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ELECTRIC CARTRIDGE FUSE FOR INTERRUPTING PROTRACTED OVERLOAD CURRENTS AND MAJOR FAULT CURRENTS

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FIG. 1

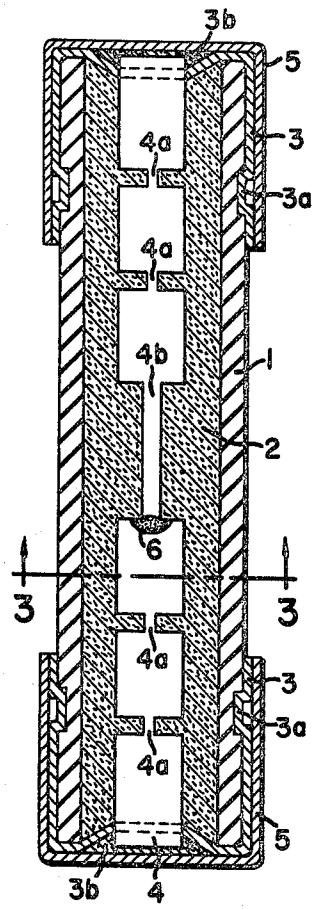


FIG. 2

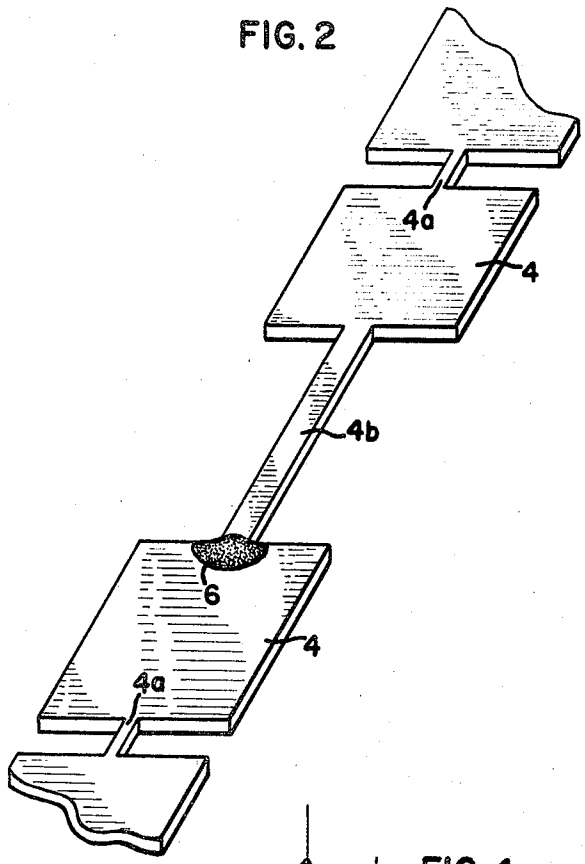


FIG. 4a



FIG. 3

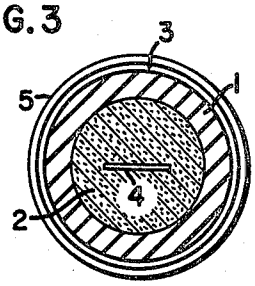
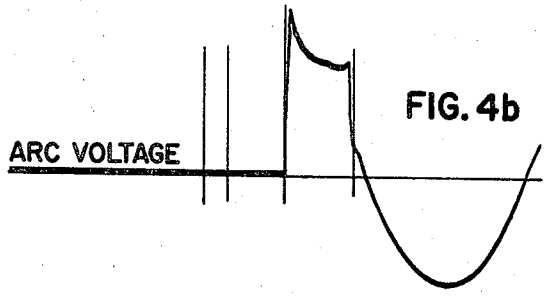


FIG. 4b



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ELECTRIC CARTRIDGE FUSE FOR INTERRUPTING PROTRACTED OVERLOAD CURRENTS AND MAJOR FAULT CURRENTS

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ABSTRACT OF THE DISCLOSURE

A cartridge fuse generates arc voltages which rise relatively rapidly after having been subjected to relatively small protracted overloads; when subjected to major fault currents, the fuse generates arc voltages which are relatively stable, i.e. which last relatively long, or do not decay rapidly, and which have spikes which are relatively low. This is achieved by imparting a particular geometry to the fuse link of the fuse.

Summary of the invention

The ribbon fuse link is made of a current-limiting metal. This term is used in this context as a generic term encompassing silver and copper. The fuse link defines a plurality of axially outer necks of predetermined length having a predetermined minimum cross-sectional area. The fuse link further defines a centrally located neck exceeding in length the aggregate length of said plurality of axially outer necks and having a cross-sectional area exceeding said minimum cross-sectional area. An overlay of a link-severing metal having a lower fusing point than said current-limiting metal is arranged adjacent one of the axially outer ends of said centrally located neck.

Brief description of drawings

FIG. 1 is substantially a longitudinal section of a fuse embodying the present invention;

FIG. 2 is an isometric view of the center region of the fuse link of the structure of FIG. 1;

FIG. 3 is a cross-section of the structure of FIG. 1 taken along 3—3 of FIG. 1; and

FIGS. 4*a* and 4*b* are a current trace and a voltage trace, respectively, illustrating the performance of the fuse of FIG. 1 under short-circuit current conditions.

