United States Patent [19]

Mikulecky

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[45] **Aug. 28, 1973**

[54] **MODULARIZED FUSE WITH PRECISE GAP**

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[73] Assignee: **McGraw-Edison Company**, Elgin, Ill.

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[52] U.S. Cl. **337/158**, 337/164, 337/229

[51] **Int. Cl.** **H01h 85/04**

[58] **Field of Search** 337/17, 18, 19, 28, 337/31, 33, 158, 159, 161, 162, 164, 229, 244, 290, 293, 297; 317/61, 69, 70

[56] **References Cited**

UNITED STATES PATENTS

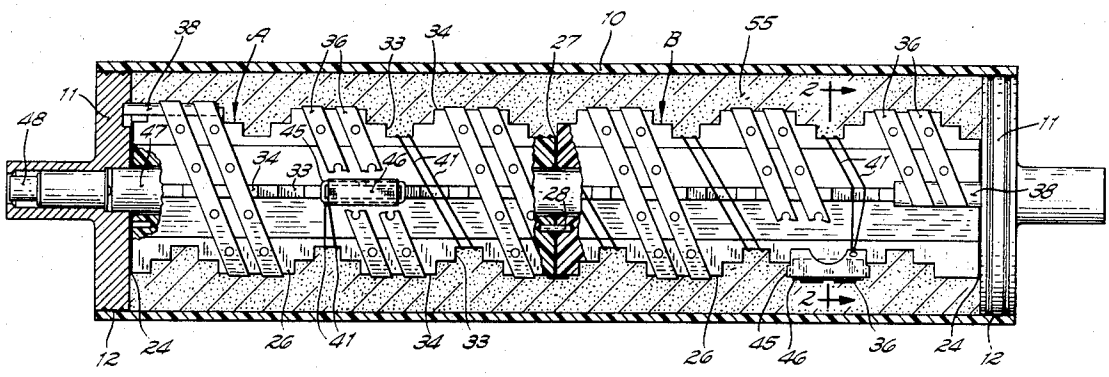
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[57] **ABSTRACT**

This current limiting fuse has a spider type support for the main fuse element. This support has a plurality of segments joined together serially by a cement-like composition. Preferably, these segments are of lengths for establishing fuse sizes corresponding to standard design voltage ratings such as 8.3 KV, 15.5 KV, 27 KV and 38 KV. An auxiliary fuse element may be wound on the spider type support and spaced from the main fusible element. A gap separates the main fusible element and at least one end of the auxiliary element. This gap is defined by the thickness of a porous tape member that forms an effective precise gap.

