United States Patent [19]

Koch

[11] **3,813,627**

[45] **May 28, 1974**

[54] **CURRENT LIMITING FUSE HAVING IMPROVED LOW CURRENT INTERRUPTING CAPABILITY**

[75] Inventor: **Robert E. Koch,** Pittsfield, Mass.

[73] Assignee: **General Electric Company,** Pittsfield, Mass.

[22] Filed: **June 11, 1973**

[21] Appl. No.: **369,051**

[52] **U.S. Cl.** **337/274,** 337/159, 337/160, 337/296

[51] **Int. Cl.** **H01h 85/38**

[58] **Field of Search** 337/273, 274, 276, 290, 337/295, 296, 159, 160

[56] **References Cited**

UNITED STATES PATENTS

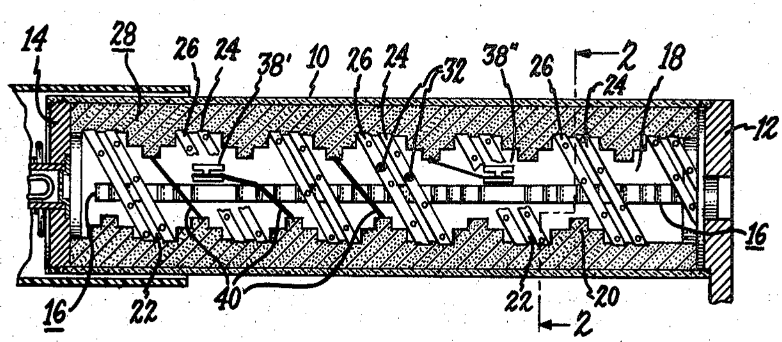
3,243,552	3/1966	Mikulecky	337/276 X
3,256,408	6/1966	Stumpe et al.	337/273
3,287,525	11/1966	Mikulecky	337/276 X
3,603,909	9/1971	Salzer	337/276 X
3,733,572	5/1973	Mikulecky	337/273

Primary Examiner—J. D. Miller
Assistant Examiner—Fred E. Bell
Attorney, Agent, or Firm—Vale P. Myles; Volkar R. Ulbrich; Francis X. Doyle

[57] **ABSTRACT**

This current limiting fuse employs auxiliary spark gaps adjacent fusion points of at least one main fuse element for the purpose of reliably melting additional series arc gaps in that main fuse element when the fuse is subjected to a low magnitude overload current.

6 Claims, 12 Drawing Figures



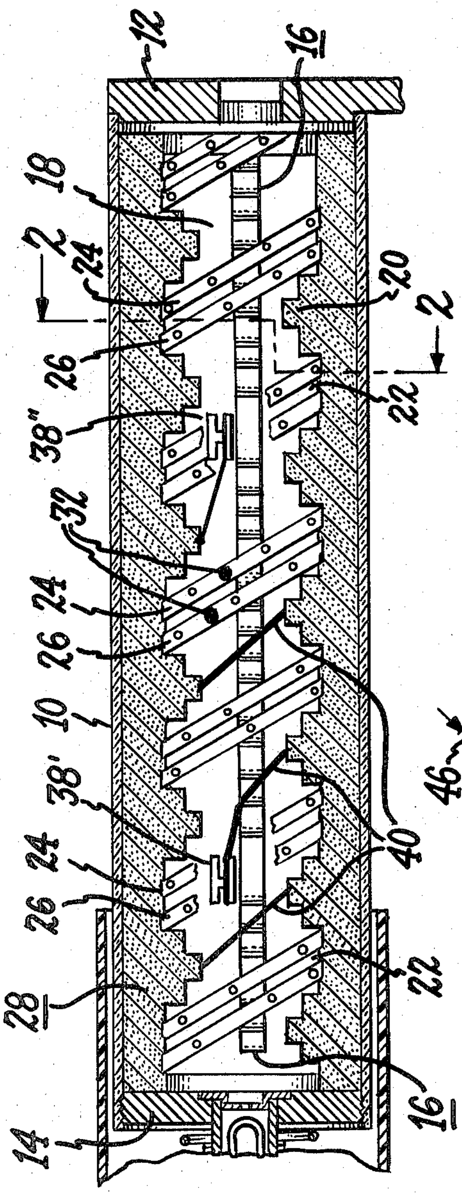


Fig. 1.

