

HIGH BREAKING CAPACITY MICRO-FUSE

The present invention relates to a component for
5 protecting components connected to an electric circuit
against burning that may occur when abnormal overcurrent
flows through the electric circuit.

Recently, there have been strong demands for the
miniaturization of the electronic apparatus. In order to
10 meet these demands, the length of wiring of a circuit on a
printed board tends to be decreased with charging sections
having opposite polarities tending to be placed in nearer
proximity to each other as well. Due to this, when compared
with a case in which a conventional printed circuit board is
15 used, a greater magnitude of abnormal current tends to flow
once an accident of short-circuit occurs.

In order to cope with this, smaller circuit protect-
ing components also have been demanded, and the distance
between terminals of such smaller circuit protecting
20 components has been decreased. In cutting off abnormal
current, there is a close relationship between the oc-
currence of arc discharge and the magnitude of abnormal
current and/or the distance between the terminals. The
greater the magnitude of abnormal current becomes, or the
25 smaller the distance between the terminals becomes, the
more easily longer arc discharge occurs. Arc discharge
generates heat having a high temperature of several
thousands centigrade degrees, and due to this there is
a risk of circuit protecting components themselves being

burnt. Thus, cutting off current becomes more and more difficult when trying to satisfy the demands for the miniaturization of circuit protecting components.

5 The present invention relates to a high breaking capacity fuse that is smaller, and which has a higher breaking capacity performance so that the above problem can be dealt with.

10 Conventionally, a fuse of this type is well known in which an arc-extinguishing material is packed around a fusible element so as to extinguish a high-temperature arc that is generated after the fusible element has been fused by abnormal current.

15 In the fuse described above, since the arc-extinguishing material is brought into direct contact with the fusible element, the arc-extinguishing material abrades or cuts into the surface of the fusible element, and thereby the fusible element is damaged. Thus, the fuse of this type has a drawback in that it mechanically
20 breaks down due to the damage so caused. In addition, when the fusible element is fused by a great magnitude of current, the complete dispersion of metal vapors rising from the fused fusible element is prevented by the arc-extinguishing material surrounding the fusible
25 element, preventing the creation of wide spaces between metal particles, and resulting in poor insulation. Thus, there is the risk of an arc discharge being caused again. Moreover, it is a very difficult operation to pack a particulate arc-extinguishing material, which deteriorates

the productivity of fuses of the type, into a small fuse's main body.

The present invention was made in view of the above drawback inherent in the prior art. So, the object thereof is to provide a reliable high breaking micro-fuse capable of securely breaking a great magnitude of current, as well as of maintaining a fusible element, used therein, free from damages when in proper operation.

According to our invention, a high breaking capacity micro-fuse comprises

an insulating body having a wall of heat and electrically insulative material defining a cavity in the body;

- a pair of electrically conductive terminals extending into said cavity through the wall of said body to respective ends of the terminals, said ends of the terminals being spaced from one another in said cavity;

a fusible element extending between said terminals, one end of said fusible element being mechanically connected to one of said terminals in an electrically conductive relation therewith, and the other end of said fusible element being mechanically connected to the other of said terminals in an electrically conductive relation therewith; and

an insulating member of heat and electrically insulative material discrete from said insulating body and disposed in said cavity thereof, said insulating member having an outer surface and defining a hole extending therethrough so as to be open at two locations on said outer surface, a relatively small part of the outer surface of said insulating member contacting the wall of said insulating body in a manner which fixes said insulating member in said cavity, a

remaining relatively large part of the outer surface of said insulating member being spaced from said insulating body with a vacant space being left between said insulating body and the remaining relatively large part of the outer surface of said insulating member, and said fusible element extending through the hole in said insulating member, whereby when said fusible element is fused, vapors emanating therefrom are dispersed over an inner surface of the wall of said insulating body defining said cavity, said relatively large part of the outer surface of said insulating member, and an inner surface of said insulating member that defines said hole through which said fusible element extends.

