June 10, 1947. G. L. PEARSON 2,421,759

RESISTOR

Filed Jan. 5, 1944

FIG. 1

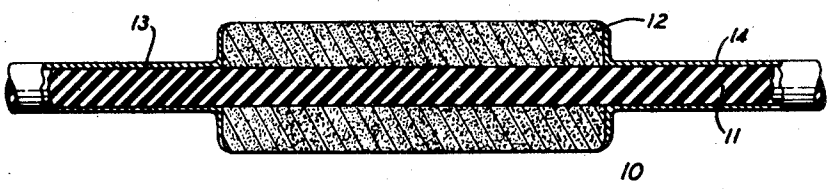
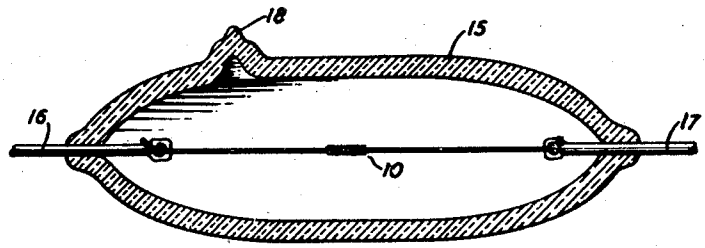


FIG. 2



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Patented June 10, 1947

2,421,759

UNITED STATES PATENT OFFICE

2,421,759

RESISTOR

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Application January 5, 1944, Serial No. 517,061

2 Claims. (Cl. 201—63)

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This invention relates to resistors and more particularly to resistors of very small volume and having a temperature coefficient of resistance of relatively high absolute value.

Resistors, the resistance of which varies greatly with changes in temperature, have for convenience of terminology been called "thermistors." Wherever the term "thermistor" is used in this specification or the appended claims, such a resistor is intended.

It has been found that for many applications thermistors in order to properly perform their functions must be very small in size. Small thermistors have usually been made in the form of a tiny bead of suitable resistance material having conductive leads embedded therein; or of small cylinders or pellets of like material with conductive leads secured to opposite ends thereof. Difficulties have been encountered in making bead or pellet type thermistors of sufficiently small volume to meet certain electrical and thermal requirements.

In the light of the foregoing, an object of this invention is a very small resistor with a relatively high absolute value of resistance-temperature coefficient and having a high resistance and high sensitivity.

A feature of this invention resides in a very fine filament of tough, flexible, insulating material, which provides a base for the current carrying portion of the improved resistor.

A further feature of this invention involves a layer of high resistance-temperature coefficient, resistance material adhering to an intermediate portion of the filament of insulating material.

Another feature of the invention resides in thin films of metallic conductive material coating the remainder of the insulating filament and making contact respectively to spaced portions of the high resistance-temperature coefficient material.

Other and further objects and features of this invention will appear more fully and clearly from the following description of an illustrative embodiment thereof taken in connection with the appended drawings in which:

Fig. 1 is a sectional view at an enlarged scale of a portion of a resistor illustrating the invention; and

Fig. 2 is a view at an enlarged scale partly in section showing a resistor, made in accordance with this invention, mounted in a protective envelope.

Referring to Fig. 1, the thermistor 10 comprises a filament 11 of insulating material having a

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band 12 of resistance material adhering to an intermediate portion thereof. The remainder of the filament 11 is coated with continuous layers 13 and 14 of conducting material, which make contact respectively with opposite ends of the band 12.

The band 12 may be made of any suitable resistance material. For example, uranium oxide has been used to make the resistance band. One way of doing this is to apply a paste of uranium oxide powder and water or uranium nitrate to an intermediate portion of the filament 11. The paste may then be subjected to a sufficiently high temperature to sinter the oxide material and cause it to adhere firmly to the filament. After the sintered material has cooled metallic films 13 and 14 may be applied to the filament, making sure that they are in good contact with the band of resistance material 12. This may be done by masking or otherwise protecting all of the band 12 except its ends and then vapor depositing a metallic film on the filament and the ends of the resistor 12. A suitable material for the adherent films 13 and 14 is gold.

The filament 11 may be made of any insulating material that can be successfully reduced to a very small cross section. A particularly suitable material for the filament is quartz, which may be drawn out very fine and still retain considerable strength.

For protection the thermistor 10 may be enclosed in an envelope as illustrated in Fig. 2. The envelope may be a tube or bulb 15 of glass or like suitable material. The thermistor assembly 10 may be secured to mounting or supporting conductors 16 and 17 which may be sealed into the ends of the tube 15. One way of securing the thermistor assembly to the supporting conductors is to slightly flatten each conductor 16 and 17 and to secure the ends of the metal coated filament 11 to each flat portion by means of a suitable conducting cement. The cement may be colloidal graphite in water, the water being evaporated to solidify the cement. If desired, the tube 15 may be evacuated and then sealed off as at 18.

The filament 11, if made of quartz, may be of the order of a few mils to a fraction of a mil in diameter and the band 12 of a thickness comparable to the diameter of the filament. Due to the particular structure and the very small dimensions, it is obvious that a very minute volume and cross section of resistance material may be made. Thus the desired high resistance and high sensitivity to applied power is obtained.

Although this invention has been disclosed by means of an illustrative embodiment thereof, it will be understood that it is not limited thereby but by the scope of the appended claims only.

What is claimed is:

1. A high resistance-temperature coefficient resistor having high sensitivity to applied power and comprising a fine filament of quartz having a diameter of the order of a few mils to a fraction of a mil, a layer of high resistance-temperature coefficient resistance material of a thickness comparable to the diameter of said filament adhering to an intermediate portion of said filament and forming a continuous band therearound, and films of metallic, conductive material coating the remainder of the filament, said films making contact respectively with opposite edges of the band of resistance material.

2. A high resistance-temperature coefficient resistor having high sensitivity to applied power

and comprising a fine filament of quartz, a layer of uranium oxide adhering to an intermediate portion of said filament and forming a continuous band therearound, and films of gold coating the remainder of the filament, said films making contact respectively with opposite edges of the band of uranium oxide.

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REFERENCES CITED

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

UNITED STATES PATENTS

Number	Name	Date
1,694,167	Dubilier	Dec. 4, 1928
1,771,056	Pender	July 22, 1930
1,832,419	Pender	Nov. 17, 1931
1,415,748	Weintraub	May 9, 1922