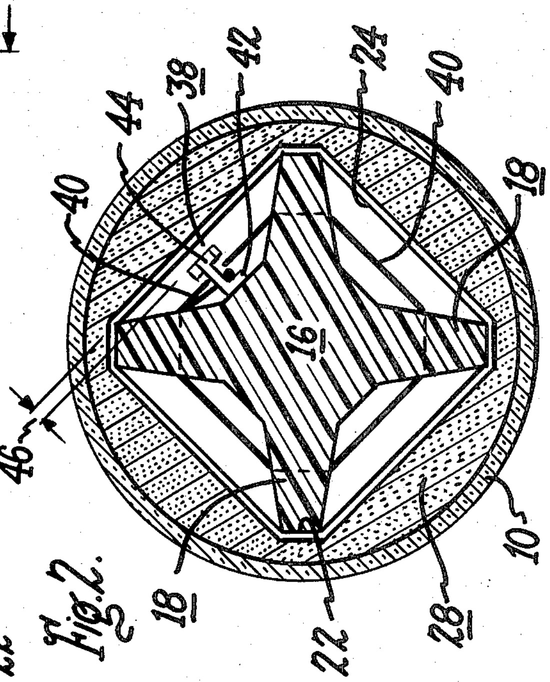


Fig. 2.

Fig. 3.

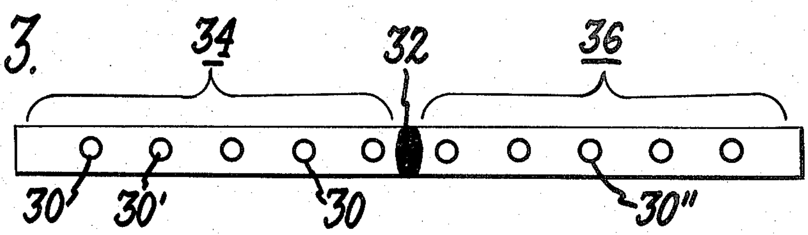


Fig. 6a.

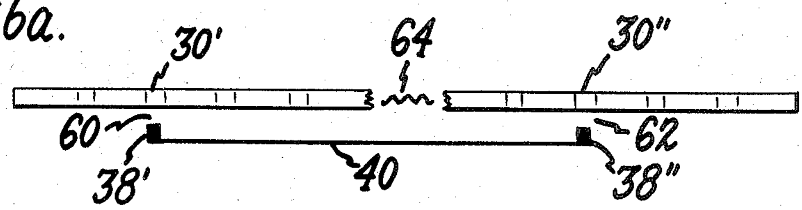


Fig. 6b.

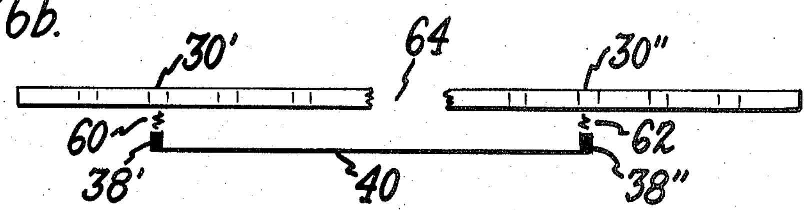


Fig. 6c.

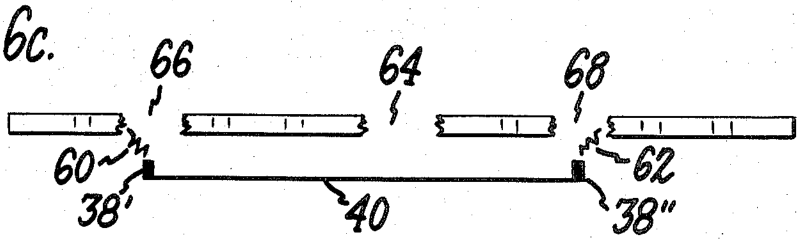


Fig. 6d.

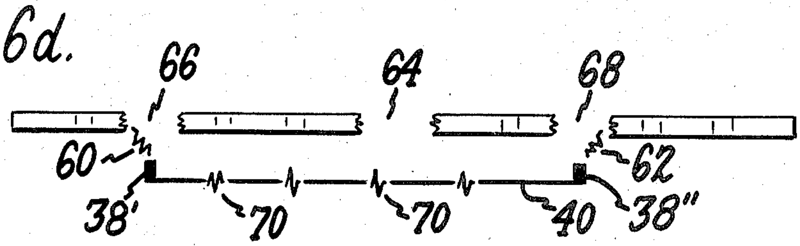


Fig. 6e.