As a result the deposition density of metal vapors to the respective surfaces of the body and the insulating member is reduced. This makes it possible to improve insulation resistance.

Fig. 1 is a perspective view of a fuse of the present invention before assembly;

Fig. 2 is a perspective view of the same fuse in which components have been incorporated;

Fig. 3 is a perspective view of the fuse of the present invention which has been completely assembled;

Fig. 4 is a longitudinal sectional view of the fuse of the present invention; and

Fig. 5 is a cross-sectional view taken along the line A-A' of Fig. 4.

Referring to the drawings, a preferred embodiment of the present invention will be described.

In Figs. 1 to 5, a fuse's main body 1 is formed from a heat-resistant insulating material, such as ceramic, by embossing and baking the same material into a rectangular parallelepiped-shaped box which is 2 to 3mm wide, 7 to 8 mm

long, and 2 to 3 mm high with the thickness of the material ranging from 0.5 to 1 mm.

Particularly speaking, slots are formed in longitudinal ends of the box 1 so as to allow terminals 3, 4 to extend outwardly from the box 1. A fusible element 6 is fixed between these terminals 3, 4 inside the box 1, and the terminals 3, 4 are electrically connected to electric circuits outside the box 1, respectively.

Partition walls 10, 11 are provided internally at the longitudinal ends of the box so as to prevent the inward movement of the terminals 3, 4, as well as movement of a cylindrical tube 2 provided in the box.

Solder-plated copper is used for the terminals 3, 4 and is press formed into a T-shaped lead wire, so as to prevent the withdrawal of the lead wire longitudinally of the main body 1 once a T-shaped end thereof is placed in the box-shaped main body 1. A heat-resistant insulating material such as ceramic is used for the cylindrical tube 2, and this material is embossed and baked, so as to be formed into a cylindrical tube having an outside diameter of 1 mm and an inside diameter of 0.5 mm, and as shown in Fig. 2, where this cylindrical tube 2 has a length allowing itself to just fit in the inside of the box-shaped main body 1 after the fusible element 6 has been put therethrough.

The fusible element 6 is fixed to the terminals 3, 4 at the ends thereof, respectively, by soldering 8, 9. Afterward, a lid 7, made from the same material as that of the box-shaped main body 1, is placed on the top of the box-shaped main body 1 so as to close by sealing the upper

opening thereof, whereby a micro-fuse having an external appearance as shown in Fig. 3 is completed.

Thus, as can be seen in Fig. 5, the cross sectional shape of a cavity formed by the box-shaped main body 1 and the lid 7 placed thereon is rectangular, and spaces 12, 13, 14 and 15 are formed between the inner wall surface of the box-shaped main body 1, including the lid 7, and the outer surface of the cylindrical tube 2.

Even in the high breaking capacity micro-fuse as mentioned above, which has a simple construction in which the cylindrical tube with the fusible element extending therethrough is inserted in the box-shaped main body, it is possible to attain superior insulation resistance by allowing metal vapors to be dispersed into spaces 12, 13, 14 and 15 and to be absorbed by the inner wall surfaces of the box-shaped main body 1 and the lid 7, and the outer and inner surfaces of the cylindrical tube 2. It is also possible to obtain a performance good enough to securely break a great magnitude of current by means of an additional simple component such as a cylindrical tube 2 and simple assembling thereof. Moreover, there is no material surrounding the fusible element 6 in the cylindrical tube such as an arc-extinguishing material, and therefore the fusible element 6 is made free from restraint that would be imposed when an arc-extinguishing material is used. In addition, the surface of the fusible element 6 is also prevented from being abraded and damaged, whereby any mechanical breakage is prevented, thereby making it possible to obtain a highly reliable fuse.

