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R. L. RULISON

2,505,066

METHOD OF MAKING ASSEMBLIES OF RESISTOR BODIES

Filed Sept. 17, 1947

FIG. 1.

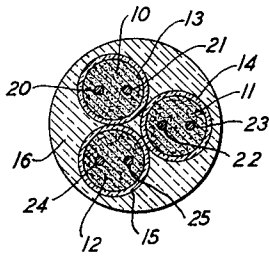


FIG. 2.

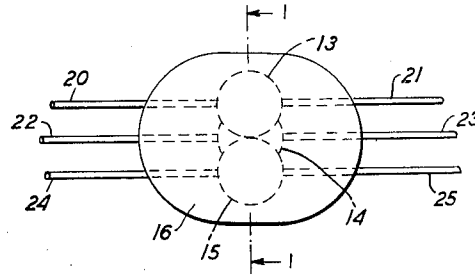


FIG. 3.

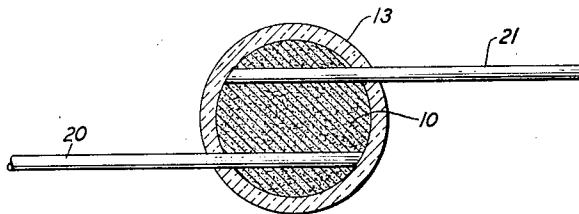
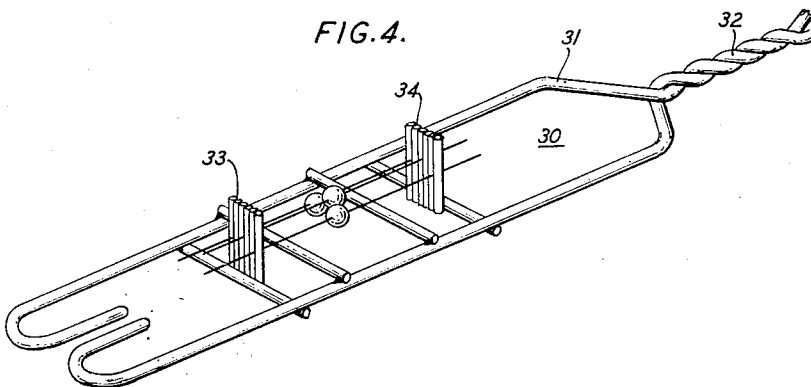


FIG. 4.



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METHOD OF MAKING ASSEMBLIES OF
RESISTOR BODIES

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3 Claims. (Cl. 49—81)

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This invention relates to a method of combining a plurality of resistor units into a unitary structure.

The invention finds particular use in the combining of several small resistor elements of the type known as thermistors. The term "thermistor" is applied to a resistor the resistance of which varies greatly with changes in temperature and such a device is intended wherever the term may be employed in the specification or the appended claims.

In some applications employing thermistors, it is desirable to subject several elements to the same temperature conditions or to arrange them so that the temperature of one element affects that of another. One way of doing this is to enclose two or more thermistor elements in closely spaced relation in a mass of insulating material such as glass. Where the elements are tiny beads of thermistor material difficulty is often encountered in preventing short-circuits or high resistance leaks among the elements of such a multiple unit.

One object of this invention is to combine a plurality of small resistor elements in a unitary structure in which each element is adequately insulated electrically from each other element, but all of the elements are in good heat transfer relation to each other.

A feature of this invention resides in coating each of several resistor elements or bodies with glass or a glass-like material, assembling the coated bodies and then securing them together with a glass or glass-like material of sufficiently lower melting point to avoid remelting of the coatings with consequent reduction of the insulation between the bodies.

The foregoing and other objects and features of this invention will be more fully and clearly understood from the following description in connection with the appended drawings in which:

Fig. 1 is a sectional view of three bead thermistor elements in an assembly illustrative of this invention;

Fig. 2 is a view in elevation of the same assembly;

Fig. 3 is a sectional view of a thermistor bead with its individual insulating coating; and

Fig. 4 is a perspective view of three individually coated beads assembled in a fixture in preparation for receiving their unifying coating.

