

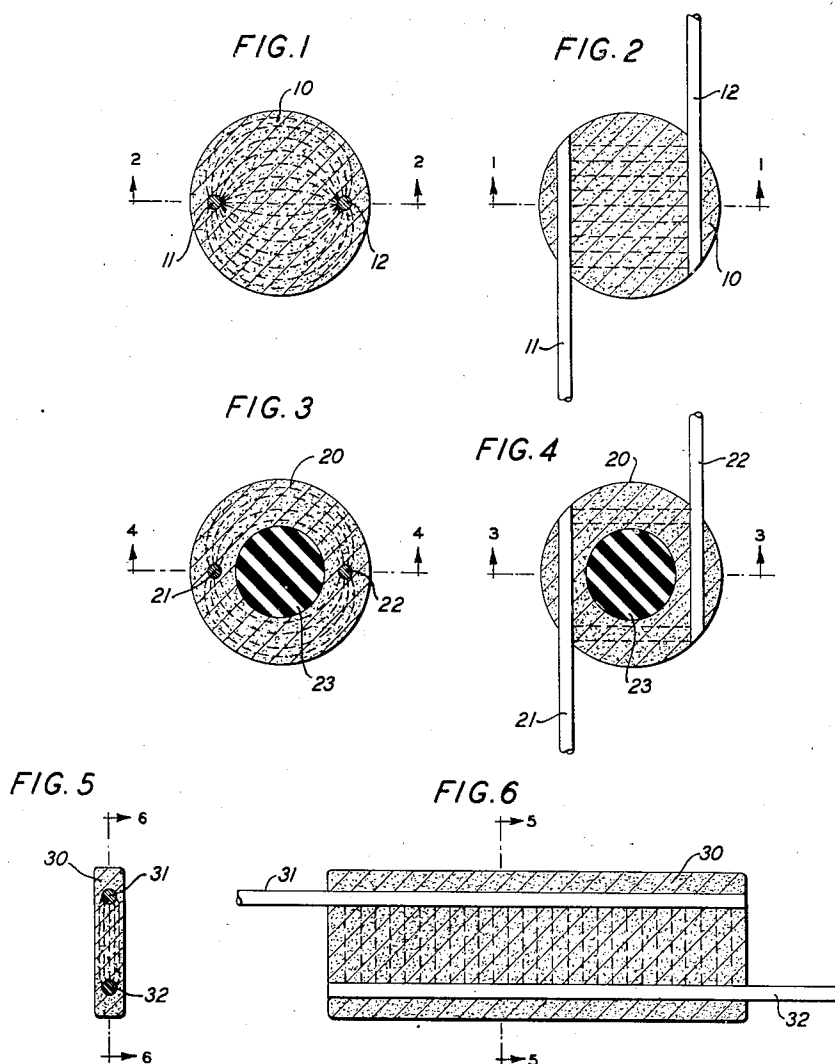
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RESISTOR HAVING A HIGH TEMPERATURE COEFFICIENT OF RESISTANCE

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RESISTOR HAVING A HIGH TEMPERATURE
COEFFICIENT OF RESISTANCE

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4 Claims. (Cl. 201—63)

This invention relates to resistors, and more particularly to high resistance-temperature coefficient resistors.

Resistors the resistance of which varies greatly with changes in temperature, have for convenience been designated as "thermistors." Wherever this term may appear in the present specification or in the appended claims, such a resistor is intended.

Thermistors may be made in several general forms one of which is designated as the directly heated bead type. The term "bead" is applied to a relatively small body of thermistor material having spaced electrodes. One particular form of "bead" thermistor, from which the name is probably derived, comprises a small, substantially spherical body or bead of thermistor material having fine wire leads, a portion of each of which is embedded in the bead in spaced parallel relation to act as electrodes. As the term implies "directly heated" refers to the fact that the heating, which changes the resistance, is due to the electric current flowing through the body of thermistor material. This current is both the controlling and the controlled current in such a thermistor.

Directly heated bead thermistors are used in electric circuit control means and are often required to be slow-acting or of "low speed." That is, the effect, or resistance change, lags somewhat behind the cause or applied power change. For example, where it is required that a circuit element act some time after the closing of the circuit, a negative resistance-temperature coefficient thermistor will first limit the current and then upon heating up will allow sufficient current to flow to operate the circuit element. Another situation where a slow-acting thermistor is employed, is in the regulation of telephone line amplifiers. In this application the thermistor is subjected to a portion of the amplifier output and reacts to fluctuation therein to readjust the amplifier so that the output remains substantially constant. A relatively slow-acting thermistor is required to avoid "over-regulation." The mass and thermal characteristics of these thermistors are chosen to give the desired time delay for slow action.

