United States Patent [19]

Kozacka et al.

[11] **3,848,215**

[45] **Nov. 12, 1974**

[54] **FLUID-TIGHT ELECTRIC FUSE**

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[52] **U.S. Cl.** **337/246,** 337/248

[51] **Int. Cl.** **H01h 85/14**

[58] **Field of Search** 337/186, 205, 222, 248, 337/246, 263; 174/DIG. 8

[56] **References Cited**

UNITED STATES PATENTS

2,681,398	6/1954	Kozacka et al.	337/246
3,624,594	11/1971	Trimble	174/DIG. 8
3,662,309	5/1972	Harmon	337/248
3,755,616	8/1973	Toth	174/DIG. 8

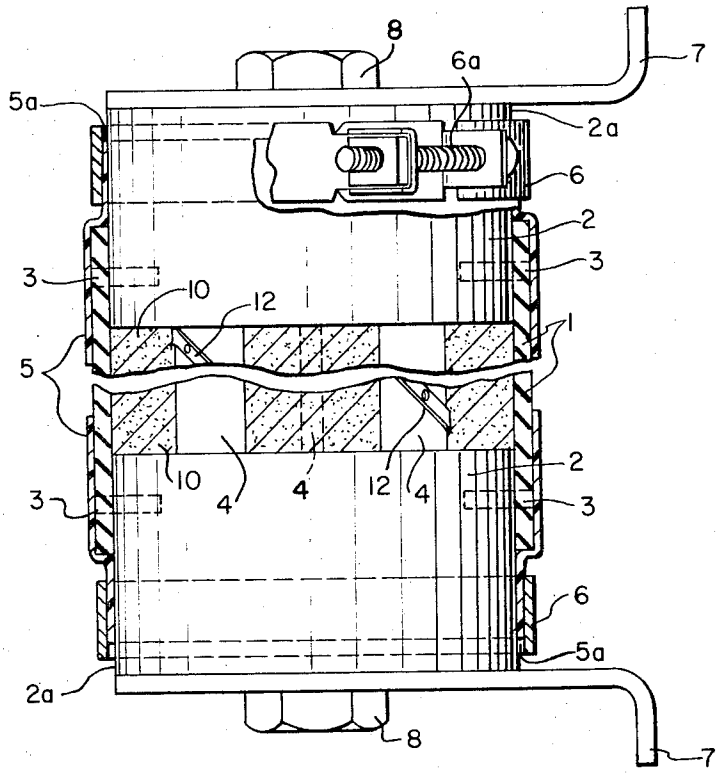
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[57] **ABSTRACT**

An electric fuse rendered fluid-tight by means of a single piece sleeve of a heat-shrinkable and heat-shrunk substance. The sleeve covers the cylindrical casing of the fuse and the lateral surfaces of cylindrical coaxial extensions of terminal plugs of the fuse having substantially the same diameter as the inner diameter of the casing. The portions of the sleeve overlapping the lateral surfaces of the aforementioned extensions are clamped against said surfaces by annular metal clamps which are provided with adjustment or clamping screws.

