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Manker et al.

[11] **3,913,051**

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[54] **PROTECTOR FOR ELECTRIC CIRCUITS**

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

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[52] **U.S. Cl.** **337/279**; 337/186; 337/252

[51] **Int. Cl.**[2] **H01H 85/44**

[58] **Field of Search** 337/186, 190, 202, 203, 337/208, 227, 228, 231, 232, 234, 252, 273, 279

[56] **References Cited**

UNITED STATES PATENTS

2,556,018	6/1951	Hoorn	337/233
3,291,939	12/1966	Hitchcock	337/279
3,348,007	10/1967	Urani	337/232
3,568,122	3/1971	Urani	337/166

Primary Examiner—Harold Broome

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[57] **ABSTRACT**

A small electric fuse includes a small but rugged support which has the upper surface thereof relieved by a notch that is intermediate two metallic surfaces, includes a small fusible element which spans that notch and which has the ends thereof immediately adjacent those metallic surfaces, includes terminals which are soldered to those metallic surfaces and to that fusible element and which project outwardly beyond the ends of that support, and includes a housing which encases and is shrunk onto that support, those metallic surfaces, and the inner ends of those terminals. The inner ends of the terminals project upwardly from, as well as outwardly beyond, the metallic surfaces; and those inner ends initially space the inner surface of the housing away from the fusible element. The initial spacing of that inner surface from the upper faces of the metallic surfaces on the support is so great that the said inner surface either will not shrink into engagement with the fusible element or, if it does shrink into engagement with that fusible element, will be unable to apply destructive forces to that fusible element. The engagement between the housing and the support and the terminals effectively seals the opposite ends of the fuse against the entry of dirt, dust and other air-borne adulterants; and that housing is sufficiently rugged to withstand rough handling in the field.

15 Claims, 6 Drawing Figures

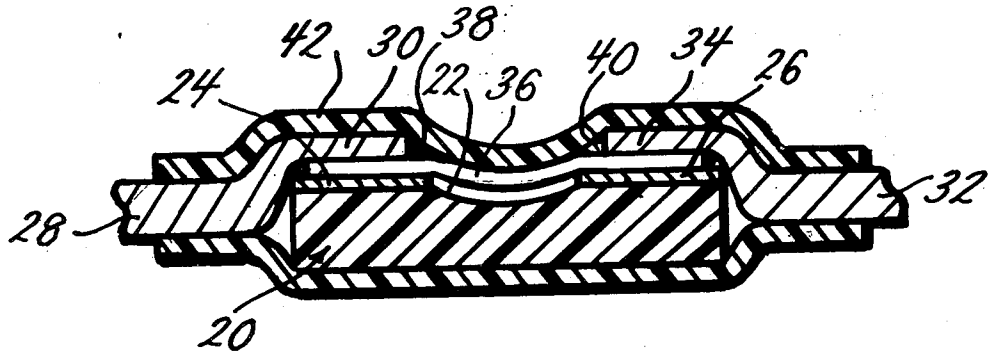


FIG. 1.

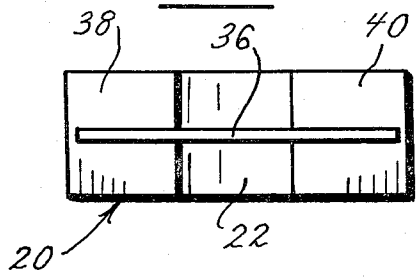


FIG. 4.

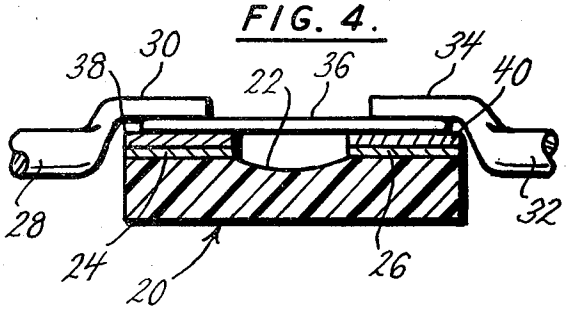


FIG. 2.

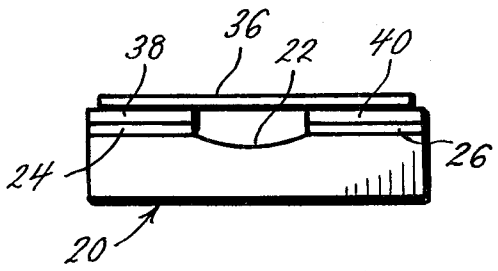


FIG. 3.

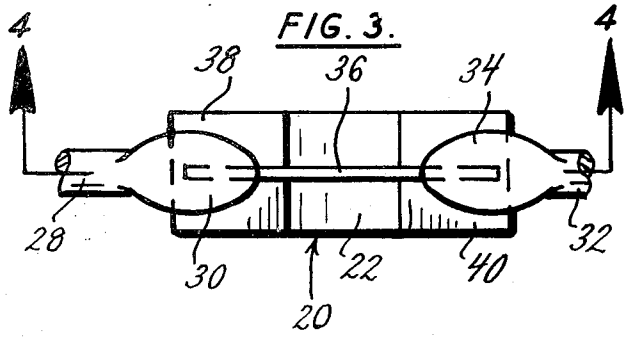
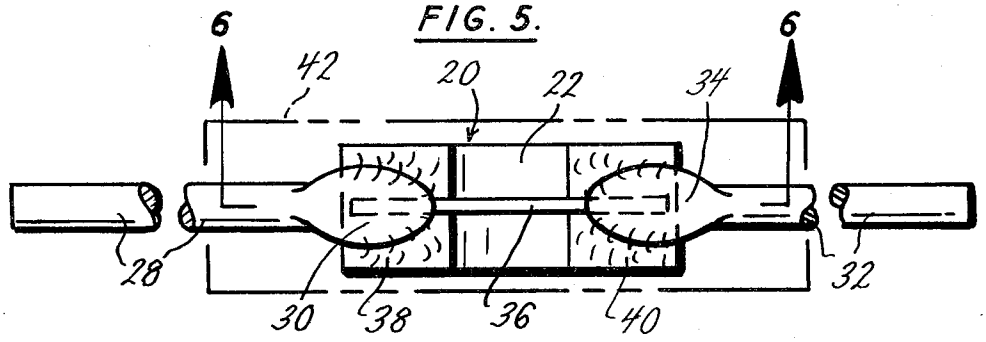


FIG. 5.