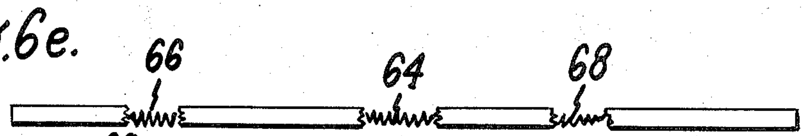


Fig. 6f.

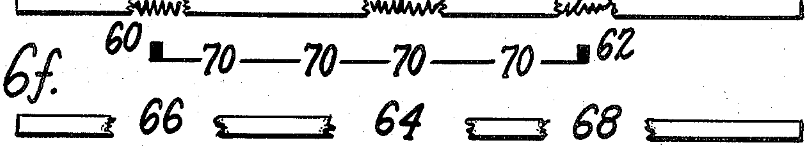


Fig. 4a.

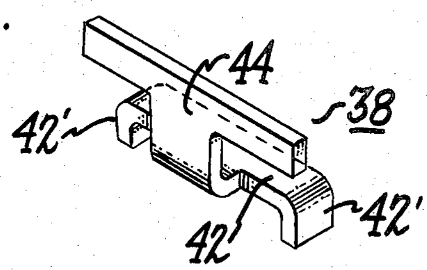


Fig. 4b.

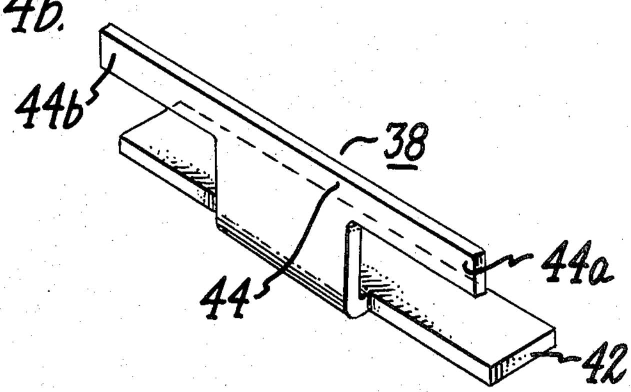
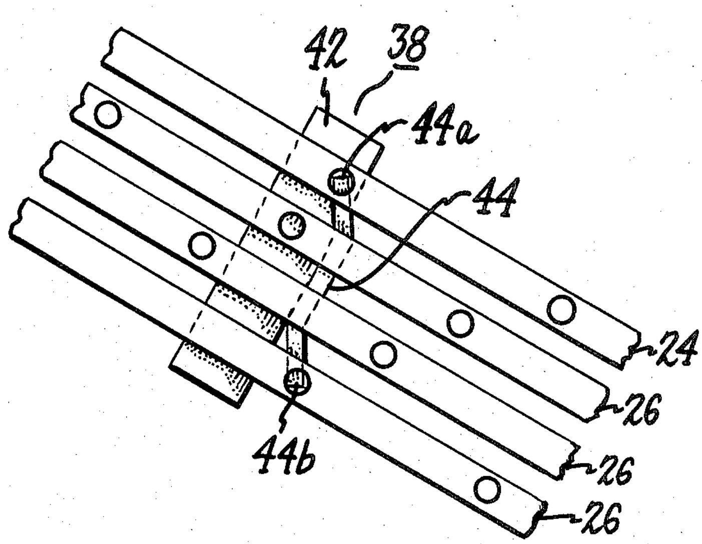


Fig. 5.



CURRENT LIMITING FUSE HAVING IMPROVED LOW CURRENT INTERRUPTING CAPABILITY

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates to electrical fuses and more particularly to improved current limiting fuses.

2. Description of Prior Art

A current limiting fuse is employed as a part of a high voltage electrical distribution system to limit the flow of current under a fault condition to a magnitude substantially less than the current available for conduction under a short-circuit condition. Such performance is attained as a result of the construction of the current limiting fuse. A current limiting fuse typically comprises one or more main fuse elements, each having a plurality of fusion points distributed along its length. Each main fuse element is longitudinally interconnected between electrical terminals and supported on a core of high-temperature-resistant ceramic material. A mass of inert granular arc quenching material surrounds each main fuse element and the core. The current limiting fuse is serially connected in a portion of the electrical distribution system, and the current flowing in that portion of the distribution system is conducted by the main fuse elements. In operation, when a fault occurs and the current increases, the fusion points, being points of higher resistance in the main fuse element, melt due to the increased temperature at the fusion points. The melted fusion points create a series of arc gaps in the main fuse element, and the high voltage of the distribution system causes electrical arcs to bridge these arc gaps. The arc gaps are electrically in series in the current path, and the voltage drop or potential across each of them reduces or limits the amount of fault current conducted by the current limiting fuse to a magnitude substantially less than the current available under short-circuit conditions.