5 Claims, 3 Drawing Figures



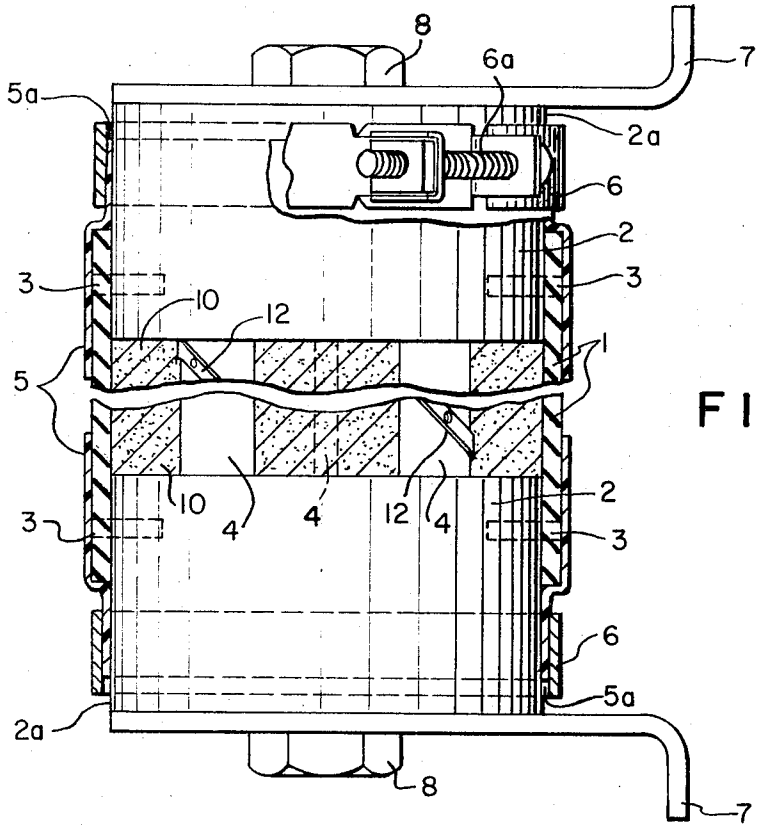


FIG. 1

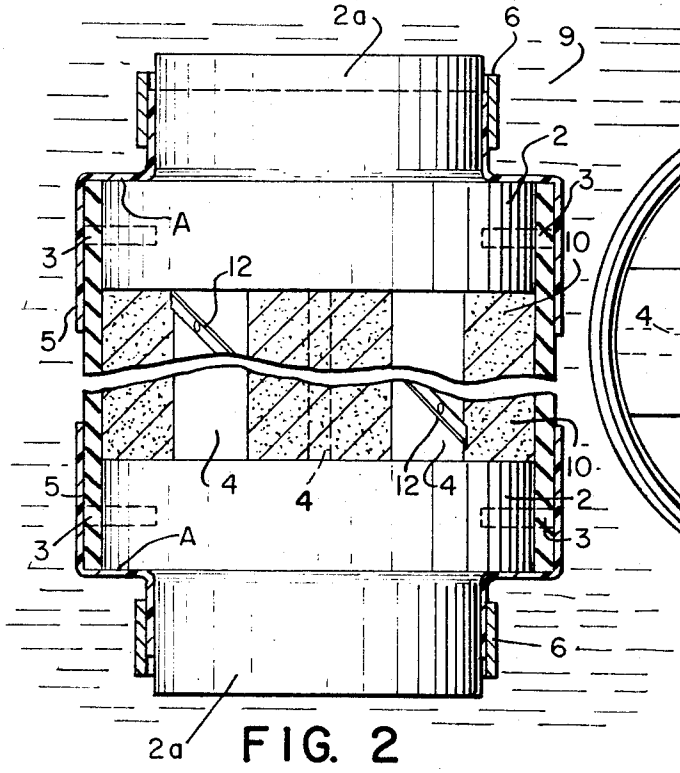


FIG. 2

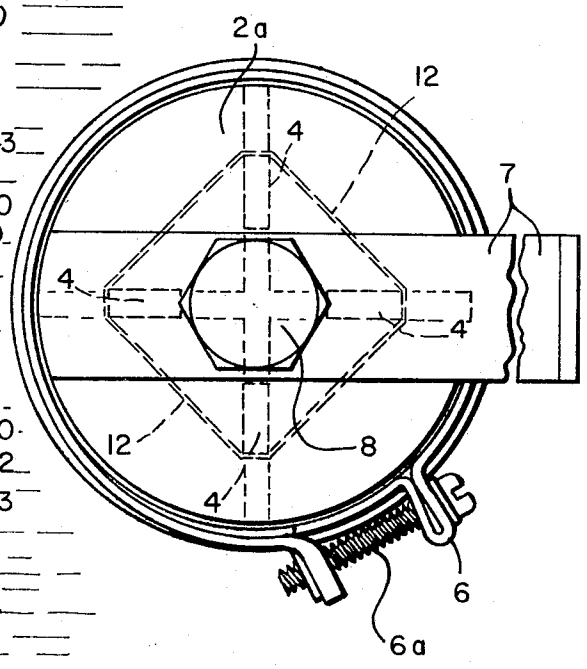


FIG. 3

FLUID-TIGHT ELECTRIC FUSE

BACKGROUND OF THE INVENTION

There is a long-felt need for fluid-tight fuses, and there are a number of prior art fuses attempting to fill that need. One of the means which is widely used to make fuses fluid-tight, e.g. to allow the installation thereof in damp vaults, is the provision of so-called boots formed of two parts of an elastomeric material which overlap in the median region of the fuse and form bushinglike extensions situated at the ends of the fuse remote from said median region for receiving the terminals of the fuse, or outgoing lines, respectively. Such boots are relatively expensive and the installation thereof is also relatively expensive. Another way of rendering electric fuses fluid-tight involving a single unitary fluid-tightening layer is disclosed in U.S. Pat. No. 2,681,398 to F. J. Kozacka, et al, June 15, 1954 for FLUID-TIGHT FUSE STRUCTURE. The cost of manufacturing fluid-tight fuses as disclosed in the above patent is also relatively high. Instead of achieving fluid-tightness by mounting sleeve-like means on non-fluid-tight fuses, fuses can be manufactured which are inherently fluid-tight and, therefore, do not call for additional sleeve-like means to achieve fluid-tightness. The cost of manufacturing fuses which are inherently fluid-tight are relatively high, and preclude the use of certain materials and design features which are highly desirable. Fuses which are not fluid-tight are sometimes enclosed in fluid-tight housings for installation in damp locations, which greatly increases the bulk and the cost of any such installation. Non-fluid-tight fuses intended for the protection of transformers have been installed in fluid-tight housings submersed in the fluid, e.g., oil, inside the tank of the transformer. Such arrangements are not only relatively expensive and bulky, but ineffective inasmuch as the fluid inside the transformer tank is not, or is not efficiently, used for cooling of the fuses.

