United States Patent [19]

Salzer

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[54] **HIGH-VOLTAGE FUSE INCLUDING INSULATING MANDREL FOR SUPPORTING FUSIBLE ELEMENTS**

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[52] **U.S. Cl.** **337/159,** 337/231, 337/290

[51] **Int. Cl.** **H01h 85/04**

[58] **Field of Search** 337/159, 186, 231, 228, 337/293, 295, 290

[56] **References Cited**

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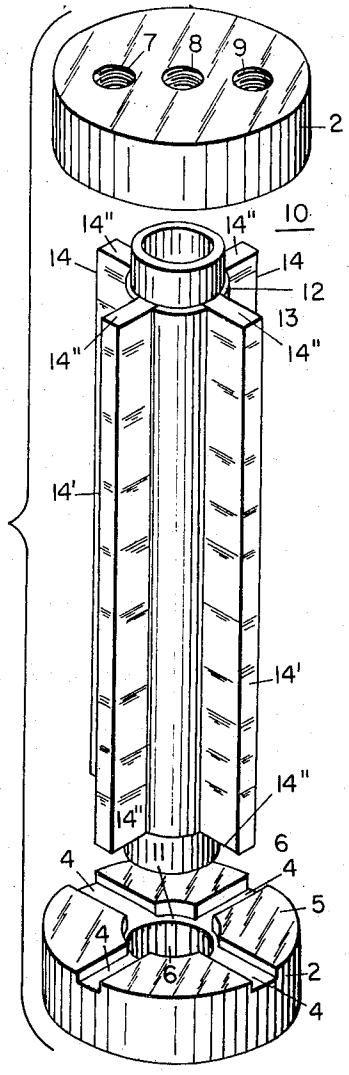
Primary Examiner—J. D. Miller

Assistant Examiner—Fred E. Bell

[57] **ABSTRACT**

A high voltage fuse is provided with a fabricated insulating mandrel made up of a center post having grooves extending in a direction longitudinally of the post and regtangular insulating plates each engaging with one edge thereof one of the grooves in the center post. Other edges of the insulating plates engage grooves provided in the axially inner end surfaces of a pair of terminal plugs closing the ends of a fuse tube or casing. Thus each relatively fragile insulating plate is supported along three edges thereof.