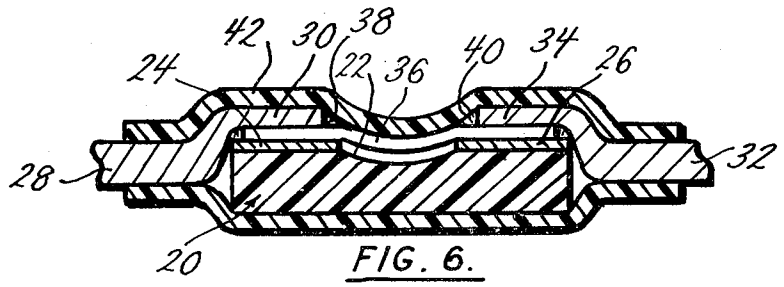


FIG. 6.

PROTECTOR FOR ELECTRIC CIRCUITS

FIELD OF THE INVENTION

The electric fuse provided by the present invention is intended to protect circuits which normally carry currents in the range of from one two-hundredth of an ampere to five amperes at voltages up to 125 volts. Fuses which are intended to protect such circuits necessarily have extremely small fusible elements; and such fusible elements are fragile. Prior electric fuses, which were intended to protect such circuits, either utilized relatively-large rugged and sturdy bridges of insulating material to support the fusible elements thereof or fixedly secured the fusible elements thereof to the interiors of glass casings which supported and protected those fusible elements. The use of relatively large bridges of insulating material necessarily made the sizes of the resulting fuses large; and the securement of fusible elements to the interiors of glass casings is difficult and expensive.

DESCRIPTION OF THE PRIOR ART

McAlister U.S. Pat. No. 2,576,405 discloses an electric fuse wherein a bridge of insulating material supports a small fusible element, McAlister U.S. Pat. No. 3,023,289 discloses an electric fuse wherein small diameter fusible elements are mechanically secured to the ends of a glass casing by solder which bonds to metallized surfaces on the ends of those casings and McAlister U.S. Pat. No. 3,123,696 also uses solder to bond the ends of small fusible elements to metallized surfaces at the opposite ends of glass casings. Urani U.S. Pat. No. 3,304,394 supports a small fusible element by solder which is bonded to metal eyelets that are fixedly secured within the ends of glass casings, and Urani U.S. Pat. No. 3,348,007 supports small fusible elements by bonding the ends thereof to metallic surfaces on a bridge of insulating material. Urani U.S. Pat. No. 3,568,122 discloses solder which bonds a fusible element to metallized surfaces on a bridge of insulating material.

SUMMARY OF THE INVENTION

The present invention provides a small electric fuse which includes a small but rugged support of insulating material which has the upper surface thereof relieved by a notch that is intermediate two metallic surfaces, includes a small fusible element which spans that notch and which has the ends thereof immediately adjacent those metallic surfaces, includes terminals which are soldered to those metallic surfaces and to that fusible element and which project outwardly beyond the ends of that support, and includes a housing which encases and is shrunk into that support, those metallic surfaces, and the inner ends of those terminals. The inner ends of the terminals project upwardly from, as well as outwardly beyond, the metallic surfaces; and those inner ends initially space the inner surface of the housing away from the fusible element. The initial spacing of that inner surface from the upper faces of the metallic surfaces on the support is so great that the said inner surface either will not shrink into engagement with the fusible element or, if it does shrink into engagement with that fusible element, will be unable to apply destructive forces to that fusible element. The engagement between the housing and the support and the terminals effectively seals the opposite ends of the fuse

against the entry of dirt, dust and other air-borne adulterants; and that housing is sufficiently rugged to withstand rough handling in the field. It is, therefore, an object of the present invention to provide a small electric fuse which has a support, a small fusible element, terminals, and a housing which is shrunk onto that support and those terminals.

The material used in the housing, of the fuse of the present invention, is a plastic material which responds to heat to evolve a gas that has arc-extinguishing characteristics. That plastic material will tend to evolve such a gas whenever the fusible element fuses to open the circuit; and hence the fuse provided by the present invention can extinguish any arc, that forms as the fusible element thereof fuses, before that arc can adversely affect the plastic housing of that fuse. It is therefore, an object of the present invention to provide a small electric fuse which has a housing of plastic material which responds to heat to evolve a gas that has arc-extinguishing characteristics.

The plastic housing of the present invention coacts with the support and with the inner ends of the terminals to provide seals that prevent the entry of dirt, dust, and other air-borne adulterants. In addition, that plastic housing is capable of withstanding sharp blows as well as fatique; and hence the electric fuse of the present invention is a sealed fuse and is able to withstand rugged service. It is, therefore, an object of the present invention to provide a small electric fuse which has a support, which has terminals that have their inner ends secured to that support, and which has a housing of plastic material that intimately engages that support and those inner ends to provide seals and that can withstand sharp blows and fatigue.

The plastic housing of the small electric fuse provided by the present invention is made from thermally stabilized plastic material which is capable of providing a definitely limited amount of shrinking. The amount of shrinking which that plastic housing can experience is limited to keep that plastic housing from applying destructive forces to the fusible element of that fuse. It is, therefore, an object of the present invention to provide a housing for a small electric fuse which is made from thermally stabilized plastic material that is capable of providing a definitely limited amount of shrinking.

