April 26, 1938. K. UTSUNOMIYA 2,115,436

ELECTRIC ARC BREAKER

Filed Aug. 19, 1935

Fig. 1.

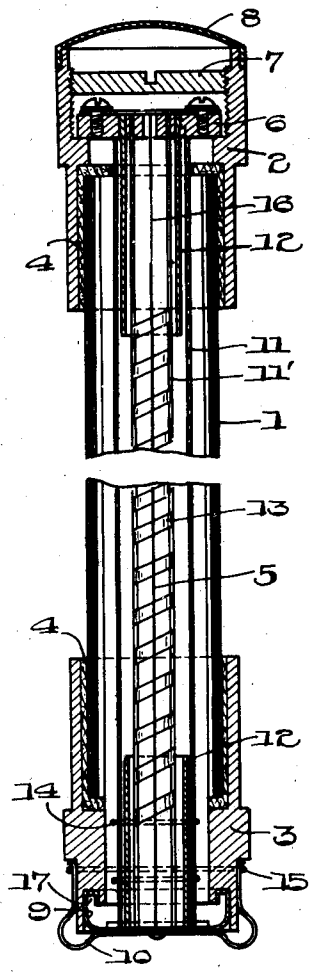


Fig. 3.

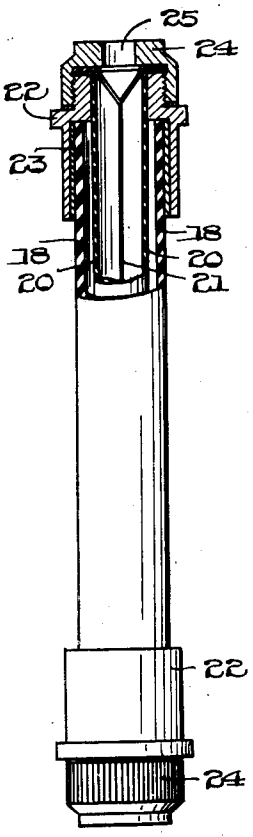


Fig. 4.

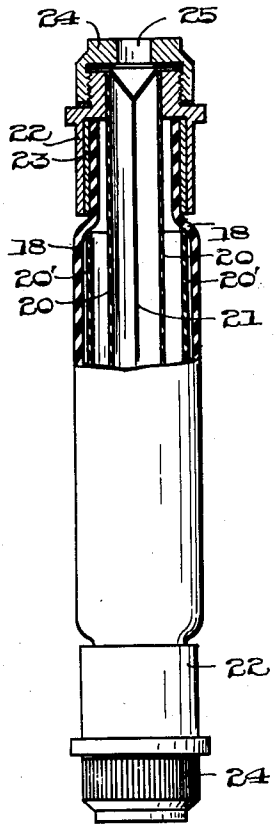
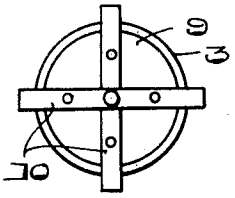


Fig. 2.



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ELECTRIC ARC BREAKER

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1 Claim. (Cl. 200—131)

The present invention relates to an electric fuse device, which consists in providing an elastic thin walled cylinder encircling a fusible member and mounted in an outer insulating cylinder, whereby the breaking of the arc formed by the fusing of the fusible member is accelerated by utilizing the internal pressure produced upon the formation of an arc to discharge the fusible member from the outer cylinder. The fusible member is suitably enclosed to prevent dust and moisture from entering the interior of the device so as to make it suitable for use for a high voltage circuit and increase the life of the device. The object of the invention is to control the scattering of the electric arc and burnt metal powder produced when the fusible member is fused, and also to prevent the burning and destruction of the outer insulating cylinder.

The appended drawing shows as an example three embodiments of the electric fuse device according to this invention, wherein

Figure 1 is a longitudinal elevation of the first embodiment of the electric fuse device according to this invention;

Figure 2 is a view looking at the bottom of Fig. 1;

Figure 3 is a side view of the second embodiment, partly broken away; and

Figure 4, a side view of a high voltage electric fuse device which is the third embodiment, partly broken away.

The embodiment of the invention illustrated in Figs. 1 and 2 of the accompanying drawing, comprises an outer insulating cylinder 1 made of glass or other transparent insulating material having electric conducting terminal pieces 2 and 3 of tubular form fixed to both ends of the outer insulating cylinder by a binding material 4 or other suitable means. A fusible member 5 is mounted substantially centrally in the outer insulating cylinder 1 by a plate 6 of electric conducting material connected to an end portion of the fusible member and engaged in the terminal piece 2 to fix said end portion of the fusible member in position on the interior of the terminal piece 2 with a nut 7 screw threaded in the piece 2 to retain the plate in position. The terminal piece 2 is closed tightly by the plate 6, nut 7 and a cap 8 which is provided when necessary. A cap 9 is inserted in the open end of the terminal piece 3 and secured therein to tightly close the same by resilient legs 10 engaging the periphery of the terminal piece 3. The cap 9 has the other end of the fusible member 5 fixed thereto. That is to say, the fusible member 5 extends between the plate 6 and cap 9. Around the fusible member 5 there is arranged one or more inner insulating cylinders 11, 11' which are made by rolling or pasting together a resilient or elastic insulating material such as "cellophane", uninflammable celluloid, or the like, into cylindrical shape. To the plate 6 and cap 9 there are attached short metallic tubes 12 respectively, and in the interior or exterior of which there is engaged the inner insulating cylinder 11' to support the said cylinder 11' and also receive pressure as described hereinafter. The inner insulating cylinder 11' is wound spirally with an electric conducting sheet 13 such as a tin foil, or the like, and is connected to an electric conducting ring 14 by a conducting wire, so that it may not only be expelled with the cap 9 from the cylinder 1, but also the tin foil 13 may be of the same potential as the terminal piece 3, thus preventing the formation of corona. The elastic legs 10 are fixed to the cap 9 as shown in Fig. 2 and to maintain the legs in engagement with the periphery of the terminal piece 3 there is provided a clamping ring 15, for example, a locking wire or tightening plate. Further, by inserting the periphery of the cap 9 in the peripheral groove 17 of the terminal piece 3 and packing this part with a sealing agent such as litharge or gum packing the electric fuse device may be given a watertight construction suitable for the outdoor use.