As illustrated in Figs. 1 and 2, a device made in accordance with this invention may comprise three resistor bodies or elements 10, 11 and 12 enclosed in individual coatings 13, 14 and 15 of

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glass or like insulating material. The three coated bodies are held in intimate heat conducting relation by the mass of insulation 16 in which they are embedded. The mass 16 may be of glass or like suitable material.

Each resistor body is provided with leads 20, 21; 22, 23; and 24, 25, respectively, embedded in spaced relation in each body to serve also as electrodes.

As a first step in the manufacture of the assembly, each resistor body is completely enclosed in an insulating coating. For example, a coating of a glass melting at about 625° C. may be applied by any suitable method. One way of doing this is to apply a paste of ground glass and water to the bead and to then fuse the glass into an integral coating by a suitable flame or other heater. Each element then is as shown in Fig. 3.

A plurality of elements, in the illustrative case 3, may then be assembled in preparation for receiving the exterior coating or enclosing mass.

One way of retaining the bodies in assembled relation while the external covering is applied, is by a suitable jig or fixture 30. As shown in Fig. 4, the fixture comprises a framework 31 provided with a stem 32 having a suitable handle (not shown). The framework, which may be made of nickel wire, includes a plurality of pairs of posts or projections divided into two spaced groups 33 and 34. Each pair of posts may be secured to the frame so as to form an elongated V to facilitate insertion of a lead wire therebetween. The posts are sufficiently resilient to clamp the resistor lead wires when such wires are forced between them.

The leads of each resistor element are clamped between posts of opposite pairs so that the coated bodies are grouped closely together. The enclosing mass is then applied to hold the elements together permanently. Where the individual coatings are of a glass melting at about 625° C., the exterior coating material may be a glass melting at about 500° C. The glass may be applied as a paste of finely ground glass and water as was done for the individual coatings. The fixture retains the assembly in position while it is inserted in a flame or furnace to fuse the glass around the bodies.

The two glasses are advantageously such, as to melting point, that although the individual coatings will not melt at the temperature necessary to fuse the outer coating, they will soften slightly so that a good bond is made between the two glasses. Thus, the resistor elements are em-

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bedded in a substantially integral mass of glass with no discontinuity that would seriously inhibit heat transfer among the resistor elements.

The resistor bodies may be made of any suitable resistance material, but this invention finds particular use in the assembly of temperature sensitive resistors such as bead thermistors. Some thermistor materials that may be employed are various combinations of the oxides of manganese, nickel, cobalt and copper, for example, a sintered mixture of the oxides of manganese and nickel in the proportions of four atoms of manganese to one atom of nickel.

The invention is not confined to the combining of three resistor elements but may be applied to an assembly of any reasonable number. It is not intended that the invention be limited by the particular illustrative embodiment described but by the scope of the appended claims only.

What is claimed is:

1. The method of making an intimate assembly of small resistor bodies that comprises coating each body with fusible insulating material, retaining a group of coated bodies in closely assembled relation, and fusing the bodies together by means of additional fusible insulating material having a melting point that is lower than that of the body coating to a degree such that said coating material is softened without melting, thus forming a substantially integral mass of insulation embedding the resistors in spaced relation.

2. The method of making an intimate assembly of small resistor bodies that comprises coating each body with glass, retaining a group of coated bodies in closely assembled relation, and fusing the bodies together by means of additional glass having a melting point that is lower than that of the body coating glass to a degree such that said coating glass is softened without melting, thus

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forming a substantially integral mass of glass embedding the resistors in spaced relation.

3. The method of assembling a plurality of thermistor beads into good mutual heat transfer relation while maintaining adequate electrical insulation among the beads, that comprises coating each bead with glass and maintaining a plurality of coated beads in closely spaced relation while fusing additional glass therearound to form an integral mass of glass enclosing said beads, the melting point of the additional glass being sufficiently lower than that of the individual coating glass to avoid remelting of the glass coatings during application of the additional glass, but to allow sufficient softening to insure good bonding between the two glasses.

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