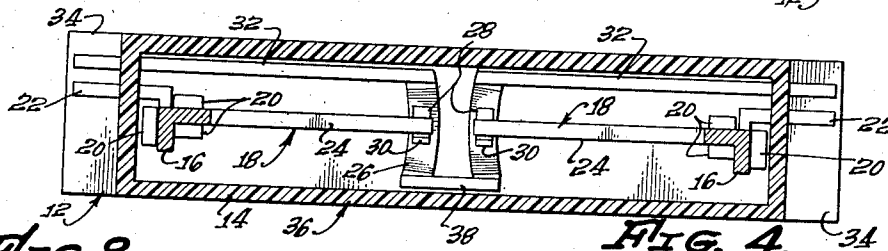
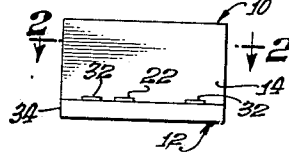


FIG. 8.

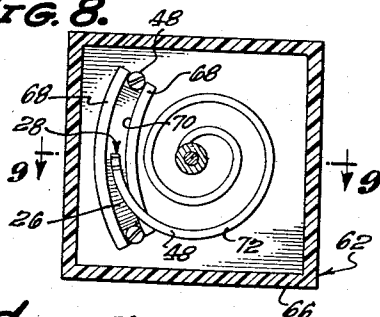


FIG. 9.

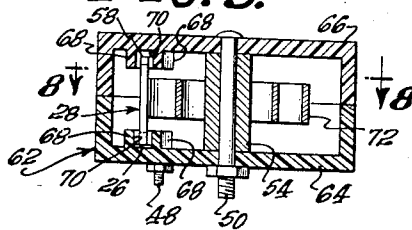


FIG. 5.

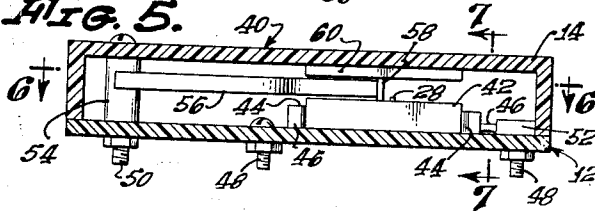


FIG. 7.

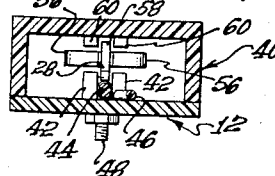
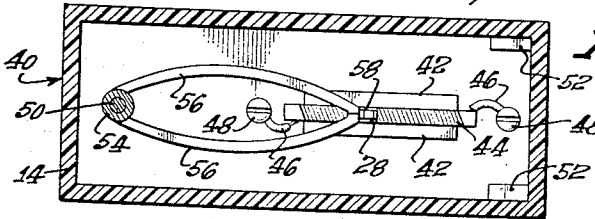


FIG. 6.



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TEMPERATURE RESPONSIVE RESISTOR

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Application March 30, 1955, Serial No. 497,877

1 Claim. (Cl. 201—48)

The present invention relates to new and improved temperature responsive variable resistors and like devices such as, for example, potentiometers.

It is frequently desired to vary an electrical value in accordance with temperature. A wide variety of different devices have been developed for the purpose in the past. Perhaps the most common of these devices are thermistors of one sort and another. All thermistors operate by virtue of a change in the electrical resistance of a resistance element with temperature. Usually thermistors employ various semi-conductive systems having irregular temperature-conductive characteristics for the resistance element itself. Such semi-conductive systems tend to be very sensitive to variation in manufacturing conditions and in many cases to various atmospheric conditions.

It is an object of this invention to provide a new and improved type of temperature responsive resistor; more specifically, it is an object of this invention to provide a variable resistor in which the change of resistance is directly proportional to the change in temperature of the resistor. Related objects of the invention are to provide devices of the class described which are exceedingly accurate; which give a substantially uniform variation in resistance value over a comparatively wide range of temperatures; and which are easily and cheaply manufactured and assembled. Further objects of this invention as well as many advantages of it are more fully explained in the remainder of this description, the appended claim and the accompanying drawings in which:

Fig. 1 is an end view of the temperature responsive variable resistor of the invention;

Fig. 2 is a cross-sectional view taken at line 2—2 of Fig. 1;

Fig. 3 is a cross-sectional view taken at line 3—3 of Fig. 2;

Fig. 4 is a cross-sectional view similar to Fig. 2 of a modified resistor of the instant invention;

Fig. 5 is a cross-sectional view similar to Fig. 3 of a second modified resistor of the invention;

Fig. 6 is a cross-sectional view taken at line 6—6 of Fig. 5;

Fig. 7 is a cross-sectional view taken at line 7—7 of Fig. 5;

Fig. 8 is a cross-sectional view similar to Fig. 2 of the drawings taken at line 8—8 of Fig. 9 showing the third modified resistor of the invention;

Fig. 9 is a cross-sectional view taken on line 9—9 of Fig. 8; and

Fig. 10 is a detailed view showing a contact construction employed with the invention.

