

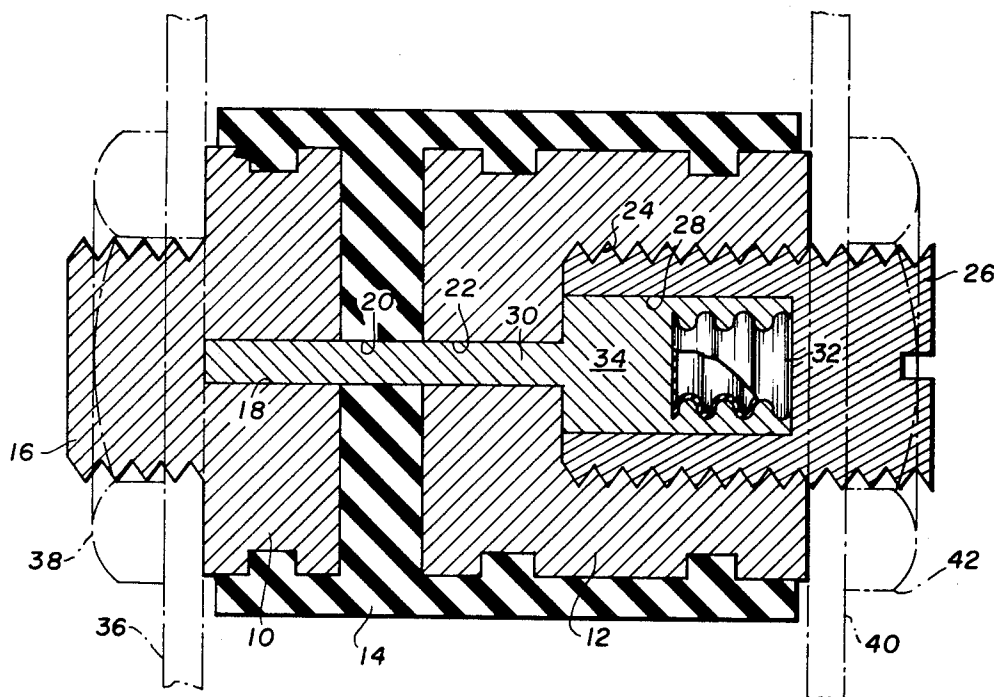
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[54] **CURRENT LIMITING DEVICE**
2 Claims, 1 Drawing Fig.

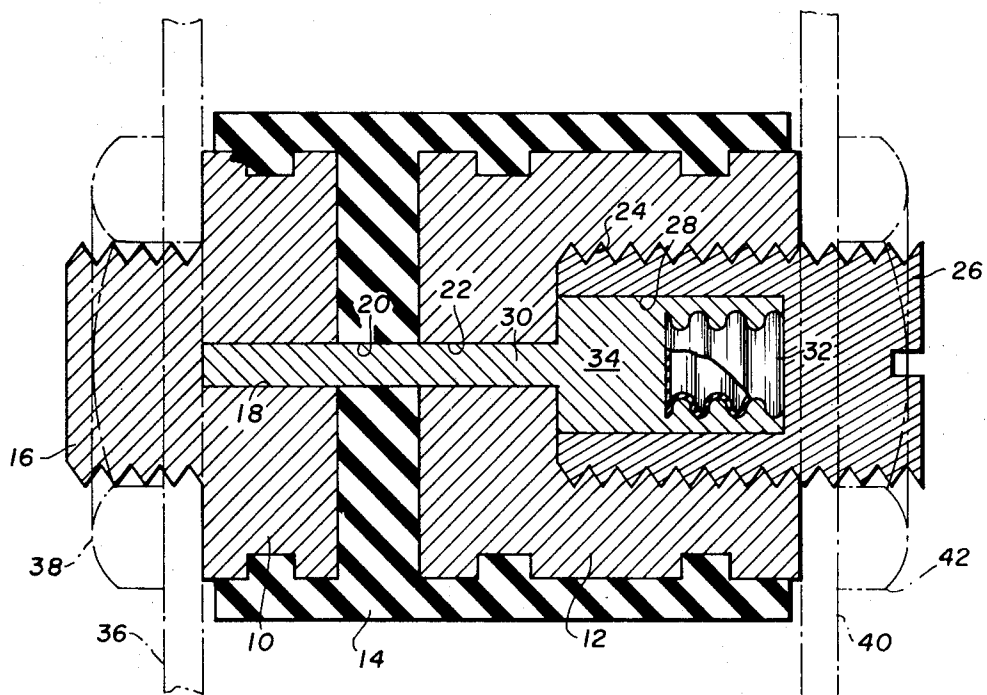
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H01h 87/00
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114, 119, 159, 290