A comparison test, between the high breaking capacity microfuse according to the present invention and a conventional fuse using an arc-extinguishing material, was carried out. With the high breaking capacity micro-fuse of the present invention, a proper current breaking operation was performed without any difficulty under the short-circuit breaking test condition voltage of 125 V, short-circuit current of 50 A and power factor of 0.7 which are stipulated under the overcurrent protection fuse standards UL198G, and showed the short-circuit breaking capacity performance similar to that of the fuse in which an arc-extinguishing material is used. Moreover, in a repeated overcurrent test, in which an exciting current equal to the rated current is repeatedly switched on and off for one second in an alternate fashion, the conventional fuse in which an arc-extinguishing material is used was fused after it had been switched on and off eight hundred and fifty-two times, while the high breaking capacity fuse of the present invention managed to endure the repeated energizations of ten thousands times, without fusing.

As is clear from the above description, the high breaking capacity fuse according to the present invention has a superior performance.

It should be noted that in order to form a space or spaces between the inner wall surface of the main body 1 and the lid 7, and the outer surface of the tube 2, the cross sectional shape of a cavity formed by the main body 1 and the lid 7 placed on the top of the main body 1, and the cross sectional outer surface shape of the tube 2 may be

various types of shapes, respectively. Moreover, it should be noted that the cylindrical tube 2 may consist of a plurality of cylindrical tubes which are disposed in series in the inside of the main body 1.

The present invention has been described in detail with reference to a certain embodiment thereof, but it will be understood that various and modifications can be effected within the scope of the invention.

CLAIMS

1. A high breaking capacity micro-fuse comprising:

an insulating body having a wall of heat and electrically insulative material defining a cavity in the body;

a pair of electrically conductive terminals extending into said cavity through the wall of said body to respective ends of the terminals, said ends of the terminals being spaced from one another in said cavity;

a fusible element extending between said terminals, one end of said fusible element being mechanically connected to one of said terminals in an electrically conductive relation therewith, and the other end of said fusible element being mechanically connected to the other of said terminals in an electrically conductive relation therewith; and

an insulating member of heat and electrically insulative material discrete from said insulating body and disposed in said cavity thereof, said insulating member having an outer surface and defining a hole extending therethrough so as to be open at two locations on said outer surface, a relatively small part of the outer surface of said insulating member contacting the wall of said insulating body in a manner which fixes said insulating member in said cavity, a remaining relatively large part of the outer surface of said insulating member being spaced from said insulating body with a vacant space being left between said insulating body and the remaining relatively large part of the outer surface of said insulating member, and said fusible element extending through the hole in said insulating member, whereby when said fusible element is fused, vapors emanating therefrom are dispersed over an inner surface of the wall of said



insulating body defining said cavity, said relatively large part of the outer surface of said insulating member, and an inner surface of said insulating member that defines said hole through which said fusible element extends.

2. A high breaking capacity micro-fuse as claimed in claim 1, characterised in that said body and said member are made of ceramic material.

3. A high breaking capacity micro-fuse as claimed in claim 1, characterised in that

said body comprises a box-shaped main body having a recess, and a cover covering said recess;

said pair of terminals being provided at longitudinal ends of said box-shaped main body,

said recess of said box-shaped main body having a rectangular shape in a cross section of said main body; and

said insulating member being a cylindrical tube.

4. A high breaking capacity micro-fuse as claimed in claim 3, characterised in that said box-shaped main body, said cover and said insulating member are made of ceramic material.

5. A high breaking capacity micro-fuse as claimed in claim 3, characterised in that said insulating member consists of a plurality of cylindrical tubes which are disposed in series in said recess of said box-shaped main body.

6. A high breaking capacity micro-fuse as claimed in claim 3, characterised in that partition walls are provided internally at the longitudinal end portions of said box-shaped main body so as to prevent the movement



of said insulating member in a longitudinal direction of said box-shaped main body.

7. A high breaking capacity micro-fuse substantially as described herein with reference to and as illustrated in the accompanying drawings.
