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McAlister

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[54] **PROTECTOR FOR ELECTRIC CIRCUITS**

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[52] **U.S. Cl.** **337/17,** 337/159, 337/231, 337/273

[51] **Int. Cl.**.....**H01h 85/08**

[58] **Field of Search**.....337/15, 17, 158, 337/159, 162, 231, 273, 282, 290, 292, 295, 296, 297

[56] **References Cited**

UNITED STATES PATENTS

2,400,408	5/1946	Heafelfinger	337/17
2,911,504	11/1959	Cohn	337/296
3,348,007	10/1967	Urahi	337/273

FOREIGN PATENTS OR APPLICATIONS

622,461	11/1935	Germany	337/290

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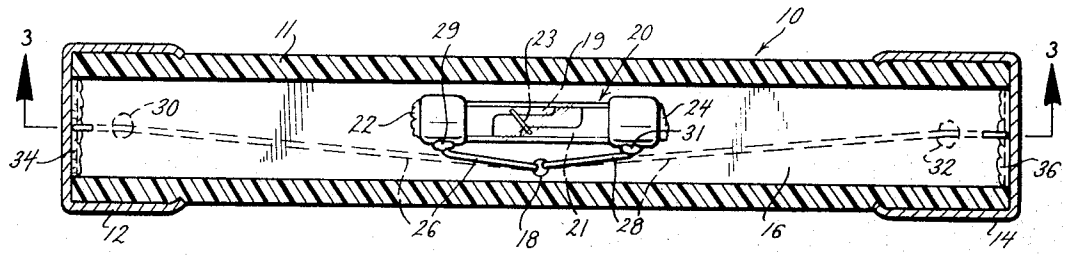
[57] **ABSTRACT**

An electric fuse has a current-sensing section and an arc-quenching section. The current-sensing section will respond to potentially hurtful overloads and to short circuits to initiate circuit-opening action, but the arc-quenching section will immediately take over and instantly complete that circuit-opening action. Because it does not have to complete the circuit-opening action, the current-sensing section can be made much smaller and much less expensively than can the current-sensing section of an electric fuse which must initiate and then complete the circuit-opening action.

20 Claims, 3 Drawing Figures



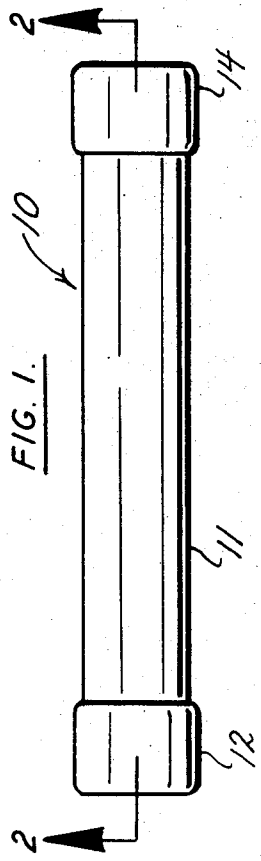


FIG. 1.

