UNITED STATES PATENT OFFICE

2,652,467

RENEWABLE FUSE WITH POROUS METAL ENDS

Fred G. von Hoorn and Howard B. Bennett, Bridgeport, Conn., assignors to General Electric Company, a corporation of New York

Application May 31, 1952, Serial No. 230,989

5 Claims. (Cl. 500—132)

1 This invention relates to a renewable cartridge fuse and in particular to an improved simplified renewable fuse construction having a minimum number of threaded parts.

A renewable cartridge fuse is that type of fuse comprising a cylindrical insulating cartridge having an electrical contacting knife blade extending one from each end. An insulating bar and a renewable and reusable fuse link are both located within the cartridge and interconnect the two knife blades. Most renewable fuses have fiber tubes that are threaded at each end and that are equipped with metal bushings also threaded to receive correspondingly threaded metal caps. The caps and other end elements are designed to form suitable end closures at each end of the fiber tube to contain the gases generated within the cartridge so formed when a fuse link blows under short circuit conditions. Specifically, the end closures restrict the venting of these gases and further they resist the relatively high pressures developed within the cartridge during short circuit. Such metal parts and threading operations required for each end of the cartridge are costly and represent a large portion of the total cost of the fuse. Obviously, the elimination of these threading operations is desirable and accordingly it is an object of this invention to provide an improved renewable cartridge fuse of a type having a minimum number of threaded parts.

The importance of suitable end closures and other fuse parts is emphasized by the following quotation from a booklet issued by the Underwriters’ Laboratories, Incorporated—"Standard for Fuses" (January 1948).

Paragraph 61—Dealing with testing of cartridge fuses—

“When one fuse is blown at a time on a system of the voltage for which the fuse is rated, with the equipment and in accordance with the test procedure called for, the fuse shall remain intact and shall open the circuit without emitting sufficient flame or molten metal to ignite surgical cotton entirely surrounding the casing or enclosure and covering the vents. Expulsion of molten solder from the end of a cartridge fuse is considered to be a failure.”

Therefore, it is a still further object of this invention to provide an improved structure for renewable cartridge fuses which will meet Underwriters’ requirements in not permitting gases of the temperature high enough to ignite cotton to emanate from the fuse.

Of incidental interest are the following specifications taken from the above enumerated “Standard for Fuses.” These specifications show the importance of a suitable fuse construction and the critical limits prescribed therefor by the Underwriters’ Laboratories, Incorporated:

Paragraph 63—

“Five renewal elements in the same casing or enclosure of a renewable fuse shall perform successively in the manner specified, and the blowing of any element shall not render it impossible to renew the element in the intended manner.”

Paragraph 64—

“During the testing of a renewable fuse it is to be possible for an experienced operator to renew the fuse within an elapsed time of 10 minutes, and parts other than the fusible element and filler (if any) are not to be replaced. Deposits of fused metal may be removed, if such removal can be accomplished readily by means of a knife, screw driver, or pliers.”

Accordingly, it is a still further object of this invention to provide an improved, inexpensive cartridge fuse that will meet all the requirements of the Underwriters’ Laboratories, Incorporated.

Further objects and advantages of this invention will occur to those skilled in the art and it is desired to be understood, therefore, that this invention is not to be limited to the particular embodiment disclosed, but rather is it intended to cover all modifications which are within the true spirit and scope of this invention.

Briefly, in accordance with the objects of this invention, an improved fuse structure is shown in the illustrated embodiment whereby a cartridge fuse is vented over a relatively large area thereby limiting maximum internal pressures to only nominal proportions by making use of porous, sintered metal end closures. With our improved structure, a renewable cartridge fuse can be assembled with the use of a minimum number of threaded parts.

In the drawing, Fig. 1 is a front elevation, partly in section, showing the structure of four improved renewable fuse; Fig. 2 is a top view of the fuse of Fig. 1; and Fig. 3 is a sectional view along line 3—3 of Fig. 1.

Referring to the drawing, a renewable fuse 1 is shown comprising a pair of knife blades 2, 3, interconnected by an insulating bar 4 and a fusible link 5. The axially positioned inner ends of the knife blades, the insulating bar 4 and the fusible link 5 are enclosed by a hollow-cylindrical or tubular insulating casing 6.
The knife blades 2, 3, are terminals which, in accordance with the Standards set forth by Underwriters’ Laboratories, Incorporated, are in substantial alignment with each other, the alignment being assured by means other than friction.

