

- [54] **VARISTORS**
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- [52] **U.S. Cl.** 338/20
- [51] **Int. Cl.** H01c 7/10
- [58] **Field of Search** 338/20, 13, 22, 25, 338/31, 329, 332, 333; 219/505, 538, 540, 552, 553

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[57] **ABSTRACT**

A plurality of heat radiating axial ribs are provided on the surface of a varistor.

For a varistor in the form of a hollow cylinder, such ribs are formed on both or either one of the inner and outer surfaces of the varistor.

2 Claims, 8 Drawing Figures

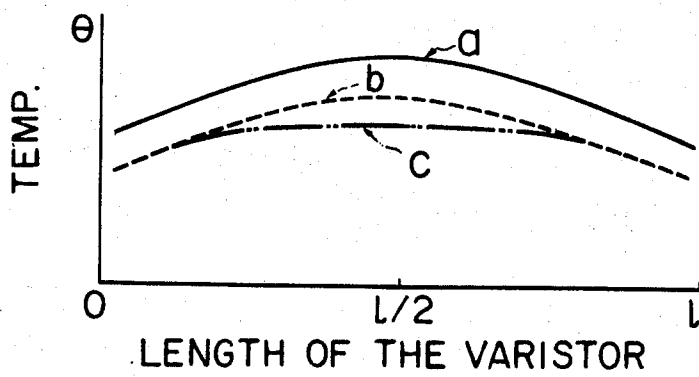
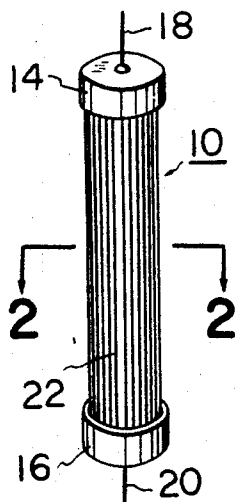


FIG. 1

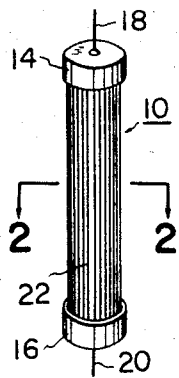


FIG. 3

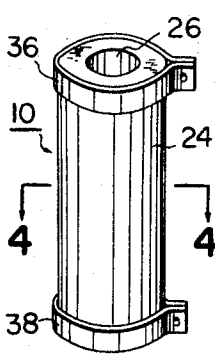


FIG. 6

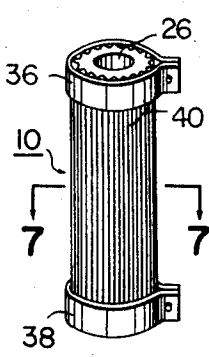


FIG. 2

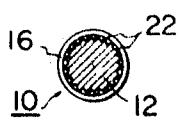


FIG. 4

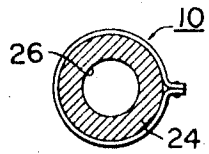


FIG. 7

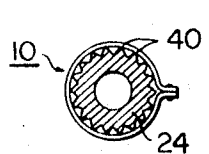


FIG. 5

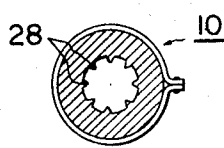
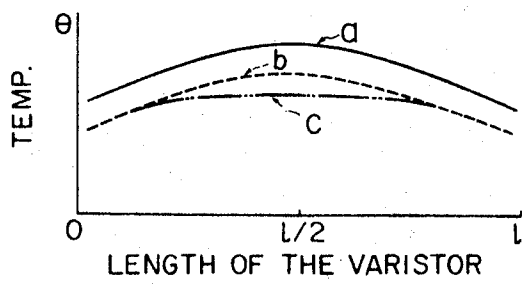


FIG. 8



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VARISTORS

BACKGROUND OF THE INVENTION

This invention relates to a varistor and more particularly to a high voltage high capacity varistor of improved heat dissipating construction.

As is well known in the art, varistors are advantageous in that they can withstand large overloads, are not destroyed by an extremely high surge voltage, and the temperature coefficient of the resistor component is relatively low near normal temperature. However, in high voltage high capacity varistors as the current and hence the quantity of heat generated by the current are substantial it is difficult to efficiently dissipate the heat, due mainly to the construction of the varistors. Consequently, the temperature coefficient of the varistors increases in the negative direction, thus decreasing the internal resistance of the varistor. For example, in a rod shaped varistor applied with a voltage of about 30KV and passing a current of about 1mA, especially with those having a small cross-sectional area, the quantity of the heat generated is very large with the result that the temperature distribution along the longitudinal axis of the varistor is such that the temperature is the highest at the axial center and gradually decreases toward the opposite ends. In other words, the temperature rise of the varistor results in a decrease in the avalanche voltage, thus deteriorating the characteristics of the varistor.

SUMMARY OF THE INVENTION

Accordingly, it is an object of this invention to provide an improved varistor having heat radiating means for efficiently dissipating the heat to prevent temperature rise.

