Jan. 29, 1963 C. L. McALISTER 3,076,079

PROTECTORS FOR ELECTRIC CIRCUITS

Filed March 16, 1959

FIG. 2

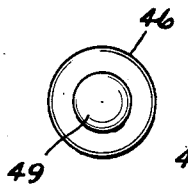


FIG. 1

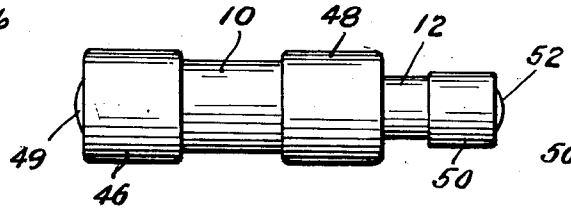


FIG. 3

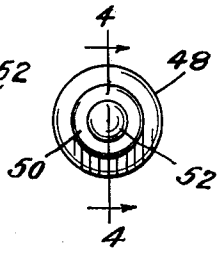


FIG. 4

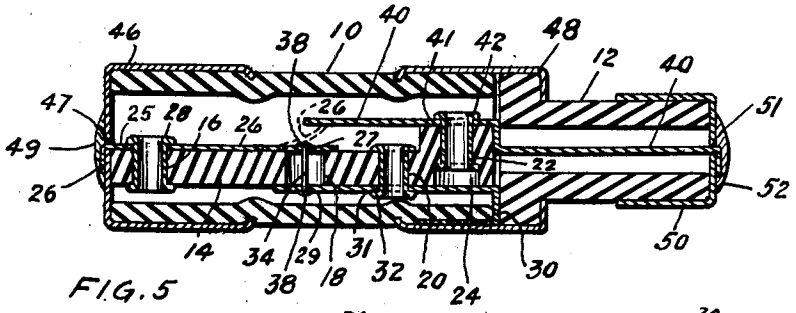


FIG. 5

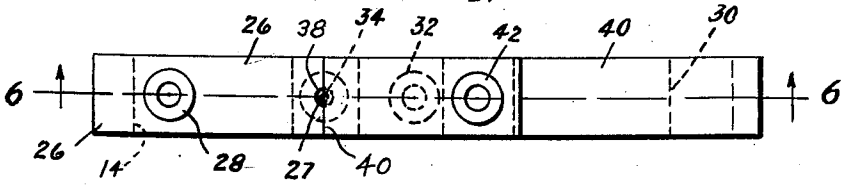


FIG. 6

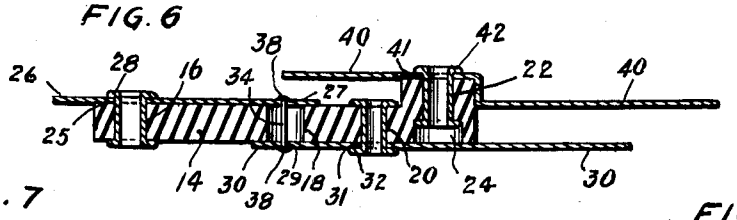


FIG. 7

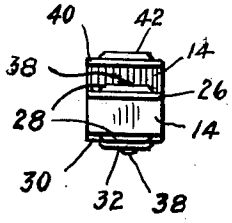
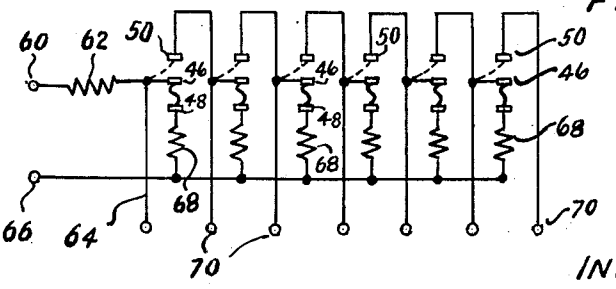


FIG. 8



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PROTECTORS FOR ELECTRIC CIRCUITS

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This invention relates to improvements in protectors for electric circuits. More particularly, this invention relates to improvements in fusible relays which complete certain circuits when they are in their normal positions and which complete other and different circuits when they are in their actuated positions.

