(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) Publication number: **0 300 654 A2**

(12) EUROPEAN PATENT APPLICATION

(21) Application number: 88306279.6

(22) Date of filing: 08.07.88

(51) Int. Cl.4: H01H 85/10 , H01H 85/18 , H01H 69/02 , H01K 1/66

(30) Priority: 24.07.87 GB 8717579

(43) Date of publication of application: 25.01.89 Bulletin 89/04

(84) Designated Contracting States: BE DE ES FR IT SE

(71) Applicant: THE GENERAL ELECTRIC COMPANY, p.l.c.
1 Stanhope Gate
London W1A 1EH(GB)

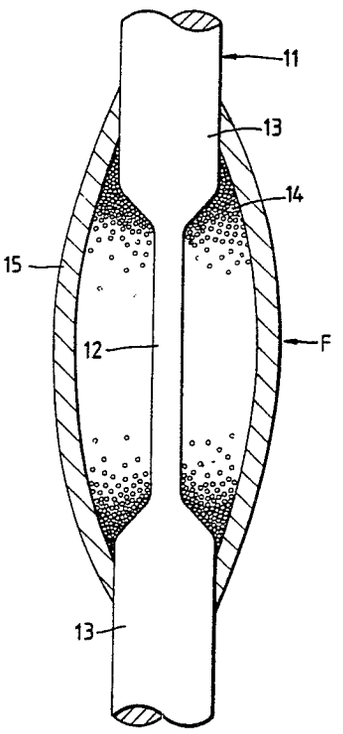
(72) Inventor: Wyman, Patrick Roy
47 Elmcroft Crescent
North Harrow Middlesex HA2 6HL(GB)

(74) Representative: Maury, Richard Philip
The General Electric Company, p.l.c. Patent Department (Wembley Office) Hirst Research Centre East Lane
Wembley Middlesex HA9 7PP(GB)

(54) Protective electric fuses.

(57) An electric fuse, mainly for an incandescent lamp comprising a length of readily fusible electrically conducting material formed with at least one region of reduced cross-section between adjoining regions of larger cross-section, and having around the smaller cross-section region a quantity of electrically insulating material in the form of grains adhering to each other and covered by a protecting coating.

Fig. 2.



EP 0 300 654 A2

Protective Electric Fuses

This invention relates to protective electric fuses, that is to say devices of the kind comprising a member of readily fusible electrically conducting material which is arranged to be connected in series with the circuit to be protected and, on the passage of excessive current, is arranged to melt and thereby interrupt the current path.

The invention is more especially, though not exclusively, concerned with such fuses which are incorporated within electric incandescent lamps.

According to the invention, in a protective electric fuse of the kind referred to the fusible member is formed with at least one region of relatively smaller cross-section between two regions of relatively larger cross-section, and the fuse incorporates a quantity of electrically insulating material in the form of grains adhering to each other around the or each region of smaller cross-section, and covered by a protective coating.

On the passage of an excess current, as by the occurrence of a short circuit, the fuse will overheat and rupture at a region of smaller cross-section because of the greater current density at that region.

The granular material serves to provide a large surface area to cool the hot metal vapour evolved on rupturing the fuse, provides that the metal film formed by condensation of the metal vapour is not continuous from end to end and conveniently comprises or contains a substance which, when heated by the arc which is formed when the fuse operates, liberates an electro-negative gas, such as fluorine. Calcium fluoride is one such material.

The protective coating serves, not only to protect the volume of granular material from physical damage, but also to retain the hot gases and plasma formed in the course of fuse operation. Preferably therefore the coating extends beyond the granular material into contact with the surfaces of the regions of the fusible material of relatively larger cross-section. In such a case it is desirable to arrange for, or to compensate for the lack of, an expansion match between the materials of the coating and the fusible member. Suitable materials for the coating may be vitreous, for example similar to those used for coating wire-wound resistors.

Fuses in accordance with the invention have the advantage that they can readily be fabricated by a continuous manufacturing process. For example in one such process a series of waisted regions are formed along a continuous length of said readily fusible material, initially having a cross-section equivalent to that of said regions of larger cross-section, each of the waisted regions is coated with an appropriate quantity of the granular material, each deposit of granular material is covered by said protective coating, and the continuous length of fusible material separated into individual fuses.

