June 2, 1936. E. A. WILLIAMS 2,043,024

FUSE

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Fig. 1.

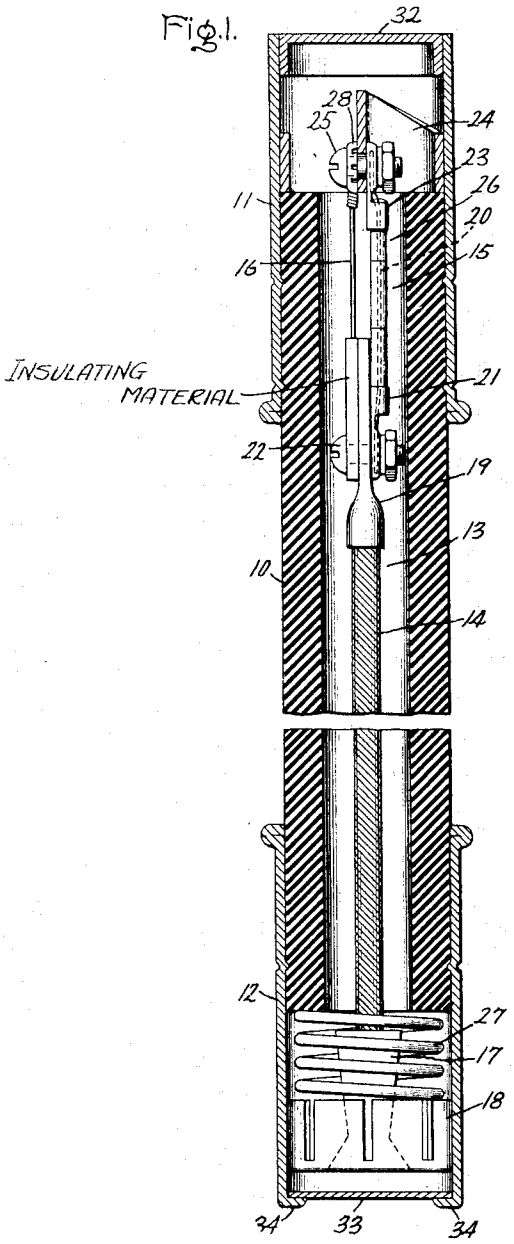
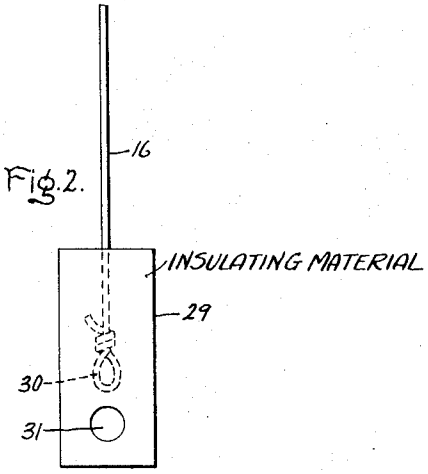


Fig. 2.



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FUSE

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5 Claims. (Cl. 200—117)

My invention relates to fuses and more particularly to fuses of the expulsion type. Expulsion fuses have been employed for general use in protecting high voltage circuits and machinery interconnected in such high voltage circuits. The operation of expulsion fuses has proven quite satisfactory for heavy overloads but some difficulty has been experienced in the operation of these fuses with overloads which are slightly in excess of the overloads for which the fuse is designed to operate. In such cases an overload though relatively light may do considerable damage by failure of the fuse to operate at all or on failure of the fuse to operate in a sufficiently short time to prevent damage to machinery connected in the circuit.

The object of my invention is to provide a fuse of the expulsion type which will operate certainly and quickly on relatively light overloads.

What I consider to be novel and my invention will be better understood by reference to the following specification and appended claims when considered in connection with the accompanying drawing in which Fig. 1 is a sectional view of an expulsion fuse embodying my improvements and Fig. 2 is a detailed view of a part of the fuse.

