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FUSE

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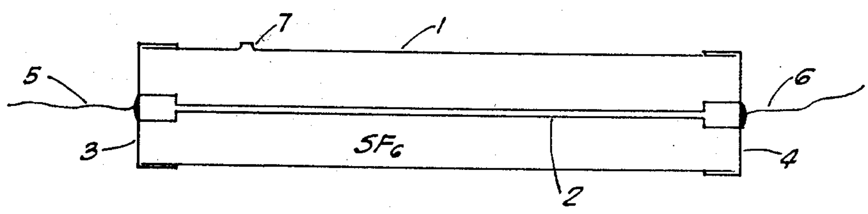

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FUSE

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6 Claims. (Cl. 200—120)

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My invention relates to electric fuses and the like.

It has come to be generally recognized, in the field of protective systems for preventing excess current flow, that one of the most simple and reliable indications of excess current is the liberation of heat. The use of fusible links in electric circuits for the purpose of protecting the circuits has, therefore, become of general practice, and is one of the accepted methods of preventing excess current flow.

Fusible links are generally satisfactory for circuit protection where the current or power is not relatively great, or where an exceptionally rapid break is not essential. However, it is generally necessary to employ protective means other than fusible links when the voltage, power or current is large, or when an exceptionally rapid break is necessary. For example, where very delicate electrical instruments are being protected a substantially instantaneous break is necessary to prevent serious damage thereto. Fusible links do not provide this rapid break since there is a tendency for an arc to form between the ends of the broken link resulting in a flow of current across the break and through the fuse until either the voltage drops to a level too low to support the arc, or until the gap becomes too wide for the arc to continue under the existing voltage conditions. This naturally results in a delayed interruption of the current with possible damage to the electric equipment the fuse was supposed to protect, the amount of delay being a function of the voltage, power or current being employed.

The formation of the arc between the broken ends of the fusible link is due primarily to the existence, during the occurrence of and immediately after the break, of metal vapor around the fusing metal and within the gap formed. This metal vapor permits the arc to form and helps maintain the arc with the result that a substantial current flow continues through the fuse link, despite the break, as long as the arc exists.

Fusible links are generally used in preference to other types of protective devices whenever it is possible to use such links satisfactorily. The reason for this is that the design of protective devices, depending on fusible links for their operation, is simple as compared with the design of other types of protective devices. This results in fuses being less expensive to manufacture than other types of protective devices and permits the manufacture of fuses of relatively small size as compared to other protective devices. This later feature becomes of prime importance in the design of electric equipment where space is an important factor.

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Despite these obvious advantages of electric fuses over other types of protective devices, it has frequently been impractical to employ electric fuses due to the danger of the current arcing over the break formed when the fuse blows with resulting damage to equipment.

I have now discovered that if the link of fusible material is enveloped in an atmosphere of sulfur hexafluoride under a pressure of preferably not less than 35 pounds per square inch absolute, the possibility of arc formation between the broken ends of the fuse is considerably reduced and any arc formed is rapidly extinguished, the rate at which the arc is extinguished being considerably more rapid than when the atmosphere surrounding the fuse is air alone. The fusible element may be formed of any of the conventional fusible alloys used for forming fuse elements such as the alloy having the composition of 53% bismuth, 32% lead, and 15% tin with a melting point of 96° C.; or the alloy having the composition of 20% bismuth and 80% tin with a melting point of 200° C.

As a result of surrounding the fusible element with an atmosphere of sulfur hexafluoride under pressure, a quick acting fuse is obtained which can be used to rapidly and safely break currents in circuits where the voltage, power or current are substantially higher than that possible with conventional air filled fuses. Also, a quicker acting fuse is obtained.

It is thought that reasons probably contributing to the excellent results obtained are: that sulfur hexafluoride is a good dielectric which in and of itself would tend to minimize arc formation; but more important, that sulfur hexafluoride reacts rapidly with the heated metal at the break, forming compounds which are non-conducting and relatively stable with respect to ionization, thus inhibiting the formation of metal vapor within the fused gap. This would seem to be substantiated by the observed fact that when circuit breakers are operated in an atmosphere of sulfur hexafluoride, a non-conducting coating is rapidly formed on the contacts preventing resumption of the electric current when the circuit breaker is again closed.

In the attached drawing 1 is a container made of a relatively non-conducting gas impervious material such as glass, in which there is positioned a fusible link 2 extending through the container and terminating in the caps 3 and 4 used to seal the container ends. The caps 3 and 4 may be made of a conducting material, or electric leads 5 and 6 may be connected to the ends of the fuse element 2 and provide the necessary contacts whereby the fuse may be connected into the electric circuits which it is to protect. The atmosphere within the container 1 consists of sulfur hexafluoride at a pressure of between 35 and 200 pounds per square inch absolute, the container having been charged through an inlet 7 which is afterwards sealed to the atmosphere.

It is apparent that the type of structure of the fuse device is not essential to the practice of my invention since it is only necessary that the container, in which the fusible element is placed, be sufficiently strong and impervious to gases to permit its being filled in whole or in part with sulfur hexafluoride preferably at total gas pressures in excess of 35 pounds per square inch absolute. Furthermore, it is apparent that small quantities of other gases may be present together with the sulfur hexafluoride without departing from the scope of the invention, it being understood that the term "sulfur hexafluoride" or "atmosphere of sulfur hexafluoride" as used in the specification and claims include pure sulfur hexafluoride together with such mixtures of sulfur hexafluoride and other gases.

Having thus described my invention, I claim:

1. In a fuse device, the combination of a container filled with sulfur hexafluoride and a fusible link within said container.

2. In a fuse device, the combination comprising a container filled with sulfur hexafluoride under pressure and a fusible link within said container.

3. In a protective device for electric circuits a container, a fusible link within said container, said link being surrounded by an atmosphere of sulfur hexafluoride under a pressure of at least 35 pounds per square inch absolute.

4. In a protective device for electric circuits a container, a fusible link within said container, said link being surrounded by an atmosphere of sulfur hexafluoride under a pressure of 35 to 200 pounds per square inch absolute.

5. A fuse device comprising a container formed of insulating material, an electric conducting path extending through said container a portion of which path consists of a fusible link, said fusible link being surrounded by an atmosphere of sulfur hexafluoride under a pressure of not less than 35 pounds per square inch absolute.

6. In a fuse device, a container formed of a material which is substantially non-conducting to electricity, terminals extending from said container formed from a material which is a relatively good electric conductor, a link of fusible material within said container electrically connected to said terminals so as to permit current passage from one terminal through said link to the other terminal, and an atmosphere of sulfur hexafluoride surrounding said link of fusible material within said container, said sulfur hexafluoride being under a pressure of from 35 to 200 pounds per square inch absolute.

HENRY C. MILLER.

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