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

In the drawing and accompanying description a preferred embodiment of the present invention is shown and described, but it is to be understood that the drawing and accompanying description are for the purpose of illustration only and do not limit the invention and that the invention will be defined by the appended claims.

BRIEF DESCRIPTION OF THE DRAWING

In the drawing, FIG. 1 is a plan view of the support and of the fusible element of one preferred embodiment of electric fuse provided by the present invention,

FIG. 2 is a side elevational view of the support and of the fusible element of FIG. 1,

FIG. 3 is a broken plan view of the support and of the fusible element of FIG. 1 after the inner ends of terminals have been disposed atop the ends of that fusible element,

FIG. 4 is a sectional view through the support shown in FIG. 3 and it is taken along the plane indicated by the line 4—4 in FIG. 3,

FIG. 5 is a broken plan view of the support, fusible element and terminals of FIG. 3 after that fusible element and the inner ends of those terminals have been soldered to metallic surfaces on that support, and it shows by dotted lines a plastic housing telescoped over the said support, fusible element and terminals, and

FIG. 6 is a broken sectional view through the support, terminals and plastic holding of FIG. 5, and it is taken along the plane indicated by the line 6—6 in FIG. 5.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring to the drawing in detail, the numeral 20 generally denotes a support which is made of insulating material; and the upper surface of that support is relieved by having a notch 22 of arcuate configuration in the upper surface thereof. In the said preferred embodiment, that support is between one hundred and ninety and two hundred and ten thousandths of an inch long, is five hundredths of an inch wide, and is four hundredths of an inch thick. The notch 22 is between sixty and sixty-five thousandths of an inch long and is about one hundredth of an inch deep at its center. The support 20 can be made of a ceramic material such as steatite or alumina, or it can be made of glass melamine, paper base epoxy or some other stable insulating material. The basic requirements of the support 20 are that it be sturdy, dimensionally stable, and essentially resistant to degrading due to heating or arcing.

The numerals 24 and 26 denote metallic surfaces which are provided on the upper face of the support 20 and which are spaced apart by the notch 22. In the said preferred embodiment, each of the metallic surfaces 24 and 26 is about sixty-six thousandths of an inch long, about five hundredths of an inch wide, and about one hundred and thirty-five one hundred thousandths of an inch thick. Although different metals could be used in forming the metallic surfaces 24 and 26, copper is preferred; because copper is easy to work, it is relatively inexpensive, and it readily alloys with solder. The metallic surfaces 24 and 26 can be formed on the upper face of the support 20 by various techniques which are known to those skilled in the art; and such techniques include metal cladding and electroplating. Those metallic surfaces preferably will be formed as parts of a continuous and homogeneous metallic surface, and then those metallic surfaces will be defined by the machining of the notch 22.

The numeral 28 denotes a metal terminal which is elongated and which is circular in cross section. The numeral 30 denotes a planished end for that terminal; and that planished end is offset radially from the axis of that terminal, as shown particularly by FIGS. 4 and 6. The planishing and offsetting of the end 30 of the terminal 28 preferably are accomplished in a punch press or similar machine; and the offsetting operation defines a shoulder, as shown by FIGS. 4 and 6. That shoulder serves as a stop which fixes the extent to which the planished end 30 can overlie the metallic surface 24. The numeral 32 denotes a second metal terminal which is elongated and which is circular in cross section. The numeral 34 denotes a planished end for that terminal; and that planished end is offset radially from the axis of that terminal, as shown particularly by FIGS. 4 and 6. The planishing and offsetting of the end 34 of the terminal 32 preferably are accomplished in a punch press or similar machine; and the offsetting operation defines a shoulder, as shown by FIGS. 4 and 6. That shoulder serves as a stop which fixes the extent to which the planished end 34 can overlie the metallic surface 26. As shown by FIGS. 2-6, the planished ends 30 and 34 are spaced short distances longitudinally outwardly of the notch 22 in the upper surface of the support 20. In the said preferred embodiment, each of the terminals 28 and 30 is made from tinned copper wire which has a diameter of twenty-five thousandths of an inch and each of those terminals is about one and five-eighths of an inch long. Each of the planished ends 30 and 34 is about fifteen thousandths of an inch thick and is about thirty-two thousandths of an inch wide.

The numeral 36 denotes a fusible element which spans the notch 22 and which has the ends thereof overlying the metal surfaces 24 and 26. That fusible element will be small; and it will, for some ratings of electric fuses, be very small. For example, when the rating of the electric fuse is one two-hundredth of an ampere, the diameter of the fusible element 36 will be thirty-five one millionths of an inch; and, when the rating of that electric fuse is five amperes, the diameter of that fusible element will be twelve ten thousandths of an inch. That fusible element preferably will be made from silver, copper, or silverplated copper. Where the diameter of that fusible element must be very small, that fusible element will preferably by made from a length of Wollaston wire.

The numeral 38 denotes solder which electrically bonds, and mechanically connects, the left-hand end of the fusible element 36 and the planished end 30 of the terminal 28 to the metallic surface 24. The numeral 40 denotes solder which electrically bonds, and mechanically connects, the right-hand end of that fusible element and the planished end 34 of the terminal 32 to the metallic surface 26. The solder 38 provides such a strong mechanical bond between the planished end 30 of terminal 28 and the metallic surface 24 that neither a rivet nor any other form of mechanical securement is required between that terminal and the support 20. Similarly, the solder 40 provides such a strong mechanical bond between the planished end 34 of terminal 32 and the metallic surface 26 that neither a rivet nor any other mechanical securement is required between the terminal 32 and the support 20.