Conveniently the fusible member is in wire form. Apart from mechanical methods, such as drawing, swageing, pressing and ring-rolling, there are chemical and electrochemicals techniques which can usefully be employed to form the waisted regions. For example the member may be in the form of a Wollaston wire which has a central core of a chemically resistant alloy surrounded by a layer of a metal or alloy which can readily be dissolved in an etching bath. The parts of the wire which are intended to remain at the full diameter are provided with a protective coating, such as a lacquer, which may be applied by any suitable technique, and following the etching away of the coating in the intervening region the lacquer is removed, the process being completed by the application of the granular material and protective coatings to the waisted regions, and the separation of the assembly into individual fuses.

The end regions of the fusible member should be of sufficiently large cross-section that they do not melt under any conditions of the fuse's operation, including short-circuit current clearance, and should also be sufficiently strong to support the weight of the fuse and any electromagnetic forces produced. They should also be readily connectable into the circuit to be protected, as well as playing a useful part in conducting away the heat dissipated under normal load current in the thinner intervening part of the member.

The dimensions of the region of smaller cross-section will be determined mainly by the required operating characteristic of operating time versus current, and by the length of arc column which is required to introduce impedance into the circuit. The region need not, however, be of uniform cross-section along its length, as certain kinds of non-uniformity can provide useful characteristics, such as causing multiple arcs to form in series, so yielding an increased voltage drop.

Fuses in accordance with the invention are especially suited for incorporated into electric incandescent lamps.

The fabrication of the fuses by a continuous technique significantly reduces the cost of manufacture, compared with that required to produce existing types of fuses employed for such a purpose.

One fuse in accordance with the invention for use in an electric incandescent lamp will now be described by way of example with reference to Figures 1 and 2 of the accompanying drawing, in

which

Figure 1 shows a sectional view of a lamp incorporating the fuse, and

Figure 2 illustrates an enlarged sectional view of the fuse itself.

Referring to Figure 1, this shows part of the envelope 1 of an electric incandescent lamp, closed in the usual manner by a pinched foot tube 2 through which are sealed a pair of conductors 3, 4, these being connected internally to the lamp filament 5.

The lamp is fitted with a cap 6, and one of the conductors 3 extends through an insulating filler 10 closing the base of the cap and is secured externally by a solder deposit 7 which provides one of the lamp contacts. The other conductor 4 is connected, as by clamping, to one end of a fuse F constructed in accordance with the invention, the other end of the fuse being similarly connected to a further length of wire 8 which extends through the insulating filler 10 and is secured by a further deposit of solder 9 which forms the second lamp contact.

The fuse, which is shown in greatly enlarged form in Figure 2, comprises a length of wire 11 of a suitable metal or alloy having a waisted central portion 12 between two thicker end portions 13. A volume of a non-electrically-conducting granular material 14 is packed around the wire 11 so as to completely enclose the waisted portion 12. The surfaces of the particles are such that where they touch they adhere. The adhesion may be of the kind that is promoted by one of various outside influences, such as heat, ionising radiation or ultraviolet light.

On the passage of excessive current, as may be caused by a short circuit, the wire will melt at the waisted portion which is surrounded by the particulate material.

The particles of the latter are conveniently formed of calcium fluoride which will liberate fluorine when heated by the arc produced following the rupturing of the fuse wire, the fluorine being an electro-negative gas which reduces the ionisation of the arc plasma and rapidly extinguishes the arc. Other materials which liberate an electro-negative gas when heated may, however, be used.

The fuse is completed by a gas-impermeable coating 15 which completely encompasses the particulate material and extends beyond it into contact with the surfaces of the end portions 13 of the fuse wire 11. The coating, which is conveniently of a vitreous material as commonly used for coating wire-wound resistors, serves to protect the particulate material and to contain the hot gases and plasma formed in the course of the fuse operation.

Fuses as above described can conveniently be formed by a continous process, a length of wire, initially of a diameter corresponding to that of the end portions 13, has a series of waisted portions 12 formed in it, each of the waisted portions being coated with an appropriate quantity of the particulate material 14 which is then surrounded by the coating 15, the wire then being separated into the individual fuses. The wire conveniently comprises a form of Wollaston wire which has a central core of chemically resistant material surrounded by a layer of material which can readily be dissolved by an etching fluid. The parts of the wire which are intended to remain at full diameter are initially coated with a protective lacquer, which may be applied where needed by an electronically controlled sprayer. Following the removal of the unprotected regions of the outer layer the lacquer is removed, the intervening waisted portions are coated with the calcium fluoride particles and the protective coatings, and the continuous length of wire separated into individual fuse elements.

Although a fuse of the form above described is particularly suitable for use in electric incandescent lamps, it could also be used to advantage on printed circuit boards, and, with the addition of suitable connecting means, for general use.

