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SAND-TEFLON MEANS TO IMPROVE LOW CURRENT INTERRUPTION PERFORMANCE OF HIGH VOLTAGE CURRENT LIMITING TYPE FUSES

Filed Oct. 28, 1964

Fig. 1

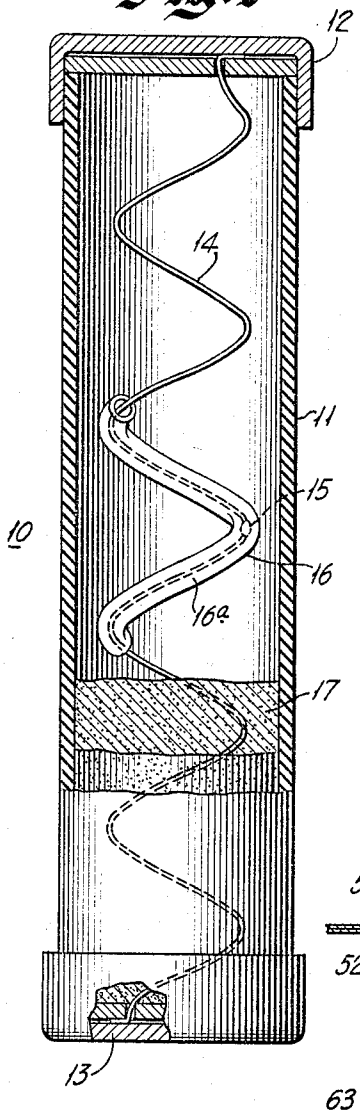


Fig. 2

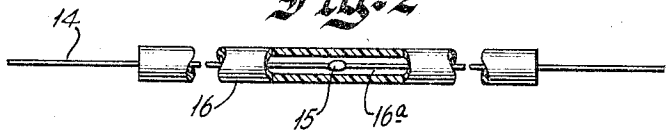


Fig. 3

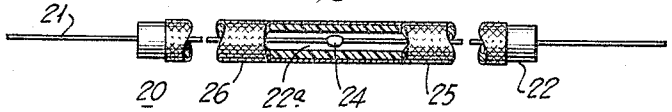


Fig. 4

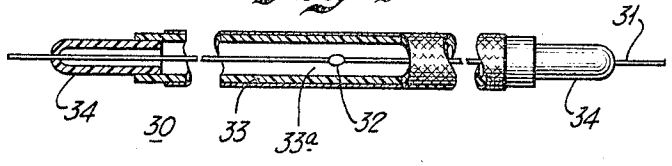


Fig. 9

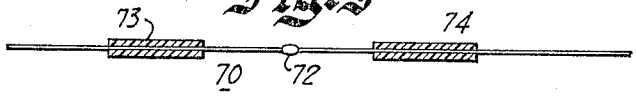


Fig. 5

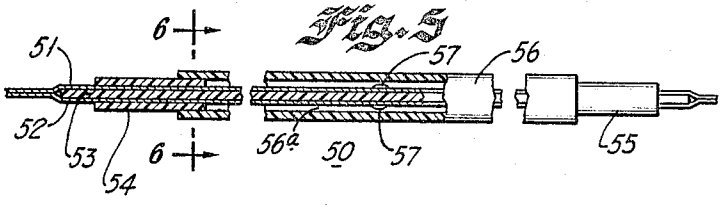


Fig. 7

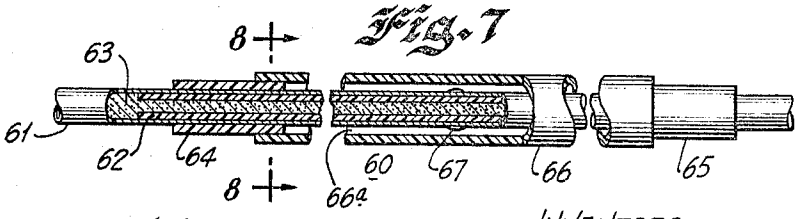


Fig. 6

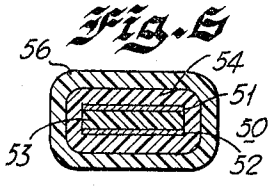
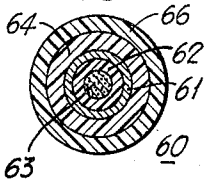


Fig. 8



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SAND-TEFLON MEANS TO IMPROVE LOW CURRENT INTERRUPTION PERFORMANCE OF HIGH VOLTAGE CURRENT LIMITING TYPE FUSES

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This invention relates to high voltage fuses, and more particularly, to current limiting-silent fuses of the silver-sand type.

The silver-sand fuse is commercially used in high-voltage fuses of the current limiting-silent type to interrupt major faults or short circuit currents. However, the elementary silver-sand arrangement does not perform satisfactorily on interruption of low fault currents of long duration, such as overloads. The poor performance on low fault currents is due in part to the relatively slow growth of the arc length and insufficient dielectric recovery of the heated sand.