The numeral 42 denotes a housing which is approximately nine thirty-seconds of an inch long, which has a nominal wall thickness of two-hundredths of an inch, and which has an initial inner diameter of ninety-three thousandths of an inch. In the said one preferred embodiment, the housing 42 is made from a military grade polyolefin heat-shrinkable tubing which is marketed by the Electronized Chemical Corp. under the designation FP-301. That plastic material is flexible and flame retarding in nature; and it is made from irradiated, thermally-stabilized, modified polyolefin. As a result, that plastic material can be shrunk only to a predetermined extent; and hence that housing will tend to "recover" to a predetermined minimum dimension as it cools.

In making the electric fuse of the said preferred embodiment, the support 20 is initially a part of a large copperclad sheet of insulating material; and the notch 22 is formed by a routing operation. That routing oper-

ation not only removes metal cladding but also removes some insulating material as it forms the notch **22.** The solder **38** and **40** is applied to the metallic surfaces **24** and **26** as a layer after the notch **22** has been formed — as indicated by FIGS. **1–4**; and then the fusible element **36** is set in position to span the notch **22** and to have its ends overlying the solder **38** and **40.** The planished end **30** of the terminal **28** is set in position above the left-hand end of the fusible element **36**; and the shoulder between that planished end and the rest of that terminal will abut the left-hand end of the support **20** to limit the extent to which that planished end can be moved inwardly of that end of that support. The planished end **34** of the terminal **32** is set in position above the right-hand end of the fusible element **36**; and the shoulder between that planished end and the rest of that terminal will abut the right-hand end of the support **20** to limit the extent to which that planished end can be moved inwardly of that end of that support. At this time, heat is applied to the planished ends **30** and **34** to cause the solder **38** and **40** to flow — as indicated by FIGS. **5** and **6**; and the solder **38** will electrically bond and mechanically secure the left-hand end of fusible element **36** and the planished end **30** of terminal **28** to the metallic surface **24,** while the solder **40** will electrically bond and mechanically secure the right-hand end of that fusible element and the planished end **34** of terminal **32** to the metallic surface **26.** This means that the fusible element **36** will be spanning the notch **22,** and will have the ends thereof overlying the metallic surfaces **24** and **26** but underlying the planished ends **30** and **34,** respectively, of the terminals **28** and **32.** Consequently, the axis of the major portion of the fusible element will be displaced below the level of the upper surfaces of the planished ends **30** and **34.** Also, the axes of the portions of the terminals **28** and **32** which extend longitudinally outwardly beyond the ends of the support **20** will be spaced even further below those upper surfaces of those planished ends. In addition, the axes of those outwardly-extending portions of the terminals **28** and **32** will be generally coaxial with the support **20.**

The housing **42** will then be telescoped over the outer portion of one of the terminals **28** and **32,** and will thereafter be shifted into a position wherein it will enclose the support **20,** the metallic surfaces **24** and **26,** the planished ends **30** and **34** of terminals **28** and **32,** respectively, the fusible element **36,** and the solder **38** and **40.** At such time, the ends of the housing **42** will extend short distances outwardly beyond the ends of the support **20,** and hence will encase the shoulders which are located between the planished ends **30** and **34** and the longitudinally outwardly-extending portions of the terminals **28** and **32,** respectively. Heat will be applied to the housing **42**; and that housing will respond to that heat to shrink into intimate engagement with the bottom and sides of the support **20,** and also into intimate engagement with the upper faces and sides of the planished ends **30** and **34** of the terminals **28** and **32,** respectively. In doing so, the material of that housing will form seals which will effectively resist the entry of dirt, dust and other airborne adulterants.

The positioning of the left-hand end of the fusible element **36** between the metallic surface **24** and the planished end **30** of the terminal **28,** and the positioning of the right-hand end of that fusible element between the metallic surface **26** and the planished end **34** of the terminal **32,** will enable those planished ends to initially space the inner surface of the housing **42** away from that fusible element. Moreover, in the said preferred embodiment, the initial spacing between the inner surface of that housing and the fusible element **36** is great enough to keep that inner surface from moving into engagement with that fusible element during the shrinking of that housing. This is desirable; because it not only avoids the application of stresses to that fusible element during the shrinking of the housing **42,** but it also avoids any contact between the inner surface of that housing and that fusible element which could affect the rating of the electric fuse. The overall result is that where the inner surface of the housing **42** continues to remain out of engagement with all portions of the fusible element **36,** that fusible element will not be subjected to destructive stresses during the shrinking of that housing, and that fusible element will be able to provide a predictable rating for the electric fuse.

If dimensional considerations were to require the use of extremely thin planished ends **30** and **34,** respectively, for the terminals **28** and **32,** and if the inner surface of the housing **42** were to tend to engage and stretch the fusible element **36** during the shrinking of that housing, the fusible element **36** could be bowed downwardly toward the bottom of the notch **22** prior to the time that fusible element was soldered to the metallic surfaces **24** and **26.** In such event, the ends of that notch would be able to coact with even very thin planished ends **30** and **34** to keep the inward movement of the inner surface of the housing **42,** during the shrinking of the material of that housing, from applying hurtful stresses to the fusible element **36.**

The fusible element **36** will respond to any current flowing through it to generate heat; and that heat will make the longitudinal center of that fusible element hotter than any other portion of that fusible element. Because the notch **22** is arcuate in side elevation, and because the deepest portion of that notch is in register with the longitudinal center of that part of the fusible element **36** which spans that notch, there will be an air space adjacent at least a portion of the surface area of that part of that fusible element. That air space will provide a predictable rate of heat radiation from that portion of the surface area of the longitudinal center of that part of the fusible element **36** which spans the notch **22.**

As long as the current flowing through the electric fuse remains below a predetermined level, the fusible element **36** will remain intact. However, if the current flowing through that electric fuse rises to an objectionable level, that fusible element will fuse and will thereby intercept the flow of current through that electric fuse — with consequent interruption of the flow of current through the circuit protected by that electric fuse.