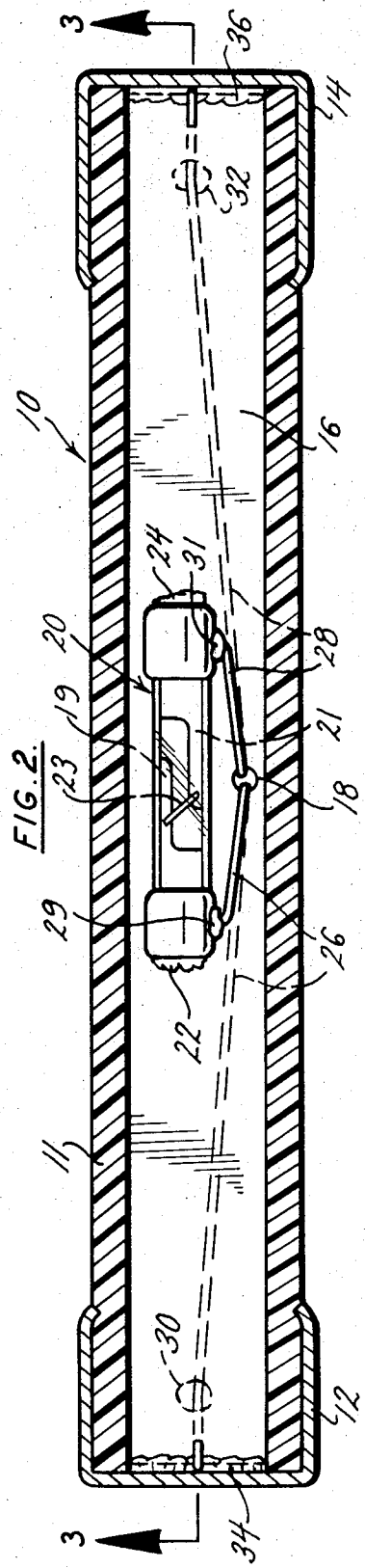


FIG. 2.

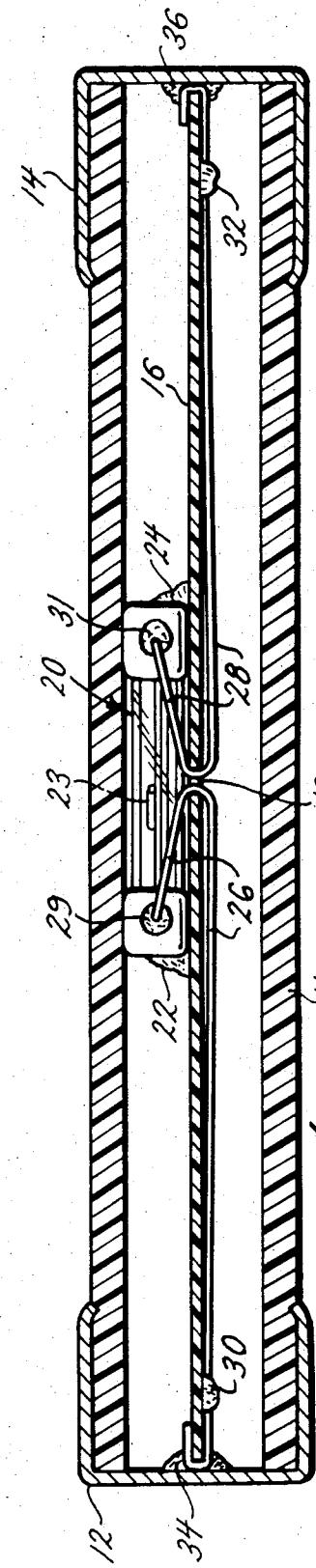


FIG. 3.

PROTECTOR FOR ELECTRIC CIRCUITS

BACKGROUND OF THE INVENTION

Some electric fuses have one or more elongated fusible elements which extend between, and are connected to, the terminals of those electric fuses. Other electric fuses have fusible elements and solder-held separable elements which are connected in series between the terminals of those electruc fuses. The current-sensing sections of those electric fuses must respond to potentially hurtful overloads and to short circuits to initiate circuit-opening action; and those current-sensing sections also must participate in the completion of that circuit-opening action. Because those current-sensing sections must participate in the completion of the circuit-opening action, those current-sensing sections must be made long enough to develop substantial arc gaps as they participate in the completion of that circuit-opening action.

SUMMARY OF THE INVENTION

The present invention provides an electric fuse which has a current-sensing section and an arc-quenching section. The current-sensing section will respond to potentially hurtful overloads and to short circuits to initiate circuit-opening action, but the arc-quenching section will immediately take over and complete that circuit-opening action. Because it does not have to complete the circuit-opening action, the current-sensing section can be made much smaller and much less expensively than can the current-sensing section of an electric fuse which must initiate and then complete the circuit-opening action. It is, therefore, an object of the present invention to provide an electric fuse which has a current-sensing section that will initiate circuit-opening action and which has an arc-quenching section that will immediately take over and instantly complete that circuit-opening action.