It has been found in accordance with this invention that the configuration of the thermistor body with respect to the electrodes, as well as the mass and thermal characteristics, must also conform to certain rules, if slow action is to be obtained, particularly where the regulated power tends to increase rapidly.

It is an object of this invention to provide a bead type thermistor in which the heating due to the power flowing therethrough is substantially uniform throughout the active portion of the body of thermistor material.

A feature of this invention resides in a bead type thermistor in which the parallel current paths from electrode to electrode are substantially equal in length. This is accomplished by making the configuration of the body of resistance material such that each section thereof that is substantially perpendicular to the parallel current paths between electrodes, is comparable in size and shape to the corresponding sections of the electrodes. In other words, each parallel current increment of the total current flowing between electrodes finds a path that differs little in length from the paths found by the other increments. Thus, the formation of a "hot spot" is avoided. If the current paths are of unequal length and consequently of unequal resistance, there is a concentration of current in the low resistance paths with resultant local heating and further reduction in resistance and increase of current until the "hot spot" condition exists. Due to the abnormal rise of temperature in the "hot spot" region the resistance change in that part of the thermistor is considerable and the effective "speed" of the action is high. The expected slow action is therefore not obtained. This difficulty is avoided, as previously indicated, by the arrangement of this invention, which insures substantially equal distribution of current in the thermistor body.

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

Figs. 1 and 2 show sections of a bead thermistor of the type previously described and having unequal parallel current paths;

Figs. 3 and 4 show similar sections of a thermistor embodying one illustrative modification of this invention; and

Figs. 5 and 6 show comparable sections of another thermistor embodying a different illustrative modification of the invention.

The device shown in Figs. 1 and 2 has been previously described and comprises a generally spherical body 10 of suitable resistance materials in which are embedded the leads 11 and 12. The embedded portions of the leads comprise the electrodes of this resistor. The dashed lines are to represent the general configuration of parallel

current paths in this type of resistor and clearly show the substantial inequalities of current path lengths.

The embodiment of the invention illustrated in Figs. 3 and 4 comprises a generally spherical body 20 of suitable resistance material with spaced, substantially parallel leads 21 and 22 embedded therein. In the center of the resistor body 20 is a generally spherical body 23 of insulating material such, for example, as glass. The insulating body 23 forms a barrier across what would be the shorter paths, if the device were in the form of Figs. 1 and 2. Thus all the parallel current paths are curved and the shorter ones running close to the insulating body are comparable in length to the longer paths running near the surface of the resistor body.

The resistor shown in Figs. 5 and 6 comprises a body 30 of resistance material having spaced, parallel leads 31 and 32 embedded therein. As may be seen from the drawing, this body is relatively flat and long in the direction of the electrodes. The thickness of the body is little greater than the diameter of the electrodes, so that the longest parallel current paths between electrodes are only slightly longer than the shortest paths. Thus substantially uniform heating is obtained throughout the body.

The disclosure of this invention by means of illustrative embodiments is not intended to impose limitations thereon. It is believed obvious that variations may be made in the structure without departing from the spirit and scope of the invention as set forth in the appended claims.

What is claimed is:

1. A resistor comprising a body of high resistance-temperature coefficient material having a pair of like, elongated electrodes embedded therein in substantially parallel relation, said electrodes being respectively adjacent opposite sides of said body, the portion of said body that includes the current paths from electrode to elec-

trode having a cross section comparable in shape and orientation to the longitudinal sections of said electrodes, whereby each parallel current path through the body is of substantially the same length.

2. A resistor comprising a body of high resistance-temperature coefficient material, and a pair of like, long, cylindrical electrodes embedded in said body in spaced substantially parallel relation, the portion of said body between electrodes being so formed that each section thereof, that is substantially perpendicular to the electrically parallel current paths between electrodes, has a length and width approximately the same respectively as the length and diameter of the embedded electrodes, whereby said parallel paths are substantially equal in length.

3. A resistor comprising a substantially spherical body of high resistance-temperature coefficient material having a pair of elongated electrodes embedded therein in substantially parallel relation, said electrodes being respectively adjacent opposite sides of said body, and a substantially spherical body of insulating material between said electrodes and at the center of said resistor body, whereby the electrically parallel current paths from electrode to electrode and around said insulating body are each of substantially the same length.

4. A resistor comprising a relatively flat, elongated body of high resistance-temperature coefficient material having a pair of elongated electrodes embedded therein in substantially parallel relation, said electrodes being respectively adjacent the long sides of said body, the body being comparable in thickness to the thickness of said electrodes, whereby each electrically parallel current path through the body is of substantially the same length.

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