The housing **42** will protect the fusible element **36** from injury due to sharp blows or abrasion; because the material of that housing is sturdy, is not brittle, and has a high resistance to fatique. In addition, that housing will help the solder **38** and **40** resist forces which could tend to shift the terminals **28** and **32,** respectively, relative to the metallic surfaces **24** and **26.** Moreover, that housing will protect the joints between the metallic surfaces **24** and **26** and the upper face of the support **20,** and thereby will help make the electric fuse strongly resistant to damage and injury.

The present invention thus makes it possible to provide an extremely small but very rugged electric fuse. Specifically, the overall length of the housing **42** can be as small as nine thirty-seconds of an inch plus or minus one thirty-second of an inch, the width of that housing can be about one-tenth of an inch, and the height of that housing can be about one-tenth of an inch.

The material of which the housing **42** is made can respond to the presence of an electrical arc, which develops as the fusible element **36** fuses, to evolve a gas or vapor which will help quench that arc. Also, the planished ends **30** and **34**, respectively, of the terminals **28** and **32** will have sufficient mass, relative to the small mass of the fusible element **36**, to enable those planished ends to act as arc-cooling arcing contacts. Because of these facts, and also because the material of the housing **42** is not brittle, the electric fuse provided by the present invention can "open" electrical circuits to which one hundred and twenty-five volts are applied; and it can open those electrical circuits and still leave the housing **42** unbroken.

The offsetting of the planished inner ends of the terminals **28** and **32** from the axes of the outwardly-extending portions of those terminals enables the axes of those outwardly-extending portions to be close to the axis of the support **20**. As a result, the extent to which any portion of the electric fuse projects radially outwardly beyond the outer surface of the outwardly-extending portion of either of the terminals **28** and **32** is just a few thousandths of an inch.

When the housing **42** is heated to shrink it, all portions of that housing will shrink. However, if desired, local heating of specific areas of the housing **42** could be provided to effect shrinking of just those portions of that housing. For example, if desired, the ends of the housing **42** could be heated to shrink them into sealing engagement with the ends of the support **20** and with the planished ends **30** and **34**, respectively, of the terminals **28** and **32**. In such event, the middle portion of the housing **42** could retain its initial dimensions, and thus could make certain that the inner surface thereof was spaced an appreciable distance from all portions of the fusible element **36**.

The plastic material used in forming the housing **42** can be obtained in a range of colors; and that is desirable, because it permits color coding of the electric fuses provided by the present invention. Color coding of those electric fuses is very desirable, because the very small sizes of those electric fuses make it very difficult to mark those electric fuses with their ampere ratings.

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 we claim is:

1. An electric fuse which comprises a support, a terminal adjacent one end of said support, a second terminal adjacent the other end of said support, a fusible element electrically connecting said terminals, and a housing of readily shrinkable material which encloses and protects said fusible element, said housing of readily shrinkable material having portions thereof shrunk into engagement with and enclosing portions of said support and of the inner ends of said terminals, said terminals extending outwardly through and beyond the ends of said housing of readily shrinkable material to have the outer ends thereof engageable with spaced-apart components of an electric circuit to be protected by said electric fuse, said terminals having said inner ends thereof spaced apart a predetermined distance, said fusible element responding to a potentially-hurtful overload of predetermined duration to fuse and thereby open said electric circuit, said spacing apart of said inner ends of said terminals acting to minimize or prevent burning of said inner ends of said terminals when said fusible element fuses to open said electric circuit.

2. An electric fuse which comprises a support, a terminal adjacent one end of said support, a second terminal adjacent the other end of said support, a fusible element electrically connecting said terminals, a housing of readily shrinkable material which encloses and protects said fusible element, said housing of readily shrinkable material having portions thereof shrunk into engagement with and enclosing portions of said support and of the inner ends of said terminals, said terminals extending outwardly through and beyond the ends of said housing of readily shrinkable material to have the outer ends thereof engageable with spaced-apart components of an electric circuit to be protected by said electric fuse, said terminals having said inner ends thereof spaced apart a predetermined distance, said fusible element responding to a potentially-hurtful overload of predetermined duration to fuse and thereby open said electric circuit, said spacing apart of said inner ends of said terminals acting to minimize or prevent burning of said inner ends of said terminals when said fusible element fuses to open said electric circuit, the first said terminal having said inner end thereof engaging and holding said one end of said support and having said outer end thereof extending outwardly beyond said one end of said support, said second terminal having said inner end thereof engaging and holding said other end of said support and having said outer end thereof extending outwardly beyond said other end of said support, said outer end of said first said terminal being offset from said inner end of said first said terminal to enable said outer end of said first said terminal to be generally coaxial with said support although said inner end of said first said terminal is displaced laterally from the axis of said support, and said outer end of said second terminal being offset from said inner end of said second terminal to enable said outer end of said second terminal to be generally coaxial with said support although said inner end of said second terminal is displaced laterally from said axis of said support.