It is therefore an object of the present invention to provide an improved fusible relay which completes one circuit when it is in its normal position and which completes a second and different circuit when it is in its actuated position.

In certain situations it is desirable to energize a number of devices in rapid succession rather than simultaneously. For example, it is desirable to energize the firing mechanisms, for the rockets carried by military aircraft, in rapid succession rather than simultaneously. Those firing mechanisms should not be energized simultaneously because the rockets are mounted so closely adjacent one another that the fins on some of the rockets could strike the fins on other of the rockets, and thereby divert those other rockets from the target, if all the rockets were fired at the same time. While the rockets should not be fired simultaneously, they should be fired in extremely rapid succession because the overall time the aircraft is "on target" is extremely short. The present invention makes it possible to provide rapid, successive firing of the rockets carried by military aircraft; and it does so by providing a chain of fusible relays wherein each fusible relay responds to actuation to energize a rocket-firing mechanism and to actuate the next-succeeding fusible relay. Each fusible relay requires a very short, but finite, time interval to become actuated; and the resultant time intervals keep the firings of the rockets from being simultaneous. It is therefore an object of the present invention to provide fusible relays that assure rapid, successive firing, rather than simultaneous firing, of rockets carried by military aircraft.

The fusible relay provided by the present invention can become actuated within an extremely short period of time. Specifically, one embodiment of the fusible relay provided by the present invention can be made to open the normally-closed circuit and to close the normally-open circuit within eight to twelve milliseconds. Such a fusible relay makes it possible to provide successive, rather than simultaneous, firing of the rockets carried by military aircraft while also making it possible to fire a number of those rockets in a mere fraction of a second. It is therefore an object of the present invention to provide a fusible relay that can become actuated within eight to twelve milliseconds.

The fusible relay provided by the present invention is enclosed within a housing and it is thus protected against dirt, grease and other foreign matter and it is also protected against bending and distortion. The housing for the fusible relay is equipped with three terminals, and those terminals are made in such a way that the fusible relay must be properly oriented before it can be installed. Proper orientation of the fusible relays is absolutely vital because if any one of the fusible relays were to be installed improperly, the next-succeeding flexible relays, and the rockets controlled thereby, could not be actuated; and this could mean the loss of the pilot and of his aircraft. Moreover, automatic orientation of the fusible relays is essential because mechanics and ordnance technicians could easily, in the heat and excitement of a military

engagement, fail to follow proper installation procedures. It is therefore an object of the present invention to form the terminals of a fusible relay so those terminals enforce proper orientation of the fusible relay whenever it is being installed.

The fusible relays that control the firing mechanisms for the rockets carried by military aircraft may not be actuated for long periods of time, but they must nevertheless operate swiftly and surely whenever they are to be actuated. During those long periods of time, when those fusible relays are not actuated, those fusible relays may be subjected to extremely heavy stresses. For example, during those long periods of time, the fusible relays may be exposed to forces that greatly exceed the force of gravity, and they may be exposed to vibrational forces and to physical shocks. The fusible relay provided by the present invention is made so it is both compact and rugged, and therefore that fusible relay is always ready for swift and certain actuation. It is therefore an object of the present invention to provide a fusible relay that is compact and rugged.

The fusible relays that control the firing mechanisms for the rockets carried by military aircraft are mounted in the wings of such aircraft. As a result, those fusible relays can be exposed to temperatures that range from as high as one hundred and thirty degrees Fahrenheit to as low as seventy degrees below zero Fahrenheit; and those fusible relays must operate swiftly and certainly at any temperature within that entire range. The present invention makes it possible for the fusible relay to operate swiftly and certainly at any temperature within that entire range by providing a fusible element that has a high fusing temperature. Such a fusible element is largely unaffected by ambient temperature conditions. It is therefore an object of the present invention to provide a fusible relay which has a fusible element with a high fusing temperature.

The fusible element of the fusible relay provided by the present invention is enclosed within a large diameter opening in a non-conductive support, and that fusible element is thus protected against injury during the assembly of the fusible relay with its housing. Also, that fusible element is buffered from the ambient temperatures by the overall housing for that fusible relay, by the non-conductive support within that housing, and by the air space within the opening in that support. In these ways, the fusible relay provided by the present invention can be made swift and certain in operation.