Claims

1. A protective electric fuse of the kind referred to wherein the fusible member is formed with at least one region of relatively smaller cross-section between two regions of relatively larger cross-section, and the fuse incorporates a quantity of electrically insulating material in the form of grains adhering to each other around the or each region of small cross-section, and covered by a protective coating.

2. A protective electric fuse according to Claim 1 wherein the granular material comprises or contains a substance which, when heated by the arc which is formed when the fuse operates, liberates an electro-negative gas.

3. A protective electric fuse according to Claim 2 wherein the granular material comprises or contains a substance which, when heated by the arc which is formed when the fuse operates, liberates fluorine.

4. A protective fuse according to Claim 3 wherein the granular material comprises or contains calcium fluoride.

5. A protective electric fuse according to any preceding Claim wherein the protective coating extends beyond the granular material at each end into contact with the respective region of the fusible material of relatively larger cross-section.

6. A protective electric fuse according to any preceding Claim wherein the cross-section of the region of relatively smaller cross section is not uniform along its length.

7. A protective electric fuse according to any preceding Claim incorporated in an electric incandescent lamp.

8. A method of manufacturing a fuse in accordance with any preceding Claim comprising the steps of forming a series of waisted regions along a continuous length of said readily fusible material initially having a cross-section equivalent to that of said regions of larger cross-section, coating each of said waisted regions with a quantity of said granular material, covering each said deposit of granular material with said protective coating and separating the continuous length of fusible material into individual fuses.

9. A method according to Claim 9 wherein the fusible member is in the form of wire and the waisted regions are formed by a mechanical, chemical or electrochemical technique.

10. A method according to Claim 10 wherein the fusible material is in the form of Wollaston wire, and the method includes the steps of coating the parts of the wire which are to form said regions of larger cross-section with a protective covering, dissolving away the outer layer of the wire between said coated regions by etching, to form said waisted region, removing the protective covering, applying said granular material and protective coatings to the waisted regions, and separating the assembly into individual fuses.

Fig. 1.

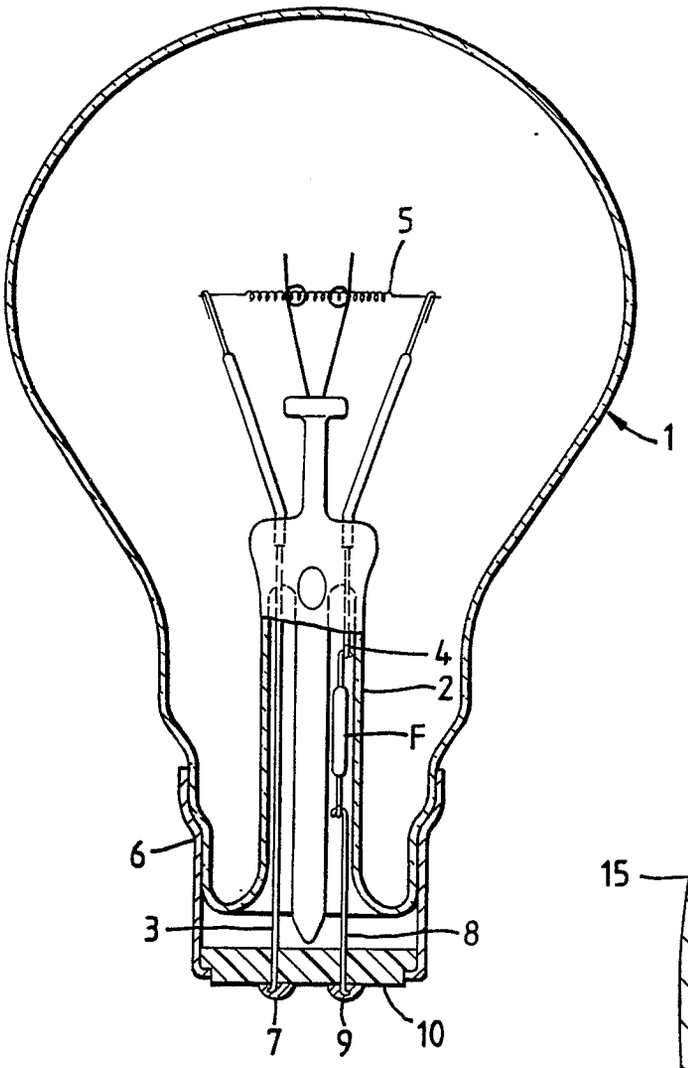


Fig. 2.