It will be apparent from the above that though many solutions have been offered to achieve fluid-tightness of fuses, all prior art solutions to the problem under consideration are subject to limitations, and drawbacks.

New possibilities of achieving fluid-tightness of miscellaneous electric equipment, including electric fuses, became apparent with the advent of heat-shrinkable organic substances which are good electric insulators and can be shrunk under stress around various pieces of electric equipment. One such substance is, for instance, cross-linked polyolefin. There are many other well known appropriate heat-shrinkable substances whose molecules have been cross-linked by high-energy beam radiation.

The present invention is predicated on the use of cross-linked heat-shrinkable and heat-shrunk sleeves, and greatly improves prior art technology developed along such lines.

SUMMARY OF THE INVENTION

Electric fuses embodying this invention have plug terminals closing the cylindrical casing thereof and are enclosed in a fluid-tight single piece sleeve of a heat-shrinkable and heat-shrunk substance under stress. The plug terminals have cylindrical coaxial extensions integral with said plug terminals projecting axially beyond the casing of the fuse to the outside of said casing. These extensions have an outer diameter substantially equal to the inner diameter of the casing of the fuse so that the extent of shrinkage required to mount said sleeve tightly on said casing and to mount said sleeve tightly on said extensions is substantially equal. Fuses embodying this invention further include annular metal clamps having adjustment screws or clamping screws for varying the extent of the periphery thereof. These annular metal clamps are mounted on the aforementioned extensions of the terminal plugs and on portions of said sleeve overlapping said extensions and clamp said overlapping portions of said sleeve against said extensions.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** shows a first embodyment of the invention partly in front elevation and partly in longitudinal section;

FIG. **2** shows in the same way as FIG. **1** a modification of the structure of FIG. **1**; and

FIG. **3** is a top plan view of structures of the kind shown in FIGS. **1** and **2.**

DESCRIPTION OF PREFERRED EMBODIMENTS

Referring now to the drawings, fuses of the kind illustrated therein are disclosed more in detail in U.S. Pat. No. 3,599,138 to Frederick J. Kozacka, issued Aug. 10, 1971 for HIGH-VOLTAGE FUSE. Reference may be had to that patent in regard to details involving such fuses, but having no immediate bearing on the present invention.

FIGS. **1** and **2** illustrate the upper portion and the lower portion of a fuse structure for elevated circuit voltages, its center portion or median portion being broken away, or deleted.

The fuses shown include a tubular cylindrical casing **1** of electric insulating material, e.g., melamine glass-cloth. The ends of casing **1** are closed by cylindrical plug terminals **2** press-fitted into casing **1** and firmly held in position by steel pins **3** projecting transversely or radially through casing **1** into plug terminals **2.** Plug terminals **2** are spaced by four spacing plates **4** of electric insulating material. The axially outer ends of plates **4** are affixed to plug terminals **2** as, for instance, by means of grooves provided in the axially inner end surfaces of plug terminals **2.** This is shown in in detail in the above referred-to U.S. Pat. No. 3,599,138. A fusible element **12** in form of a silver ribbon is wound helically around the radially outer edges of spacing plates **4.** The ends of fusible element **12** are conductively connected to the axially inner end surfaces of plug terminals **2.** This may be achieved by the means more fully disclosed in U.S. Pat. No. 3,571,775 to F. J. Kozacka, et al, Mar. 23, 1971 for HIGH-VOLTAGE FUSE HAVING A PLURALITY OF HELICALLY WOUND RIBBON LINKS. Casing **1** is filled with a pulverulent arc-quenching filler **10,** e.g., quartz sand, engaging physically casing **1** and the axially inner surfaces of plug terminals **2.** Each plug terminal **2** is provided with a coaxial extension **2a** projecting axially beyond casing **1.** The outer diameter of extensions **2a** is substantially equal to the inner diameter of casing **1** so that the extent of shrinkage required to mount heat-shrinkable sleeve **5** tightly on casing **1** and to mount said sleeve tightly on extensions **2*a*** of plug terminals **2** is substantially equal. As shown in FIG. **1** the diameters of exten-