In the various figures of the drawings like numerals have been used to designate like parts wherever convenient for purposes of illustration and explanation. It is to be understood that the instant invention is not to be considered as being limited to variable resistors constructed as precisely illustrated in the drawings inasmuch

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as the sizes and shapes of many of the parts shown have been altered from their normal proportional sizes so as to simplify the explanation and illustration of the invention.

In Figs. 1, 2, and 3 of the drawings there is shown a temperature responsive variable resistor 10 of the invention which is formed with terminals so as to be capable of being used as a potentiometer. The resistor 10 includes a non-conductive base 12 formed of an appropriate resinous material such as, for example, a filled phenolic resin to which there is attached by means of suitable adhesive such as an adhesive based upon an epoxy resin a lid 14. This lid 14 is formed of the same materials as the base 12. Held between the lid 14 and the base 12 is an L-shaped end 16 of a bimetallic movable element 18. This L-shaped end 16 is prevented from moving by contact with three upstanding projections 20 formed integrally with the base 12. Thus, with this construction the end 16 is securely held against a printed circuit layer 22 formed of conductive material such as for example a silver paint so as to be in electrical contact with this layer. If desired, the end 16 may be soldered or otherwise contacted to the layer 22 although this is not considered necessary.

The movable element 18 includes a long bimetallic arm 24 which is attached to the end 16 so as to project therefrom to immediately above a printed circuit resistance layer 26 formed of any appropriate printed circuit composition of a type known to the art. This layer 26 is preferably of arcuate shape so that if the resistor 10 is either heated or cooled the arm 24 will bend moving a small contact 28 attached to this arm immediately above the layer 26 with respect to the layer 26. Preferably this contact is formed as shown in Fig. 10 of the drawings so as to include a curved extremity 30, which resiliently bears against the layer 26 so as to be in electrical contact therewith. The contact 28 may be attached to the arm 24 by any convenient means such as, for example, welding, or the like.

The ends of the layer 26 are covered by layers 32 by the same material as the layer 22 so as to be in electrical communication with the layer 26. The layers 32 are formed so as to project along the base 12 outwardly from the lid so as to terminate upon a projecting end 34 of the base 12. The layer 22 is also brought out from under the lid 14 so as to terminate upon the same end. Thus with this construction various electrical connections may be made to the three layers 22 and 32.

Those skilled in the art will realize from the foregoing description that the resistor 10 forms a very simple compact device which may be used for the purpose intended. When the resistor 10 is heated or cooled the arm 24 bends moving the contact 28 along the layer 26 so as to accomplish the intended variation in electrical resistance. It is possible to modify the construction shown in Figs. 1, 2, and 3 of the drawings so as to produce a modified resistor 36 such as is shown in Fig. 4 of the drawings. This modified resistor differs from the resistor 10 primarily in that two movable elements 18 are held by projections 20 in such a manner that these movable elements 18 point toward one another so that contacts 28 disposed upon them move with respect to two separate resistance layers 26 of the same shape and construction previously described. Two adjacent ends of these two resistance layers 26 shown in Fig. 4 are connected together through the use of a short electrically conductive layer 38 of the same type as the layer 22. The other ends of the two layers 26 are shown in Fig. 4 of the drawings as connected to layers 32 as previously described.

Thus with the construction shown in Fig. 4 two mov-

able members are provided in such a manner that both of these movable members move with respect to what, in effect, is a single resistance layer created from two layers 26 so as to provide a double temperature variation.

This type of construction is considered to be of utility in many missile and other applications in which a single movable element 18 as described in connection with the resistor 10 does not provide sufficient motion with respect to the resistance layer 26 so as to produce an electrical signal variation of a desired amount or in which a unique current dividing action is desired. Obviously the ends of the layers 32 and 22 shown in both Figs. 2 and 4 need not be all connected into an electrical circuit.