ABSTRACT: The current limiter comprises two spaced opposite electrodes interconnected into a unitary structure by an insulation. A compartment formed within the electrodes and insulation is hermetically closed by a plug screw threaded into one of the electrodes and provided with a hole forming a part of the compartment. Disposed within the compartment are a current limiting material normally put in a liquid or solid state and a pressure relief member. The material responds to a short circuit current to be evaporated to limit the current after which it returns to its original state.



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CURRENT LIMITING DEVICE

BACKGROUND OF THE INVENTION

This invention relates to improvements in a current limiting device of self-restoration type capable of repeatedly limiting extraordinary currents such as short-circuit current apt to cause faults in wiring and equipments of an electric circuit as do overload currents.

Current limiting devices of the type referred to may sometimes be called "permanent fuses" and include the current limiting material composed of a low melting point metal liquidized or solidified at room temperature or at relatively low temperatures up to 100° C. at the outside. Examples of such low melting point metals involve sodium (Na), potassium (K), sodium-potassium (NaK), mercury (Hg) etc. The current limiting material as above described electrically good conductive and is responsive to a high current flowing therethrough to generate Joule heat therein to be evaporated thereby to form a plasma very high in vapor pressure. The plasma exhibits its specific resistance greatly higher than the short circuit impedance of the associated circuit thereby to limit the particular short circuit to a predetermined magnitude or less. In addition after the completion of the current limiting operation, the evaporated material is rapidly cooled to be liquified or solidified state. That is, the material is self-restored to the original electrically good conductive material.

In the conventional current limiting devices of the type referred to there has been a fear that, upon evaporating the current limiting material, the enclosed compartment filled with that material has abruptly increased in pressure thereby to release the screw threaded screw for the compartment.

SUMMARY OF THE INVENTION

Accordingly it is an object of the invention to eliminate the above-mentioned disadvantage of the prior art practice.

The invention accomplishes this object by the provision of a current limiting device comprising, in combination, a pair of electrodes disposed in spaced parallel relationship, an electric insulation for insulating interconnecting the electrodes into a unitary structure, a compartment formed within the electrodes and insulation, a screw threaded plug screw threaded in one of the electrodes to hermetically seal the compartment, and provided with a hole forming a part of the compartment, and a current limiting material filling the compartment and responsive to a current in excess of a predetermined magnitude flowing through the device to be evaporated to perform a current limiting operation after which the material is self-restored.

BRIEF DESCRIPTION OF THE DRAWING

The invention will become more readily apparent from the following detailed description taken in conjunction with the accompanying drawing wherein a single FIGURE is an axial sectional view, partly in elevation, of a current limiting device constructed in accordance with the principles of the invention with parts broken away.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring now to the drawing, it is seen that an arrangement disclosed herein comprises a pair of electrodes 10 and 12 disposed in spaced opposite relationship and an electric insulation 14 for mechanically interconnecting the electrodes 10 and 12 therewith into a unitary structure while surrounding the outer peripheries of both electrodes. One of the electrodes, in this case, the left-hand electrode 10 as viewed in the drawing has disposed at the exposed end a screw threaded end portion 16 of reduced diameter and drilled in the interior an axial bore 18 of small diameter communicating with an axial bore 20 extending through that portion of the insulation 14 interposed between both electrodes. The bore 20 then communicates with an axial bore 22 partly extending through the other electrodes 12 and terminating in a screw threaded hole

24 larger in diameter than the bores 22 and opening at the exposed end of the electrode 12.

