Dec. 24, 1968 D. J. KRUEGER 3,418,614

TIME DELAY CARTRIDGE FUSE

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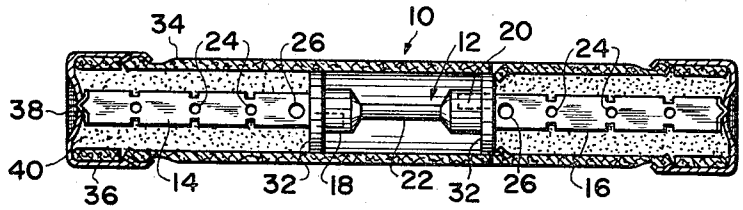


FIG. 1

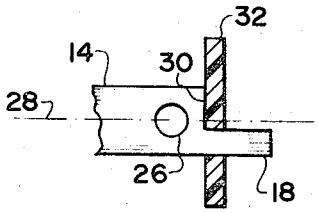


FIG. 2

INVENTOR.

DAVID J. KRUEGER

BY Richard M. Rabkin

ATTORNEY

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TIME DELAY CARTRIDGE FUSE

David J. Krueger, Elk Grove, Ill., assignor to Federal Pacific Electric Company, a corporation of Delaware

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ABSTRACT OF THE DISCLOSURE

A cartridge fuse that is relatively free of mounting position sensitivity and which includes a time delay mass and offset conductive portions connected thereto to insure breaking of the circuit when the time delay melts.

This invention relates to time delay cartridge fuses and more particularly to improvements in lag fuses to increase the reliability of operation on sustained overloads.

Time delay or lag fuses of the type herein contemplated include a multicompartmented housing of insulation and a slug or mass of relatively low melting point metal as a circuit element positioned in one of said compartments. The mass and the melting point of the slug determines, in part, the overload responsive characteristic of the fuse.

A problem of particular importance has arisen in insuring that the slug, once fused on overload to break the connection between the link terminals, will remain sufficiently separated from the terminals to maintain an open circuit condition without regard to the position of the fuse. It is an object of this invention to provide an improved lag fuse construction for increasing the reliability of the break of connection between the terminal links and the slug, once fused, irrespective of the position of the fuse in use.

It is another object of this invention to provide an improved fuse construction which is substantially free of position-of-use restrictions.

Briefly, the above and other objects and advantages of the invention are achieved in one embodiment of the invention by a time delay cartridge fuse including fusible means within an insulating tube. A pair of terminal elements are secured respectively to opposite ends of the insulating tube with the fusible means in the tube interconnecting the terminal elements. The fusible means includes a pair of inwardly extending conductors connected to the terminal elements respectively. The conductors are spaced apart lengthwise of the tube and are of relatively high melting point metal. A time delay electrically conducting mass of relatively low melting point metal interconnects the conductors. The time delay mass is positioned within a compartment within the tube, the compartment being defined by partition walls and the side wall of the tube. Both of the conductors and the axis of the compartment are coplanar and the conductors are offset oppositely relative to the axis. The time delay mass, when molten and supported in the compartment by the side wall, being substantially disposed below the axis of the compartment.

The above and other novel features and advantages of the invention will become apparent from the following description when taken in conjunction with the drawings in which:

FIG. 1 is a longitudinal midsectional view of a fuse made in accordance with the present invention; and

FIG. 2 is a view of a portion of FIG. 1 on a greatly enlarged scale with some portions broken away and others omitted in the interest of clarity.

Referring to the drawings the cartridge fuse **10** includes a fusible element assembly **12** that includes a pair of spaced fusible conductors or links **14, 16**. One end **18, 20** of each of the flat links **14, 16** is united to a fusible

member **22** located between the links **14** and **16**. The fusible links **14, 16** may be made of any preferred relatively high melting point material such as commercial brass or bronze which will fuse upon the passage therethrough of a sufficiently high current. The fusible element or slug **22** is preferably composed of a well-known eutectic alloy that has a relatively low and sharply defined melting point. The slug **22** is joined to the ends of the links **14, 16** in a casting operation as described in Patent No. 2,688,676 which is assigned to the assignee of the present invention. Preferentially the ends **18, 20** of the links **14, 16** are tinned before the casting operation so that an electrical joint of high conductivity results.