Another object of this invention is to provide an improved varistor having heat dissipating means to make substantially flat the temperature distribution along the varistor.

Still another object of this invention is to provide a varistor having efficient heat dissipating means capable of preventing decrease in the avalanche voltage due to temperature rise.

According to one feature these objects can be accomplished by providing heat radiating means in the form of a plurality of axial ribs on the peripheral surface of a solid varistor. In accordance with another feature of this invention the varistor is made hollow to substantially increase the heat radiating surface area. Further, a plurality of axial ribs are provided on the outer and or inner peripheries of a hollow cylindrical varistor over a limited axial length thereof to locally increase the heat radiating area thus obtaining a uniform temperature distribution.

BRIEF DESCRIPTION OF THE DRAWINGS

The invention can be more fully understood from the following detailed description when taken in conjunction with the accompanying drawings in which:

FIG. 1 is a perspective view of one embodiment of the novel varistor;

FIG. 2 is a cross-sectional view taken along a line 2—2 in FIG. 1;

FIG. 3 is a perspective view of a modified embodiment of this invention;

FIG. 4 is a cross-sectional view taken along a line 4—4 in FIG. 3;

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FIG. 5 is a cross-sectional view similar to FIG. 4 of another embodiment of this invention;

FIG. 6 shows still further modification of this invention;

FIG. 7 is a sectional view taken along a line 7—7 in FIG. 6 and

FIG. 8 is a graph to show temperature distribution characteristics along the length of the varistor.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring now to the accompanying drawing, the varistor shown in FIGS. 1 and 2 and generally designated by a reference numeral 10 comprises a fired solid main body 12 in the form of a solid round rod of small diameter and terminal metal caps 14 and 16 secured to the opposite ends of the main body 12. Lead wires 18 and 20 are secured to the end walls of terminal caps by soldering or welding, for example. A plurality of radial ribs 22 are formed on the outer periphery of the main body 12 along the entire length thereof. These ribs can be formed by providing corresponding grooves for the extrusion die or molding die used for shaping the main body.

As above described since the temperature rise of the varistor is most significant at the axial center, these ribs 22 may be formed only on the axial central portion of the main body 12. In such a case, to improve the heat dissipating efficiency, the number of ribs may be increased. Alternatively, the radial height of the ribs may be increased to increase the heat dissipating area of the central portion of the varistor. With this construction the heat radiating surface area of the main body 12 is increased locally or as a whole thus improving the efficiency of heat radiation. For this reason, the temperature rise of the varistor is decreased, and the temperature distribution along the axial length becomes flat. Accordingly, it is possible to prevent decrease of the avalanche voltage of the varistor thus assuring normal operation thereof at a predetermined voltage in a circuit in which the varistor is connected.

FIGS. 3 and 4 shows a modified embodiment of this invention in which the main body 24 has a flat outer surface and a central bore axially extending through the main body. Terminals 36 and 38 in the form of metal bands are secured by screws (not shown) to the opposite ends of the main body 24. In this embodiment the heat generated in the varistor is dissipated from its inner and outer surfaces to increase the heat dissipation, so that it is possible to limit the temperature rise below a permissible value even when the current is increased to some extent. Increase in the sectional secondary moment increases the mechanical strength of the varistor against mechanical shocks and vibrations.

In another embodiment, the heat dissipating surface area of the varistor shown in FIGS. 3 and 4 is increased further by providing a plurality of axial ribs 28 on the inner surface as shown in FIG. 5. Again such ribs may be formed at the central portion alone to make uniform the temperature distribution.

In yet another modification shown in FIGS. 6 and 7, the hollow cylindrical main body 24 of the varistor shown in FIG. 3 is provided with a plurality of axial ribs 40.

FIG. 8 compares temperature distribution curve *a* of a prior art varistor and those *b* and *c* of varistors embodying this invention. As can be noted from FIG. 8,

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curve *b* showing the temperature distribution characteristic of a solid varistor with ribs on the outer periphery (FIG.1) or a hollow cylindrical varistor (FIG.3) is lower than curve *a* and the provision of ribs only in the central portion of the varistor flattens the temperature distribution curve as shown by curve *c*. From this it will be clear that this invention provides a varistor of improved heat dissipation. In other words, even when larger current is passed it is possible to prevent excessive temperature rise. The metal terminals and lead wires connected thereto further enhance the heat dissipation whereby the current carrying capacity of the varistor is improved without the risk of decreasing the avalanche voltage.

What is claimed is

1. A varistor comprising a solid rod shaped main

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body, terminals secured to the opposite ends of said main body and a plurality of heat radiating axial ribs formed on the surface of said main body at only the axial center portion thereof so that the temperature axially along said main body is substantially uniform when current is applied to said terminals.

2. A varistor comprising a solid rod shaped main body, terminals secured to the opposite ends of said main body and a plurality of heat radiating axial ribs formed on substantially all of the peripheral surface of said main body, those ribs located at the axial center portion of said main body having a greater height so that the temperature axially along said main body is substantially uniform when current is applied to said terminals.

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