5 Claims, 3 Drawing Figures



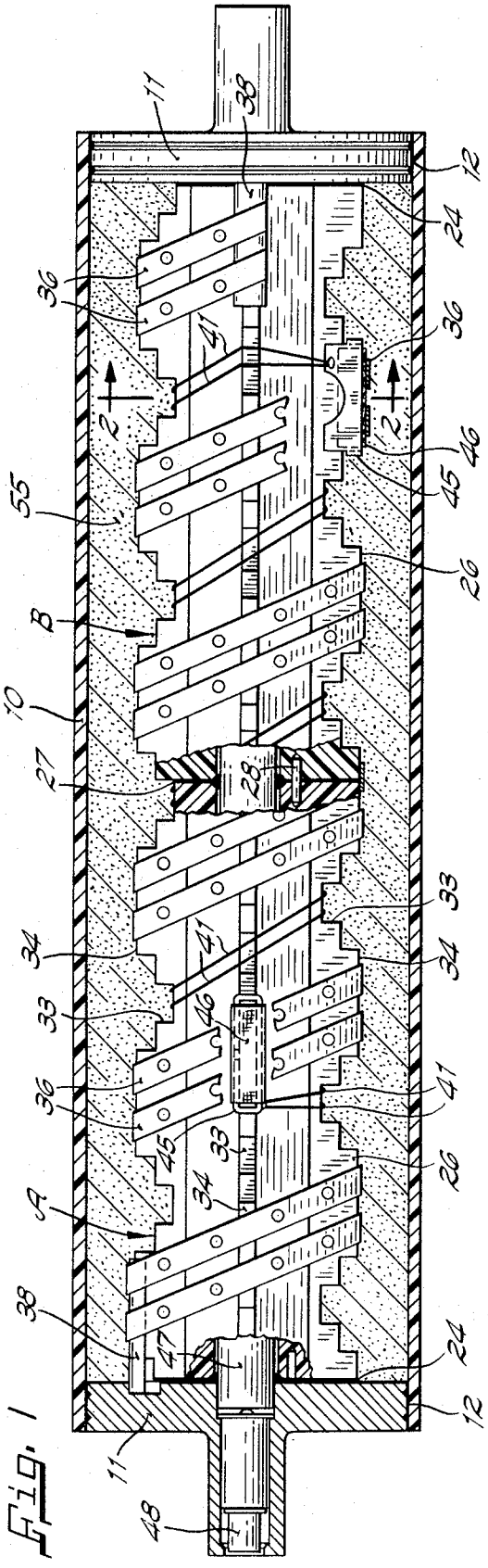


Fig. 1

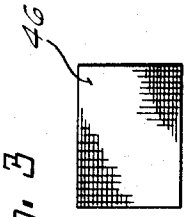


Fig. 3

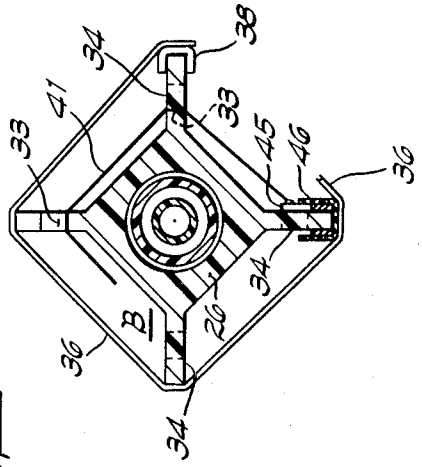


Fig. 2

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MODULARIZED FUSE WITH PRECISE GAP

BACKGROUND OF THE INVENTION

This application relates to fuses and, more particularly, to current limiting fuses having auxiliary elements.

Current limiting fuses have been constructed heretofore with a fusible element embedded in a granular inert material of high dielectric strength such as sand or finely divided quartz. Usually the fusible element is in the form of one or more thin conductors of silver wound on a supporting core or spider of high temperature resistant material, such as is described in U. S. Pat. No. 3,437,971, dated Apr. 8, 1969, by the same inventor and assignee as the present invention. Excessive current will cause the fusible element to vaporize, with subsequent cooling of the vapors on the inert material, thereby opening the circuit. An auxiliary fusible element may be wound on the core separated from the main element by a gap to cause multiple arc regions under minimum melting current operation and thereby to more effectively break the circuit. This is shown in U. S. Pat. No. 3,243,552, dated Mar. 29, 1966, by the same inventor and assignee as the present invention, wherein an end gap is stated to be approximately 1/16 inch to 1/32 inch. For the optimum result, this auxiliary element operates more effectively if this gap is minimized further. An indicator fusible element has been placed in parallel with the main fusible elements to cause a visual indication through an indicator button or other means for indicating when the fuse has blown.

As the fuse art has progressed, the need for, first, a greater number of standard fuse sizes and, second, the more precise control of the fusing action has grown. Fuses have been constructed of various lengths according to their voltage ratings. More precise fusing control has been achieved through use of improved fusible elements, through use of specific melt points on the fusible elements, through use of auxiliary elements with a precise gap to the main element and through other means. The present invention has advanced the art in both of the aforementioned areas of need, namely the simplification of standardized fuse lengths and the more precise fusing of the fusible element through use of a more precise gap construction.

It is an object of this invention to provide a current limiting fuse having a spider on which main and auxiliary fusible elements are wound; the auxiliary element being separated from the main element by an improved gap structure.

A current limiting fuse according to this invention has a core or spider constructed of segments that are joined endwise by a cementitious material so that an integral core is formed on which main and auxiliary fusible elements may be wound. A novel gap structure between the main and auxiliary fusible elements is formed by using the thickness of a porous insulating tape to determine the gap spacing. An indicator wire subassembly may occupy a cavity through the center of the spider to support the end pieces and spider segments. A housing normally covers the fusible elements and core. The housing is filled with inert material such as sand. Terminals extend from the fuse ends for connection of the main fusible elements to an external circuit.

DESCRIPTION OF THE DRAWING

FIG. 1 is a fragmentary longitudinal cross-sectional view through a current limiting fuse embodying the invention;

FIG. 2 is a view taken on line 2—2 of FIG. 1; and

FIG. 3 shows the porous material member used in forming the gap between main and auxiliary fusible elements.

DESCRIPTION OF THE PREFERRED EMBODIMENT

In the drawings, FIG. 1 shows a current limiting fuse structure with a housing **10** which surrounds the central longitudinally extending core or spider **26** with a main fusible element **36** and auxiliary fusible element **41** wound thereon. Housing **10** may be constructed of suitable insulating material such as glass fiber impregnated with epoxy resin, glass, or fiber.

Spider **26** may be of inert material such as porcelain, but it is constructed preferably of an electrical insulating material adapted to evolve gas in the presence of an arc, as is described in U. S. Pat. No. 3,437,971. FIG. **2** shows the preferred cross-sectional view of spider **26** as generally star-shaped. However, other cross-sectional shapes, such as rectangular or circular, may be used for spider **26.**

Spider **26** has two equal segments designated as "A" and "B" that are joined by a suitable inorganic refractory cement **27.** A suitable cement is sold commercially and designated with the trademark "SAUEREISEN." This cement cures to become a ceramic-like material and fulfills the requirement that no carbon be present to create tracking surfaces which interfere with the operation of the fuse.