The objective of a current limiting fuse is not only to create as many serially connected arc gaps as possible to initially limit the magnitude of current conducted as a result of a short circuit on the system, but further to extinguish the arcs as rapidly as possible to terminate further conduction of current. The inert granular arc quenching material helps achieve this result by providing a medium for the metal vapors of the melting main fuse element to be received and condensed, thereby removing energy from the arc. However, the high temperature of the arc at the arc gaps causes the inert arc quenching material to melt and form a material surrounding the arc gap called a fulgurite. The fulgurite is a semiconductor of current when hot but an insulator when cool. Thus, the fulgurite must be cooled as rapidly as possible to terminate the flow of current and extinguish the arc. Rapid cooling of the fulgurite during high fault current operation can be achieved by reducing the amount of arc energy at each arc gap, by creating a large number of serially connected arc gaps.

Under high magnitude fault current conditions, the operation of the current limiting fuse is precise and consistent. The fault current causes each of the longitudinally displaced fusion points to substantially instantaneously melt, creating a large number of serially connected arc gaps in the current path, to limit the current as described above. However, under low magnitude overload current conditions, as for example, a current slightly greater than the normal maximum current magnitude, additional features must be incorporated in the current limiting fuse to insure reliable low current interrupting ability.

A conventional feature for improving the low current interrupting capability of a current limiting fuse is that of employing a body of low-melting-temperature alloy in intimate contact with each main fuse element in its middle section. Under the influence of low magnitude overload current and before the fusion points melt the body of low-melting-temperature alloy melts and amalgamates with the main fuse element. This amalgamation is a spot of high resistance which causes an initial arc gap and a resulting semiconductive fulgurite. As the main fuse element begins to burn back from the initial arc gap, the heat energy present maintains the fulgurite in a conductive state to sustain the arc. If the arc and the fulgurite are not cooled, the arc and the semiconductive fulgurite will continue to lengthen along the total length of the main fuse element until a conductive path of fulgurite exists between the electrical terminals. Should this condition occur, the current limiting fuse will become a conductor having no ability to provide the desired function of a fuse which is to terminate the flow of current.

Means devised to avoid this problem and improve the ability of the current limiting fuse to function reliably when required to limit and terminate the flow of low magnitude overload current are described in U.S. Pat. No. 3,243,552 issued to Harvey W. Mikulecky. In this patent the current limiting fuse employs auxiliary arc gaps to create additional series arcs in the main fuse element after the initial arc gap at the body of low-melting-temperature alloy had been created. The additional arc gaps have the effect of increasing the fusible element burn-back rate resulting in a more rapid arc voltage development and thereby reliably terminating the flow of current.

The additional series arc gaps provided in the aforementioned patent are the result of auxiliary arc gaps spaced from the main fuse element at points intermediate the body of low-melting-temperature alloy and the electrical terminals. The auxiliary arc gaps are interconnected by an auxiliary fuse element whose melting characteristic is coordinated with the melting characteristic of the main fuse element. The auxiliary arc gaps interconnected by the auxiliary fuse element form an electrical circuit which is electrically in parallel with the initial arc gap created by the body of low-melting-temperature alloy. In operation, a low magnitude overload current causes the body of low-melting-temperature alloy to melt and form an initial arc gap. The main fuse element begins to burn back and the voltage across the initial arc gap increases in magnitude and causes the auxiliary arc gaps to arc over. The arcs at the auxiliary arc gaps begin to melt the main fuse element in two additional positions. The coordinated melting ratios of the main and auxiliary fuse elements should insure that the auxiliary arc gaps will conduct current long enough to melt completely through the main fuse element at the two additional points, thereby forming two additional arc gaps or a total of three arc gaps electrically connected in series. After the two additional arc gaps have been formed in the main fuse element, the auxiliary fuse element melts in a number of spots to limit the current flowing through it. In this condition the main and auxiliary fuse elements theoretically both have a sufficient number of series arc gaps to extinguish the arcs at all the arc gaps and cool them to terminate current conduction.