The current-sensing section of the electric fuse provided by the present invention includes two spaced-apart electrically conductive surfaces and a fusible element which spans the space between those surfaces. The arc-quenching section of that electric fuse includes lead-in wires which have portions thereof disposed in such close proximity to each other that an arc will develop between those portions as the current-sensing section initiates circuit-opening action. One or both of those lead-in wires is made of a metal that will respond to the development of an arc, between the closely spaced portions of those lead-in wires, to instantly burn away, and thereby instantly form an arc gap which is so long that the arc can not bridge it. It is, therefore, an object of the present invention to provide an electric fuse which has a current-sensing section that includes two spaced-apart electrically conductive surfaces and a fusible element that spans the space between those surfaces, which has an arc-quenching section that includes lead-in wires with portions thereof in such close proximity to each other that an arc will form between those portions as the current-sensing section initiates circuit-opening action, and which has at least one of those lead-in wires made of a metal that will respond to the development of an arc, between the closely spaced portions of those lead-in wires, to instantly burn away.

In one preferred embodiment of the present invention, the current-sensing section of the electric fuse is a small, inexpensive, low voltage fuse; and the arc-quenching section of that electric fuse includes lead-in wires of pyrophoric metal which have the outer ends thereof connected to the terminals of that electric fuse, which have the inner ends thereof connected to the terminals of that small, inexpensive, low voltage fuse, and which have intermediate portions thereof in close proximity to each other. That small, inexpensive, low voltage fuse will provide the desired current rating for the electric fuse, and those lead-in wires will keep that small, inexpensive, low voltage fuse from being subjected to arcing which could adversely affect the circuit-opening action of the electric fuse. It is, therefore, an object of the present invention to provide an electric fuse which has a small, inexpensive, low voltage fuse as the current-sensing section thereof, and which has lead-in wires of pyrophoric metal as the arc-quenching section thereof.

Other and further objects and advantages of the present invention should become apparent from an examination of the drawing and accompanying description.

BRIEF DESCRIPTION OF THE DRAWING

In the drawing,

FIG. 1 is a side elevational view of one preferred embodiment of electric fuse that is made in accordance with the principles and teachings of the present invention,

FIG. 2 is a sectional view, on a larger scale, through the electric fuse of FIG. 1, and it is taken along the plane indicated by the line 2—2 in FIG. 1, and

FIG. 3 is another sectional view, on the scale of FIG. 2, through the electric fuse of FIG. 1, and it is taken along the plane indicated by the line 3—3 in FIG. 2.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring to the drawing in detail, the numeral **10** generally denotes one preferred embodiment of electric fuse that is made in accordance with the principles and teachings of the present invention. The numeral **11** denotes the casing of that electric fuse, and the numerals **12** and **14** denote terminals which are secured to the ends of that casing. In the said one preferred embodiment of the present invention, the casing **11** is tubular in form and is made of insulating material, and the terminals **12** and **14** are cup-like in configuration and are made of metal.

The numeral **16** denotes a generally rectangular plate of insulating material; and, in the said one preferred embodiment of the present invention, that plate is made from glass melamine. Where the electric fuse **10** has a rating of from one five-hundredth to thirty-one thousandths of an ampere at 750 volts, that plate is 4 and 9/10 inches long, one-half of an inch wide, and one-thirty second of an inch thick. A small opening **18** is formed in the plate **16**; and that opening is approximately midway between the opposite ends of that plate, but it is closer to one side of that plate than it is to the other side of that plate. In the said one preferred embodiment of the present invention, the opening **18** is one-thirty second of an inch in diameter.