Other and further objects and advantages of the present invention should become apparent from an 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.

In the drawing, FIG. 1 is a side elevational view of a fusible relay that is made in accordance with the principles and teachings of the present invention,

FIG. 2 is an elevational view of the left-hand end of the fusible relay shown in FIG. 1,

FIG. 3 is an elevational view of the right-hand end of the fusible relay shown in FIG. 1,

FIG. 4 is a sectional view through the fusible relay of FIGS. 1–3, and it is taken along the plane indicated by the line 4—4 in FIG. 3,

FIG. 5 is a plan view of the current-carrying components of the fusible relay before they are assembled with the housings of FIGS. 1–4,

FIG. 6 is a sectional view of the components shown in

FIG. 5, and it is taken along the plane indicated by the line 6—6 in FIG. 5,

FIG. 7 is an elevational view of the left-hand end of the components shown in FIG. 6, and

FIG. 8 is a circuit diagram showing how a number of the fusible relays of the present invention can be interconnected to form a chain of relays.

Referring to the drawing in detail, the numeral 10 denotes a tubular casing of insulating material, such as fiber. The numeral 12 denotes a tubular casing of insulating material; and that casing has a large diameter left-hand portion and a small diameter right-hand portion. The diameter of the large diameter left-hand portion of the casing 12 is equal to the outer diameter of the casing 10, but the diameter of the small diameter right-hand portion is smaller than the diameter of the passage through the casing 10. The diameter of the passage through the casing 12 is appreciably smaller than the diameter of the passage through the casing 10. Whenever the large diameter left-hand portion of the casing 12 is adjacent one end of the casing 10, the passages through those casings are coaxial.

The numeral 14 denotes a support of insulating material, such as Bakelite; and that support is generally rectangular in plan while being generally L-shaped in side elevation. That support has a vertically-directed opening 16 through it to receive a tubular rivet 28, has a vertically-directed opening 18 through it to receive a fusible element 34, has a vertically-directed opening 20 through it to receive a tubular rivet 32, and has a vertically-directed opening 22 through it to accommodate a tubular rivet 42. The openings 16, 18 and 20 have the same diameters throughout their lengths, but the opening 22 has an enlarged diameter lower end 24. The opening 22 and its enlarged diameter lower end 24 coact to define a radially-extending shoulder, and that shoulder accommodates the lower end of the rivet 42. The support 14 is as long as the casing 10, and its right-hand end is larger than the cross section of the passage through the casing 12.

An elongated, flat conductor 26 has two openings 25 and 27 through it, and the opening 25 accommodates the tubular rivet 28. That rivet extends upwardly through the opening 16 in the support 14 and through the opening 25 in the conductor 26, and is then riveted over to permanently secure the conductor 26 to the support 14. The opening 27 in the conductor 26 will be above and in register with the opening 18 in the support 14, but it will be much smaller than the opening 18. The conductor 26 is made from a springy and resilient metal, and it is bent so the right-hand end thereof is biased upwardly away from the support 14, and is thus biased upwardly and away from the upper end of the opening 18.

An elongated conductor 40 has an opening 41 through it which can accommodate the tubular rivet 42. That rivet extends upwardly through the opening 22 in support 14 and through the opening 41 in conductor 40. The lower flange of rivet 42 abuts the shoulder defined by the opening 22 and its larger diameter lower portion 24, and the upper end of that rivet is riveted over to permanently secure the conductor 40 to the support 14. The left-hand end of the conductor 40 will overlie, and be in the path of movement of, the upwardly biased right-hand end of the conductor 26. The conductor 40 will be stiff enough to withstand the bending force applied to its left-hand end by the right-hand end of the conductor 26 whenever that right-hand end of conductor 26 is freed to enable it to move upwardly and engage the left-hand end of conductor 40.

The conductor 40 is bent downwardly, at a point to the right of the opening 41, and it is then bent to extend horizontally. As a result, part of that conductor abuts the upper surface of the right-hand end of support 14, another part of that conductor abuts the upper part of the right-hand end face of that support, and the right-hand end of that conductor extends generally axially of the support 14.

