United States Patent

[11] **3,573,699**

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[54] **HIGH-VOLTAGE FUSE**
6 Claims, 4 Drawing Figs.

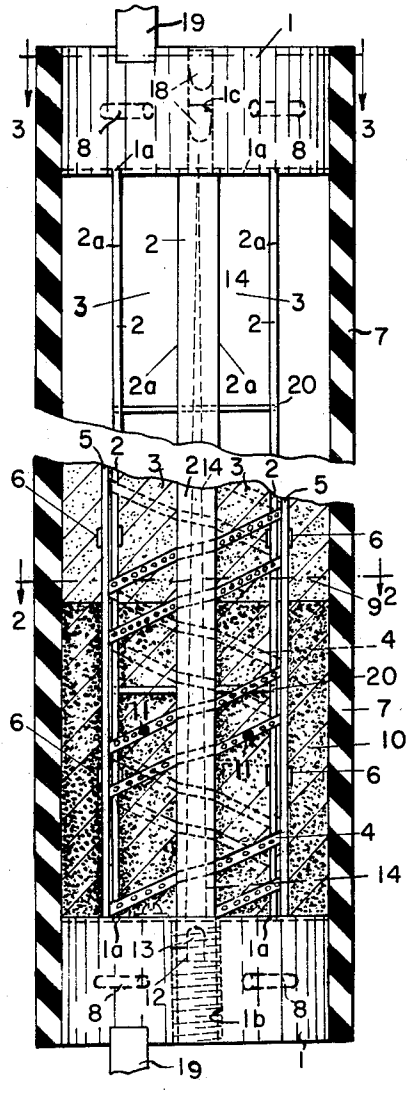
[52] **U.S. Cl.** **337/161,** 337/293
[51] **Int. Cl.** **H01h 85/12,** H01h 85/14
[50] **Field of Search** 337/158, 159, 161, 163, 166, 276, 290, 293, 295

[56] **References Cited**
UNITED STATES PATENTS

3,391,369	7/1968	Kozocka	337/276(X)
2,740,187	4/1956	Jacobs, Jr. et al.	337/159(X)
2,964,604	12/1960	Jacobs, Jr. et al.	337/295(X)

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Assistant Examiner—Dewitt M. Morgan

ABSTRACT: A subassembly for making a high-voltage fuse has a mandrel supporting a fusible element which is helically wound around the same, and the mandrel is adapted to perform, in addition to its fuse-element-supporting function, the function of controlling the arc voltage generated incident to blowing of the fuse.