The numeral **20** generally denotes a small, inexpensive, low voltage fuse which has an electrically conduc-

tive surface **19** that is spaced from an electrically conductive surface **21** to define a gap which normally is spanned by a fusible element **23**. Where the electric fuse **10** has a rating from one five-hundredths to one two-hundredths of an ampere, that gap will be at least one-sixteenth of an inch long, where that electric fuse has a rating from one hundredth to fifteen thousandths of an ampere, that gap will be at least three thirty-seconds of an inch long, and where that electric fuse has a rating between fifteen thousandths and thirty-one thousandths of an ampere, that gap will be at least one hundred and thirty-five thousandths of an inch long. Where the rating of the electric fuse **10** is still higher, the gap between the surfaces **19** and **21** will be appreciably longer than one hundred and thirty-five thousandths of an inch. The small, inexpensive, low voltage fuse **20** has a tubular glass casing and has ferrule-like metal terminals at the ends of that casing. The overall length of the small, inexpensive, low voltage fuse **20** can be as short as five-eighths of an inch or as long as 1 ¼ inches; and the diameters of the terminals of that small, inexpensive, low voltage fuse will not exceed one-quarter of an inch. Different kinds of small, inexpensive low voltage fuses can be used as the small, inexpensive, low voltage fuse **20**; and hence the electric fuse **10** can be provided with various desired current-sensing characteristics. For example, if one of the small, inexpensive, low voltage, fast-acting fuses of the assignee of the present application were to be used as the small, inexpensive, low voltage fuse **20**, the electric fuse **10** would have the current-sensing characteristics of a fast-acting fuse. On the other hand, if one of the small, inexpensive, low voltage slow-blowing fuses of that assignee were to be used as the small, inexpensive, low voltage fuse **20**, the electric fuse **10** would have the current-sensing characteristics of a slow-blowing fuse.

The small, inexpensive, low voltage fuse **20** is suitably cemented to the plate **16** by masses **22** and **24** of a cement such as an epoxy cement. Those masses of cement directly engage the plate **16** and the ferrule-like metal terminals of the small, inexpensive, low voltage fuse **20**, and thereby hold that small, inexpensive, low voltage fuse fixedly secured to that plate. A lead-in wire **26** of pyrophoric metal is electrically bonded to the left-hand ferrule-like metal terminal of the small, inexpensive, low voltage fuse **20** by low melting point solder **29**; and that lead-in wire is passed downwardly through the opening **18**. That lead-in wire is passed along the under surface of the plate **16** to the left-hand end of the plate **16**, and then is bent upwardly around that left-hand end. A small amount of epoxy cement is applied to the plate **16** and to the lead-in wire **26** at the point **30**, to fixedly secure the outer end of that lead-in wire to that plate. A lead-in wire **28** of pyrophoric metal is electrically bonded to the right-hand ferrule-like terminal of the small, inexpensive, low voltage fuse **20** by low melting point solder **31**; and that lead-in wire is passed downwardly through the opening **18**. That lead-in wire is passed along the under surface of the plate **16** to the right-hand end of plate **16**, and then is bent upwardly around that right-hand end. A small amount of epoxy cement is applied to the plate **16** and to the lead-in wire **28** at the point **32**, to fixedly secure the outer end of that lead-in wire to that plate.

The plate **16**, the small, inexpensive, low voltage fuse **20**, the lead-in wires **26** and **28**, the four amounts of cement, and the two masses of low melting-point solder constitute a subassembly which can be telescoped within the casing **11** of the electric fuse **10**. Once that sub-assembly has been telescoped within that casing, the cap-shaped terminals **12** and **14** can be telescoped over the opposite ends of that casing, and then crimped to that casing. Those terminals will be "inside soldered" to the lead-in wires **26** and **28** by low melting-point solder **34** and **36**.

As long as the current, in the circuit of which the electric fuse **10** is a part, is below the rated current of that electric fuse, current can flow from terminal **12** via solder **34**, lead-in wire **26**, solder **29**, the left-hand ferrule-like terminal of the small, inexpensive, low voltage fuse **20**, conductive surface **19**, fusible element **23**, conductive surface **21**, the right-hand ferrule-like terminal of that small, inexpensive, low voltage fuse, solder **31**, lead-in wire **28**, solder **36**, and cap-like terminal **14**. However, if the current flowing through that circuit were to rise to a potentially hurtful level and were to remain at that level for a predetermined length of time, the fusible element **23** would melt and open the circuit. Immediately, an arc would develop between those portions of the lead-in wires **26** and **28** which pass downwardly through the opening **18**, and those portions plus the portions of those lead-in wires which extend between the opening **18** and the opposite ends of the plate **16** would instantly burn away. Although the circuit voltage was large enough to establish an arc between the portions of the lead-in wires **26** and **28** which extend downwardly through the opening **18**, that circuit voltage would be far too small to maintain an arc between the ferrule-like terminals **12** and **14**. Consequently, the electric fuse **10** would instantly and safely prevent further flow of current through the circuit.

