Dec. 23, 1969 J. R. McCAUGHNA 3,486,155

ELECTRIC FUSES

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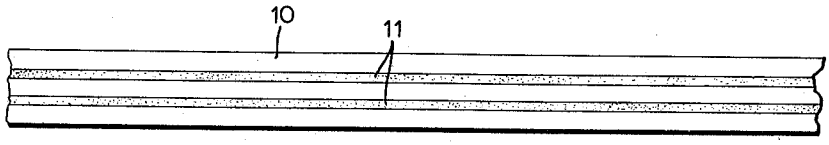

FIG. 1

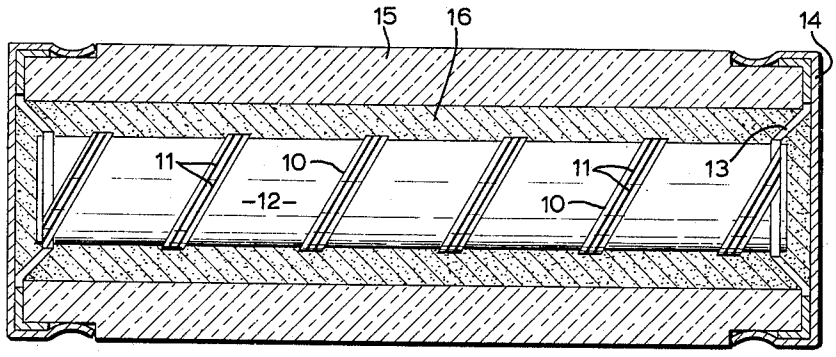

FIG. 2

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ELECTRIC FUSES

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U.S. Cl. 337—231 3 Claims

ABSTRACT OF THE DISCLOSURE

The fuse element of an electric fuse is constituted by a thin silver ribbon reinforced by a strip of plastics material that has insulating properties such that the response of the ribbon to a fault current is substantially unaffected by the presence of the plastics strip.

This invention relates to electric fuses, in particular, to current-limiting cartridge fuses.

Current-limiting cartridge fuses normally comprise a fuse element of silver ribbon wound on a ceramic core, such core usually having a star-shaped cross-section. The core bearing the fuse element is located in an insulating cartridge casing by means of end fittings which also serve to provide electrical connection between the ends of the fuse element and conductive end caps fitted on the cartridge casing. In such a fuse for high voltage use, the silver ribbon used is thick enough, about 0.0016", and, as a result, strong enough, to stand up to handling during assembly of the fuse and subsequent self support on the core. For use in the low and medium voltage ranges the silver ribbon is required to be thinner, e.g. from 0.0001" to 0.0006", and thus is relatively fragile. It has been found that such a thin ribbon cannot satisfactorily either stand up to handling or support itself on the core.

One object of this invention is to provide an electric fuse having a silver fuse ribbon which can be produced for use in the low and medium voltage ranges.

The fuse according to the invention comprises a fuse element constituted by a thin silver ribbon reinforced by a tape or strip of flexible insulating plastics material.

The plastics material used to reinforce the silver ribbon must have insulating properties that will ensure that the reinforced ribbon will provide the same very rapid clearance of overcurrents as the unreinforced ribbon. Other properties are also relevant to the suitability of the material. One such property is a relatively high zero strength temperature. It is also desirable that the material should have a high dimensional stability.

Organic polymers, such as polyester film, are found generally to satisfy the requirements as to properties. One such polyester film known to be suitable is that known by the trademark "Mylar." Materials other than polyesters can be used. For example a polyimide such as that sold under the trademark "Kapton" has been found to be quite suitable.

The method of attachment of the ribbon to the tape or strip of plastics material is important only insofar as it must not affect the properties already mentioned above and must allow for the fragility of the ribbon. Of the methods available, examples are the chemical deposition of silver on to sensitised plastics material, adhesive bonding or heat-bonding of the ribbon to the plastics material, or partial embedding of the ribbon into the plastics material.

A preferred practical embodiment of electric fuse according to the invention now will be described by way

of example with reference to the accompanying drawings, in which,

FIGURE 1 shows a fuse element, and

FIGURE 2 shows, partially in section, a practical construction of cartridge fuse incorporating the fuse element of FIGURE 1.

The fuse element shown in FIGURE 1 preferably is produced by chemically depositing silver in ribbons **11** on to a strip **10** of sensitised "Kapton" polyimide film; each ribbon being, for example, 0.02" wide and deposited to a thickness of 0.0002".

"Kapton" polyimide film has highly desirable properties for the purposes of the invention. It has high dimensional stability, no known solvent, a zero strength temperature of 800° centigrade and excellent insulating properties.

The strip **10** of "Kapton" polyimide film shown in FIGURE 1 has two silver ribbons **11** deposited thereon. However, the strip may bear as many parallel strips of silver ribbon as required by the electrical characteristics of the fuse being assembled.

The cartridge fuse shown in FIGURE 2 is made by winding the "Kapton" strip **10** bearing the silver ribbons **11** helically around a ceramic core **12**, conveniently of conventional star cross-section, with the silver ribbons on the outside. The ends of the reinforced fuse element have suitable electrical terminal fittings **13** attached to them in good electrical contact with the deposited silver ribbons **11**. The assembly is inserted into a cartridge casing **15** which is sealed with conductive end terminals in the form of caps **14** forced into tight engagement with the terminal fittings **13**. Before the cartridge is sealed, it is filled with high purity silica sand **16** of suitable mesh size.

The fuse shown in FIGURE 2 is particularly suitable for voltages of up to 1000 volts and for currents of between 2 amps. and 200 amps. For higher voltages a silver ribbon fuse element which will not normally need reinforcement can be used. However, if a particular fuse element does prove to be relatively fragile, this method of reinforcement still will be applicable, and the fuse according to the invention is not limited to use in any particular range of voltage or current.

Although a sand-filled cartridge fuse has been described hereinbefore, the fuse element shown in FIGURE 1 would be equally satisfactory for use in an evacuated cartridge fuse. Various plastics material other than "Kapton" may be used to form the supporting plastics strip, and the silver ribbon or ribbons may be mounted thereon other than by chemical deposition, for example, by adhesive bonding of a conventionally produced ribbon, if this can be effected without encountering handling difficulties.

While a preferred embodiment of this invention has been disclosed herein, those skilled in the art will appreciate that changes and modifications may be made therein without departing from the spirit and scope of this invention as defined in the appended claims.

What I claim as my invention is:

1. A totally enclosed cartridge-type fuse comprising an open-ended hollow housing; electrically conductive end caps closing the open ends of said housing; a fuse element supporting core axially mounted within said housing; a fuse element spirally wound on said core, said fuse element comprising at least one thin silver ribbon mounted on and supported by a strip of polyimide plastic material; and means electrically connecting said end caps and said fuse element.

2. An electric fuse according to claim **1** wherein said polyimide plastic strip bears a plurality of parallel ones of said silver ribbons.

3. A totally enclosed cartridge-type fuse according to claim 1 including sand within said housing and in which said core is embedded.

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