The insulation 14 is preferably of a mixture of powdered mica and powdered glass. Such a mixture is placed in a mold (not shown) having both electrodes 10 and 12 disposed in place therein and heated and molded under a pressure into the desired unitary structure.

As shown, a screw threaded plug 26 is screw threaded into the hole 24 in the electrode 12 and has a hole 28 greater in diameter than the bore 22 and forming a hermetically sealed compartment generally designated by the reference numeral 30 along with the axial bores 18, 20 and 22. The plug 26 projects beyond the exposed end of the electrode 12. The compartment 30 has a pressure relief member 32 disposed at the bottom of the larger hole 28 and a current limiting material 34 filling the remaining portion of the compartment 30.

The current limiting material 34 is composed of a low melting point metal normally put in the form of a liquid or a solid electrically good conductive such as Na, K, NaK, Hg or the like. The material is responsive to a high current in excess of a predetermined magnitude to be evaporated. The pressure relief member 32 may be preferably a bellows filled with any suitable inert gas such as argon.

The device thus formed can be connected to the associated circuit (not shown) by having both the screw threaded end portion 16 fitted into a conductor 36 which is, in turn, fastened to the electrode 10 by a nut 38 and the plug 26 fitted into a conductor 40 that is, in turn, fastened to the electrode 12 by a nut 42. Then conductors 34 and 38 are connected across the circuit.

The arrangement thus far described is operated as follows: Upon the occurrence of a short circuit current, it flows from the conductor 34 for example, through the electrode 10, at least one portion of the current limiting material 32 and the electrode 12 and thence to the conductor 38 to evaporate at least partly of the current limiting material by means of Joule heat generated therein. The evaporated material 34 is very high in vapor pressure and presents a high resistance to the shorted circuit (not shown) to limit the current. After the current limiting operation has been performed, the evaporated material 34 is rapidly cooled to be self-restored to its original liquid or solid state thereby to be ready for the succeeding operation.

Upon evaporating the current limiting material 34, the pressure in the compartment 30 is abruptly increased but it is absorbed through the compression of the pressure relief member 32. However, the pressure in the compartment 30 can be frequently increased too abruptly to be absorbed by the pressure relief member 32. If the plug 26 would not be provided with the hole 28 as in the conventional devices, then the plug will have axially exerted thereon a pressure sufficient to be blown away from the electrode 12.

According to the principles of the invention, however, such a pressure is also radially exerted on the inner periphery of the hole 28 in the plug 26 to reinforce the engagement of the screw threaded plug 26 with the screw threaded hole 28. This ensures that the plug 26 is prevented from being released from the hole 24 by means of the axial pressure exerted thereon due to an increase in pressure within the compartment 30.

While the invention has been illustrated and described in conjunction with a single preferred embodiment thereof it is to be understood that various changes and modifications may be resorted to without departing from the spirit and scope of the invention. For example, instead of the bellows, the pressure relief member 32 may be a hollow bulb of any suitable synthetic rubber or a slide member slidably fitted into the hole 28 and normally biased toward the bore 22 by means of a gas or a spring.

What is claimed is:

1. A current limiting device comprising, in combination, a pair of electrodes disposed in spaced opposite relationship, an electric insulation for insulatingly interconnecting said electrodes into a unitary structure, a compartment formed within

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said electrodes and said insulation, a screw threaded plug screw threaded into one of said electrodes and provided with a hole forming a part of said compartment, and a current limiting material filling said compartment and responsive to the occurrence of a current in excess of a predetermined magnitude to be evaporated to perform the current limiting operation

after which it is restored.

2. A current limiting device as claimed in claim 1 comprising a pressure relief member disposed in said hole formed in said plug.

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