Once the conductor 40 has been riveted to the support 14, an elongated, flat conductor 30, which has two openings 29 and 31 through it, is placed in engagement with the bottom face of the support 14. The tubular rivet 32, which was telescoped downwardly through the opening 20 in the support 14 before the conductor 40 was riveted to that support, will extend through the opening 31 in the conductor 30. The lower end of that rivet will be riveted over to permanently secure the conductor 30 to the support 14. The opening 29 in the conductor 30 will be below and in register with the opening 27 in the conductor 26; and both of those openings will be at the geometric center of the opening 18 in support 14.

A small diameter, readily fusible conductor 34 is threaded through the opening 27 of the conductor 26 and through the opening 29 of the conductor 30; and solder 38 is then used to secure the upper end of that fusible conductor to the conductor 26 and to secure the lower end of that fusible conductor to the conductor 30. The conductor 34 will be very small, being less than twenty three ten thousandths of an inch in diameter in one preferred embodiment, but it will be strong enough to withstand the tension exerted by the resilient forces within the springy conductor 26. That fusible conductor will, however, fuse rapidly and release the right-hand end of the conductor 26 whenever a predetermined voltage is applied to the conductors 26 and 30.

The current-carrying components of FIGS. 5–7 will be assembled with the support 14 before that support and those components are telescoped within the casings 10 and 12. That support and its components are initially telescoped within the casing 10, and thereupon the right-hand end of the conductor 30 is bent downwardly against the right-hand end of the casing 10 and is then additionally bent into engagement with the outer periphery of that casing. At this time, the right-hand end of the support 14 will be alined with the right-hand end of the casing 10. The large diameter left-hand portion of the casing 12 is then placed in abutting relation with the downwardly bent portions of the conductor 40 and of conductor 30, as shown particularly by FIG. 4. A tubular terminal 48 with an inwardly directed flange at the right-hand end thereof, is then telescoped over the small diameter right-hand portion of the casing 12 and over the large diameter left-hand portion of that casing until its flange abuts the shoulder between the large diameter left-hand and the small diameter right-hand portions of the casing 12. The casings 10 and 12 and the terminal 48 are then placed in a fixture or jig and the left-hand end of the tubular terminal 48 is crimped or rolled into permanent engagement with the casing 10.

The terminal 48 will engage that portion of the conductor 30 which abuts the outer periphery of the casing 10, and hence it will be in electrical engagement with that terminal. If a more intimate electrical engagement is desired, the inner surface of the terminal 48 can be "tinned" and the conductor 30 can be "tinned"; and then the terminal 48 can be heated to bond that terminal to the conductor 30.

A cup-shaped terminal 46 is provided with an opening 47 through the end thereof, and that opening is dimensioned to accommodate the left-hand end of the conductor 26. As the opening 47 in the terminal 46 is telescoped over the left-hand end of conductor 26, the open end of that terminal will telescope over the left-hand end of the casing 10. Once that cup-shaped terminal has been fully seated, it can be permanently secured to the casing 10 by a crimping or rolling operation. Thereafter, the portion of the left-hand end of conductor 26 which projects outwardly beyond the cup-shaped terminal 46 can be bent against the end of that terminal and covered with solder 49.

A cup-shaped terminal 50 is provided with an opening

51 through it, and that opening can telescope over the right-hand end of the conductor 40. As that opening telescopes over the right-hand end of that conductor, that terminal will telescope over the small diameter right-hand portion of the casing 12. When the terminal 50 has been fully seated on the reduced diameter right-hand portion of the casing 12, that terminal can be permanently secured to that casing by a crimping or rolling operation. Thereafter, the projecting portion of the right-hand end of the conductor 40 can be bent against the end of the terminal 50; and solder 52 can be used to bond that end to that terminal.

If desired, the conductors 26 and 40 could be made shorter in length so their projecting ends would just abut the closed ends of the terminals 46 and 50, respectively. Where that was the case, those conductors would be secured to those terminals by an "inside soldering" operation; and the openings 47 and 51 could be eliminated. However, the "outside soldering" shown in the drawing is preferred because the openings 47 and 51 provide a centering of the support 14 and its current-carrying components.