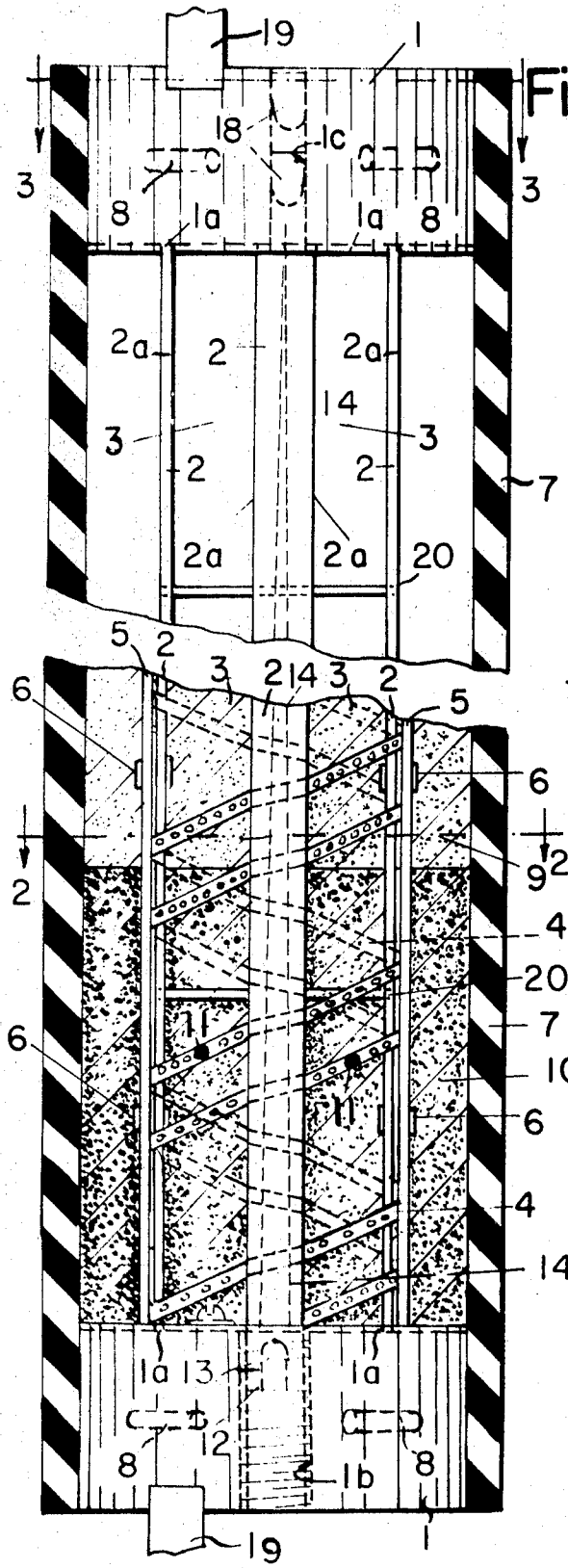


Fig.1

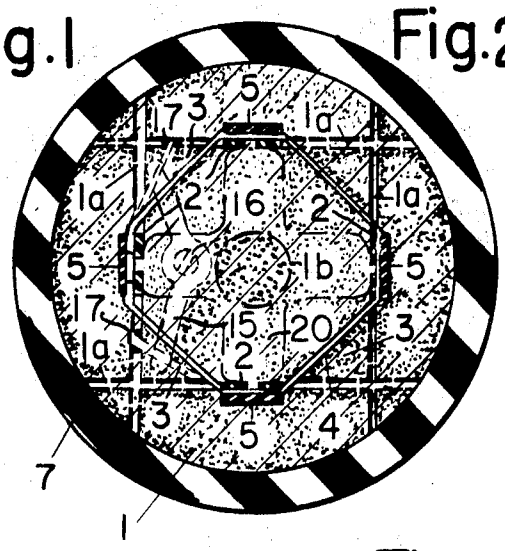


Fig.2

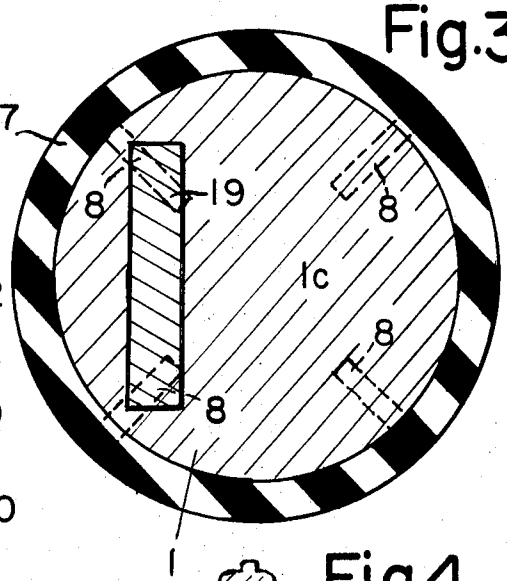


Fig.3

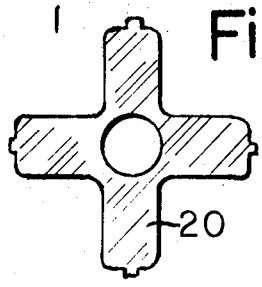


Fig.4

INVENTOR:

HIGH-VOLTAGE FUSE

BACKGROUND OF INVENTION

In high-voltage fuses the length of the fusible element is often required to exceed the spacing between the terminals of the fuse. This may be achieved by winding the fusible element helically around a supporting mandrel.

Another important problem occurring in connection with high-voltage fuses is the control of the arc voltage generated incident to blowing of the fuse. That arc voltage tends to have a rapid rate of rise and to reach a relatively high initial peak, and then to decay relatively rapidly. It is desirable to limit the rate of rise and the peak of the arc voltage, and to preclude its rapid decay or, in other words, it is desirable to stabilize the arc voltage as much as possible.