It has been determined that the above-described arrangement of auxiliary arc gaps frequently fails to melt the main fuse element and create the additional series arc gaps. This is a result of the auxiliary fuse element melting and interrupting before the auxiliary arc gaps have conducted current long enough to melt the main fuse element and create the additional series arc gaps. When the additional series arc gaps are not created, the initial arc gap created by the body of low-melting-temperature alloy resumes arcing and melting the main fuse element while being sustained by the semiconductive fulgurite until the total length of the main fuse element has been melted, resulting in the previously described detrimental effects.

A current limiting fuse constructed according to the present invention avoids this problem. It provides reliable, low current, interrupting capability by insuring that the auxiliary arc gaps consistently melt the main fuse element to produce additional series arc under a low magnitude overload current condition. This improved low current interrupting capability is achieved by locating auxiliary arc gaps at points adjacent fusion points of the main fuse element and controlling the gap spacing to assure low sparkover voltage. The reduced cross-sectional area of the fusion points and the location and controlled gap spacing of the auxiliary arc gaps adjacent these points insure that the auxiliary fuse element will conduct current long enough to completely melt the main fuse element at the auxiliary arc gaps.

SUMMARY OF THE INVENTION

It is an object of this invention to provide a current limiting fuse having an improved low magnitude overload current interrupting capability.

It is another object of this invention to provide a current limiting fuse that reliably produces a plurality of current limiting arc gaps in the main fuse element when the current limiting fuse is subjected to low magnitude overload currents.

It is a further object of this invention to provide a current limiting fuse having a current interrupting capability under low magnitude overload currents which is just as reliable as its current interrupting capability under high magnitude fault currents.

To achieve these and other objects, a current limiting fuse embodying the invention and having improved low current interrupting capability employs means for providing auxiliary arc gaps adjacent fusion points of at least one or a primary main fuse element. The primary main fuse element is supported on a core of insulating material within a hollow insulating housing, and the primary main fuse element is electrically interconnected longitudinally between electrical terminals attached to the ends of the insulating housing. A plurality of fusion points are distributed along the length of the primary main fuse element, and a body of low-melting-temperature alloy is in intimate contact with the primary main fuse element at a point separated from the electrical terminals by a first and a second group of fusion points. The first group comprises the fusion points longitudinally distributed along the primary main fuse element between one electrical terminal and the body of low-melting-temperature alloy, and the second group comprises the fusion points longitudinally distributed along the remainder of the primary main fuse element between the other electrical terminal and the body of the low-melting-temperature alloy. Means for providing a first auxiliary arc gap adjacent a fusion point of the first group and means for providing a second auxiliary arc gap adjacent a fusion point of the second group are electrically interconnected by an auxiliary fuse element. An inert granular arc quenching material surrounds all of the elements within the hollow insulating housing. During low magnitude overload current interruption, the means for providing the auxiliary arc gaps adjacent the fusion points of the first and second groups insures that the primary main fuse element will completely melt through to establish at least two additional series arc gaps between the electrical terminals after the body of low-melting-temperature alloy has produced the initial arc gap. Complete and reliable melting of the primary main fuse element is achieved as a result of the concise location and adjustment of the means for providing the first and second auxiliary spark gaps adjacent the fusion points of the first and second groups, respectively, of the primary main fuse element.

BRIEF DESCRIPTION OF THE DRAWINGS

A more complete understanding of the invention may be had by referring to the accompanying detailed description of the invention and drawings in which:

FIG. 1 is a sectional side view of a current limiting fuse embodying the present invention;

FIG. 2 is a cross-sectional view taken on line 2—2 of FIG. 1;

FIG. 3 is a longitudinal view of a main fuse element comprising a part of the invention;

FIG. 4*a* and 4*b* are views of preferred forms of arcing clips forming a portion of the invention illustrated in FIG. 1;

FIG. 5 is a partial view illustrating the arcing clip of FIG. 4*a* or 4*b* as it may be employed in the invention; and

FIGS. 6*a* through 6*f* are illustrative schematic representations of the operation of the current limiting fuse of the present invention, illustrating its improved interrupting capability under low magnitude overload currents.