9 Claims, 5 Drawing Figures



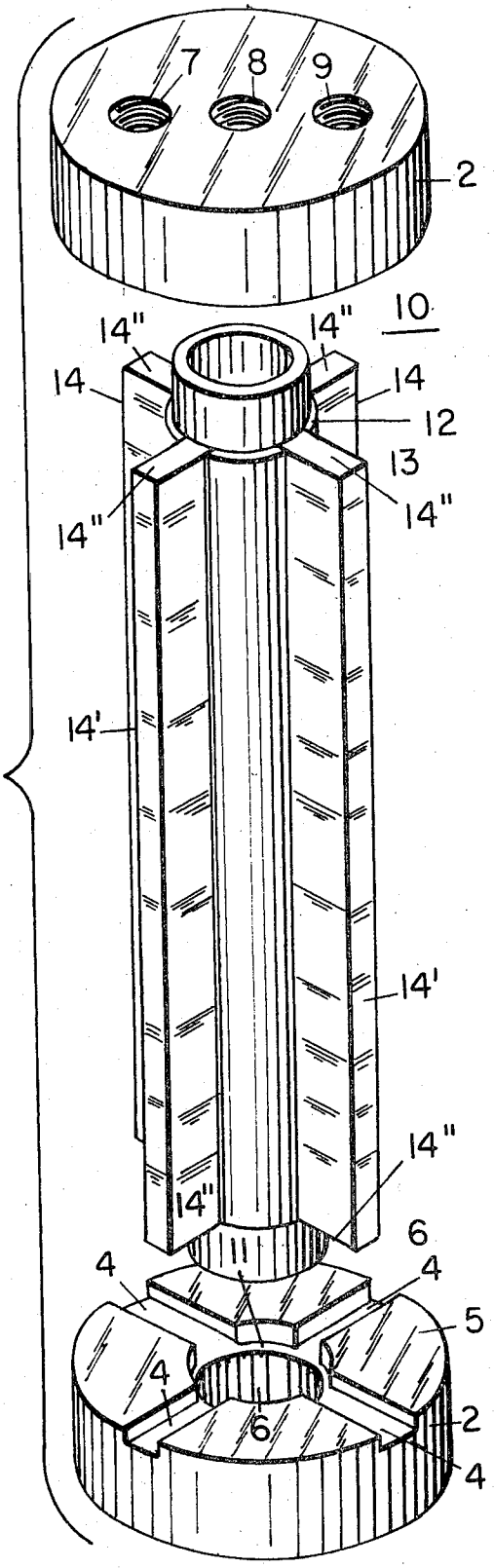


FIG. 1.

FIG. 2.

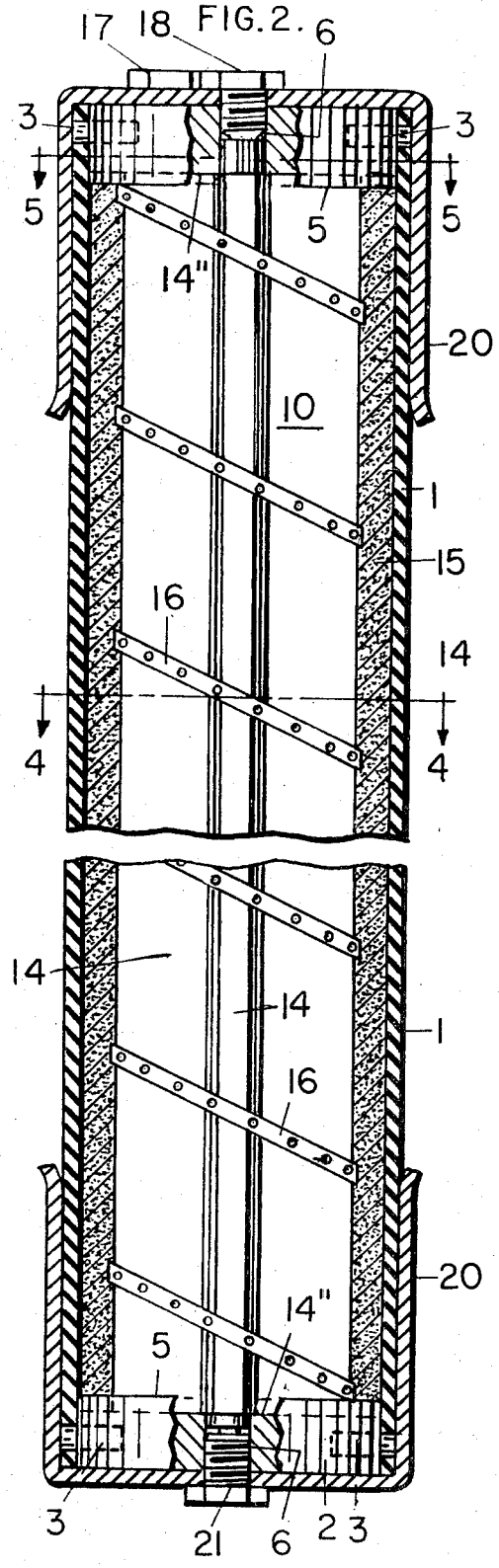


FIG. 3.

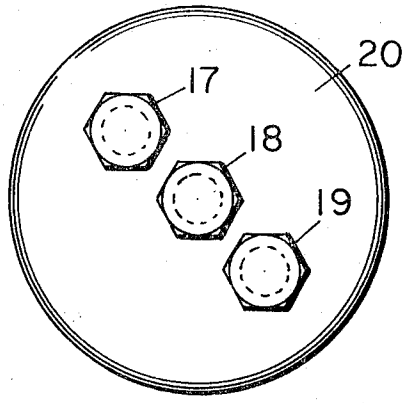


FIG. 4.