Various kinds of pyrophoric wire could be used in making the lead-in wires **26** and **28**. However, the pyrofuze wire which is made by the Sigmund Cohn Company of New York has been found to be very useful.

It will be noted that the major portions of the lengths of the lead-in wires **26** and **28** are located at the under surface of the plate **16**, whereas the small, inexpensive, low voltage fuse **20** is located at the upper surface of that plate. This is desirable, because it physically isolates that small, inexpensive, low voltage fuse from the products of combustion that develop as those lead-in wires instantly burn back to the cap-like terminals **12** and **14**. As a result, none of the metal of the ferrule-like terminals of the small, inexpensive, low voltage fuse **20** can be vaporized during the opening of the circuit.

Because the lead-in wires **26** and **28** instantly respond to the arc, which develops in the opening **18** as the fusible element **23** fuses, to burn back to the terminals **12** and **14**, those lead-in wires free the small, inexpensive, low voltage fuse **20** of the need of completing the circuit-opening action. As a result, that small, inexpensive, low voltage fuse can be designed to have a current-sensing characteristic which is optimum for the particular kind of circuit of which that small, inexpensive, low voltage fuse is to be a part. Also as a result, a small, inexpensive, low voltage fuse **20** which has a voltage rating of just 250 volts can be used as the cur-

rent-sensing section of an electric fuse **10** which has a voltage rating of 750 volts. The fact that a relatively low voltage can be used as the current-sensing section of a relatively high voltage electric fuse is very desirable, because it permits all of the rating and other tests of that current-sensing section to be made at relatively low voltages.

While it is desirable that both lead-in wires be made from pyrophoric wire, one of those lead-in wires could be made from a metal other than a pyrophoric metal. In such event, a longer casing for the electric fuse **10** would be desirable.

Whereas the drawing and accompanying description have shown and described a preferred embodiment of the present invention, it should be apparent to those skilled in the art that various changes may be made in the form of the invention without affecting the scope thereof.

What I claim is:

1. An electric fuse which has a casing, spaced-apart terminals on said casing, a first electrically conductive surface, a second electrically conductive surface which is adjacent to but spaced from the first said electrically conductive surface, a fusible element which is displaced from both of said terminals and which is electrically connected to both of said electrically conductive surfaces and which spans the space between said electrically conductive surfaces, a lead-in wire which is electrically connected to the first said electrically conductive surface and which extends toward one of said terminals, a second lead-in wire which is electrically connected to said second electrically conductive surface and which extends toward the other of said terminals, portions of said lead-in wires being disposed in close proximity to each other to define a gap which is small enough to permit an arc to form thereacross as said fusible element fuses in response to a low overload, said fusible element constituting the sole current-responsive element of said electric fuse and said fusible element having to fuse before any arc can form across said gap, said portions of said lead-in wires being displaced from said first electrically conductive surface and from said second electrically conductive surface and from said fusible element, whereby any arc which forms across said gap can not extend to said first electrically conductive surface or to said second electrically conductive surface or to said fusible element, and at least one of said lead-in wires being formed of pyrophoric material.

2. An electric fuse as claimed in claim **1** wherein said first electrically conductive surface, said second electrically conductive surface, and said fusible element are components of a small, inexpensive low voltage fuse which is bodily located within said casing.

3. An electric fuse as claimed in claim **1** wherein a plate of insulating material is located within said casing, wherein said plate has a small opening therein, and wherein said portions of said lead-in wires are disposed within said opening.

4. An electric fuse as claimed in claim **1** wherein said space between the first said electrically conductive surface and said second electrically conductive surface is too short to keep the circuit voltage from developing an arc between said conductive surfaces, and wherein said lead-in wires respond to fusing of said fusible element to instantly form an arc gap which can not be spanned by an arc developed by said circuit voltage.