Various voltage ratings, such as 8.3 KV, 15.5 KV, 27 KV, 38 KV and others are obtained by varying the number of segments joined end to end. While standardization of parts favors use of segments of equal length, the number and length of segments will vary according to the rating of the fuse and the need for a spider with precise linear alignment. In other words, it has been found also that this segmented spider eliminates any problem of camber in the spider.

A pin **28** may be used to align segments "A" and "B" prior to the application and curing of the cement **27.** This will ensure formation of a continuous helix on which the fusible elements **36** and **41** may be wound, as will be described hereinafter.

Spider **26** is joined to metallic end pieces **11** by an epoxy adhesive **24** or other suitable sealing material. Housing **10** is joined to metallic end pieces **11** also with an epoxy seal **12** or other suitable sealing material. Housing **10** is sufficiently rigid to give support to the entire internal structure. The space between housing **10** and the spider **26** is filled with a granular inert or refractory material **55** of high dielectric strength such as sand or finely divided quartz. This material **55** serves to isolate the fusing action of elements **36** and **41** from the environment outside of housing **10,** as is well known to those skilled in the fuse art.

Main fusible element **36** is wound helically on raised shoulders **34** formed on spider **26.** This main element **36** may be formed of single or multiple wires or bands formed of silver or other material well known to those skilled in the art. FIG. **1** shows the use of two parallel bands for element **36** while other designs have used five ribbons in parallel.

The ends of main element **36** are fastened to terminals **38** which are attached to conductive end pieces **11**

that are connected into an electrical circuit (not shown).

An auxiliary fusible element **41** is wound helically on depressions **33** formed into the spider **26.**

This auxiliary element **41** may be single or multiple wires or ribbons of silver or copper material. Normally, auxiliary element **41** has a lower melting current characteristic than the main element **36.** The operating sequence for a fuse with main and auxiliary fuse elements is discussed thoroughly in U. S. Pat. No. 3,243,552, mentioned above. Ends of auxiliary element **41** are attached to conductive metallic clips or electrodes **45** fastened to the spider **26.** At least one clip **45** is separated from the main fuse elements **36** by the thickness of a porous insulating member or tape **46.** FIGS. **1** and **2** illustrate the positions for clip **45,** tape **46** and main element **36.** It has been found that an unfilled glass fiber tape of approximately 0.003 inch to 0.005 inch thickness provides an ideal minimum gap between main fusible element **36** and metallic clip **45.** Some resinous material may be added to the tape to provide rigidity as long as the porosity is not affected. FIG. **3** illustrates this type of porous tape **46.** This provides a precise means for switching in the auxiliary fusible element **41** for low fault current clearing.

An indicator wire assembly **47,** not shown in detail, extends through the center of spider **26** and activates an indicator button **48** after the fuse has blown.

This indicator wire assembly **47** forms a support for end pieces **11** and the spider segments **26** ("A" and "B") during assembly and thereafter.

While only one embodiment of the invention has been described in the specification and shown in the drawing, this invention should not be limited thereby but should be extended to all similar constructions apparent to those skilled in the art.

I claim:

1. A current limiting fuse comprising:

a housing,

electrical connecting terminals mounted on the housing and adapted to connect the fuse into an electrical circuit,

a spider extending longitudinally within the housing,

a main fusible element connected to and between the electrical connecting terminals and wound around the spider,

at least one conductive electrode positioned adjacent the main element,

an auxiliary conductive element wound along a portion of the spider and connected at one end to the electrode, and

a porous woven glass fiber tape positioned at the electrode between said electrode and the main fusible element to thereby space said electrode from said main fusible element by a distance substantially equal to the thickness of said member.

2. A current limiting fuse according to claim **1** wherein said tape has a thickness of about 0.003 inches to 0.005 inches.

3. A current limiting fuse comprising:

a housing,

electrical connecting terminals adapted to connect the fuse into an electrical circuit,

a spider extending longitudinally within the housing,

a main fusible element connected to the electrical connecting terminals and helically wound around the spider,

two electrodes positioned adjacent the main element and spaced apart from each other along the length of the spider,

an auxiliary conductive element wound along a portion of the spider and connected at one end to one electrode and at the other end to the other electrode, and

a porous woven glass fiber tape positioned at each electrode between said electrode and the main fusible element to thereby space said electrode from said main fusible element by a distance substantially equal to the thickness of said member.

4. A current limiting fuse according to claim **3** wherein said tape has a thickness of about 0.003 inches to 0.005 inches.

5. A current limiting fuse according to claim **3** wherein said auxiliary element is a fusible element having a lower melting current characteristic than the main fusible element.

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