The following is an explanation of the operation of the electric fuse device of the present invention.

When the fusible member 5 starts fusing at a starting point which is a reduced portion 16, internal pressure is produced in the inner insulating cylinder 11' by the fusing of said fusible member. This pressure is received by the short metallic tube 12 due to the elasticity of the cylinder 11'. That is to say, said tube 12 transmits the above internal pressure directly to the cap 9 without allowing it to escape out of the inner insulating tube 11'. This causes the cap 9 metallic tube 12, the remaining part of the fusible member 5 and the insulating tube 11 to be expelled together as a unit from the terminal piece 3, releasing the connection between the terminal piece 3 and resilient legs 10.

As in this invention there is provided the metallic tube 12 adapted for both supporting the inner insulated cylinder 11' and receiving pressure as described hereinbefore, it is possible to obtain such construction that the inner cylinder 11' is easily supported concentrically with the fusible member 5 and the internal pressure pro-

duced in the inner cylinder 11' is made to act upon the cap 9 effectively. Thus, even in case of low or high voltage the expulsion due to the internal pressure is effected satisfactorily, so that the blowing of the fusible member is done quickly and accurately, especially when the device is used in connection with an electric current of a high voltage.

In the embodiments of the invention shown in Figs. 3 and 4, there is provided a transparent outer insulating cylinder 18 in which there is inserted one or more inner insulating cylinders 20 and 20' formed tubularly of a thin sheet such as a regenerated cellulose sheet (popularly known as "cellophane"), a fibre coated with regenerated cellulose or a starchy sheet, for example, "oblate". The inner insulating cylinder 20 is expanded by the internal pressure produced upon the formation of an arc in an arcing circuit provided in the inner cylinder and is shrunk axially by the high vacuum induced with the escape of the internal pressure, thereby pressing and dispersing the arc and thus increasing the current density of the unit arc and extinguishing it. To both ends of the outer insulating cylinder 18 there is engaged a metallic cap 22 which is united tightly to the outer cylinder 18 by a suitable binding agent, as indicated at 23. The said cap has a screw thread at its outer end portion and also has a central opening in said end. Also, there is screwed to the cap 22 a cap-shaped piece 24 which has an air outlet 25. A fusible member 21 is mounted in the inner cylinder 20 in such a manner so that the fusible member does not contact with the cylinder. Both ends of this fusible member are bent to a Y or T-shape and the end portions of such Y-shaped portions are bent horizontally. Then, the bent horizontal end portions thus formed are inserted between the outer end of the cap 22 and cap-shaped piece 24. If the fusible member 21 or arcing circuit is disposed on the axial line of the insulating cylinder 18 and is fused or broken, the temperature will be raised quickly owing to the formation of an arc and at the same time high internal pressure will be produced in the inner cylinder 20. Now, the high internal pressure expands the inner cylinder 20 in an instant and presses the air or liquid between said cylinder 20 and the outer cylinder 18, but said inner cylinder serves well as a buffer against momentary high pressure lasting only till the internal pressure escapes through the opening 25.

By the internal pressure escaping through from the opening 25 immediately high vacuum is induced in the inner cylinder 20 by its reaction to shrink the cylinder 20 axially and rapidly as if it were to collapse the arc by tightening, and as the high temperature is lowered by having part of it absorbed by the inner wall of the inner cylinder, the effect of so-called surface deionization is great. Thus, by applying pressure reactionally at the same time with the formation of an arc and absorbing its heat energy the arc is quenched.

The burnt metallic powder produced upon the formation of an arc adheres to the inner wall of the inner insulating cylinder, and not to the outer cylinder. Therefore, there is no apprehension of the insulation being reduced by the attachment of the metallic powder, and even when cutting off a high voltage current, the object of protecting the outer insulating cylinder by the above action is readily attained. Moreover, with a closed type of electric fuse device the desired action is found to be successful owing to the high vacuum created in the cylinder (at the time of fusing) without burning even an inflammable object. If the inner cylinder 20 has a diameter the same or larger than the diameter of the air outlet 25 and is long enough to contact internally with the opening 25 or to reach the edge of the inner end of the cap 22, it can be expanded without interference by the internal pressure produced upon the formation of an arc and the escape of that pressure is made easy.

In Fig. 4, an elastic insulating cylinder 20' is shown engaged in an enlarged intermediate portion of the outer insulating cylinder 18 to doubly protect said outer cylinder during the fusing of the fusible member.

I claim:

An electric fuse member comprising an outer cylinder of insulating material, tubular terminals of conducting material mounted on opposite ends of the cylinder, a fusible member disposed in said cylinder and electrically connected at its opposite ends with said terminal members, a flexible cylinder of insulating material disposed within the outer cylinder and encircling said fusible member, said flexible cylinder being subject to expansion under pressure developed therein by the formation of an arc, and end-closing members carried by said terminals and adapted to permit escape of such pressure to cause the flexible cylinder to contract and thereby create a partial vacuum therein.

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