

[54] **HIGH STRENGTH ELECTRICAL LEAD FOR DISK TYPE THERMISTORS**

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[22] Filed: **Apr. 9, 1973**

[21] Appl. No.: **348,946**

[52] U.S. Cl. **338/22 R, 338/324, 338/329**

[51] Int. Cl. **H01c 7/04**

[58] Field of Search ... 338/22 R, 22 SD, 23, 25, 28, 338/324, 329

[56] **References Cited**

UNITED STATES PATENTS

3,547,835 12/1970 Short 338/22 SD

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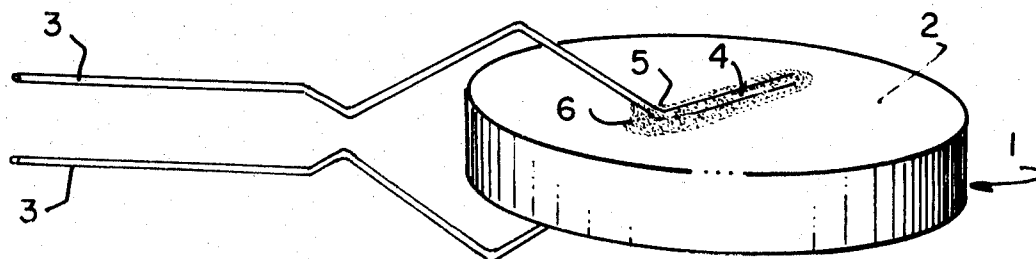
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[57] **ABSTRACT**

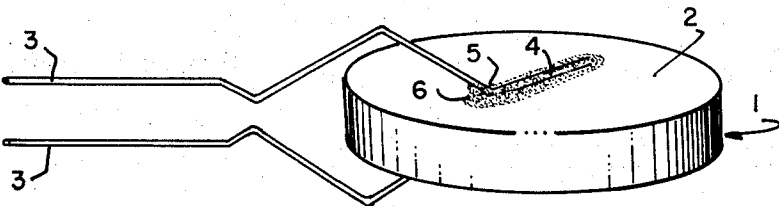
A disk type thermistor has a conductive metallic coating bonded to each face thereof. A lead-in wire is soldered to each metallic coating, each lead-in wire extending beyond the edge of the thermistor in a plane generally parallel to the face thereof. Each lead-in wire is shaped so that the solder bond between the lead-in wire and the metallic coating does not extend to the periphery of the thermistor.

1 Claim, 1 Drawing Figure



PATENTED FEB 19 1974

3,793,604



HIGH STRENGTH ELECTRICAL LEAD FOR DISK TYPE THERMISTORS

SUMMARY OF THE INVENTION

Thermistors are relatively simple, two-terminal semiconductor devices the electrical resistance of which varies in a known retraceable manner with temperature. They are commonly manufactured in various shapes, such as rods, disks, washers, beads and molded.

This invention relates to disk type thermistors and particularly to such thermistors having generally radial lead-in wires. In such thermistors a lead-in wire is laid across the face of the thermistor and soldered thereto. The solder bond therebetween extends from the inner end of the lead-in wire to the periphery of the thermistor, the lead-in wire extending therebeyond.

We have found that such a construction does not produce an adequately strong lead-in wire bond in those situations where the peel strength requirement of the lead-in wire is quite high. The peel strength is determined by measuring the amount of force required to rupture the bond between the wire and the disk face. The force is applied to the wire outside the periphery of the disk and in a direction substantially parallel to the axis of the disc, the effect being to peel the wire up from the face of the disk.

We have found that the peel strength of such lead-in wires can be substantially increased by the use of a lead-in wire bent in such a manner that the solder bond between the wire and disk face does not extend to the periphery of the disk. That is to say, at about the point where the lead-in wire extends beyond the periphery of the disk, the wire should be sufficiently above the surface of the disk so that a solder fillet therebetween does not extend to the periphery of the disk.

The single FIGURE in the drawing is a perspective view of a thermistor in accordance with this invention.

In one embodiment of this invention, thermistor 1 was a disk type barium titanate thermistor, made by the usual process of blending thermistor material in powder form, pressing the powder into a disk shape and then firing the disk at an elevated temperature, above about 1,000° C. In this example, the fired disk had a diameter of ½ inch and a thickness of 125 mils.

A conductive metallic coating 2 was then applied in known manner to each face of the disk to provide an ohmic contact. Such a coating is made of a powdered metal, such as silver, aluminum or copper, dispersed in a liquid vehicle. The coating also contains a small amount of inorganic binder, such as glass frit. After coating 2 has dried, the thermistor is fired at a temperature above the melting point of the glass frit to provide a good bond between the conductive coating and the thermistor surface. It is necessary that coating 2 provide good ohmic contact and be readily wettable by solder.

In some cases it may be desirable that coating 2 consist of two coatings, the first coating selected to provide ohmic contact and a good bond to the thermistor surface and the second coating selected to bond well to the first coating and also provide better solderability than the first coating. In such a case, the first coating could contain silver or aluminum in an amount that provides good ohmic contact to the barium titanate. The second coating could contain a higher percentage of metal, e.g. silver, to provide better solderability.

Lead-in wire 3 was made of 25 mil tinned copper wire and had an overall length of about 1½ inches. The end, segment 4, of lead-in wire 3 that was soldered to coating 2 was straight and had a length of ¼ inch. Segment 4 was positioned on the face of the thermistor so that acute angle bend 5 in lead-in wire 3 raised lead-in wire 3 sufficiently above the surface of the thermistor that solder fillet 6 did not extend to the periphery of the thermistor. We have found that in order to prevent solder fillet 6 from extending to the periphery of the thermistor, lead-in wire 3 should be elevated above the face of the thermistor, at its periphery, at least about double the wire diameter of lead-in wire 3. Both lead-in wires 3, one on each face of the thermistor, were bent so that the space between them, at their outer ends, was about equal to the thickness of the thermistor.

Lead-in wires 3 were soldered to thermistor 1 by the process shown in U.S. Pat. No. 3,721,003, where both lead-in wires 3 constituted a prebent single wire which was cut after soldering. Prior to soldering, the thermistor, held between the lead-in wires, was dipped into a liquid flux and was then dipped in molten solder. In this example the solder was 96.5% tin - 3.5% silver having a melting point of about 221° C. The solder formed a fillet all around segment 4 and securely bonded lead-in wire 3 to coating 2.

Disk thermistors in accordance with this invention had a lead-in wire peel strength at least 50% greater than that of similar prior art thermistors, where the solder bond between the lead-in wire and the thermistor extend to the periphery of the disk.

We claim:

1. A barium titanate disk type thermistor having a solderable coating securely bonded to each face thereof and a separate bent lead-in wire fastened with solder to each of said coatings, the solder bond between said coating and said lead-in wire extending across the face of the thermistor but not as far as the periphery thereof, each of said lead-in wires having a bend so as to be elevated above the face of the thermistor at the periphery thereof by a distance at least about double the thickness of the lead-in wire, a peel-strength-improving solder fillet between said thermistor face and said lead-in wire at said bend of the lead-in wire and each of said lead-in wires having additional bends so that their outer ends are substantially parallel and spaced apart about the thickness of the thermistor.

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