Accordingly, an insulating bar 4 is positioned between the inner ends of the knife blades and in contact therewith, thereby to provide alignment in one plane. Alignment in a plane transverse to the first plane is the result of the fuse structure and the interrelationship between the cartridge and end closures as shall be hereinafter described.

The fuse link 5 is of any suitable shape and is made from a material, usually zinc, approved by Underwriters’ Laboratories, Inc. The link 5 is interconnected and secured to the knife blades by bolts 7, 8 to prevent any high resistance path between the knife blades and the fuse link.

It has already been pointed out that because of the requirements of the Underwriters’ Laboratories, Inc., suitable end closures for a fuse are required to prevent the escape of hot gases. Accordingly, one of the important features of this invention lies in the provision of the porous end closures 6, 10. Each of these closures is made from a porous, sintered metal, preferably by the coating copper particles and sintering them at a temperature which melts the tin but not the copper. The tin fuses to form with the copper a porous sintered or sintered member having no straight through passageways. The porosity is controlled by the size of the copper particles since the pores are defined by the interstitial spaces between the coated particles.

The advantage of porous metal is that the hot gases emanating from the fuse upon rupture of the link are allowed to escape through a plurality of restricted, tortuous passages whereupon their velocity is restrained and they are caused to give up heat thereby to reduce the temperature of the escaping gases and to prevent fires.

The particular configuration of the porous metal end closures, as described in this application, is one of the important features of our invention since it makes possible the structure whereby a minimum number of threaded parts are required for complete fuse assembly. For example, the porous end closure 6 is cylindrical and it has two diameters one of which fits snugly within the inner diameter of tubular casing 6 and the second dimension of which is large enough to act as a shoulder against which the end of tube 6 may butt. Closure 9 is further provided centrally with a slotted opening 11 having dimensions suitable for the entrance of the inner end 12 of knife blade 3. Accordingly, in assembling the fuse, the end closure 9 is first positioned in alignment with knife blade 3 and then the slotted opening 11 is slid over the inner end 12 of the knife blade 3 until the end closure 9 rests against a shoulder 13 of the knife blade 3.

The second end closure 10 is also cylindrical and formed of porous metal similar to that used for end closure 9, but preferably it has a single diameter. End closure 10 has a threaded outer periphery 14 which serves as a pressure applying means for a cap which will be hereinafter described. End closure 10 is further provided with a central slot 15 of a size commensurate with the dimensions of the inner end 18 of knife blade 2, whereby the inner end 16 of the knife blade 2 can be slid through the slot 15 until a knife blade shoulder 16a butt up against end closure 10.

When the inner end 12 of knife blade 3 has been slid through the end closure 9, and when end portion 16 of knife blade 2 has been slid through the slot 15, then the insulating bar 4 and fuse link 5 can be secured to the inner ends 12, 16 of the knife blades 2, 3, thereby to provide a functioning fuse structure. Preferably each end closure should be staked to the knife blades on which it is mounted to prevent blow-by of gases.

To enclose this fuse structure in accordance with Underwriters’ Laboratories’ requirements, the tubular casing 6 for the cartridge is made of a good quality hard fiber or glass tubing and positioned to enclose the fuse structure. It follows that the tube 6 has an inner diameter 19mensurate with the smaller diameter of the end closure 9 and yet large enough to fit over knife blades 2, 3 and the threaded peripheral portion 14 of the end closure 10. The tubular casing should also have at least the minimum wall thickness specified by the standards of Underwriters’ Laboratories, Incorporated.

When the tube casing has been installed over the fuse structure, its lower end 17 rests against one end of the diameter or flange 5a of end closure 6, while its upper end 18 terminates in a plane passing transversely through end closure 10.

To complete the fuse structure, a threaded ring or cap 15 is provided. Cap 15 is made of brass or other suitable material and it has an internal threaded diameter 20 which will interlock with the threaded diameter 14 of end closure 10. Cap 15 further has an external diameter large enough to provide a hollowed out portion 21 and a lip 22 for housing the upper end 18 of the casing 6.

The lip 22 will align the cartridge so that when a clamping force is applied by threading force 16 onto threaded portion 14, the fuse parts will remain in assembled relationship and a tight rigid structure will be provided.