Each of the links **14, 16** has a higher melting point than the slug **22** and is provided with multiple restricted portions **24** along the length which are in series with a restricted area **26** of a different configuration adjacent the inwardly disposed ends **18, 20** of the links. In the embodiment of the invention shown in the drawing the fusible links **14, 16** are coplanar and are substantially coaxial with the longitudinal axis **28** of the tube. The ends **18** and **20** of the links are less than one-half the width of the link **14, 16** and are oppositely offset relative to the fuse axis **28**. The ends **18, 20** are formed by removal of a portion of the link which forming operation provides a shoulder **30** against which is located a partition wall **32** of insulation. The partition walls **32** closely conform to the wall of the tubing **34** and are maintained in position by cooperation of the shoulders **30** and the cast slug **22**.

Fusible element **12** is located within the cylindrical casing **34** of insulation which is provided at each of its ends with a terminal element in the form of a ferrule **36**. The ferrules **36** may be secured to the casing **34** by a staking operation or by spinning the free ends of the ferrules into the wall of the casing. The ends of the links **14, 16** remote from the fusible element **22** are secured to the respective ferrule **36** at a central location **38** as by a soldering operation.

The space at each end of the fuse between the partition walls **32** and the ferrule **36** may be filled with an inert powder **40** to assist in the quenching of any arc formed by the fusing of one or both of the links **14, 16** under short circuit interruption conditions.

The links **14, 16** act as heaters to cause the mass of low melting alloy **22** to melt if the fuse is subjected to overload for a predetermined length of time. The relatively large mass of low melting point alloy **22** serves as a "heat sink" so that overloads of short duration will not heat the alloy to the melting point and thus avoid nuisance blowing of the fuse.

It will be noted that the spaced partition walls **32**, together with the adjacent portions of the wall of the casing **34** form a compartment for the time delay mass or slug **22** which compartment is free of the inert powder **40**. If sufficient powder should be present below the alloy mass **22** it might remain suspended in the powder after melting in which case the fuse would fail to open. If the fuse is in the horizontal position with the links **14, 16** in a vertical position as illustrated, when the slug **22** melts after a prolonged overload, the laterally oppositely offset ends **18, 20** of the links assure that if a bridge of molten eutectic were to form therebetween, it would be broken. The increased distance from link end **20** to the pool assures, with a high degree of reliability, that the circuit opens. Reestablishment of the circuit between the ends **18, 20** of the links and the pool of molten alloy is inhibited by this construction. It may be speculated that the uneven distances from the ends **18, 20** of the links **14, 16** to the pool of eutectic together with the effect of surface tension on the molten alloy, which causes it

to tend to assume a spherical shape, overcomes the adhesion that might have caused it to stick to the ends of the fuse links. In the presently described construction the offset of the ends **18**, **20** of the links **14**, **16** on opposite sides of the longitudinal axis **28** of the casing **34** provides a fuse of much greater reliability as to blowing time and circuit interruption. Fuses of the character described have been successfully constructed for currents of from 5 to 30 amperes and above for use at 600 volts.

It is believed that the use of the restricted or reduced cross section link end **18**, **20** is further advantageous in that, when the element **22** is melted, an arc may be drawn between a link end and the molten pool of alloy. Such arcs have been found to persist until the link end is vaporized. By reducing the amount of link material to be removed by the arc, it is possible that the circuit opening process occurs sooner than with the full width link.

While only one embodiment of the invention has been shown and described in detail it will be apparent to those skilled in the art that various changes and modifications may be made therein without departing from the spirit and scope of the invention.

I claim:

1. A time delay cartridge fuse including an insulating tube, a pair of terminal elements secured respectively to the opposite ends of said insulating tube and fusible means in said tube interconnecting said terminal elements, said means including a pair of inwardly extending conductors connected to said terminal elements respectively, said conductors being spaced apart lengthwise of said tube and being of a relatively high melting-point metal, and a time delay electrically conducting mass of relatively low melting-point metal interconnecting a first portion of each of said conductors, said tube including a tubular side wall portion adjacent said time-delay mass, said first conductor portions and the axis of the tube being coplanar and said first conductor portion being offset oppositely relative to said axis, said mass when molten and supported by said tubular side wall being substantially disposed below said axis.

2. A time delay cartridge fuse according to claim **1** further including end walls defining a compartment enclosing said time delay mass, each of said end walls being formed as a partition of insulation closely fitting within said tube, said conductors having second portions of a given width between said terminal elements and said partition walls, said aforementioned first portions being of reduced width and extending into said compartment for connection to said time delay mass.

3. A time delay fuse according to claim **2** wherein said second portions of said conductors are coaxial with the axis of said insulating tube and said first portions are laterally offset oppositely relative to said axis.

4. A time delay fuse according to claim **3** wherein said first portions of said conductors are less than one-half the width of said second portions thereof.

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BERNARD A. GILHEANY, *Primary Examiner.*

H. B. GILSON, *Assistant Examiner.*

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337—162, 166, 229