Nov. 24, 1970 F. J. KOZACKA 3,543,209

COMPOSITE FUSE LINK AND FUSE WITH COMPOSITE FUSE LINK

Filed Sept. 15, 1969

FIG. 1

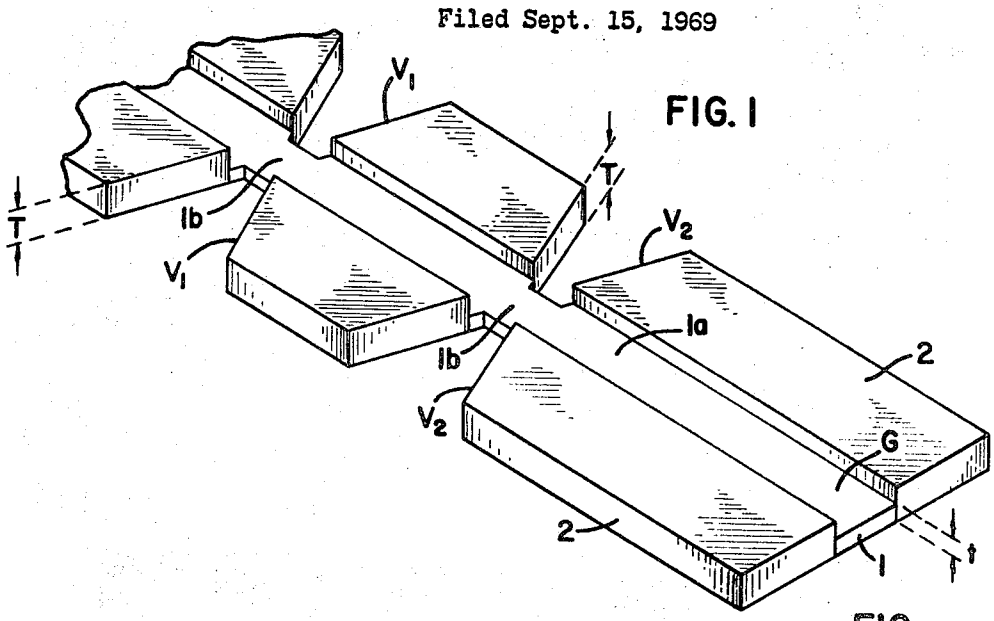


FIG. 2

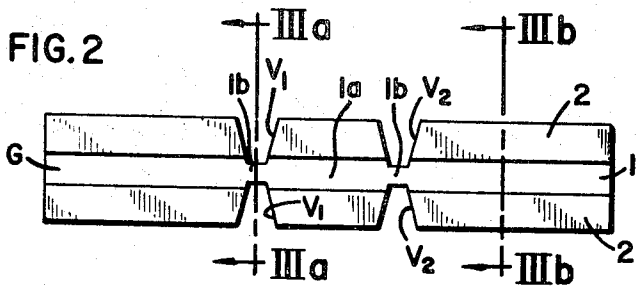


FIG. 3a 3b 3a' 3b'

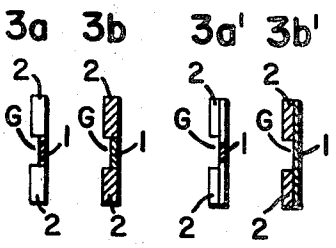


FIG. 4

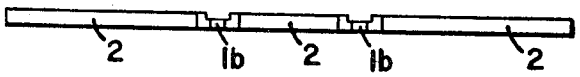


FIG. 5

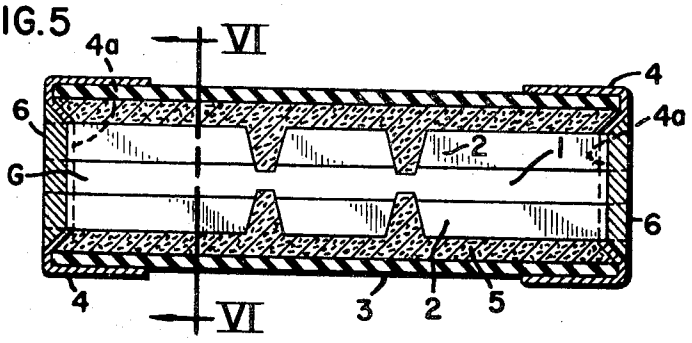
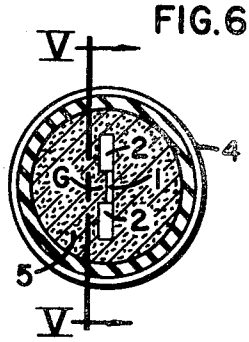


FIG. 6



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COMPOSITE FUSE LINK AND FUSE WITH COMPOSITE FUSE LINK

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Continuation-in-part of application Ser. No. 813,033, Apr. 13, 1969. This application Sept. 15, 1969, Ser. No. 857,821

Int. Cl. H01h 85/08

U.S. Cl. 337—159 6 Claims

ABSTRACT OF THE DISCLOSURE

A composite integral ribbon fuse link for current-limiting fuses including a relatively thin strip of silver and a pair of relatively thick strips of copper is designed to form series breaks, to minimize fusing $i^2 \cdot t$ values and to maximize current-carrying capacity. The composite integral fuse link has a groove extending in a direction longitudinally thereof. The points of reduced cross-sectional area or necks of the fuse link are formed of silver, and their cross-sectional area is smaller than the cross-sectional area of the strip of silver at any point thereof remote from the necks.