The fusible relay of the present invention provides a normally-closed circuit between the terminal 46 and the terminal 48; that circuit extending from terminal 46 through conductor 26, through fusible element 34, and through the conductor 30 to the terminal 48. That fusible relay also provides a normally-open circuit between the terminal 46 and the terminal 50; that circuit extending from the terminal 46 through the flexible conductor 26, and then through the conductor 40 to the terminal 50. As long as the fusible element 34 remains intact, the normally-closed circuit will conduct current and the normally-open circuit will not conduct current. However, as soon as the fusible element 34 fuses, the right-hand end of the flexible conductor 26 will bend upwardly and engage the left-hand end of conductor 40; and in doing so that right-hand end of conductor 26 will close the normally-open circuit between the terminals 46 and 50.

This fusible relay can be used in many different installations and overall circuits. One installation to which it is readily adapted is shown by FIG. 8; wherein the numeral 60 generally denotes a terminal of an electrical circuit used in controlling the firing of rockets carried by military aircraft. That terminal is connected to the battery of the aircraft through a rocket-firing switch, not shown, in the cockpit of the aircraft. That switch is normally open; but whenever it is closed, the terminal 60 becomes electrically "hot." A resistor 62 is provided intermediate the terminal 60 and the terminal 46 of one of the fusible relays provided by the present invention. In actual practice, the right-hand end of the resistor 62 will be connected to a holder in which the fusible relay of the present invention can be releasably disposed; but in the circuit diagram of FIG. 8 the right-hand end of the resistor 62 is shown directly engaging the terminal 46. A lead 64 which extends to the firing mechanism of a rocket is connected intermediate the resistor 62 and the terminal 46, and that lead will conduct current to that firing mechanism whenever the pilot closes the rocket-firing switch in the aircraft cockpit. That firing mechanism has a connection, not shown, to "ground"; and the terminal 66 in FIG. 8 also is connected to "ground."

A resistor 68 will be connected to the holder for the fusible relay and will thus be connected to the terminal 48 of that fusible relay. The other end of that resistor will be connected to the "grounded" terminal 66. The terminal 50 of the fusible relay is directly connected to a lead 70 and to the terminal 46 of an adjacent fusible relay. The lead 70 extends to a second firing mechanism for a second rocket carried by the aircraft. That second fusible relay and several other fusible relays have their terminals 48 connected to the "grounded" terminal 66 by resistors 68, and have their terminals 50 connected to succeeding leads to succeeding firing mechanisms for further rockets carried by the aircraft. That second fusible relay and those other fusible relays will be releasably held in holders in the wings of the aircraft, but those holders are not shown in FIG. 8.

As long as the rocket-firing switch in the cockpit is left open, the circuit to the first firing mechanism and to the first fusible relay will be open. However, when that rocket-firing switch is closed, current will flow to the first firing mechanism through the conductor 64 and to the fusible relay through the terminal 46. Those current flows will cause the firing mechanism to ignite the first rocket, and will fuse the fusible conductor 34. The rocket will be ignited almost immediately but the fusible conductor 34 will require several milliseconds to fuse and release the right-hand end of the conductor 26. This short, but finite, time interval is desirable because it enables the first rocket to be ignited and launched before the conductor 26 can complete the circuit to the firing mechanism for the second rocket.

The second rocket will be fired and launched almost immediately after the right-hand end of the conductor 26 moves into engagement with the conductor 40 and completes the circuit to the terminal 70. The second fusible relay will begin to carry current as soon as the right-hand end of the conductor 26 of the first fusible relay engages the conductor 40 of that relay, but the fusible element of that second fusible relay will not fuse for several milliseconds, thereby providing the desired time interval between the firing of the second and third rockets.

The right-hand end of the conductor 26 of the first fusible relay will, after it is released by the fusing of the fusible element 34, remain in engagement with the conductor 40 and constitute part of the energizing path for the second firing mechanism and the second fusible relay. The right-hand end of the conductor 26 of the second fusible relay will, after it is released by the fusing of the fusible element 34 of that second fusible relay, remain in engagement with the conductor 40 and constitute part of the energizing path for the third firing mechanism and the third fusible relay. Thus, each fusible relay is energized by the preceding relay and will, after a finite time interval, energize the succeeding firing mechanism and fusible relay. The action of the fusible relays is rapid, and thus enables the pilot to fire all of his rockets while "on target," but that action provides enough of a time interval between rocket firings to keep the fins of the various rockets from colliding.