In Figs. 5, 6, and 7 of the drawings a second modified resistor 40 of the invention is shown which includes a base 12 and a lid 14 as previously described. Upon this base 12 there are mounted parallel elongated projections 42 between which there is disposed a wound resistance element 44 of the type well known to the art. Preferably this resistance element is held in position through the use of an epoxy resin adhesive. The ends of this resistance element are connected through wires 46 to bolts 48 projecting through the base 12 so that appropriate electrical connection may be made to this resistance element.

In the construction shown in Figs. 5, 6, and 7 the lid 14 is held with respect to the base 12 by means of bolt 50 which projects through both the base 12 and the lid 14. Movement of the lid 14 or of the base 12 about this bolt is prevented by edge lugs 52 formed integrally with the base 12 engaging the interior of the adjacent portions of the lid 14. About the bolt 50 there is positioned a metallic sleeve 54 the ends of which bear against both the base 12 and the lid 14. This sleeve is preferably of such dimension that it fits tightly against the bolt 50 so as to be in electrical contact therewith. Secured to the sleeve 54 as by welding or the like are two bowed metallic arms 56 the ends of which remote from the sleeve 54 are secured together as by welding, or the like, to a contact 28 of the category previously described. This contact includes an upper end 58 which is adapted to slide between parallel projections 60 formed integrally with the lid 14 immediately above the projections 42.

The operation of the modified resistor 40 of the invention is considered to also be essentially obvious. As this resistor is heated or cooled the bowed bimetallic arms 56 either tend to increase their curvature or to decrease their curvature so as to slide the contact 28 between the projections 42 and the projections 60 so as to place this contact in electrical communication with different portions of the resistance element 44. Thus, with this construction the projections 42 and the projections 60 act as guides preventing undesired movement of the contact 28. The use of such guides is exceedingly advantageous when the resistor 40 is used under conditions where it is apt to be subjected to extreme vibration. The bolt 50 is obviously designed to be used as one terminal of this resistor 40.

In Figs. 8 and 9 of the drawings a third modified resistor 62 of the invention is illustrated which is formed of two identical non-conductive housing sections 64 and 66 formed of materials such as previously indicated. Within both of these sections there are provided integrally formed projections 68 so as to define arcuate grooves

70. The two sections 64 and 66 are held together by means of a bolt 50 of the class previously described around which there is disposed between the two sections a sleeve 54, also as previously indicated. In this case the sleeve is held between the sections 64 and 66 so as to be secure against rotation. Various means preventing rotation of this sleeve 54 can be employed if desired. Attached to this sleeve is a bimetal helical or spiral movable element 72 to the end of which there is secured a contact 28 of the type illustrated in Figs. 5, 6, and 7 of the drawings in such a manner that the curved extremity 30 of this contact 28 is in electrical engagement with a resistance layer 26 disposed between the projections 68. The upper end 58 of this contact 28 is located within the groove 70 opposite the resistance layer 26 so as to serve as an additional guide means tending to prevent undesirable movement of the contact 28. The projections 68 on the sections 64 also serve to prevent such undesirable movement of the contact 28. The ends of the resistance layer are contacted by small bolts 48 passing through one of the sections 64 so that these bolts may be used as end terminals for the layer 26 with the resistor 62. The bolt 50 is also designed to be used as a terminal of this category.

The operation of the resistor 62 is essentially similar to the operation of the other resistors previously described. If the temperature of the resistor 62 either increases or decreases the movable element 72 will either tend to unwind or wind about the bolt 50 moving the contact member 28 along the grooves 70 so as to place this contact in electrical communication with different portions of the layer 26.

Those skilled in the art will realize that a number of different variable resistor constructions may be designed embodying the essential features of this invention. For this reason the present invention is to be considered as being limited only by the appended claim.

I claim:

A temperature responsive variable resistor which comprises: a base formed of a non-conductive material, said base including three upstanding projections formed integrally therewith so as to extend from one side of said base; a bimetallic temperature responsive element having an L-shaped end and a movable end positioned with respect to said base with said L-shaped end held in a fixed position by said upstanding projections; a resilient contact attached to said movable end of said temperature responsive element; an arcuate resistance element located on said base so as to be engaged by said contact; terminal means formed on said base so as to lead from the ends of said resistance element and from beneath said L-shaped end of said temperature responsive element; a non-conductive lid secured to said base above said temperature responsive element and said resistance element, said lid holding said temperature responsive element in place against said base in contact with one of said terminal means.

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