BACKGROUND OF INVENTION

This application is a continuation-in-part of my copending patent application Ser. No. 813,033, filed Apr. 3, 1969 for Current-Limiting Fuse Having Fuse Link With Longitudinal Groove.

This invention is an improved version of the fuse link structures shown in U.S. Pat. 2,809,257 to K. W. Swain; Oct. 8, 1957 for Composite Fuse Links of Silver and Copper. The most significant improvement consists in that the necks of the link where series arcs are kindled on occurrence of sufficiently high fault currents are formed by a longitudinal groove and by reducing both the thickness and the width of the fuse link at particular points situated at the bottom of the groove. The longitudinal groove geometry of the fuse link makes it possible to achieve this dual "modulation" of the dimensions of the link at the points of its necks with straight forward conventional manufacturing methods.

SUMMARY OF INVENTION

Fuse links embodying this invention include an elongated relatively thin center strip of silver and a pair of relatively thick strips of copper integral with said strip of silver. Each of said pair of strips of copper is arranged to an opposite side of said strip of silver and each projects above the upper surface of said strip of silver and defines jointly with said strip of silver a groove extending in a direction longitudinally of said strip of silver and longitudinally of said pair of strips of copper. Said strip of silver and said pair of strips of copper. Said strip of silver and said pair of strips of copper have a plurality of pairs of opposite recesses. Each pair of said plurality of pairs of recesses extends transversely across said pair of strips of copper into said strip of silver and establishes a complete interruption of the current paths formed by said pair of strips of copper. Each pair of said plurality of pairs of recesses further establishes in said strip of silver a point of reduced cross-sectional area having a smaller cross-sectional area than said strip of silver at points thereof remote from each pair of said plurality of pairs of recesses.

BRIEF DESCRIPTION OF DRAWINGS

FIG. 1 is an isometric view of a ribbon fuse link embodying this invention;

FIG. 2 is a top-plan view of the fuse link of FIG. 1;

FIGS. 3*a* and 3*b* are transverse sections across III*a*—III*a* and III*b*—III*b* of FIG. 2;

FIGS. 3*a'* and 3*b'* are transverse sections across III*a*—III*a* and III*b*–III*b* of FIG. 2 but made of a material different from that to which FIGS. 3*a* and 3*b* refer;

FIG. 4 is a side view of the structure of FIG. 2;

FIG. 5 is a section taken along V—V of FIG. 6 and shows a complete fuse embodying this invention; and

FIG. 6 is a section along VI—VI of FIG. 5.

DESCRIPTION OF PREFERRED EMBODIMENTS

The fuse ling shown in FIGS. 1–4 includes an elongated relatively thin center strip **1** of silver and a pair of elongated lateral relatively thick strips **2** of copper integral with silver strip **1**. Reference character t indicates the thickness of silver strip **1** and reference character T indicates the thickness of copper strips **2**. $t \ll T$. Each copper strip **2** is arranged on an opposite side of silver strip **1** and each projects above the upper surface **1***a* of silver strip **1**. Thus strips **2,1,2** define jointly a groove G extending in a direction longitudinally of strips **2,1,2**. Strips **2,1,2** have a plurality of pairs of opposite recesses V_1,V_1; V_2,V_2. The pair of recesses V_1,V_1 extends transversely across strips **2** into strip **1**. Thus the pair of recesses V_1,V_1 establishes a first complete interruption of the longitudinal current paths formed by strips **2**, and establishes in strip **1** a point **1***b* of reduced or minimal cross-sectional area. The cross-sectional area of point **1***b* of strip **1** is less than the cross-sectional area at any point of strip **1** remote from recesses V_1,V_1. Thus point **1***b* is a point of reduced thickness ($t \ll T$) and of reduced width, resulting in a minimized fusing $i^2 \cdot t$ since the fusing $i^2 \cdot t$ decreases in proportion to the decrease of the cross-sectional area of a neck, or point of reduced cross-sectional area, of a ribbon fuse link. The pair of recesses V_2,V_2 establishes a second complete interruption of the longitudinal current paths formed by strips **2** and establishes in strip **1***a* a second point **1***b* of reduced or minimal cross-sectional area. The cross-sectional area of second point **1***b* is less than that of any other point of fuse link **2,1,2** remote from recesses V_1,V_1; V_2,V_2, etc. The number of serially related points **1***b* of minimal cross-sectional area may be larger than two and it depends primarily upon the intended voltage rating of the fuse and upon the arc voltage the fuse is intended to generate during interruption of fault currents.