Because of the unsatisfactory low current interruption performance of the elementary silver-sand arrangement, a number of solutions have been proposed in the past. U.S. Patent 2,143,038, granted January 10, 1939 to Smith uses boric acid in part of the fuse as the low current interrupting means. U.S. Patent 2,294,767, granted September 1, 1942 to Williams uses a mechanical means of enlarging a gap to assist interruption. U.S. Patent 2,808,487, granted October 1, 1957 to Jacobs, uses a silver fusible element in ribbon form, perforated or otherwise, with a glass cloth chamber over a part of the fusible element. U.S. Patent 2,833,891, granted May 8, 1958 to Jacobs uses a silver fusible element in ribbon form with special perforations. All these arrangements are complicated and expensive to manufacture and are limited as to the geometry of the fusible element and are likely to have high interruption energies and long arcing times.

Accordingly, one object of the present invention is to provide a high voltage fuse which overcomes the above mentioned difficulties.

Another object of the present invention is to provide a new and improved high voltage fuse which will interrupt reliably at low fault loads.

Another object of the present invention is to provide a new and improved high voltage fuse which is inexpensive to manufacture.

Yet a further object of the present invention is to provide a new and improved high voltage fuse.

Further objects and advantages of the present invention will become apparent as the following description proceeds and the features of novelty which characterize the invention will be pointed out with particularity in the claims annexed to and forming a part of the specification.

In accordance with these and many other objects of the present invention, there is provided a new and improved high voltage current-limiting fuse, wherein a sleeve of insulating and arc-quenching gas-liberating material forms a chamber along a length of the fuse link. The fuse link, as is well known, is then imbedded in a casing filled with pulverulent inorganic arc-quenching filler. The new fuse utilizes the thermal insulation characteristic and/or arc extinguishing characteristic of polytetrafluoroethylene, commonly known under the trade name of Teflon, or similar material to provide simple and economical means to improve the low current interruption performance of high voltage current limiting type fuses.

The improved fuse is adaptable to any cross-sectional geometry, wire, ribbon or tubular, of the fusible element in any essential disposition of the fusible element in suitable pulverulent interrupting medium, for example, sand.

The fusible element may be of silver or other suitable material such as copper. However, silver is the preferred material from other considerations. The method, according to the present invention, can be applied to other types of fuses as well to improve the low current interruption performance.

For a better understanding of the present invention reference may be had to the accompanying drawings wherein:

FIGURE 1 is a longitudinal broken-away view taken through an improved high voltage fuse according to the present invention;

FIGURE 2 is an enlarged partial view of the fuse link and sleeve assembly according to the present invention;

FIGURES 3, 4 and 5 are also partial views of fuse link and sleeve assemblies according to additional embodiment of the present invention;

FIGURE 6 is a cross-sectional view of the fuse link and sleeve assembly of FIGURE 5, taken along line **6—6** of FIGURE 5;

FIGURE 7 is a partial view of a fuse link and sleeve assembly according to another embodiment of the present invention;

FIGURE 8 is a cross-sectional view of the fuse link and sleeve assembly of FIGURE 7, taken along line **8—8** of FIGURE 7; and

FIGURE 9 is a partial view of fuse link and sleeve assemblies according to yet another embodiment of the present invention.

Referring to the drawings, and particularly to the embodiment of FIGURES 1 and 2, there is illustrated an improved current-limiting fuse **10**. The fuse **10** includes a tubular casing **11** of insulating material forming a chamber, the respective ends of which are closed by a pair of electrical terminals **12** and **13**. A fuse link **14** conductively interconnects the terminals **12** and **13**. As is know in the high voltage fuse art, the fuse link **14** may have any cross-sectional geometry, but is here shown as circular in cross section, and is formed of suitable fuse material of relatively low resistivity and with a relatively low specific heat such as silver. The fuse link **14** may, if desired, have incorporated any M-effect, low melting point alloy soldered to the fusible element to form a body **15** of metal. As is well known, the body **15** of low fusing point metal will destroy the fuse link **14** by a metallurgical reaction taking place at a temperature below the fusing point of the fuse link **14** thereby to provide for rupture of the fuse link **14** upon inadmissable duration of low overloads. The body **15** of M-effect metal may suitably be formed of tin or tin alloys, or indium which will form alloys with the metal of the fuse link **14**.

In accordance with the present invention, a sleeve **16** of Teflon or other suitable insulating and arc-quenching, gas-liberating material forms a chamber **16***a* along the fuse link **14** symmetrically about a point in the fuse link, here illustrated as the body **15** of M-effect material. The Teflon sleeve **16** will, of course, have a cross-sectional shape to accommodate the fuse link **14**, and in the illustrated embodiment is round or tubular. Means are provide at the ends of the chamber to allow the escape of gaseous material from the chamber to the interrupting medium and to prevent the pentration of interspace, the space between the inside of the chamber and the outer surface of the fusible element, by the particles of the interrupting medium. The fuse link and sleeve assembly is surrounded within the casing **11** by a suitable pulverulent interrupting medium having arc quenching properties, such as sand **17**.