DETAILED DESCRIPTION OF THE INVENTION

One embodiment of the invention, a current limiting fuse having improved low current interrupting capability, is generally illustrated in FIG. 1. The current limiting fuse comprises a hollow insulating housing **10** having two ends to which are attached electrical terminals **12** and **14** through which current from the electrical distribution system passes. The hollow insulating housing **10** may be constructed of ceramic material, pyrex glass, or a composite of glass fibers mixed with epoxy resin, and it encloses the elements of the current limiting fuse within its interior. A spider or core **16** extends axially between the electrical terminals **12** and **14** within the housing **10**. The core may be constructed of inert ceramic material such as steatite, but it is preferably of an electrical insulating material adapted to evolve gas in the presence of an arc, for example a thermosetting composition including a filler having water of hydration which is emitted when the core is heated. The core is generally of a star-shaped or cruciform cross-section (as best seen in FIG. 2), and has a plurality of longitudinally extending and radially protruding ribs **18.** Each of the ribs **18** includes depressions **20** for defining a number of shoulders **22.** The arrangement of the shoulders generally form a helical path between the electrical terminals, and at least one or a primary main fuse element **24** is wound or supported on the shoulders **22** in a generally helical path to electrically interconnect the terminals **12** and **14.** The current requirements of current limiting fuses may require that more than one main fuse element be employed, but, at minimum, the primary main fuse element **24** must always be employed. FIG. **1** illustrates two main fuse elements, the primary main fuse element **24** and one secondary main fuse element **26.** Each secondary main fuse element is electrically connected in parallel with the primary main fuse element **24** between the electrical terminals **12** and **14,** and is also mechanically supported by the shoulders **22** in a generally helical path parallel to the helical path of the primary main fuse element **24.** An inert granular arc quenching material **28,** for example quartz sand, is packed within the housing **10** and surrounds all of the elements.

The primary main fuse element **24** and each secondary main fuse element **26** are substantially the same and constructed, for example, of silver. One such main fuse element is shown in longitudinal form in FIG. **3.** Referring to FIG. **3,** each main fuse element has a plurality of fusion points **30** distributed along its length from one end to the other. The fusion points are points of decreased cross-sectional area which may result, for example, from forming holes or apertures in the main fuse element. The decreased cross-sectional area of the fusion points exhibit higher resistance to the flow of current than the full cross section of the main fuse element. A high magnitude fault current causes the main fuse element to melt at the fusion points and a series of arc gaps are established. The voltage drops across the arc gaps opposes the voltage of the electrical distribution system to limit the current conducted by the current limiting fuse. The main fuse element also includes a body **32** of low-melting-temperature alloy, for example lead-tin solder, in intimate contact with the main fuse element at a point intermediate the ends of the main fuse element. Because the main fuse element is electrically interconnected longitudinally between the electrical terminals, the body **32** of the low-melting-temperature alloy is separated from one terminal by a first group **34** of fusion points and is separated from the other electrical terminal by a second group **36** of fusion points. The first and second groups **34** and **36,** respectively, each include at least one fusion point, thereby insuring that at least one fusion point separates the body of low-melting-temperature allow from each electrical terminal. Under a low magnitude overload current insufficient to melt the fusion points, the body of low-melting-temperature alloy melts and forms an amalgamation with the main fuse element. This amalgamation has a resistance much higher than the resistance of the fusion points **30** and will melt the main fuse element at the point of amalgamation to create an initial arc gap.

The elements providing auxiliary arc gaps adjacent fusion points, which achieve the improved low magnitude overload current interrupting capability, will now be described in conjunction with FIG. **1.** Attached to the core **16** in a position intermediate the axially extending and radially protruding ribs **18** are means **38'** for providing a first auxiliary arc gap adjacent a fusion point of the first group **34** and means **38''** for providing a second auxiliary spark gap adjacent a fusion point of the second group **36.** Means **38'** and **38''** are rigidly attached to the core by cement or are mechanically attached. An auxiliary fuse element **40** electrically interconnects the means **38'** and **38''** and is tightly wound and supported in a helical path in the depressions **20** of the ribs **18.** The melting characteristics of the auxiliary fuse element are coordinated with the melting characteristics of the main fuse element, and in many applications the auxiliary fuse element **40** may comprise a plurality of fuse wires electrically connected in parallel between the means **38'** and **38''**. Generally, the ratio of the one hundred second melting current of the main fuse element will be a number of times greater than the one hundred second melting current of the auxiliary fuse element.

Means **38'** and **38''** may comprise, for example, an arcing clip **38,** such as those illustrated in FIGS. *4a* and *4b*. Each arcing clip **38** comprises a base portion **42** for attaching the arcing clip to the core **16** and an electrode portion **44** electrically connected to the base portion **42.** The base portion may include tabs **42'** as shown in FIG. *4a* for centering or positioning the arcing clip in depressions which have been formed in the core.