sions 2*a* and of plug terminals 2 proper are equal, and equal to the inner diameter of casing 1. According to FIG. 2 the diameter of extensions 2*a* is slightly less than the diameter of plug terminals 2 and the inner diameter of casing 1. Reference numeral 6 has been applied to indicate a pair of metal clamps having adjustment or clamping screws 6*a* for varying the extent of the periphery thereof. Such metal clamps are often referred-to as hose clamps since they are widely used for clamping hoses to pipes. Clamps 6 are mounted on extensions 2*a* and on portions of sleeve 5 overlapping extensions 2*a* and clamp said portions of sleeves 5 against extensions 2*a*. Clamps 6 are arranged in such a way that the axially outer edges of sleeve 5 are covered and protected by the former. This precludes tearing of sleeves 5 at their edge regions and makes it unnecessary to use wound tape generally used in like situations as, for instance, for closing the axially outer ends of so-called boots.

The axial length of extensions 2*a* and the width of annular metal clamps 6 are substantially equal. As a result of this configuration of parts 2*a* and 6, the lateral surfaces of extensions 2*a* are substantially unexposed. The axial end surfaces of extensions 2*a* are exposed and form contact surfaces allowing insertion of the fuse into an electric circuit by means of the exposed end surfaces of extensions 2*a*. FIGS. 1 and 3 show a pair of metal straps 7 screwed by means of screws 8 against the exposed end surfaces of extensions 2*a*. This arrangement of parts is less expensive and not as bulky as connecting an electric fuse into an electric circuit by means of ferrules which engage a fuse holder.

The particular kind of heat-shrinkable material used for achieving fluid-tightness depends very much upon the intended application. Where resistance to mechanical action is of importance, the thickness of the sleeve 5 ought to be relatively large. This can be achieved because the degree of required shrinkage is substantially uniform along the entire length of sleeve 5. Mechanical strength can also be enhanced by using a heat-shrinkable substance having an insert of glass-cloth. In instances where mechanical ruggedness is a lesser consideration than maximizing heat transfer between the fuse and a surrounding liquid medium the thickness of sleeve 5 ought to be as small as possible.

FIG. 2 shows a fuse embodying this invention submersed in a body 9 of cooling liquid. Sleeve 5 is shrunk so as to engage the annular planar areas A situated between the lateral surface of casing 1 and the lateral surfaces of extensions 2*a*. Such a close fit cannot be achieved if the diameter of extensions 2*a* is significantly less than the diameter of plug terminals 2.

The clamp 6 may be arranged in such a way that screw 6*a* may assume any desired angular position. In FIG. 1 the upper clamp 6 is shown with its clamping screw 6a and the lower clamp 6 without its clamping screw, the latter being sectioned away. FIG. 2 shows the upper clamp 6 and the lower clamp 6 without their respective clamping screws, these screws being sectioned away in FIG. 2. FIG. 3 has been drawn assuming that both the upper clamp 6 and the lower clamp 6 and their respective clamping screws 6a are arranged in registry.

We claim as our invention:

1. An electric fuse including a cylindrical casing of electric insulating material, a pulverulent arc-quenching filler inside of and in engagement with said casing, metallic plug terminals having an outer diameter equal to the inner diameter of said casing plugging the ends of said casing, fusible element means inside said casing immersed in said pulverulent arc-quenching filler conductively interconnecting said pair of plug terminals and a fluid-tight single piece sleeve of heat-shrinkable and heat-shrunk substance mounted under stress upon said casing wherein the improvement comprises

a. cylindrical coaxial extensions on and integral with said plug terminals projecting axially beyond said casing to the outside of said casing, said extensions having an outer diameter substantially equal to the inner diameter of said casing so that the extent of shrinkage required to mount said sleeve tightly on said casing and to mount said sleeve tightly on said extensions is substantially equal; and

b. annular metal clamps having adjustment screws for varying the extent of the periphery thereof mounted on said extensions and on portions of said sleeve extending beyond said casing and overlapping said extensions, said annular metal clamps clamping said portions of said sleeve against said extensions.

2. An electric fuse as specified in claim 1 wherein the diameter of said extensions is equal to the inner diameter of said casing so that said plug terminals and said extensions thereof have lateral surfaces which are a continuous cylindrical surface.

3. An electric fuse as specified in claim 1 wherein the axially outer edges of said sleeve are covered and protected by said annular metal clamps.

4. An electric fuse as specified in claim 1 wherein the axial length of each of said extensions and the width of each of said annular metal clamps are substantially equal so that the lateral surfaces of said extensions are substantially unexposed and wherein the axial end surfaces of said extensions are exposed and form contact surfaces allowing insertion of said fuse into an electric circuit by means of said exposed end surfaces of said extensions.

5. An electric fuse as specified in claim 1 being submersed in a body of liquid and having a sleeve shrunk so as to engage tightly the planar annular areas situated between the lateral surface of said casing and the lateral surfaces of said extensions.

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