The fusible relays will be held in holders that utilize standard fuse clips; large fuse clips accommodating the terminals 46 and 48 and a small fuse clip accommodating the terminal 50. The distinctiveness of the terminal 50 is important in making certain that the fusible relays will always be oriented properly when they are inserted in their holders, even when the installer is experiencing the excitement and heat of a military engagement.

The fusible element will hold the right-hand end of the conductor 26 tightly against the upper face of the support 14; and this is important because it frees that right-hand end from all tendency it would otherwise have to flex as it was recurrently exposed to centrifugal forces tending to force it to bend toward that support. Also, by holding the right-hand end of the conductor 26 tightly against the upper face of the support 14, the fusible element 34 keeps itself under tension and avoids flexing. As a result, that fusible element experiences little or no "working" or fatigue. That fusible element is held adjacent the geometric center of the large opening 18 and will thus not rub against or be bent and distorted by the side walls of that opening. Consequently, that fusible element will not prematurely release the right-hand end of the conductor 26.

The fusible element 34 is made of a metal having a melting point in excess of twelve hundred degrees centi-

grade. As a result, that fusible element will be largely insensitive to ambient temperatures in its fusing operation, and hence it will have a predetermined fusing time. The fusible element 34 will be short, approximately three thirty seconds of an inch long, and consequently it will blow quickly.

The drawing shows the terminals 46 and 48 to be the same in size, and shows the terminal 50 to be small. However, the terminal 50 could be made large and either the terminal 46 or the terminal 48 made small. Furthermore, the terminals 46, 48 and 50 need not have the form of ferrules. All that is necessary is that the terminals be so formed and positioned that they enforce proper orientation of the casing as it is being mounted in the holder.

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. A fusible relay that comprises a housing, an electrically non-conducting support disposed within said housing, said support having an opening through it, a substantially flat conductive plate that is fixedly secured to said support and has a portion thereof in register with and abutting and closing one end of said opening, a second substantially flat conductive plate that is fixedly secured to said support and has a portion thereof in register with and normally abutting and closing the other end of said opening, a third substantially flat conductive plate that is fixedly secured to said support and has a portion thereof in register with but normally spaced away from said portion of said second substantially flat plate, said portion of said second substantially flat plate being intermediate said other end of said opening and said portion of said third substantially flat plate and being biased away from said other end of said opening and toward said portion of said third substantially flat plate, a fusible wire that is disposed within said opening and that extends between and is secured to said portions of the first said and said second substantially flat plates, said fusible wire being dimensioned to normally hold said portion of said second substantially flat plate in intimate abutting and closing relation with said other end of said opening but responding to the passage of a predetermined current therethrough to melt and thereby free said portion of said second substantially flat plate for movement away from said other end of said opening and into engagement with said portion of said third substantially flat plate, and terminals on said housing that are connected to said three substantially flat plates, said second substantially flat plate normally connecting a circuit to the first said substantially flat plate through the medium of said fusible wire but responding to the melting of said fusible wire to cause the said portion thereof to engage, and transfer said circuit to, said portion of said third substantially flat plate, the first said and said third substantially flat plates being stiff and resistant to bending, the terminal connected to said second substantially flat plate being at one end of said housing, the terminal connected to said third substantially flat plate being at the opposite end of said housing, the terminal connected to the first said substantially flat plate being intermediate the ends of said housing, said terminal connected to said third substantially flat plate being smaller than the terminals connected to the first said and said second substantially flat plates.

