Oct. 20, 1931. M. H. BENNETT 1,828,277

FUSE

Filed Nov. 13, 1925

Fig. 1.

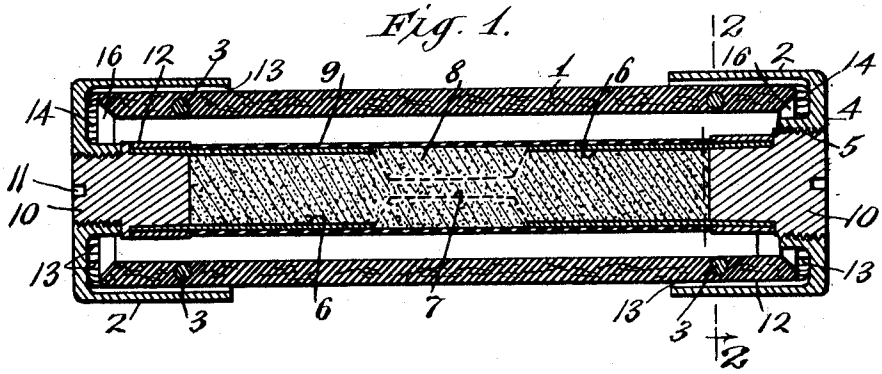


Fig. 2.

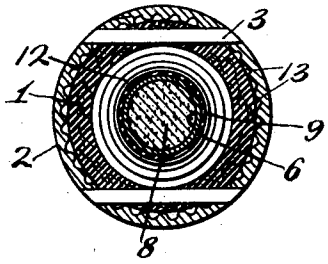


Fig. 3.

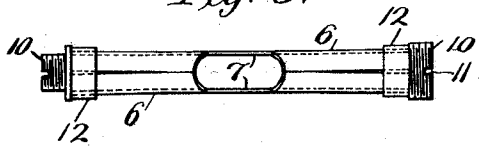
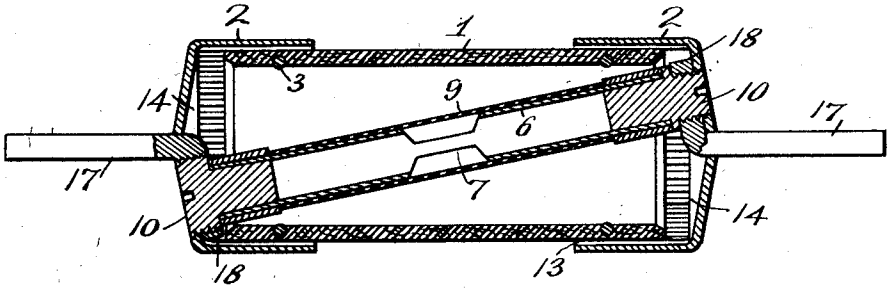


Fig. 4.



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UNITED STATES PATENT OFFICE

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FUSE

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This invention relates to what are known as renewable fuses, that is, a construction comprising a casing within which there is located a current carrying member or link which will, under proper conditions, be destroyed and open the circuit in which the fuse is located, the construction being such that the current carrying member or link may be renewed, the remainder of the construction being unaffected by the destruction of the link.

Because of fire hazard, certain rigid requirements as to renewable fuses have been laid down by the National Board of Underwriters. These requirements have been generally accepted, and a fuse cannot be commercially employed at the present time unless it responds to these requirements. From an electrical point of view, the construction of the fuse must be such that it will carry the normal rated current without overheating. It must, however, be destroyed, or, as it is ordinarily termed, "blow", when overloaded within certain specific limits, and it must blow when so overloaded within a specified time, this time varying according to the different amounts of current to be carried by the fuse. Further, in case of a short circuit on a high capacity system, the fuse must blow without other damage to itself than the destruction of the link. Further, in blowing, the fuse must not emit gases which are hot enough to be dangerous, which is determined by subjecting the fuse to a test, such as the ignition of highly inflammable material, for instance, loose cotton.