Referring now to the embodiment of FIGURE 3, there is illustrated a fuse link and sleeve assembly **20** including a fuse link **21** having a Teflon sleeve **22** forming a chamber **22***a* about a section of the fuse link **21**. As illustrated

in FIGURE 3, M-effect material **24** is incorporated in the fuse link **21** and the Teflon sleeve **22** is positioned symmetrically with reference to M-effect material **24**. In the illustrated embodiment, a glass cloth sleeve **25** is slipped on the Teflon chamber just for added thermal insulation.

Referring now to the embodiment of FIGURE 4, there is illustrated a fuse link and sleeve assembly **30** including a fuse link **31** incorporating M-effect material **32**. A sleeve **33** of Teflon or other suitable material is symmetrically positioned along the fuse link **31** symmetrically with reference to the M-effect material **32** to provide a chamber **33***a*. End enclosures **34** are provided to prevent the penetration of the interspace by the pulverulent material surrounding the fuse link assembly **30**. If desired, a suitable glass cloth sleeve **26** may be provided on the Teflon sleeve **33**.

FIGURE 5 and 6 illustrate a fuse link formed of parallel ribbons of fusible elements. As therein illustrated there is shown a fuse link and sleeve assembly **50**, wherein the fusible elements consist of two ribbons **51**, **52** of fusible material in parallel. A Teflon strip **53** is sandwiched between the fusible element ribbons **51** and **52**. Spaced Teflon end sections **54**, **55** are interconnected by a central tubular section **56** of Teflon forming a heat insulating and arc-quenching chamber **56***a*. In the illustrated embodiment, suitable M-effect material **57** is incorporated in the respective ribbons **51** and **52** of the fuse link.

FIGURES 7 and 8 illustrate the invention applied to a tubular fusible element. As therein illustrated, there is shown a fuse link and sleeve assembly **60**, including a tubular fusible link **61**. Throughout a selected portion of the fusible element **61** there is provided an inner core of Teflon **62**, here illustrated as in tubular form, but which also may be in rod form. The hollow center of the Teflon inner core **61** and the tubular fusible element **61** are filled with suitable inorganic filler **63**, for example, of glass fiber. Concentrically positioned over the inner core **62** are spaced Teflon end sections **64**, **65** interconnected by a central section **66** of Teflon forming a chamber **66***a*. Suitable M-effect material **67** may be incorporated in the fuse link **61**.

Referring now to the embodiment of FIGURE 9, there is illustrated a fuse link and sleeve assembly **70** including a fuse link **71** incorporating M-effect material **72**. A pair of spaced sleeves **73** and **74** of Teflon or other suitable material is positioned along the fuse link **71** symmetrically with reference to the M-effect material **72**. The thermal insulating and arc extinguishing characteristics of the Teflon sleeves are effective to improve the low current interruption performance of the fuse; however, the effects of the sleeves are not as pronounced as in the previously described embodiments having a chamber along the fuse link.

Referring to FIGURES 2 through 8, it will be seen that the chamber formed by the Teflon or Teflon and glass sleeve is effective to initiate the melting of the fusible element at about the midpoint of the portion occupied by the chamber at desired low over currents within desired times. For a given fusible element, with or without M-effect, and interrupting medium, this interruption characteristic can be controlled by the location of the chamber along the fusible element and the construction and dimensions of the chamber as illustrated in FIGURES 2 through 8. The chamber is also effective to quench the arc upon melting off the fusible element within the chamber and limiting the arcing time and arc energy under low current interruption.

Referring to FIGURE 9, it will be seen that the melting of the fusible element is initiated by M-effect or other means at a point between two Teflon sleeves. The low current arc is then interrupted by the Teflon. This particular arrangement then ensures, if desired, higher insulation after interruption. The arc quenching action of the Teflon is believed to be due to the electronegative character of fluorocarbon gases, such as CF_4, which use the main components of decomposition of the Teflon.

Tests on high voltage fuses constructed in accordance with the present invention indicate that the interruption energies involved are small in the low current range when the melting of the fusible element is confined only to the portion occupied by the chamber formed by the Teflon sleeve. The interruption energies could be reduced to relatively minute amounts by a suitable form of chamber. The arcing time may be reduced to maximums of one-half cycles. The high current interruption performance of the fuse is unaffected by the presence of the Teflon portions in the chamber. Accordingly, the proposed improvement renders the interrupting ability of the silver-sand fuse satisfactory over the entire range of fault currents.

Although the present invention has been described by reference to several embodiments thereof, it will be apparent that numerous other modifications and embodiments will be devised by those skilled in the art which will fall within the true spirit and scope of the present invention.

What is claimed as new and desired to be secured by Letters Patent of the United States is:

A high voltage current limiting fuse comprising a casing of insulating material, a pair of terminal elements closing the ends of said casing, a uniform fuse link of round wire free of M-effect material conductively interconnecting said terminal elements, sleeve means of Teflon spaced around a portion of said fuse link, sleeve means of glass cloth provided over the above mentioned sleeve means, end enclosure means closing the ends of said Teflon sleeve, and a pulverulent arc-quenching filler surrounding said fuse link and said sleeve means within said casing.

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