3. An electric fuse which comprises a support, a terminal adjacent one end of said support, a second terminal adjacent the other end of said support, a fusible element electrically connecting said terminals, a housing of readily shrinkable material which encloses and protects said fusible element, said housing of readily shrinkable material having portions thereof shrunk into engagement with and enclosing portions of said support and of the inner ends of said terminals, said terminals extending outwardly through and beyond the ends of said housing of readily shrinkable material to have the outer ends thereof engageable with spaced-apart components of an electric circuit to be protected by said electric fuse, said terminals having said inner ends

thereof spaced apart a predetermined distance, said fusible element responding to a potentially-hurtful overload of predetermined duration to fuse and thereby open said electric circuit, said spacing apart of said inner ends of said terminals acting to minimize or prevent burning of said inner ends of said terminals when said fusible element fuses to open said electric circuit, the first said terminal having an inner end that engages said support and having an outer portion that extends outwardly beyond said support, said second terminal having an inner end that engages said support and having an outer portion that extends outwardly beyond said support, said inner end of said first said terminal being planished to provide a large area of engagement between said inner end of said first said terminal and said one end of said support, said inner end of said second terminal being planished to provide a large area of engagement between said inner end of said second terminal and said other end of said support, said planished inner end of said first said terminal being wider but thinner than an outer portion of said first said terminal, and said planished inner end of said second terminal being wider but thinner than an outer portion of said second terminal.

4. An electric fuse which comprises a support, a terminal adjacent one end of said support, a second terminal adjacent the other end of said support, a fusible element electrically connecting said terminals, a housing of readily shrinkable material which encloses and protects said fusible element, said housing of readily shrinkable material having portions thereof shrunk into engagement with and enclosing portions of said support and of the inner ends of said terminals, said terminals being connectable to an electric circuit, said inner ends of said terminals being exposed at the same side of said support, said fusible element having the effective length thereof disposed at said side of said support, said terminals having said inner ends thereof spaced apart axially of said support a predetermined distance, said fusible element responding to a potentially-hurtful overload of predetermined duration to fuse and thereby open said electric circuit, said predetermined distance by which said inner ends of said terminals are spaced apart being substantially equal to said effective length of said fusible element, a portion of said inner end of said first said terminal extending laterally outwardly of one end of said fusible element to hold the corresponding portion of the inner surface of said housing of readily shrinkable material laterally outwardly of said one end of said fusible element, and a portion of said inner end of said second terminal extending laterally outwardly of the other end of said fusible element to hold the corresponding portion of said inner surface of said housing of readily shrinkable material laterally outwardly of said other end of said fusible element, and said spacing apart of said inner ends of said terminals acting to minimize or prevent burning of said inner ends of said terminals when said fusible element fuses to open said electric circuit.

5. An electric fuse which comprises a support, a terminal adjacent one end of said support, a second terminal adjacent the other end of said support, a fusible element electrically connecting said terminals, a housing of readily shrinkable material which encloses and protects said fusible element, said housing of readily shrinkable material having portions thereof shrunk into engagement with and enclosing portions of said support and of the inner ends of said terminals, said terminals being connectable to an electric circuit, said inner ends of said terminals being exposed at the same side of said support, said fusible element having the effective length thereof disposed at said side of said support, said terminals having said inner ends thereof spaced apart axially of said support a predetermined distance, said fusible element responding to a potentially-hurtful overload of predetermined duration to fuse and thereby open said electric circuit, a portion of said inner end of the first said terminal extending laterally outwardly of one end of said fusible element, a portion of said inner end of said second terminal extending laterally outwardly of the other end of said fusible element, said portions of said inner ends of said terminals extending laterally outwardly of said ends of said fusible element far enough to hold said inner surface of said housing of readily shrinkable material out of engagement with said effective length of said fusible element, said spacing apart of said inner ends of said terminals acting to minimize or prevent burning of said inner ends of said terminals when said fusible element fuses to open said electric circuit.

6. An electric fuse which comprises a support, said support having a metallic surface adjacent one end thereof, said support having a second metallic surface adjacent the other end thereof, a terminal adjacent said one end of said support, a second terminal adjacent said other end of said support, a fusible element electrically connecting said terminals, a housing of readily shrinkable material which encloses and protects said fusible element, said housing of readily shrinkable material having portions thereof shrunk into engagement with and enclosing portions of said support and portions of the inner ends of said terminals, said terminals being connectable to an electric circuit, said inner ends of said terminals being exposed at the same side of said support, said fusible element having the effective length thereof disposed at said side of said support, a portion of said inner end of the first said terminal being in register with the first said metallic surface but one end of said fusible element being interposed between said first said metallic surface and said portion of said inner end of said first said terminal, and a portion of said inner end of said second terminal being in register with said second metallic surface but the other end of said fusible element being interposed between said second metallic surface and said portion of said inner end of said second terminal, said portions of said inner ends of said terminals being disposed between said ends of said fusible element and the inner surface of said housing of readily shrinkable material and acting to hold said inner surface of said housing of readily shrinkable material out of engagement with said ends of said fusible element, said fusible element responding to a potentially-hurtful overload of predetermined duration to fuse and thereby open said electric circuit.

7. An electric fuse which comprises a support, said support having a metallic surface adjacent one end thereof, said support having a second metallic surface adjacent the other end thereof, a terminal adjacent said one end of said support, a second terminal adjacent said other end of said support, a fusible element electrically connecting said terminals, a housing of readily shrinkable material which encloses and protects said fusible element, said housing of readily shrinkable material having portions thereof shrunk into engagement

with and enclosing portions of said support and portions of the inner ends of said terminals, said terminals being connectable to an electric circuit, said inner ends of said terminals being exposed at the same side of said support, said fusible element having the effective length thereof disposed at said side of said support, a portion of said inner end of the first said terminal being in register with the first said metallic surface but one end of said fusible element being interposed between said first said metallic surface and said portion of said inner end of said first said terminal, a portion of said inner end of said second terminal being in register with said second metallic surface but the other end of said fusible element being interposed between said second metallic surface and said portion of said inner end of said second terminal, said portions of said inner ends of said terminals being disposed between said ends of said fusible element and the inner surface of said housing of readily shrinkable material and acting to hold said inner surface of said housing of readily shrinkable material out of engagement with said ends of said fusible element, said portions of said inner ends of said terminals holding said inner surface of said housing of readily shrinkable material against movement into an engagement with any portion of said effective length of said fusible element which could apply destructive forces to said effective length of said fusible element, said fusible element responding to a potentially-hurtful overload of predetermined duration to fuse and thereby open said electric circuit.