Of course, in a renewable fuse, the link must obviously be capable of easy and quick removal and replacement, whether it be removed in pieces after blowing, or removed intact to change the rating. When a filling, granular or otherwise, is used in connection with the link, it should be of such a character that it will not materially change its shape or increase in bulk after being placed in the fuse, and particularly it must not be affected by moisture or other atmospheric conditions, so as to change in shape or bulk, as changes such as suggested may interfere either with the functioning of the link or with its easy and quick removal. Again, the fuse construction must be such that after the link has blown, a substitute for it, such as a piece of wire, cannot be used without the substitution being readily observed.

It is the object of this invention to produce an improved renewable fuse which satisfies the requirements above stated and which shall be, relatively speaking, inexpensive to manufacture.

With this and other objects not specifically referred to in view, the invention consists in certain parts, improvements and combinations herein described and then specifically pointed out.

Referring to the accompanying drawings in which is shown one embodiment of a fuse constructed in accordance with the invention,

Figure 1 is a vertical, longitudinal section of a fuse embodying the invention.

Figure 2 is a cross-section on the line 2—2 of Fig. 1.

Figure 3 is a side elevation of the link on a reduced scale.

Figure 4 is a vertical, longitudinal section of a fuse of the knife blade type embodying the invention.

In said drawings, 1 indicates the casing or body of the fuse which, as shown, is tubular in form, and which should consist of a suitable non-conducting material, such, for instance, as fiber. The body or casing of the fuse is provided with closures in the form of metallic caps, and, as shown, the flanges 2 of the caps extend along the outer side of the casing. In the best constructions, these caps are secured to the casing by pins, as 3, or in some other manner, so that they cannot be readily removed without destroying the casing. In the particular construction selected to illustrate the invention, the tops 4 of these caps are provided with threaded apertures 5, the threads on both caps being alike, that is, they have the same number of threads per inch and the threads run in the same direction.

The renewable link of the fuse comprises a tubular current carrying link 6 which is so constructed as to provide a restricted current carrying section. In the construction shown, this section is formed by cutting away the

tube so as to provide two or more narrow parts forming fusible connectors, as indicated at 7, which will be so arranged that the current traverses them in multiple.

The tube will be so located in the casing as to provide a substantial air space between the outer wall of the tube and the inner wall of the casing, thus providing an expansion and cooling chamber for the hot gases which are generated when the link blows. In the best constructions embodying the invention the tubular member will be so arranged that it, or, at least, that part of it which forms the restricted current carrying section, will enclose a body of refractory material which should have the characteristics of rapid heat conductivity and electrical non-conductivity. This material may consist of plaster of Paris, for instance, as indicated at 8, and in the best constructions, when plaster of Paris is used, it will be set. For ease in filling and preventing the displacement of the refractory material either during filling or thereafter, a paper label, as 9, may be used around the restricted current carrying section. The tubular member will, of course, be of conducting material, such, for instance, as zinc, which has been found to be highly satisfactory.

The construction will be such that the closures referred to will hold the link in position. In the particular construction shown, the closures include threaded plugs 10 and 10^a which engage the threaded openings 5 in the caps. The ends of these plugs enter the tubular member, these plugs being so constructed as to be engaged by a suitable tool. As shown, they are provided with slots 11 which may be engaged by a screw driver. To insure a tight fit between the plugs and the tubular member, sleeves 12 may be used which are forced down on the ends of the tubular member after the plugs have been inserted.

In order to provide for venting of the fuse when the same blows, the flanges 2 of the caps may be provided with longitudinal channels 13. As shown, these channels connect with spaces 14 between the horizontal portions 4 of the caps and the ends of the casing. The ends of the casing may be chamfered off slightly, as indicated at 16, to provide for a free communication between the space in the casing around the tubular member and the spaces underneath the caps with which the channels 13 connect.

In the form of construction which has just been described, the connections to the circuit are made by the usual metallic clips which engage the flanges 2 of the cap, this type of fuse being known as the ferrule type.