The electrode portion **44** may include extensions ***44a*** and ***44b***, as illustrated in FIG. *4b*, which may be bent and adjusted to align the electrode portion in a precise position to secure maximum performance. As best seen in FIG. **2,** the electrode portion **44** extends upward from the core **16** a distance less than than needed to touch the main fuse element **24,** and the resulting spacing between the main fuse element, and the electrode portion of the arcing clip **38** forms the auxiliary arc gap. This spacing is referenced by dimension **46,** and this spacing is adjustable due to the bendable construction of the electrode portion **44** and the extensions ***44a*** and ***44b***.

Referring now to FIG. **5,** the extensions ***44a*** and ***44b*** also insure that the electrode portion of the arcing clip can readily be adjusted to produce the auxiliary arc gap at a point adjacent a fusion point in the main fuse element. Thus, the electrode extensions ***44a*** and ***44b*** of the arcing clip **38** are readily adjustable both in position relative to the fusion points and in spacing from the main fuse elements.

As previously discussed, any number of main fuse elements may be connected in parallel depending upon the current requirements of a particular current limiting fuse. However, when more than one main fuse element is employed, it has been determined that providing auxiliary arc gaps adjacent fusion points in two of the parallel-connected main fuse elements is sufficient to achieve improved low current interrupting capability. This is because any remaining main fuse elements will melt more rapidly after the two main fuse elements having the adjacent auxiliary arc gaps have melted. For example, in FIG. **5** one primary main fuse element **24** and three secondary main fuse elements **26** are shown, but the auxiliary arc gaps are provided adjacent only two main fuse elements. The extensions ***44a*** and ***44b*** have been adjusted to align the auxiliary arc gaps adjacent fusion points in the primary fuse element **24** and the outermost secondary main fuse element **26.** Although improved performance will result when auxiliary arc gaps are adjacent the fusion points of two of a plurality of main fuse elements connected in parallel, it is conceivable that any number of extensions on the arcing clip could be employed to provide auxiliary arc gaps adjacent fusion points of any number of parallel connected main fuse elements.

The foregoing description has related primarily to the construction and physical arrangement of elements within the current limiting fuse having improved low current interrupting capability. The following description taken in conjunction with FIGS. *6a* through *6f* will relate to the operation in providing improved low magnitude overload current interrupting capability. It should be understood that FIGS. *6a* through *6f* are merely schematic representations used to clearly describe the operation of the invention.

In FIG. *6a* means **38'** for providing a first auxiliary arc gap **60** adjacent a fusion point **30'** of the first group **34** is shown. Similarly, means **38''** for providing a second auxiliary arc gap **62** adjacent a fusion point **30''** of the second group **36** is illustrated. Means **38'** and **38''** are interconnected by the auxiliary fuse element **40.** Under the influence of a low magnitude overload current, the body **32** of low-melting-temperature alloys melts, amalgamates, and causes the main fuse element to melt at the point of amalgamation, resulting in the establishment of an arc at an initial arc gap **64.** The heat energy at the initial arc increases the length of the gap **64,** while at the same time causing the inert body of granular arc quenching material to turn to fulgurite, as previously described. The increased length of the initial arc gap **64** causes the voltage to increase across it to a magnitude sufficient to cause the first and second auxiliary arc gaps **60** and **62** to arc over, as shown in FIG. *6b*. This results because the voltage necessary to bridge the first and second auxiliary arc gaps is less than the voltage necessary to bridge the initial arc gap **64.** By arcing over, the first and second auxiliary arc gaps extinguish the arc at the initial arc gaps **64,** and the fulgurite surrounding the arc gap **64** begins to cool. The heat associated with the arc energy at the first and second auxiliary arc gaps melts the main fuse element at the first and second auxiliary arc gaps as shown in FIG. *6c* to form two arc gaps **66** and **68** in the main fuse element in addition to the initial arc gap **64.** Because the first and second auxiliary arc gaps are located adjacent the fusion points **30'** and **30''**, this adjacent alignment insures that the main fuse element will reliably melt to produce the additional arc gaps **66** and **68.**

Referring now to FIGS. *6d*, the arcs at the first and second auxiliary arc gaps **60** and **62** continue conducting current until the auxiliary fuse element **40** melts in a number of spots, a few of these melting spots being illustrated at **70.** Arcs are established in these melting spots, and the voltage across each of these arcs limits the flow of current through the first and second auxiliary arc gaps and the auxiliary fuse element. The arcs in the auxiliary fuse element continue to lengthen until they can no longer sustain a flow of current, at which time the flow of current through the auxiliary fuse element is terminated. At this time the initial arc gap **64** and gaps **66** and **68** reignite and resume arcing. The arcing and element burn-back is now taking place at three points which produces an elongation of the total arcing gap at three times the rate which existed when only one arc was at gap **64.** This condition is illustrated in FIG. *6e*. This rapid increase in arc length results in a total arc voltage high enough to extinguish the arc current as shown in FIG. *6f*, and the flow of current through the current limiting fuse has been terminated.