This invention relates to a structure serving the dual purpose of supporting a helically wound fusible element and of controlling, or stabilizing, the arc voltage generated incident to blowing of a high-voltage fuse.

One aspect of the invention consists in controlling the action of a pulverulent arc-quenching filler on fuse links in the way more fully disclosed in U.S. Pat. No. 2,964,604 to P. C. Jacobs, Jr. et al.; Dec. 13, 1960 for Current-Limiting Fuses Having Compound Arc Voltage Generating Means. This patent is considered to be the closest prior art.

It is common practice in high-voltage fuses having a helical fusible wire supported on a tubular mandrel of ceramic material which is star-shaped in cross section to thread the fusible wire through beads arranged in spaced relation along the same. This measure is not intended to control, or stabilize, the arc voltage generated incident to blowing of the fuse, and does not control, or stabilize, the arc voltage. In some high-voltage fuses having a helical fusible element supported on a mandrel which is star-shaped in cross section the mandrel itself is shaped to function in the same fashion as the aforementioned beads, i.e. to establish spaced points of relatively reduced heat flow along the fusible element. Such arrangements have no significant effect upon the geometry of the arc voltage.

SUMMARY OF INVENTION

Fuses embodying this invention comprise a subassembly including a pair of cylindrical coaxially arranged spaced metal blocks having systems of registering grooves at the juxtaposed end surfaces thereof. Each of said systems of grooves is substantially in the shape of a polygon. The subassembly further includes a plurality of strips of insulating material arranged parallel to the common axis of said pair of metal blocks and inserted with the end edges thereof into said systems of grooves. Said plurality of strips define a prismatic surface and leave wide gaps between immediately adjacent longitudinal edges thereof. A ribbon fuse link is wound helically around said plurality of plates and engages with the wide surface thereof the wide surfaces of said plurality of plates. The ends of the ribbon fuse link are in contact with said juxtaposed end surfaces of said metal blocks.

BRIEF DESCRIPTION OF DRAWINGS

FIG. 1 is generally a longitudinal section of a fuse embodying the present invention showing some parts in side elevation, the upper part of FIG. 1 showing the fuse structure without, and the lower part of FIG. 1 showing the fuse structure with, its fusible elements and its pulverulent arc-quenching filler;

FIG. 2 is a transverse section taken substantially along 2–2 of FIG. 1;

FIG. 3 is a transverse section of the structure of FIG. 1 taken along 3–3 of FIG. 1; and

FIG. 4 is a top-plan view of a detail of the structure of FIGS. 1 and 2.

DESCRIPTION OF PREFERRED EMBODIMENT OF INVENTION

Reference character 1 has been applied to indicate a pair of cylindrical coaxially arranged spaced metal blocks. The lower block 1 has a system of grooves 1*a* at the axially inner end surface thereof. The grooves 1*a* are arranged in the shape of a polygon, and more particularly that of a square. The axially inner end surface of the upper block 1 is provided with a system of grooves 1*a* which is identical to that on the axially inner end surface of lower metal block 1. Reference numeral 2 has been applied to indicate a plurality of strips of insulating material arranged parallel to the common axis of the pair of metal blocks 1. Insulating strips 2 may be of melamine-glass-cloth laminate, or of an appropriate inorganic insulating material being more temperature resistant than melamine-glass-cloth laminates. The choice of the material of which strips 2 are made is of critical importance. Melamine-glass-cloth laminates are very satisfactory as long as the temperatures occuring in the fuse are sufficiently low to preclude aging of that material. When considering higher temperatures and inorganic insulating materials the latter must be chosen to avoid tracking along the surfaces of strips 2. Strips 2 have end edges inserted into grooves 1*a* and longitudinal edges 2*a*. Wide gaps 3 are left between immediately adjacent longitudinal edges 2*a* of strips 2. The four strips 2 define a prismatic surface having a square cross section. As best shown in FIG. 1 one or more multiperforated ribbon fuse links 4 are would helically around strips 2 and engage with the wide surface thereof the radially outer wide surfaces of strips 2. An additional strip 5 electric insulating material is arranged parallel to each insulating strip 2 and ribbon fuse links 4 are sandwiched at a large number of spaced points between a pair of strips 2 and 5. Strips 5 may be of the same material as strips 2, and the same considerations apply relative to the choice of the material for strips 5 as those that apply relative to the choice of the material for strips 2. Strips 5 are attached to, and supported by, strips 2. This may be achieved by fasteners, e.g. eyelets 6 projecting transversely through strips 2 and 5. The ends of ribbon links 4 are firmly secured to metal blocks 1 and conductively connected to metal blocks 1. This may be achieved by fasteners as, for instance, screws, and solder joints. As shown in FIG. 2 clip 15 is attached to metal block 1 by a screw 16 and clamps the ends of fuse links 4 against the axially inner surface of metal block 1. Each fuse link 4 is inserted into a groove 1*a* and conductively connected by a solder joint 17 inside groove 1*a* to metal block 1.