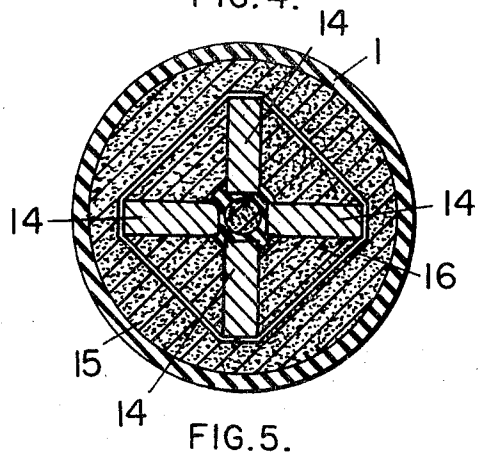
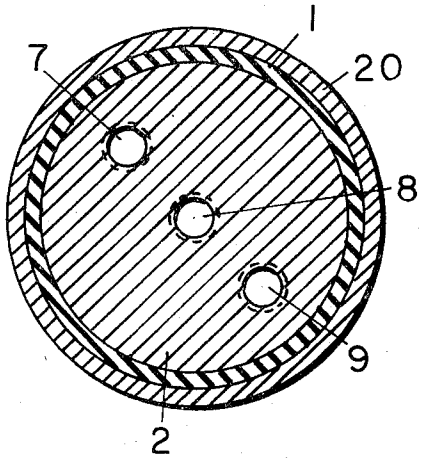


FIG. 5.



HIGH-VOLTAGE FUSE INCLUDING INSULATING MANDREL FOR SUPPORTING FUSIBLE ELEMENTS

BACKGROUND OF THE INVENTION

Many high-voltage fuses include helically wound fusible elements. In most high-voltage fuses the helically wound fusible elements are supported by insulating mandrels which are generally made of a ceramic material. Some high-voltage fuses have helically wound fusible elements which are solely supported by the pulverulent arc-quenching filler by which they are surrounded, i.e., in such fuses a supporting mandrel for supporting the fuse links is dispensed with.

This invention relates to electric fuses having an insulating mandrel for supporting fusible elements which are helically wound around it. The manufacture of such mandrels is generally expensive and can only be considered where it is intended to manufacture large quantities of high-voltage fuses of the same kind. The high cost of fuse-link-supporting mandrels result from the fact that they must be made of high grade ceramics. In addition tools for making link-supporting mandrels are relatively high.

There has been and there is an urgent need for fuse link supporting mandrels which can be manufactured in relatively small quantities at relatively small cost, thus making it possible to readily vary the design of link-supporting mandrels in accordance with various performance characteristics which may be required. Back-up fuses not designed to interrupt small overload currents may require link-supporting mandrels of an entirely different nature than fuses having full range interrupting ability, and vice versa. A mandrel material acceptable for a given voltage rating and a given pitch of the helically wound fusible elements may be unacceptable for fuses having a relatively higher voltage rating whose fusible elements have a relatively smaller pitch.

In view of some of the facts which are outlined above U.S. Pat. No. 3,599,138 to Frederick J. Kozacka; Aug. **10, 1971** for HIGH-VOLTAGE FUSE proposes to substitute for conventional ceramic fuse-link-supporting mandrels a plurality of radially extending insulating plates engaging with edges thereof radial grooves provided in juxtaposed axially inner end surfaces of a pair of terminal plugs by which the casing or fuse tube of the fuse is closed. Since the diameter of a high-voltage fuse is generally considerably less than its length, i.e., a small fraction of its length, the support which is offered to the fragile mandrel-forming insulating plates in the above referred-to Kozacka design is relatively small, and insufficient in many instances. Hence there is a strong tendency for the fusible element-supporting insulating plates of Kozacka to break during shipment, or when the fuse is subjected to vibrations while in service. This tendency is particularly large when the aforementioned plates are made of a relatively brittle ceramic material.

It is one object of this invention to provide high-voltage fuses having relatively inexpensive fabricated mandrels for supporting the fusible elements which mandrels impart a high degree of dimensional stability to the fuses, are not likely ever to break, and at the same time allow a high degree of design flexibility.