With this structure, the gases emanating from a blown fuse, upon short circuits, will escape through the plurality of tortuous porous-like passages in each of the end closures. Thereby, the temperature of the gases is reduced by virtue of their intimate contact with large cooling metal areas.

The end closures 9, 10 are sintered pieces readily cast or molded and furthermore, through their use, the only threaded portions required will be those at 14 and 20. It follows that a single inexpensive fuse structure is provided which greatly reduces the cost of renewable fuses.

Modifications of this invention will occur to those skilled in the art and it is desired to be understood, therefore, that this invention is not to be limited to the particular embodiment disclosed, but rather it is intended to cover all modifications which are within the true spirit and scope of this invention.

What we claim as new and desire to secure by Letters Patent of the United States is:

1. A reusable fuse structure comprising a pair of knife blades, a fuse link, means securing said fuse link and said support bar to the inner ends of said knife blades, a tubular insulator enclosing said fuse structure, a porous metal end closure having a diametrical slot positioned between each end of said insulator and the contiguous knife blade, one of said porous metal ends.
closures having a threaded periphery, and a tightening ring having a threaded central bore, said ring being engageable both with said threaded end closure and with the contiguous end of said insulator, whereby, by tightening said ring on said threaded end closure, a rigid fuse structure is produced.

2. A renewable fuse structure comprising a pair of knife blades, an insulating support bar, a fuse link, means securing said fuse link and said support bar to the inner ends of said knife blades, a cylindrical insulating casing enclosing said fuse structure, a porous metal end closure having a diametrical slot positioned between each end of said casing and the contiguous knife blade, one of said porous metal end closures having two diameters of which one fits within said casing while the other butts up against a contiguous casing end, the other of said porous metal end closures having a threaded periphery, and a tightening ring having a threaded central bore, said ring being engageable both with said threaded end closure and with the contiguous end of said casing, whereby, by tightening said ring on said threaded end closure, a rigid fuse structure is produced.

3. A renewable fuse structure comprising a pair of knife blades, an insulating support bar, a fuse link, means securing said fuse link and said support bar to the inner ends of said knife blades, a cylindrical insulating casing enclosing said fuse structure, and a porous metal end closure having a diametrical slot positioned between each end of said casing and the contiguous knife blade, each of said knife blades having a reduced inner end to provide a shoulder engageable with one of said porous end closures respectively, said end closures being held against said shoulders by said support bar, and a threaded tightening ring engageable with one of said end closures to hold said fuse parts in assembled relationship.

4. A renewable fuse structure comprising a pair of knife blades, an insulating support bar, a fuse link, means securing said fuse link and said support bar to the inner ends of said knife blades, a fiber tube enclosing said fuse structure, a porous metal end closure having a diametrical slot positioned between each end of said tube and the contiguous knife blade, each of said knife blades having a reduced inner end to provide a shoulder engageable with one of said porous end closures respectively, said end closures being positioned against said shoulders by said support bar, one of said porous metal end closures having two diameters of which one fits within said tube and the other of which butts against a contiguous tube end, the other of said porous metal end closures being cylindrical and having a threaded periphery, and a tightening ring having a threaded central bore engageable with said threaded end closure and a peripheral portion butting against the contiguous end of said tube whereby by tightening said ring on said threaded end closure a rigid fuse structure is produced.

5. A renewable fuse structure for holding a removable fuse link comprising a pair of fuse terminals axially spaced and aligned, an insulating support bar secured between the inner ends of said terminals, a tubular insulating casing enclosing said structure, and end closures for said casing including a porous metal disk having a diametrical slot positioned between one end of the casing and the contiguous terminal, said terminal having a shoulder engageable with said disk to hold the disk against the said one end of said casing.

FRED G. VON HOORN.
HOWARD B. BENNETT.

References Cited in the file of this patent
UNITED STATES PATENTS

<table>
<thead>
<tr>
<th>Number</th>
<th>Name</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>2,017,491</td>
<td>Glowacki Oct. 15, 1935</td>
<td></td>
</tr>
<tr>
<td>2,166,174</td>
<td>Popp    July 18, 1939</td>
<td></td>
</tr>
<tr>
<td>2,447,048</td>
<td>Baker   Aug. 17, 1948</td>
<td></td>
</tr>
</tbody>
</table>