8. An electric fuse which comprises a support, a terminal adjacent one end of said support, a second terminal adjacent the other end of said support, a fusible element electrically connecting said terminals, a housing of readily shrinkable material which encloses and protects said fusible element, said housing of readily shrinkable material having portions thereof shrunk into engagement with and enclosing portions of said support and portions of the inner ends of said terminals, said terminals extending outwardly through and beyond the ends of said housing of readily shrinkable material, said terminals having said inner ends thereof spaced apart a predetermined distance, said fusible element responding to a potentially-hurtful overload of predetermined duration to fuse and thereby open said electric circuit, said housing of said readily shrinkable material having the outer ends thereof engaging portions of said terminals which are adjacent to but which extend outwardly from said ends of said support, said portions of said terminals which are adjacent to but which extend outwardly from said ends of said support having cross sections which are only small fractions of the cross sections of said ends of said support, said support being acircular in cross section, said terminals making said cross sections of said ends of said support irregular, and said portions of said housing of readily shrinkable material closely engaging said portions of said terminals which are adjacent to but which extend outwardly from said ends of said support and also closely engaging said ends of said support despite the irregularity of said ends of said support and despite the disparity between the cross sections of said ends of said support and the cross sections of said portions of said terminals which are adjacent to but which extend outwardly from said ends of said support, the engagements between said portions of said housing of readily shrinkable material and said portions of said terminals which are adjacent to but which extend outwardly from said ends of said support resisting tilting of said terminals relative to the axis of said support, and thereby helping said terminals remain in assembled relation with said support.

9. An electric fuse which comprises a support, a terminal adjacent one end of said support, a second terminal adjacent the other end of said support, a fusible element electrically connecting said terminals, a housing of readily shrinkable material which encloses and protects said fusible element, said housing of readily shrinkable material having portions thereof shrunk into engagement with and enclosing portions of said support and portions of the inner ends of said terminals, said terminals being connectable to an electric circuit, said inner ends of said terminals being exposed at the same side of said support, said fusible element having the effective length thereof disposed at said side of said support, a portion of said side of said support which is intermediate said terminals being relieved by a notch, said effective length of said fusible element spanning said notch of said side of said support and thereby being held out of direct engagement with said side of said support, and said inner ends of said terminals extending laterally outwardly beyond said side of said support to keep said inner surface of said housing of readily shrinkable material from applying destructive forces to said effective length of said fusible element, whereby said effective length of said fusible element is out of engagement with said notch of said side of said support and is not subjected to destructive forces by said inner surface of said housing of readily shrinkable material.

10. An electric fuse which comprises a support, a terminal adjacent one end of said support, a second terminal adjacent the other end of said support, a fusible element electrically connecting said terminals, a housing of readily shrinkable material which encloses and protects said fusible element, said housing of readily shrinkable material having portions thereof shrunk into engagement with and enclosing portions of said support and of the inner ends of said terminals, said terminals extending outwardly through and beyond the ends of said housing of readily shrinkable material and being adapted to hold said support, said terminals being connectable to an electric circuit, said terminals having said inner ends thereof spaced apart a predetermined distance, said fusible element responding to a potentially-hurtful overload of predetermined duration to fuse and thereby open said electric circuit, said support having a metallic surface adjacent said one end thereof, said support having a second metallic surface adjacent said other end thereof, a portion of said inner end of the first said terminal being planished and being in register with the first said metallic surface, said portion of said inner end of said first said terminal being bonded to said first said metallic surface in electrical conducting relation, a portion of said inner end of said second terminal being planished and being in register with said second metallic surface, said portion of said inner end of said second terminal being bonded to said second metallic surface in electrical conducting relation, said first said metallic surface having a large face-to-face engagement with said one end of said support, said planished portion of said inner end of said first said terminal having a relatively large face-to-face engagement with said first said metallic surface, said second metallic surface having a large face-to-face engagement with

said other end of said support, said planished portion of said inner end of said second terminal having a relatively large face-to-face engagement with said second metallic surface, the ends of said housing of readily shrinkable material closely engaging those portions of said terminals which are adjacent to and which extend outwardly beyond said ends of said support, the close engagements between said ends of said housing of readily shrinkable material and said portions of said terminals which are adjacent to and which extend outwardly beyond said ends of said support coacting with said face-to-face engagements between said inner ends of said terminals and said metallic surfaces and also coacting with said face-to-face engagements between said metallic surfaces and said ends of said support to resist tilting of said terminals relative to the axis of said support, and thereby helping to maintain said terminals in assembled relation with said support.

11. An electric fuse which comprises a support, a terminal adjacent one end of said support, a second terminal adjacent the other end of said support, a fusible element electrically connecting said terminals, a housing of readily shrinkable material which encloses and protects said fusible element, said housing of readily shrinkable material having portions thereof shrunk into engagement with and enclosing portions of said support and portions of the inner ends of said terminals, said terminals being connectable to an electric circuit, the first said terminal having an inner portion that is in register with and is fixedly secured to said one end of said support and having an outer portion that extends outwardly through said housing of readily shrinkable material and beyond said one end of said support and beyond one end of said housing of readily shrinkable material to be adapted to hold said one end of said support, said second terminal having an inner portion that is in register with and is fixedly secured to said other end of said support and having an outer portion that extends outwardly through said housing of readily shrinkable material and beyond said other end of said support and beyond the other end of said housing of readily shrinkable material to be adapted to hold said other end of said support, said housing of readily shrinkable material engaging said inner portions of said terminals, and said ends of said housing of readily shrinkable material extending outwardly beyond said ends of said support to enclose and intimately engage a part of each of said outer portions of said terminals, the intimate engagement between said ends of said housing of readily shrinkable material and said parts of said outer portions of said terminals enabling said housing of readily shrinkable material to resist tilting of said terminals relative to the axis of said support and thereby helping prevent separation of said terminals from said support.