5. An electric fuse as claimed in claim **1** wherein said first said electrically conductive surface and said second electrically conductive surface and said fusible element are components of a small, inexpensive, low-voltage fuse which is bodily located within said casing, wherein a plate of insulating material is located within said casing, and wherein said small, inexpensive, low-voltage fuse is disposed at one face of said insulating plate, and wherein the major portions of said lead-in wires are disposed at the opposite face of said insulating plate.

6. An electric fuse which has a current-sensing section that includes a fusible element and an arc-quenching section that includes an arc gap, said fusible element of said current-sensing section responding to a potentially hurtful overload or to a short circuit to initiate circuit-opening action, said arc gap of said arc-quenching section being dimensioned to permit an arc to form thereacross as soon as said fusible element initiates said circuit-opening action in response to such an overload, whereby said arc-quenching section immediately takes over and completes said circuit-opening action and thereby effectively relieves said current-sensing section of the arcing which occurs during the completion of circuit-opening action initiated in response to such an overload, said arc gap of said arc-quenching section being displaced from said fusible element of said current-sensing section whereby any arc which forms across said arc gap of said arc-quenching section can not engage said fusible element of said current-sensing section.

7. An electric fuse as claimed in claim **6** wherein said arc-quenching section includes lead-in wires which have portions thereof disposed in such close proximity to each other that an arc forms between these portions as said current-sensing section initiates circuit-opening action in response to such an overload.

8. An electric fuse as claimed in claim **6** wherein said current-sensing section includes a first electrically conductive surface, a second electrically conductive surface which is adjacent to but spaced from the first said electrically conductive surface, and a fusible element which is electrically connected to both of said electrically conductive surfaces and which normally spans the space therebetween.

9. An electric fuse as claimed in claim **6** wherein said current-sensing section includes a first electrically conductive surface and a second electrically conductive surface which is adjacent to but spaced from the first said electrically conductive surface and a fusible element which is electrically connected to both of said electrically conductive surfaces and which normally spans the space therebetween, wherein said arc-quenching section includes a lead-in wire which is electrically connected to the first said electrically conductive surface and includes a second lead-in wire which is electrically connected to said second electrically conductive surface and wherein at least one of said lead-in wires is formed of pyrophoric material.

10. An electric fuse as claimed in claim **6** wherein a casing encloses said current-sensing section and said arc-quenching section, and wherein said current-sensing section comprises a small, inexpensive, low-voltage fuse which is bodily located within said casing.

11. An electric fuse as claimed in claim 6 wherein said current-sensing section comprises a small, inexpensive, low-voltage fuse, wherein said arc-quenching section includes lead-in wires, wherein an insulating plate is interposed between said small, inexpensive, low-voltage fuse and the major portions of the lengths of said lead-in wires, and wherein at least one of said lead-in wires is made of phrophoric material.

12. An electric fuse as claimed in claim 6 wherein said arc-quenching section includes a lead-in wire which initially extends in one direction from said current-sensing section and then extends in the opposite direction and includes a second lead-in wire which initially extends from said current-sensing section in said opposite direction and then extends in said one direction, and wherein said lead-in wires define re-entrant bends which are in such close proximity to each other that an arc will form therebetween when said current-sensing section initiates circuit-opening action in response to such an overload.