Various types of clad metals may be used for making fuse links of the type illustrated in FIGS. 1 to 4. The center strip **1** may be bonded at its lateral edges to the outer copper strips **2**. If such a material is used and recesses V_1,V_1; V_2,V_2; etc. are punched out of the material, the fuse link appears in cross-sections III*a*—III*a* and III*b*—III*b* as shown in FIGS. 3*a* and 3*b*. On the other hand, the width of center strip **1** may exceed the sum of the width of strips **2** and the former may overlap the latter. If such a material is used and recesses V_1,V_1; V_2,V_2; etc. are punched out of the material, the fuse link appears in cross-sections III*a*—III*a* and III*b*—III*b* as shown in FIGS. 3*a'* and 3*b'*.

FIGS. 5 and 6 show a conventional current-limiting fuse provided with a ribbon fuse link according to FIGS. 1 to 4. In FIGS. 5 and 6 reference numeral **3** has been applied to indicate a casing of insulating material, e.g. silicone-glass-cloth. A pair of electroconductive terminal elements in the form of caps or ferrules **4** closes the ends of casing **1**. A pulverulent arc-quenching filler **5**, preferably quartz sand, is arranged inside casing **3**. Ribbon fuse link **2,1,2** is submersed in filler **5** and conductively

interconnects terminal elements 4. Fuse link 2,1,2 includes the relatively thin center strip of silver 1 extending from one terminal element 4 to the other terminal element 4 and the relatively thick copper strips 2,2 also extending ment 4. Strips 2,1,2 form an integral unit. As shown in FIG. 6 strips 2 project above the surface of strip 1. As a result strips 2,1,2 jointly define a groove G extending in a direction longitudinally of casing 3 from one terminal element 4 to the other terminal element 4. The fuse link 2,1,2 of FIGS. 5 and 6 is identical to that of FIGS. 2, 3*a* and 3*b*; but a fuse link according to FIGS. 2, 3*a'*, 3*b'* might be substituted for it wherein silver strip 1 overlaps copper strips 2,2. The axially outer ends of fuse link 2,1,2 projects through slits 4*a* in caps 4 to the outside of the latter and are soldered to the latter by external solder joints 6.

I claim:

1. A composite ribbon fuse link for current-limiting fuses including in combination:

(a) an elongated relatively thin center strip of silver;

(b) a pair of elongated relatively thick strips of copper integral with said strip of silver each arranged on an opposite side of said strip of silver and each projecting above the upper surface of said strip of silver and defining jointly with said strip of silver a groove extending in a direction longitudinally of said strip of silver and longitudinally of said pair of strips of copper; and

(c) said strip of silver and said pair of strips of copper having a plurality of pairs of opposite recesses, each pair of said plurality of pairs of recesses extending transversely across said pair of strips of copper into said strip of silver, each of said plurality of pairs of recesses establishing a complete interruption of the current paths formed by said pair of strips of copper and each of said plurality of pairs of recesses establishing in said strip of silver a point of reduced cross-sectional area having a smaller cross-sectional area than said strip of silver at points thereof remote from each of said plurality of recesses.

2. A ribbon fuse link as specified in claim 1 wherein each of said plurality of pairs of recesses is formed by a pair of substantially V-shaped incisions having open entrance portions defined by said pair of strips of copper and having closed end portions defined by said strip of silver.

3. A ribbon fuse link as specified in claim 1 wherein said strip of silver overlaps the surface of each of said pair of strips of copper.

4. An electric current-limiting fuse including in combination:

(a) a tubular casing of insulating material;

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

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

(d) a ribbon fuse link submersed in said filler conductively interconnecting said pair of terminal elements, said fuse link including a relatively thin center strip of silver extending from one of said pair of terminal elements to the other of said pair of terminal elements and a pair of relatively thick strips of copper extending from one of said pair of terminal elements to the other of said pair of terminal elements and being integral with said strip of silver, each of said pair of strips of copper projecting above the upper surface of said strip of silver and defining jointly with said strip of silver a groove extending from one of said pair of terminal elements to the other of said pair of terminal elements, said strip of silver and said pair of strips of copper having a plurality of pairs of opposite recesses extending transversely across said pair of strips of copper into said strip of silver, each of said plurality of pairs of recesses establishing a complete interruption of the current paths formed by said pair of strips of copper and each of said plurality of pairs of recesses establishing in said strip of silver a point of reduced cross-sectional area having a smaller cross-sectional area than said strip of silver at points thereof remote from each of said plurality of recesses.

5. An electric fuse as specified in claim 4 wherein each of said plurality of pairs of recesses in said strip of silver and in said pair of strips of copper is formed by a pair of substantially V-shaped incisions having open entrance portions defined by said pair of strips of copper and having closed end portions defined by said strip of silver.

6. An electric fuse as specified in claim 4 wherein said strip of silver overlaps the surface of each of said pair of strips of copper.

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U.S. Cl. X.R.

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