Referring to the drawing, 10 indicates a tube of insulating material which forms the housing for an expulsion fuse. Ferrules 11 and 12 are secured to each end of tube 10 and are made of metal and adapted to contact with terminals connected in an electric circuit. In order to complete the connection of the circuit through the fuse, a fuse element 13 which consists of a flexible conductor 14, fusible link 15, and strain wire 16, is located within tube 10. Flexible conductor 14 is connected at one end to a copper shoe 17 which has a conical end which fits within the conical opening in contact 18. Conductor 14 terminates at its opposite end in a swaged terminal 19. Fusible link 15 consists of a wire 20 which is made of one of the well known fusible elements which is readily fusible upon an increase in temperature due to the passage of electric current therethrough and which has a relatively low specific resistance. Wire 20 is connected at one end to a metal terminal 21 which is connected to terminal 19 by means of a bolt 22. The other end of wire 20 is connected to a terminal 23 which is connected to a contact 24 by means of a bolt 25. A tube 26 of insulating material completely surrounds wire 20 between terminals 21 and 23. Contact 24 rests upon the top of tube 10 and is in engagement with ferrule 11 to complete connection betweer fuse link 13 and the top contact terminal. To assist in the rapid separation of the severed ends of fusible element 15 upon the operation of the fuse, a compression spring 27 is provided and located between the lower end of tube 10 and contact 18. The tension produced through the intermediary of spring 27 is necessarily greater than the fusible link 15 is able to withstand especially when the fuse is designed for operation on a circuit at a relatively low current value. Thus to relieve fusible link 15 of this tension, strain member 16 is provided and secured to contact 24 at one end and terminal 19 at the other end. Strain member 16 may consist of a wire of a nickel chromium alloy, stainless steel, or similar material, which will withstand the relatively high tension even when of small cross section. It has been the previous practice to provide a strain member for the fusible element which is electrically connected to the terminals of the fusible element. Such a strain member which is placed in parallel with the fusible element, due to its high specific resistance, carries a relatively low portion of the current which passes through the fuse link. Upon the blowing of the fusible element all of the current which is passing through the fuse link must then pass through the strain member. It has been found that the smallest strain wire which can be used to transmit the necessary tension and also withstand the usual operating conditions of vibration, rough handling, etc., will carry 25 amperes for five minutes before it operates. Obviously fuses for operation on currents below 20 amperes cannot make use of the conventional strain member without a great reduction in its section and a corresponding reduction in mechanical strength. To reduce both the current required to operate the fuse and the time of operation without reduction in mechanical strength, strain member 16 is provided and placed in parallel physically to fuse link 15 but is electrically insulated from one terminal of fuse link 15. Strain member 16 is directly connected by a grommet 28 to contact 24 by means of bolt 25. The other end of strain member 16 is molded as an insert in a plate or member 29 of insulating material, as better indicated in Fig. 2. The end of strain member 16 is formed into a loop 30 with the free end of the strain member 16 being wound tightly about the adjacent portion of the wire. The loop 30 is then placed in a mold and insulating material molded about it in the form of a flat plate with an opening 31. Opening 31 in plate 29 is provided to permit the passage of bolt 22 therethrough to secure the lower end of strain member 16 to terminal 19. Thus, strain member

16 is electrically connected to one end of fusible link 15 and is insulated from the other end of the fusible link. By this arrangement, the strain member is not connected in parallel electrically to the fusible link as is the usual practice and is not in the electrical circuit of the fuse element at all as long as the fusible link 15 remains intact. Upon the blowing of the fusible link the continuity of the circuit through the fuse element is broken and an arc is drawn which strikes from terminal 19 to an adjacent portion of strain member 16. As is well known, an arc seeks the shortest path and so would not strike from terminal 19 to the other terminal 23 of the fusible link 15 but as stated above would strike to an adjacent portion of the strain member 16. The current then flows through a portion of the strain member 16. The combination of the current through the strain member 16 and the arc striking the strain member will burn the wire through and thus release the tension produced by compression spring 27 to immediately separate the blown ends of the fusible link 15 and positively clear the circuit. It has been found that while the strain member 16 may not be melted by the passage of 25 amperes through the strain member in less than five minutes, an arc of 1½ amperes will burn through the strain member 16 in .05 second. Thus, by my improved strain member 16 the fuse will operate at a relatively low overload and the blown ends of the fusible link begin to separate within .05 seconds after the melting of the fusible element. At the same time, a mechanically strong fuse which does not require careful handling is provided.