13. An electric fuse which has a casing, spaced-apart terminals on said casing, a first electrically conductive surface, a second electrically conductive surface which is adjacent to but spaced from the first said electrically conductive surface, a fusible element which is displaced from both of said terminals and which is electrically connected to both of said electrically conductive surfaces and which spans the space between said electrically conductive surfaces, a lead-in wire which is electrically connected to the first said electrically conductive surface and which extends toward one of said terminals, a second lead-in wire which is electrically connected to said second electrically conductive surface and which extends toward the other of said terminals, portions of said lead-in wires being disposed in close proximity to each other to define a gap which is small enough to permit an arc to form thereacross as said fusible element fuses in response to a low overload, said fusible element constituting the sole current-responsive element of said electric fuse and said fusible element having to fuse before any arc can form across said gap, said portions of said lead-in wires being displaced from said first electrically conductive surface and from said second electrically conductive surface and from said fusible element, whereby any arc which forms across said gap can not extend to said first electrically conductive surface or to said second electrically conductive surface or to said fusible element, at least one of said lead-in wires being formed of pyrophoric material, a plate of insulating material located within said casing, said plate having a small opening therein, said portions of said lead-in wires being disposed within said opening, the first said lead-in wire extending in one direction from said first said electrically conductive surface toward said opening and then extending in the opposite direction from said opening toward said one terminal, and said second lead-in wire extending in said opposite direction from said second electrically conductive surface toward said opening and then extending in said one direction from said opening toward said other terminal.

14. An electric fuse which has a casing, spaced-apart terminals on said casing, a first electrically conductive surface, a second electrically conductive surface which is adjacent to but spaced from the first said electrically conductive surface, a fusible element which is displaced from both of said terminals and which is electrically connected to both of said electrically conductive surfaces and which spans the space between said electrically conductive surfaces, a lead-in wire which is electrically connected to the first said electrically conductive surface and which extends toward one of said terminals, a second lead-in wire which is electrically connected to said second electrically conductive surface and which extends toward the other of said terminals, portions of said lead-in wires being disposed in close proximity to each other to define a gap which is small enough to permit an arc to form thereacross as said fusible element fuses in response to a low overload, said fusible element constituting the sole current-responsive element of said electric fuse and said fusible element having to fuse before any arc can form across said gap, said portions of said lead-in wires being displaced from said first electrically conductive surface and from said second electrically conductive surface and from said fusible element, whereby any arc which forms across said gap can not extend to said first electrically conductive surface or to said second electrically conductive surface or to said fusible element, at least one of said lead-in wires being formed of pyrophoric material, a plate of insulating material located within said casing, said plate having a small opening therein, said portions of said lead-in wires being disposed within said opening, the first said electrically conductive surface and said second electrically conductive surface and said fusible element being disposed at one face of said insulating plate, and the major portions of said lead-in wires being disposed at the opposite face of said insulating plate.

15. An electric fuse which has a casing, spaced-apart terminals on said casing, a first electrically conductive surface, a second electrically conductive surface which is adjacent to but spaced from the first said electrically conductive surface, a fusible element which is displaced from both of said terminals and which is electrically connected to both of said electrically conductive surfaces and which spans the space between said electrically conductive surfaces, a lead-in wire which is electrically connected to the first said electrically conductive surface and which extends toward one of said terminals, a second lead-in wire which is electrically connected to said second electrically conductive surface and which extends toward the other of said terminals, portions of said lead-in wires being disposed in close proximity to each other to define a gap which is small enough to permit an arc to form thereacross as said fusible element fuses in response to a low overload, said fusible element constituting the sole current-responsive element of said electric fuse and said fusible element having to fuse before any arc can form across said gap, said portions of said lead-in wires being displaced from said first electrically conductive surface and from said second electrically conductive surface and from said fusible element, whereby any arc which forms across said gap can not extend to said first electrically conductive surface or to said second electrically conductive surface or to said fusible element, at least one of said lead-in wires being formed of pyrophoric material, said first said electrically conductive surface and said second electrically conductive surface and said fusible element being components of a

small, inexpensive, low-voltage fuse which is bodily located within said casing, a plate of insulating material located within said casing, said small, inexpensive, low-voltage fuse being disposed at one face of said insulating plate, the major portions of said lead-in wires being disposed at the opposite face of said insulating plate, and said portions of lead-in wires being disposed within an opening in said insulating plate.