Another object of this invention is to provide high-voltage fuses which are a significant improvement of the above referred to Kozacka structure inasmuch as they provide a firm support for the insulating plates of Kozacka along three edges thereof including one of their long edges which long edges are substantially equal in length to the length of the fuses.

SUMMARY OF THE INVENTION

Fuses embodying this invention include a tubular casing of electric insulating material and a pair of terminal plugs closing the ends of said casing. Each of said pair of terminal plugs has a pair of narrow grooves in the axially inner end surface thereof arranged at right angles. Each of said pair of terminal plugs has a circular recess in the axially inner end surface exceeding in depth the depth of said pair of grooves. One of said pair of plugs has an eccentric screw-threaded filling hole normally closed by a plug means. The structure further includes a post arranged in the center of said casing and projecting with the ends thereof into said recess in each of said pair of terminal plugs. The post has grooves in the lateral surface extending in a direction longitudinally of the post and being angularly displaced 90°. The fuse further includes substantially rectangular plates of heat resistant electric insulating material arranged inside the casing and each having relatively long edges and each having relatively short edges. Each of said plates engages with a radially inner relatively long edge thereof one of the grooves in the aforementioned post and each of said plates engages with the axially outer relatively short edges thereof one of said pair of grooves in the axially inner end surfaces of said pair of terminal plugs. A fuse link is wound helically around the radially outer edges of said plates and pulverulent arc-quenching filler inside said casing fills the space thereof unoccupied by said post, said plates and said fuse link.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is an isometric exploded view of a composite link supporting mandrel and of a pair of terminal plugs intended to form part of the fuse structure of FIG. **2**;

FIG. **2** is substantially a longitudinal section of a fuse embodying this invention, some of the constituent parts of the fuse being shown in front view rather than in section, and the center portion of the fuse being broken away;

FIG. **3** is a top-plan view of the structure of FIG. **2**;

FIG. **4** is a section along **4—4** of FIG. **2**; and

FIG. **5** is a section along **5—5** of FIG. **2**.

DESCRIPTION OF PREFERRED EMBODIMENT

In the drawings numeral **1** has been applied to indicate a tubular housing or fuse tube of electric insulating material, e.g., melamine-glass-cloth. Casing **1** is closed on the ends thereof by a pair of terminal plugs which may be made of copper or brass. Steel pins **3** project transversely through casing **1** and into plugs **2**, firmly securing the latter to the former. Each of the pair of terminal plugs **2** has a pair of narrow grooves **4** in the axially inner end surface **5** thereof. Grooves **4** are arranged at right angles. Each terminal plug **2** has a circular center recess **6** in the axially inner end surface **5** thereof. The depth of recess **6** exceeds that of grooves **4**. Upper plug **2** is provided with three internally screw-threaded holes or bores **7,8,9**. Bore **8** is an extension of recess **6** in upper terminal plug **2**. Post **10** is arranged in the center of casing **1** in coaxial relation thereto. The