Metal blocks 1, strips 2, fuse links 4 and strips 5 form a self-contained subassembly that may be used to manufacture a high-voltage fuse. Strips 2 form spacers between metal blocks 1 upon which ribbon fuse links 4 may be wound by means of a lathelike winding machine. To stiffen the subassembly during the fuse-link winding and assembly process additional spacing means may be used to space metal blocks 1 and these additional spacing means may be removed prior to filling the fuse with an arc-quenching filler. The use of such additional temporary space means is more fully disclosed in U.S. Pat. No. 2,740,187 to P. C. Jacobs, Jr. et al.; Apr. 3, 1956 for Methods Of Assembling Fuses.

As best shown in FIG. 1 the assembled fuse includes a tubular casing 7 of insulating material closed on both ends by cylindrical metal blocks 1. Transverse steel pins 8 project through casing 7 into metal blocks 1 to preclude any relative movement between parts 7 and 1. The lower portion of casing 7 is filled with a pulverulent arc-quenching filler 10 having a relatively small thermal conductivity, e.g. gypsum powder, and the upper portion of casing 7 is filled with a pulverulent arc-quenching filler 9 having a relatively large thermal conductivity, e.g. quartz sand. Casing 1 may be filled with about 25 percent of low thermal conductivity arc-quenching filler 10 and with about 75 percent of quartz sand. Each of fuse links 4 is provided with a link-severing overlay 11 of a metal having a

lower fusing point than the metal of which fuse links 4 are made. Normally fuse links 4 are of silver and overlays 11 may be of tin. The portions of fuse links 4 submersed in filler 10 are provided with the overlays 11. Filler 10 is carefully compacted to avoid mixing thereof with filler 9. In order to allow convenient filling of casing 7 with fillers 9 and 10 and compacting of the latter, the lower metal block 1 is provided with a central bore 1*b* of relatively large diameter which is internally screw-threaded and closed by an externally screw-threaded metal plug 12. The latter has a central bore closed by a sheet metal cap 13. The upper metal block 1 has a bore 1*c* of relatively small diameter in which a spring-biased indicator pin mechanism 18 is arranged. This mechanism 18 may be of the kind more fully disclosed in U.S. Pat. No. 3,391,369 to Frederick J. Kozacka; Jul. 2, 1969 for High Voltage Fuse. Sheet metal cap 13 clamps the lower ends of a V-shaped restraining wire 14 normally restraining the indicator mechanism 18. Each metal block 1 may be provided with a blade contact 19 for inserting the fuse in a fuse holder or securing it to a pair of bus bars.

It will be apparent from the foregoing that ribbon fuse links 4 include portions, or sections, which are entirely exposed to the action of the pulverulent arc-quenching fillers 9, 10, and portions, or sections, sandwiched between plates 2 and 5 and, therefore, shielded from the direct action of the arc-quenching fillers 9, 10. The portions, or sections, of fuse links 4 immediately exposed to the action of arc-quenching fillers 9, 10 generate upon blowing of the fuse rapidly rising and rapidly decaying arc voltages. The portions, or sections, of fuse links 4 sandwiched between strips 2 and 5 generate upon blowing the fuse arc voltages which rise relatively slowly and decay relatively slowly. The aggregate of both arc voltages is, therefore, relatively stable. By increasing the width of plates 2 and 5 the arc-quenching action of the arc-quenching fillers 9, 10 upon the arc or arcs taking the place of fuse links 4 may be decreased. The action of the arc-quenching fillers 9, 10 upon the arc or arcs taking the place of fuse links 4 may be increased by deleting some, or all, of the cover plates 5 from the fuse structure. In other words, the arc voltage may readily be controlled by effecting some minor structural changes.