16. An electric fuse which has a current-sensing section that includes a fusible element and an arc-quenching section that includes an arc gap, said fusible element of said current-sensing section responding to a potentially hurtful overload or to a short circuit to initiate circuit-opening action, said arc gap of said arc-quenching section being dimensioned to permit an arc to form thereacross as soon as said fusible element initiates said circuit-opening action in response to such an overload, whereby said arc-quenching section immediately takes over and completes said circuit-opening action and thereby effectively relieves said current-sensing section of the arcing which occurs during the completion of circuit-opening action initiated in response to such an overload, said arc gap of said arc-quenching section being displaced from said fusible element of said current-sensing section whereby any arc which forms across said arc gap of said arc-quenching section can not engage said fusible element of said current-sensing section, said arc-quenching section including a pyrophoric wire that responds to initiation of circuit-opening action by said current sensing section in response to such an overload to instantly lengthen said arc gap to a value that is too long to sustain an electric arc.

17. An electric fuse which has a current-sensing section that includes a fusible element and an arc-quenching section that includes an arc gap, said fusible element of said current-sensing section responding to a potentially hurtful overload or to a short circuit to initiate circuit-opening action, said arc gap of said arc-quenching section being dimensioned to permit an arc to form thereacross as soon as fusible element initiates said circuit-opening action in response to such an overload, whereby said arc-quenching section immediately takes over and completes said circuit-opening action and thereby effectively relieves said current-sensing section of the arcing which occurs during the completion of circuit-opening action initiated in response to such an overload, said arc gap of said arc-quenching section being displaced from said fusible element of said current-sensing section whereby any arc which forms across said arc gap of said arc-quenching section can not engage said fusible element of said current-sensing section, said arc-quenching section including lead-in wires which have portions thereof disposed in such close proximity to each other that an arc forms between these portions as said current-sensing section initiates circuit-opening action in response to such an overload, at least one of said lead-in wires being made of pyrophoric material.

18. An electric fuse which has a current-sensing section that includes a fusible element and an arc-quenching section that includes an arc gap, said fusible element of said current-sensing section responding to a potentially hurtful overload or to a short circuit to initiate circuit-opening action, said arc gap of said arc-quenching section being dimensioned to permit an arc to form thereacross as soon as said fusible element initiates said circuit-opening action in response to such an overload, whereby said arc-quenching section immediately takes over and completes said circuit-opening action and thereby effectively relieves said current-sensing section of the arcing which occurs during the completion of circuit-opening action initiated in response to such an overload, said arc gap of said arc-quenching section being displaced from said fusible element of said current-sensing section whereby any arc which forms across said arc gap of said arc-quenching section can not engage said fusible element of said current-sensing section, and a plate of insulating material physically interposed between said current-sensing section and the major portion of said arc-quenching section.

19. An electric fuse which has a current-sensing section that includes a fusible element and an arc-quenching section that includes an arc gap, said fusible element of said current-sensing section responding to a potentially hurtful overload or to a short circuit to initiate circuit-opening action, said arc gap of said arc-quenching section being dimensioned to permit an arc to form thereacross as soon as said fusible element initiates said circuit-opening action in response to such an overload, whereby said arc-quenching section immediately takes over and completes said circuit-opening action and thereby effectively relieves said current-sensing section of the arcing which occurs during the completion of circuit-opening action initiated in response to such an overload, said arc gap of said arc-quenching section being displaced from said fusible element of said current-sensing section whereby any arc which forms across said arc gap of said arc-quenching section can not engage said fusible element of said current-sensing section, said arc-quenching section including lead-in wires, an insulating plate supporting said lead-in wires, portions of said lead-in wires passing through an opening in said insulating plate, and said portions of said lead-in wires being in such close proximity to each other that an arc will form therebetween when said current-sensing section initiates circuit-opening action in response to such an overload.

20. The method of opening an electric circuit which comprises sensing an excessive current by means of a current-sensing fusible element and causing that fusible element to fuse in response to that excessive current to initiate circuit-opening action, developing an arc between closely-spaced portions of lead-in wires which are in series relation with said current-sensing element but which are remote from said current-sensing element to relieve said fusible element of the need of completing said circuit-opening action, and substantially instantaneously burning back at least one of said lead-in wires to complete said circuit-opening action by forming an arc gap between said portions of said lead-in wires which is too long to sustain an arc.

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