ends 10', 10'' of post 10 are reduced in diameter and their diameter is equal to the diameter of recesses 6 and project into recesses 6. Each recess 6 in end surfaces 5 includes an axially inner portion of relatively large diameter and an axially outer portion of relatively small diameter forming a shoulder 11 between said axially inner portion and said axially outer portion. This has been best shown in FIG. 1. Each reduced diameter end 10',10'' of post 10 forms a shoulder 12 between it and the large diameter portion of the post 10. The shoulders 12 on each end of post 10 abut against the shoulders 11 formed in terminal plugs 2. Post 2 has grooves 13 in the lateral surface thereof extending in a direction longitudinally of post 10. There are four such grooves 13 in post 10, and the grooves 13 are angularly displaced 90°. Reference character 14 has been applied to indicate four substantially rectangular plates of heat-resistant electric insulating material arranged inside of casing 1 each having relatively long edges and relatively short edges. The radially inner relatively long edges 14' of plates 14 engage grooves 13 in post 10 and the axially outer relatively short edges 14'' of plates 14 engage the grooves 4 in the axially inner end surfaces 5 of terminal plugs 2. Thus three edges including a long edge 14' of each of plates 14 has a firm support virtually eliminating the danger of breaking of plates 14. A fuse link 16 of silver is wound helically around the radially outer edges of the four plates 14 and conductively interconnects terminal plugs 2. The pulverulent arc-quenching filler 15 — preferably quartz sand — fills the space inside of casing 1 unoccupied by post 10, plates 14 and fuse link 16. Fuse link 16 preferably formed by a silver ribbon having a plurality of serially related points of reduced cross-sectional area. The relatively long radially inner edges 14' of plates 14 are cemented into grooves 13 of post 10, preferably by means of an epoxy resin cement. In a similar fashion, transverse or radial edges 14'' projecting into grooves 4 are bonded to terminal plugs 2 by means of an epoxy resin cement. Post 10 is made of a material that can readily be machined. It is preferably made of melamine-glass-cloth tubing. If post 10 is tubular, the inside thereof should be filled with the pulverulent arc-quenching filler 15. This can be achieved by means of screw-threaded hole 8 forming an extension of one of the recesses 6. The two bores or passageways 7,9 in upper terminal plug 2 make it possible to readily fill the fuse casing 1 with arc-quenching filler 15. Bores or passageways 7,9 are arranged eccentrically to opposite sides of post 10, and the axially inner end of each passageway 7,9 is arranged between transverse edges 14'' of plates 14. The axially outer ends of bores or passageways 7,8,9 are normally plugged by screws whose hexagonal heads 17,18,19 appear in FIGS. 2 and 3. The aforementioned screws may be used to clamp ferrules 20 against the end surfaces of terminal plugs 2. The recess 6 in lower terminal plug 2 may or may not extend all the way through the aforementioned plug. In the former case the recess or passageway is closed by a plugging screw 21, as shown in FIG. 2.

If post 10 is tubular and filled with a pulverulent arc-quenching filler, the post 10 may be used to house a restraining wire for a spring-biased blown fuse indicator. In that instance center recess 6 and bore 8 in the upper terminal plug 2 are internally screw-threaded in the axially outer portion therof. The bore or passageway 8 is closed by a plug-screw having a recess in the center thereof housing a spring-biased blown fuse indicator normally restrained by the restraining wire (not shown) in tubular post 10. A plug-screw with built-in blown fuse indicator of the kind referred-to above is disclosed more in detail in U.S. Pat. No. 3,621,433 to Richard A. Belcher, Nov. 16, 1971 for ELECTRIC CARTRIDGE FUSE HAVING PLUG TERMINALS. Reference may be had to this patent for further details relating to the arrangement of a spring-biased blown fuse indicator in a plug screw. The lower plug screw 21 shown in FIG. 2 may be adapted to anchor the end of a restraining wire arranged inside of post 10 remote from the blown fuse indicator which is affixed to upper terminal plug 2.

It will be apparent from the drawings that the radially inner ends of grooves 4 and the axially outer ends of grooves 14 are substantially coextensive.

I claim as my invention:

1. A high-voltage fuse including
   a. a tubular casing of electric insulating material;
   b. a pair of terminal plugs closing the ends of said casing, each of said pair of terminal plugs having a pair of narrow grooves in the axially inner end surface thereof arranged at right angles to each other, and each of said pair of terminal plugs having a circular recess in the axially inner end surface thereof exceeding in depth the depth of said pair of grooves, and one of said pair of plugs having an eccentric internally screw-threaded filling hole normally closed by a plug means;
   c. a post of electric insulating material arranged in the center of said casing and projecting with each end thereof into said recess in one of said pair of terminal plugs, said post having grooves in the lateral surface thereof extending in a direction longitudinally of said post and being angularly displaced 90°;
   d. substantially rectangular plates of heat resistant electric insulating material arranged inside said casing each having relatively long edges and relatively short edges and each engaging with a radially inner relatively long edge thereof one of said grooves in said post and each engaging with an axially outer relatively short edge thereof one of said pair of grooves in the axially inner end surfaces of said pair of terminal plugs;
   e. a fuse link wound helically around the radially outer edges of said plates; and
   f. a pulverulent arc-quenching filler inside said casing filling the space thereof unoccupied by said post, said plates and said fuse link.