12. An electric fuse which comprises a support, a terminal adjacent one end of said support, a second terminal adjacent the other end of said support, a fusible element electrically connecting said terminals, a housing of readily shrinkable material which encloses and protects said fusible element, said housing of readily shrinkable material having portions thereof shrunk into engagement with and enclosing portions of said support and of the inner ends of said terminals, said terminals being connectable to an electric circuit, said terminals having said inner ends thereof spaced apart axially of said support a predetermined distance, said fusible element responding to a potentially-hurtful overload of predetermined duration to fuse and thereby open said electric circuit, said predetermined distance by which said inner ends of said terminals are spaced apart being substantially equal to the effective length of said fusible element, the cross section of said fusible element being just a small fraction of the cross section of said inner end of either of said terminals, whereby said inner ends of said terminals have sufficient mass to cool any arc which forms as said fusible element fuses to open the circuit, and said spacing apart of said inner ends of said terminals acting to minimize or prevent burning of said inner ends of said terminals when said fusible element fuses to open said electric circuit.

13. An electric fuse which comprises a support, a terminal adjacent one end of said support, a second terminal adjacent the other end of said support, a fusible element electrically connecting said terminals, a housing of readily shrinkable material which encloses and protects said fusible element, said housing of readily shrinkable material having portions thereof shrunk into engagement with and enclosing portions of said support and portions of the inner ends of said terminals, the first said terminal having an inner end that is in register with and is fixedly secured to said one end of said support and having an outer portion that extends outwardly through said housing of readily shrinkable material and beyond said one end of said support and beyond one end of said housing of readily shrinkable material to be connectable to an electric circuit, said second terminal having an inner end that is in register with and is fixedly secured to said other end of said support and having an outer portion that extends outwardly through said housing of readily shrinkable material and beyond said other end of said support and beyond the other end of said housing of readily shrinkable material to be connectable to said electric circuit, a shoulder in said first said terminal which is intermediate said inner end and said outer portion of said first said terminal, a shoulder in said second terminal which is intermediate said inner end and said outer portion of said second terminal, and said housing of readily shrinkable material intimately engaging said inner ends and said shoulders of said terminals plus parts of said terminals which are outward of but which are immediately adjacent said ends of said support, the intimate engagements between said housing of readily shrinkable material and said inner ends and said shoulders and said parts of said terminals enabling said housing of readily shrinkable material to resist tilting of said terminals relative to the axis of said support and thereby helping prevent separation of said terminals from said support.

14. An electric fuse which comprises a support, a terminal adjacent one end of said support, a second terminal adjacent the other end of said support, a fusible element electrically connecting said terminals, a housing of readily shrinkable material which encloses and protects said fusible element, said housing of readily shrinkable material having portions thereof shrunk into engagement with and enclosing portions of said support and portions of the inner ends of said terminals, the first said terminal having an inner end that is in register with and overlaps and is fixedly secured to said one end of said support and having an outer portion that extends outwardly through said housing of readily shrinkable material and beyond said one end of said support and beyond one end of said housing of readily shrinkable material to be connectable to an electric circuit,

said second terminal having an inner end that is in register with and overlaps and is fixedly secured to said other end of said support and having an outer portion that extends outwardly through said housing of readily shrinkable material and beyond said other end of said support and beyond the other end of said housing of readily shrinkable material to be connectable to said electric circuit, said inner end of said first said terminal being planished to provide a large area of securement between said inner end of said first said terminal and said one end of said support, said inner end of said second terminal being planished to provide a large area of securement between said inner end of said second terminal and said other end of said support, a shoulder in said first said terminal which is intermediate said inner end and said outer portion of said first said terminal, a shoulder in said second terminal which is intermediate said inner end and said outer portion of said second terminal, said shoulder in said first said terminal abutting said one end of said support to limit the extent to which said planished inner end of said first said terminal overlaps said one end of said support, said shoulder in said second terminal abutting said other end of said support to limit the extent to which said planished inner end of said second terminal overlaps said other end of said support, and said housing of readily shrinkable material intimately engaging said inner ends and said shoulders of said terminals plus parts of said terminals which are outward of but which are immediately adjacent said ends of said support, the intimate engagement between said housing of readily shrinkable material and said inner ends and said shoulders and said parts of said terminals enabling said housing of readly shrinkable material to resist tilting of said terminals relative to the axis of said support and thereby helping prevent separation of said terminals from said support.

15. An electric fuse which comprises a support, a terminal adjacent one end of said support, a second terminal adjacent the other end of said support, a fusible element electrically connecting said terminals, a notch in one side of said support which is spaced inwardly from said ends of said support and which is in register with the effective length of said fusible element, a housing of readily shrinkable material which encloses and protects said fusible element, said housing of readily shrinkable material having portions thereof shrunk into engagement with and enclosing portions of said support and portions of the inner ends of said terminals, said terminals being connectable to an electric circuit, said inner ends of said terminals being exposed at said side of said support, said fusible element having said effective length thereof disposed at said side of said support, said inner ends of said terminals acting to hold the inner surface of said housing of shrinkable material out of engagement with said ends of said fusible element, said inner ends of said terminals also holding said inner surface of said housing of shrinkable material against movement into and engagement with any portion of said effective length of said fusible element which could apply destructive forces to said effective length of said fusible element, said notch being arcuate in side elevation, the deepest portion of said notch being adjacent the longitudinal center of said effective length of said fusible element, and said fusible element responding to a potentially-hurtful overload of predetermined duration to fuse and thereby open said electric circuit.

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