In Fig. 4, the construction is shown as embodied in a fuse known as the knife blade type. In the construction shown in this figure, knife blade extensions 17 are provided, which are angular in form, their inner ends 18 being bent up at an angle to the body of the extension and being soldered to the under side of the caps, each extension 17 projecting through an opening in the cap. In order that the knife blades may be centrally located with respect to the caps and the blowing point also located centrally of the fuse, the link is arranged diagonally in the casing. For this purpose ferrules 2^a, $2^{a'}$ are conical in form. In this construction, the inner bent ends of the knife blades are, practically speaking, integral with the cap, although they are soldered thereto, and the threaded openings for the plugs which close the ends of the tubular member, pass through the bent portion 18 of the knife blades. The two constructions of fuses are identical except in the respects mentioned.

With the construction as described, the current carrying sections can be readily proportioned so that the fuse will readily blow either under overload or short circuit condition. The non-conducting material enclosed within the tubular link prevents any convergence of the arcs which are formed when the link fuses, with the result that there is no gas pressure due to such convergence. There is ample space around the link to provide for expansion of the gases which necessarily form due to the burning of the fusible connectors of the tubular member. Experience with this fuse has shown that the burning of the tubular member is substantially confined to the restricted current carrying member, so that an amount of gas is not generated which would result in a pressure sufficient to burst the casing.

The link can be readily inserted and removed and because of the fact that plug 10^a is of smaller diameter than plug 10 it may be removed in its entirety before blowing or in sections after blowing.

Changes and variations may be made in the constructions herein described without departing from the invention, and it is to be understood that the invention claimed is not confined to the particular constructions shown and described.

What is claimed is:

1. In a renewable fuse, the combination with a casing of non-conducting material, of a tubular current-carrying link so located within the casing that there is an air space between it and the inner wall of the casing, said link providing a restricted current carrying section, a body of refractory material having the characteristics of rapid heat conductivity and electrical non-conductivity enclosed by the section, and closures of conducting material for the ends of the casing to which closures the link is removably connected, said closures having annular flanges enclosing and spaced from the ends of said non-conducting casing, and the spaces so formed being in communication with said air space.

2. In a renewable fuse, the combination

with a casing of non-conducting material, of closures for the ends of the casing, said closures having threaded openings one of which is large enough to permit the insertion and removal of a removable link, a tubular current carrying link so located within the casing that there is an air space between it and the inner wall of the casing, said link having restricted current carrying connectors through which the current passes in multiple, and a body of refractory non-conducting material having the characteristics of rapid heat conductivity and electrical non-conductivity within the connectors, said link having threaded end sections which engage the openings in the closures and hold the link in position.

3. In a renewable fuse, the combination with a casing of non-conducting material, of conducting flanged caps permanently attached to the ends of the casing, said flanged caps and casing being so arranged as to provide free venting passages between the flanges of the caps and the casing, said caps having threaded openings one of which is large enough to permit the insertion and removal of a fusible link, a tubular link comprising a tube slotted to provide restricted current carrying connectors through which the current passes in multiple, and a body of refractory material having the characteristics of rapid heat conductivity and electrical non-conductivity within the connectors, the tube being provided with threaded portions which engage and close the openings in the caps, the link being so located within the casing as to provide an air space between it and the inner wall of the casing.

4. In a renewable fuse, the combination with a casing of non-conducting material, of a tubular current carrying link so located within the casing that there is an air space between it and the inner wall of the casing, said link being arranged diagonally in the casing and comprising a plurality of fusible current carrying connectors, a body of refractory materal having the characteristics of rapid heat conductivity and electrical non-conductivity within the connectors, and closures of conducting material for the ends of the casing to which closures the link is removably connected.

5. In a renewable fuse, the combination with a casing of non-conducting material, of a tubular current carrying link so located within the casing that there is an air space betwen it and the inner wall of the casing, said link being arranged diagonally of the casing and comprising a plurality of fusible current carrying connectors through which the current passes in multiple, a body of set plaster of Paris within the connectors, and closures of conducting material for the ends of the casing to which closures the link is removably connected.

6. In a renewable fuse, the combination with a casing of non-conducting material, of flanged caps of conducting material for closing the ends of the casing, knife blade extensions having bent ends soldered to the under side of the caps, each of said caps and the inner bent end of its knife blade having a threaded opening, one of said openings being sufficiently large to permit the insertion and removal of the fusible link, screw plugs for closing the openings, and a fusible link connected to the plugs.

In testimony whereof, I have hereunto set my hand.

MORRIS H. BENNETT.