2. A high-voltage fuse as specified in claim 1 wherein

   a. said recess in the axially inner end surface of each of said pair of terminal plugs includes an axially inner portion of relatively large diameter and an axially outer portion of relatively small diameter forming a shoulder between said axially inner portion and said axially outer portion, and wherein
   b. each end of said post projecting into said recess of said pair of terminal plugs is reduced in diameter forming a shoulder between each said end and the center portion of said post, said shoulder on each end of said post abutting against said shoulder in each of said pair of terminal plugs.

3. A high-voltage fuse as specified in claim 1 wherein the relatively long radially inner edges of said plates are cemented into said grooves of said post.

4. A high-voltage fuse as specified in claim 1 wherein said relatively long radially inner edges of said plates are bonded to said post and the relatively short axially outer edges of said plates are bonded to said terminal plugs by means of an epoxy resin cement.

5. A high-voltage fuse including

a. a tubular casing of electric insulating material;

b. a pair of terminal plugs closing the ends of said casing, said pair of terminal plugs having center recesses in the axially inner end surfaces thereof and a plurality of grooves extending radially outwardly from said center recesses;

c. substantially rectangular plates of heat resistant electric insulating material arranged inside said casing, said plates having longitudinal edges arranged parallel to the axis of said casing and said plates having transverse edges conforming to the shape of and projecting into said radially extending grooves in said axially inner end surfaces of said pair of terminal plugs;

d. fusible element means wound helically around the radially outer edges of said plates of insulating material anc conductively interconnecting said pair of terminal plugs;

e. an insulating post arranged inside of and in coaxial relation to said casing and projecting with the ends thereof into said center recesses of said pair of terminal plugs, said post having grooves extending in a direction longitudinally thereof, the axially outer ends of said grooves in said post being substantially coextensive with the radially inner ends of said radially extending grooves in said axially inner end surfaces of said pair of terminal plugs, said grooves extending in a direction longitudianally of said post receiving the radially inner longitudinal edges of said plates of insulating material and said plates of insulating material being affixed at said radially inner longitudinal edges thereof to said post; and

f. a pulverulent arc-quenching filler inside said casing embedding said plates of insulating material, said fusible element means and said post.

6. A high-voltage fuse as specified in claim 5 wherein one of said pair of terminal plugs is provided with a pair of eccentric axially extending passageways arranged to opposite sides of said post, the axially inner end of each of said pair of passageways being arranged between said transverse edges of one pair of said plates of insulating material, and the axially outer end of each of said pair of passageways being plugged by one of a pair of plug screws.

7. A high-voltage fuse as specified in claim 5 wherein said post is formed by a tube of glass-cloth melamine and wherein said plates of insulating material include a ceramic substance.

8. A high-voltage fuse as specified in claim 5 wherein said post is tubular and filled with a pulverulent arc-quenching filler, wherein one of said center recesses extends to the axially outer surface of one of said pair of terminal plugs, is internally screw-threaded in the axially outer portion therof and receives a screw having a recess in the center therof housing a spring-biased blown fuse indicator, said blown fuse indicator being normally restrained by a restraining wire arranged inside of said tubular post.

9. A high-voltage fuse including

a. a tubular casing of electric insulating material;

b. a pair of terminal plugs closing said casing and having narrow grooves in the axially inner end surfaces extending radially outwardly from the centers thereof;

c. plates of heat-resistant insulating material having relatively long edges positioned parallel to the axis of said casing and having relatively short edges inserted into said grooves of said pair of terminal plugs;

d. fusible element means wound helically around the radially outer edges of said plates and conductively interconnecting said pair of terminal plugs;

e. a cylindrical center post of electric insulating material inside said casing arranged in coaxial relation thereto and having ends projecting into said axially inner end surfaces of said pair of plugs, said center post having straight grooves in the outer surface thereof each receiving one of said relatively long edges of said plates;

f. cementitious bonds firmly affixing the portions of said plates engaging said grooves in said center post to said center post to support said plates by said center post along the entire length of said plates; and

g. a pulverulent arc-quenching filler inside said casing submersing said plates, said fusible element means and said center post.

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