The improved low current interrupting capability previously described results from aligning the means **38'** and **38''** adjacent fusion points of the main fuse element. This alignment and gap spacing insures that the main fuse element will always reliably and rapidly melt to create the additional arc gaps **66** and **68.**

If the means **38'** and **38''** are not positioned adjacent fusion points, as is the case with prior art current limiting fuses, the additional arc gaps **66** and **68** are not always created because the auxiliary fuse elements **40** melts and terminates the flow of current through it before additional arc gaps have been formed in the main fusion element. If the additional arc gaps are not completely formed, the initial arc gap **64** may resume arcing while the fulgurite surrounding the initial arc gap **64** remains a semiconductor. If this occurs the main fuse element will continue to burn-back at one point in its length which could result in a failure of the current-limiting fuse to interrupt the low fault current. By locating the auxiliary arc gaps adjacent fusion points as just described, the current limiting fuse has a reliable and improved low current interrupting capability that eliminates the danger of damage to the electrical system.

Although one embodiment of the current limiting fuse having improved low current interrupting capability has been shown and described, those skilled in the art will preceive changes and modifications without departing from the invention. Therefore, it is intended by the appended claims to cover all such changes and modifications as fall within the true spirit and scope of the invention.

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

1. A current limiting fuse comprising:

a. a hollow insulating housing having two ends;

b. electrical terminals attached to the ends of said housing;

c. a core of insulating material within and extending axially through said housing;

d. a primary main fuse element having a plurality of fusion points, said primary main fuse element having a length and being electrically interconnected longitudinally between said electrical terminals, the fusion points being distributed along the length of said primary main fuse element, said primary main fuse element being supported on said core,

a body of low-melting-temperature alloy in intimate contact with said primary main fuse element, the body of low-melting-temperature alloy being separated from one electrical terminal by a first group of fusion points and being separated from the other electrical terminal by a second group of fusion points, the first and second groups each including at least one fusion point;

e. means within said housing for providing a first auxiliary arc gap adjacent a fusion point of the first group;

f. means within said housing for providing a second auxiliary arc gap adjacent a fusion point of the second group;

g. an auxiliary fuse element electrically interconnecting said means for providing first and second auxiliary arc gaps, said auxiliary fuse element being within said housing; and

h. an inert granular arc quenching material within said housing and surrounding the elements within said housing.

2. The current limiting fuse as recited in claim 1 wherein said means for providing first and second auxiliary arc gaps each comprise an arcing clip having a base portion for attaching said arcing clip to said core and an electrode portion electrically connected to the base portion.

3. The current limiting fuse as recited in claim 2 wherein each electrode portion is adjustable both in position relative to the fusion point adjacent each auxiliary arc gap and in spacing from said primary main fuse element.

4. The current limiting fuse as recited in claim 1 further including:

at least one secondary main fuse element electrically connected in parallel with said primary main fuse element, each secondary main fuse element having substantially the same construction as said primary main fuse element; and wherein:

said means for providing a first auxiliary arc gap adjacent a fusion point of the first group of said primary main fuse element further provides a first auxiliary arc gap adjacent a fusion point of the first group of at least one secondary main fuse element; and

said means for providing a second auxiliary arc gap adjacent a fusion point of the second group of said primary main fuse element further provides a second auxiliary arc gap adjacent a fusion point of the second group of each secondary main fuse element also having a first auxiliary arc gap adjacent a fusion point of its first group.

5. The current limiting fuse as recited in claim 4 wherein said means for providing first and second auxiliary arc gaps adjacent fusion points of said primary and secondary main fuse elements each comprise an arcing clip having a base portion for attaching said arcing clip to said core and an electrode portion electrically connected to the base portion.

6. The current limiting fuse as recited in claim 5 wherein:

first and second auxiliary arc gaps are provided adjacent fusion points of one secondary main fuse element; and

the electrode portion of each said arcing clip includes two extensions, one extension being adjustable both in position relative to the fusion point of said primary main fuse element and in spacing from said primary main fuse element, and the other extension being adjustable both in position relative to the fusion point of said secondary main fuse element and in spacing from said secondary main fuse element.

* * * * *