As a general rule the aggregate length of the fuse link sections which are fully exposed to the action of arc-quenching fillers 9, 10 should exceed the aggregate length of the fuse link sections sandwiched between plates 2 and 5 and thus not in immediate physical engagement with the pulverulent arc-quenching fillers 9, 10. This imposes limitations on the width of strips 2 and 5 which, in turn, tend to limit the bending strength of strips 2 and 5. If their bending strength should prove insufficient, strips 2 may be braced by one or more transverse braces arranged between the ends thereof. Such bracing means may be formed by spiders 20 having four arms enclosing angles of 90° each engaging with a radially outer end one of the four strips 2. As best shown in FIG. 2 the spider 20 is arranged in coaxial relation to metal blocks 1 and casing 7 and has radially outer ends engaging openings in plates 2.

The upper ends of fuse links 4 are conductively connected to the upper metal block 1 in the same way as the lower ends of fuse links 4 are conductively connected to the lower metal block 1 illustrated in the lower portion of FIGS. 1 and 2.

The fabricated link-supporting structure of FIGS. 1 and 2 is more desirable than the use of conventional tubular link-supporting insulating mandrels of a ceramic material which are star-shaped in cross section. It is apparent from the foregoing that the structure illustrated in FIGS. 1 and 2 is more flexible than any conventional mandrel structure, lends itself far better to arc voltage control and requires less volume inside of the casing, thus leaving a larger portion of the latter for accommodating pulverulent arc-quenching fillers.

I claim:

1. A subassembly for making high-voltage fuses including:
   a. a pair of cylindrical coaxially arranged spaced metal blocks having systems of registering grooves at the juxtaposed end surfaces thereof, each of said systems of grooves being substantially in the shape of a polygon;
   b. a plurality of strips of insulating material arranged parallel to the common axis of said pair of metal blocks and inserted with the end edges thereof into said systems of grooves, said plurality of strips defining a prismatic surface, and said plurality of strips further leaving wide gaps between immediately adjacent longitudinal edges thereof; and
   c. a ribbon fuse link having a plurality of points of reduced cross section would helically around said plurality of strips and engaging with the wide surface thereof the wide surfaces of said plurality of strips, the ends of said fuse link being in contact with said juxtaposed end surfaces of said metal blocks.

2. A subassembly as specified in claim 1 wherein each of said systems of grooves is in the shape of a square.

3. A subassembly as specified in claim 1 including additional strip means arranged parallel to the constituent strips of said plurality of strips and sandwiching said ribbon fuse link jointly with said constituent strips of said plurality of strips, said additional strip means being supported by said plurality of strips.

4. A high-voltage fuse including:
   a. a tubular casing of electric insulating material;
   b. a pair of cylindrical spaced metal blocks plugging the ends of said casing, each of said pair of metal blocks having a polygon-shaped system of grooves on the axially inner end surface thereof;
   c. a plurality of strips of insulating material arranged parallel to the joint axis of said housing and said pair of metal blocks and inserted with the end edges thereof into said system of grooves of each of said pair of metal blocks and defining a prismatic surface, said plurality of strips leaving wide gaps between immediately adjacent longitudinal edges thereof;
   d. ribbon fuse link means having a plurality of serially related points of reduced cross section wound helically around said plurality of strips and engaging with the wide surface thereof the wide surfaces of said plurality of strips, the ends of said fuse link means being in contact with said axially inner end surface of each of said pair of metal blocks; and
   e. pulverulent arc-quenching filler means inside said casing submersing said plurality of strips and said ribbon fuse link means.

5. A high-voltage fuse as specified in claim 4 wherein said system of grooves in each of said pair of metal blocks has the shape of a square.

6. A high-voltage fuse as specified in claim 4 including additional strip means arranged parallel to the constituent strips of said plurality of strips and sandwiching said ribbon fuse link means jointly with said constituent strips of said plurality of strips, said additional strip means being supported by said plurality of strips.