The upper end of the fuse tube 10 is closed by means of a cap 32 which is soldered within the top of ferrule 11 to form a waterproof joint. The lower end of tube 10 is closed by a frangible disc 33 held in the end of ferrule 12 which is turned in at spaced points 34 to loosely hold the disc 33 in position. Upon operation of the fuse, disc 33 is forced out of the lower end of the tube by the expansion of spring 27. The passage is then open for the fuse element 13 to be expelled from the lower end of tube 10. The connection between copper shoe 17 and contact 18 is collapsed upon movement of the fuse element 13 and so does not interfere with the exodus of the fuse element from the tube 10. Frangible disc 33 by closing the lower end of tube 10 prevents moisture and dust from entering the tube 10 and also serves as a target to indicate the operation of the fuse.

From the foregoing it may be seen that by means of my improved fuse the current required to operate the fuse and the time of operation on relatively low overloads is greatly reduced without any reduction of mechanical strength of the fuse element. This reduction in time of operation of the fuse greatly reduces the damage which might be done to the machinery interconnected in the circuit protected by the fuse. In addition, my improved fuse insures a completed operation of the fuse on relatively low overloads to thus greatly reduce the damage which might occur upon failure of operation of the fuse.

What I claim as new and desire to secure by Letters Patent of the United States is:

1. In a fuse having a fuse element under tension, a fusible wire conductor, a metallic strain wire, means for electrically and mechanically connecting said wires together at one end and for maintaining the wires in spaced apart relationship at their connected ends, and means for mechanically connecting the other ends of said wires together in non-conducting relationship including a member of insulating material rigidly attached to one of said wires and secured to said other end of the other of said wires.

2. In a fuse having a fuse element under tension, a fusible wire conductor and means for relieving the wire conductor of tension comprising a metallic strain wire, means for mechanically and electrically connecting one end of the strain wire to one end of said wire conductor with the connected ends of the wires in spaced apart relationship, a block of insulation material molded securely onto the other end of said strain wire, and means for securing said block of insulating material to the other end of said fusible wire conductor with said other ends of the wires in spaced apart relationship.

3. In a fuse device, the combination with a fuse tube having a pair of spaced apart terminals for supporting a fuse element extending longitudinally through the tube and having means for tensioning said fuse element, of a fusible wire conductor connected between said terminals, a metallic strain wire, means for securing one end of said strain wire to one of said terminals in electrical conducting and spaced apart relationship with the adjacent end of said wire conductor, a member of insulating material secured to the other of said terminals, and means for fastening the other end of said strain wire to said insulating member with the strain wire extending through said tube in spaced apart relationship with respect to said wire conductor, whereby the strain wire carries no current while the fusible wire conductor is intact but is severed by an arc upon the blowing of the wire conductor.

4. In a fuse having a fuse element under tension, a fusible link, insulating material surrounding said fusible link, and a strain member for the fusible link electrically connected to one terminal of the fusible link and insulated from the other terminal of the fusible link whereby the strain member does not carry any of the current passing through the fuse element while the fusible link is intact but is severed by an arc upon the blowing of the fusible link.

5. In a fuse having a fuse element under tension, a fusible link, terminals for each end of said fusible link, insulating material surrounding said fusible link between said terminals, and a strain member for the fusible link electrically connected to one of said terminals and insulated from the other of said terminals whereby the strain member does not carry any of the current passing through the fuse element while the fusible link is intact but is severed by an arc upon the blowing of the fusible link.

EDWIN A. WILLIAMS.