2. A fusible relay that comprises a housing, an electrically nonconducting support disposed within said housing, said support having an opening through it, a substantially flat conductive plate that is fixedly secured to said support and has a portion thereof in register with and abutting and closing one end of said opening, a second substantially flat conductive plate that is fixedly secured to said support and has a portion thereof in register with and normally abutting and closing the other end of said opening, a third substantially flat conductive plate that is fixedly secured to said support and has a portion thereof in register with but normally spaced away from said portion of said second substantially flat plate, said portion of said second substantially flat plate being intermediate said other end of said opening and said portion of said third substantially flat plate and being biased away from said other end of said opening and toward said portion of said third substantially flat plate, a fusible wire that is disposed within said opening and that extends between and is secured to said portions of the first said and said second substantially flat plates, said fusible wire being dimensioned to normally hold said portion of said second substantially flat plate in intimate abutting and closing relation with said other end of said opening but responding to the passage of a predetermined current therethrough to melt and thereby free said portion of said second substantially flat plate for movement away from said other end of said opening and into engagement with said portion of said third substantially flat plate, and terminals on said housing that are connected to said three substantially flat plates, said second substantially flat plate normally connecting a circuit to the first said substantially flat plate through the medium of said fusible wire but responding to the melting of said fusible wire to cause the said portion thereof to engage, and transfer said circuit to, said portion of said third substantially flat plate, the first said and said third substantially flat plates being stiff and resistant to bending.

3. A fusible relay that comprises a housing, an electrically nonconducting support disposed within said housing, said support having an opening through it, a conductive plate that is fixedly secured to said support and has a portion thereof in register with and abutting and closing one end of said opening, a second conductive plate that is fixedly secured to said support and has a portion thereof in register with and normally abutting and closing the other end of said opening, a third conductive plate that is fixedly secured to said support and has a portion thereof in register with but normally spaced away from said portion of said second plate, said portion of said second plate being intermediate said other end of said opening and said portion of said third plate and being biased away from said other end of said opening and toward said portion of said third plate, a fusible element that is disposed within said opening and that extends between and is secured to said portions of the first said and said second plates, said fusible element being dimensioned to normally hold said portion of said second plate in intimate abutting and closing relation with said other end of said opening but responding to the passage of a predetermined current therethrough to melt and thereby free said portion of said second plate for movement away from said other end of said opening and into engagement with said portion of said third plate, and terminals on said housing that are connected to said three plates, said second plate normally connecting a circuit to the first said plate through the medium of said fusible element but responding to the melting of said fusible element to cause the said portion thereof to engage, and transfer said circuit to, said portion of said third plate.

4. A fusible relay that comprises a housing, an electrically nonconducting support disposed within said housing, a recess in said support, a conductor that is fixedly secured to said support and has a portion thereof in register with and abutting one side of said recess, a second conductor that is fixedly secured to said support and has a portion thereof in register with and normally abutting the other side of said recess, a third conductor that is fixedly secured to said support and has a portion thereof in register with but normally spaced away from said portion of said second conductor, said portion of said second conductor being intermediate said recess and said portion of said third conductor and being biased away from said recess

and toward said portion of said third conductor, a fusible element that is disposed within said recess and that extends between and is secured to said portions of the first said and said second conductors, said fusible element being dimensioned to normally hold said portion of said second conductor in intimate abutting and closing relation with said other side of said recess but responding to the passage of a predetermined current therethrough to melt and thereby free said portion of said second conductor for movement away from said other side of said recess and into engagement with said portion of said third conductor, and terminals on said housing connected to said three conductors, said second conductor normally connecting a circuit to the first said conductor through the medium of said fusible element but responding to the melting of said fusible element to cause the said portion thereof to engage, and transfer said circuit to, said portion of said third conductor.

5. A fusible relay that comprises an elongated housing, an electrically conductive element fixedly disposed within said housing, a second electrically conductive element within said housing, a third electrically conductive element fixedly disposed within said housing, said second electrically conductive element being springy, a fusible element that is disposed within said housing and that extends between and is secured to the first said and said second electrically conductive elements, said fusible element normally holding the first said and said second electrically conductive elements in electrically conducting relation and holding said second electrically conductive element out of electrically conducting relation with said third electrically conductive element but responding to the passage of a predetermined current therethrough to melt and thereby free said second electrically conductive element for movement into electrically conducting relation with said third electrically conductive element, and tubular terminals on said housing that are connected to said three electrically conductive elements, the terminal connected to said second electrically conductive element being at one end of said housing, the terminal connected to said third electrically conductive element being at the opposite end of said housing, and the terminal connected to the first said electrically conductive element being intermediate the ends of said housing, each of said terminals being formed to extend into and be held by a standard fuse clip, at least one of said terminals of said housing being smaller than another of said terminals of said housing to assure proper orientation and installation of said fusible relay.