Description of preferred embodiment

In FIGS. 1 and 3 reference character **1** has been applied to indicate a tubular casing of insulating material containing a pulverulent arc-quenching filler **2**, e.g. quartz sand. Casing **1** is closed by a pair of terminal elements in the form of caps **3** mounted on the axially outer ends of casing **1**. Caps **3** are crimped at **3***a* so as to engage circular grooves in casing **1**. The end surfaces of caps **3** define recesses **3***b* each in the shape of a frustum of a cone intended to be used as a solder-receiving pool. Reference numeral **4** has been applied to generally indicate a ribbon fuse link of a current-limiting metal, i.e. silver or copper, preferably silver. Fuse link **4** interconnects conductively terminal caps **3**. To this end the end surfaces of caps **3** are slotted and fuse link **4** projects through the slots in the end surfaces of caps **3** into recesses **3***b* which are filled with solidified solder. The solder joints thus formed are covered by caps **5**, press-fitted upon caps **3**. Fuse link **4** includes four axially outer necks **4***a* of predetermined length having a predetermined minimum cross-sectional area, i.e. a predetermined cross-sectional area smaller than the cross-sectional area of fuse link **4** at any other point thereof. Fuse link **4** further includes a centrally located neck **4***b* exceeding in length the aggregate length of necks **4***a* and having a cross-sectional area exceeding the cross-sectional area of each of necks **4***a*. Reference character **6** has been applied to indicate an overlay on link **4** of a link-severing metal having a lower fusing point than the current-limiting base metal—silver or copper—of which fuse link **4** is made. Overlay **6** is arranged adjacent one of the axially outer ends of neck **4***b*. This way of positioning overlay **6** is critical because it permits vaporization of neck **4***b* under major fault current conditions without contamination of the resulting arc gap by vapors formed by the vaporization of overlay **6**. Silver vapor is virtually an insulator at the vaporization temperature of silver.

If a fuse of the kind which has been disclosed above is subjected to relatively small overloads of inadmissible duration, overlay **6**—which may consist of tin, or an alloy thereof—melts, and thus initiates formation of a circuit-interrupting break. The burnback of neck **4***b* generates a relatively high arc voltage tending to interrupt the overload current. This arc voltage may not suffice to achieve this end if the circuit under consideration is highly inductive. Then formation of the aforementioned initially formed break is followed by the formation of additional breaks at the four necks **4***a*. This results in definite final interruption of the overload current.

On occurrence of major fault currents, or short-circuit currents, initial break formation occurs simultaneously at the four necks **4***a*. Due to the relatively larger cross-sectional area of neck **4***b*, the latter fuses subsequent to fusion of necks **4***a*. Fusion of neck **4***b* tends to stabilize and extend the duration of the arc voltage in the structure of FIG. 1, thus resulting in ultimate interruption of the faulted circuit. The latter occurs within a small fraction of a half cycle of the fault current.

The effectiveness of the structure of FIG. 1 under major fault current or short-circuit current conditions is apparent from FIGS. 4*a* and 4*b*. The areas under the current trace from the time of fault inception to the time of arc inception and from the time of arc inception to the time of final arc extinction are about equal and melting time and arcing time are about equal. The arc voltage forms a relatively small spike at the time of arc inception and remains relatively high and stable throughout the entire arcing time of the fuse. FIGS. 4*a* and 4*b* refer to tests made in a 300 volt circuit having a relatively high available current that was interrupted at a let-through peak significantly less than the available peak current.

The ratio of the cross-sectional areas of necks **4***a* and **4***b* is of great importance in regard to the mode of operation of the fuse. It has been found that this ratio should preferably be in the order of 1:5.

Considering the overload performance of the fuse, neck **4***b* forms the principal circuit-interrupting break and necks **4***a* form auxiliary breaks, or clean-up means. On the other hand, under major fault current conditions, or short-circuit current conditions, necks **4***a* form principal circuit-interrupting breaks and neck **4***b* forms an auxiliary break, or a clean-up means.

It will be apparent from FIG. 1 that each of necks **4***a* and neck **4***b* is formed by a pair of lateral substantially rectangular incisions in fuse link **4**.

It will be understood that we have illustrated and described a preferred embodiment of our invention, and that various alterations may be made in the details thereof without departing from the spirit and scope of the invention as defined in the appended claims.

We claim as our invention:

1. An electric fuse comprising in combination:

(a) a tubular casing of insulating material;

(b) a pulverulent arc-quenching filler inside said casing;

(c) a pair of terminal elements closing the ends of said casing;

(d) a ribbon fuse link of a current-limiting metal conductively interconnecting said pair of terminal elements, said fuse link including a plurality of axially outer necks of predetermined length having a predetermined minimum cross-sectional area and a centrally located neck exceeding in length the aggregate length of said plurality of axially outer necks and having a cross-sectional area exceeding said minimum cross-sectional area; and

(e) an overlay of a link-severing metal having a lower fusing point than said current-limiting metal arranged adjacent one of the axially outer ends of said centrally located neck.

2. An electric fuse as specified in claim 1 wherein the ratio of the cross-sectional area of each of said plurality of axially outer necks to the cross-sectional area of said centrally located neck is in the order of 1:5.

3. An electric fuse as specified in claim 1 wherein each of said plurality of axially outer necks and said centrally located neck is formed by a pair of lateral incisions in said ribbon fuse link.

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