6. A fusible relay that comprises a housing, an electrically conductive element within said housing, a second electrically conductive element within said housing, a third electrically conductive element within said housing, a fusible element that is disposed within said housing and that extends between and is secured to the first said and said second electrically conductive elements, said fusible element normally holding the first said and said second electrically conductive elements in electrically conducting relation and holding said second electrically conductive element out of electrically conducting relation with said third electrically conductive element but responding to the passage of a predetermined current therethrough to melt and thereby free said second electrically conductive element for movement into electrically conducting relation with said third electrically conductive element, and terminals on said housing that are connected to said three electrically conductive elements, the terminal connected to said second electrically conductive element being at one end of said housing, the terminal connected to said third electrically conductive element being at the opposite end of said housing, and the terminal connected to the first said electrically conductive element being intermediate the ends of said housing, each of said terminals being formed to extend into and be held by a standard fuse clip, one of the end terminals of said housing being smaller than the other end terminal of said housing to assure proper installation of said fusible relay.

7. A fusible relay that comprises an electrically nonconducting support, said support having an opening through it, a substantially flat conductive plate that is fixedly secured to said support and has a portion thereof in register with and abutting and closing one end of said opening, a second substantially flat conductive plate that is fixedly secured to said support and has a portion thereof in register with and normally abutting and closing the other end of said opening, said second substantially flat plate having said portion thereof biased away from said other end of said opening, and a fusible wire, said opening having a diameter many times greater than the diameter of said fusible wire, said portions of said substantially flat plates having holes therein that are in register with the geometric center of said opening and that are larger than said fusible wire, said fusible wire being disposed within said opening and extending through said holes in said portions of said substantially flat plates and being bonded to said portions of said substantially flat plates, said fusible wire being dimensioned to normally hold said portions of said substantially flat plates in intimate abutting and closing relation with said ends of said opening but responding to the passage of a predetermined current therethrough to melt and to free said portion of said second substantially flat plate for movement away from said other end of said opening, the greater diameter of said opening coacting with the positioning of said holes in register with the geometric center of said opening to hold said fusible wire out of engagement with the sides of said opening.

8. A fusible relay that comprises an eletcrically nonconducting support, an opening through said support, a conductive plate that is secured to said support and has a portion thereof in register with and abutting and closing one end of said opening, a second conductive plate that is secured to said support and has a portion thereof in register with and normally abutting and closing the other end of said opening, said second plate having said portion thereof biased away from said other end of said opening, and a fusible wire, said opening having a diameter many times greater than the diameter of said fusible wire, said portions of said plates having holes therein that are in register with said opening and that are larger than said fusible wire, said fusible wire being disposed within said opening and extending through said holes in said portions of said plates and being bonded to said portions of said plates, said fusible wire being dimensioned to normally hold said portions of said plates in intimate abutting and closing relation with said ends of said opening but responding to the passage of a predetermined current therethrough to melt and to free said portion of said second plate for movement away from said other end of said opening.

9. A protector for electric circuits which comprises a casing of electrically insulating material, electrically conducting terminals on said casing, said terminals being adapted to be inserted in standard fuse clips, at least one of said terminals being adapted to be inserted in a standard fuse clip which is different from the standard fuse clip in which another of said terminals is adapted to be inserted, said other terminal being incapable of insertion in the first said fuse clip, a normally complete electrically conducting path connecting two of said terminals and a normally incomplete electrically conducting path interposed between a third terminal and one of the said two terminals, a normally movable conductor constituting a part of said normally complete electrically conducting path, said movable conductor being biased for movement out of said normally complete electrically conducting path, and a fusible conductor constituting a part of said normally complete electrically conducting path, fusible conductor normally holding said movable conductor in said normally complete electrically conducting path but permitting said movable conductor to move out of

said normally complete electrically conducting path and into position to complete said normally incomplete electrically conducting path between said third terminal and said one of said two terminals when said fusible conductor is fused.

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