Dec. 4, 1951 G. F. LAING 2,577,531

FUSE CONSTRUCTION

Filed April 14, 1948

Fig. 1

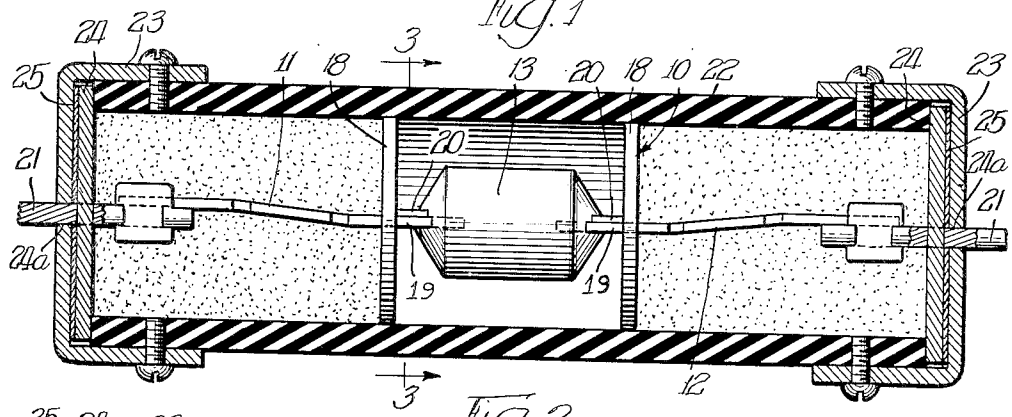


Fig. 2

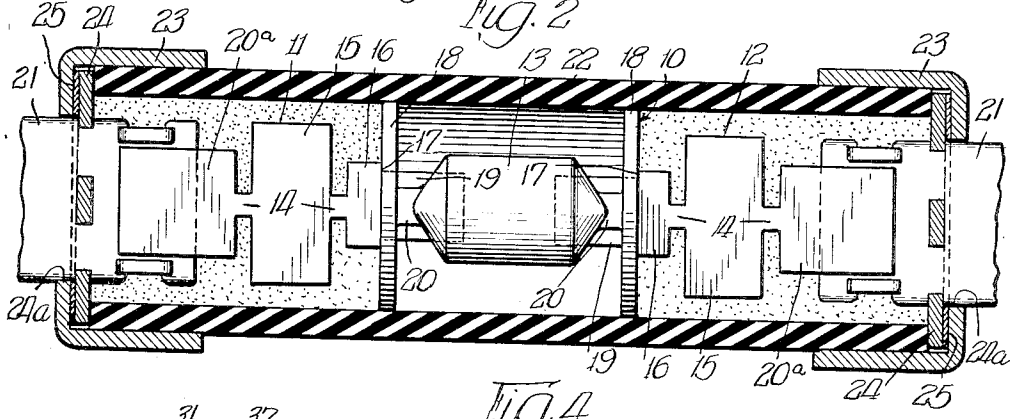


Fig. 4

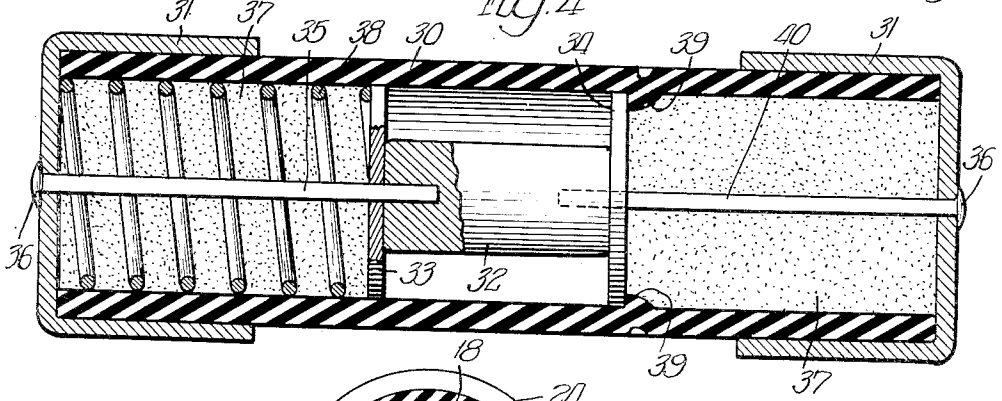
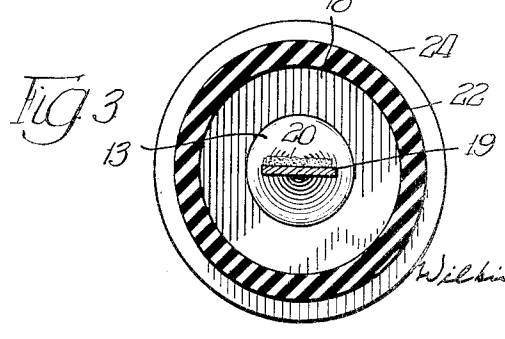


Fig. 3



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FUSE CONSTRUCTION

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3 Claims. (Cl. 200—123)

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The present invention relates to improvements in fuse construction.

An object of the present invention is to provide an improved electric fuse construction which is simple, relatively cheap to manufacture, and reliable in service.

A further object is to provide a fuse construction embodying an element which will become open circuited under conditions approximating an electrical short circuit but which will provide a substantial time lag under reasonable overload conditions, which time lag may be accurately predetermined.

A further object is to provide an improved fuse construction including a portion having a relatively large mass which will melt at a relatively low temperature and an adjoining fuse portion which will melt at a higher temperature but which is adapted gradually to communicate heat to said portion of relatively great mass.

A further object is to provide a fuse which has certainty of action under conditions approximating short circuit conditions and which will provide a predeterminable time lag under reasonable overload conditions.

A further object is to provide a fuse having a portion adapted to fuse under conditions approximating an electrical short circuit, which portion is adapted to be packed in inert powder and another portion of relatively great mass adapted to fuse under reasonable overload conditions, said fuse construction including means for preventing such powder from interfering with the operation of said fusible portion of relatively great mass.

A further object is to provide an improved fuse construction involving a portion of relatively great mass adapted to fuse under reasonable overload conditions, said fuse construction being provided with means for preventing the fused material from completing circuit between the unfused portions of the fuse construction.

Further objects will appear as description proceeds.

Referring to the drawings—

Figure 1 is a sectional view illustrating one embodiment of the present invention;

Figure 2 is a sectional view of the embodiment illustrated in Figure 1, but taken at a plane at right angles to the plane of Figure 1;

Figure 3 is a sectional view taken along the plane indicated by the arrows 3—3 of Figure 1; and

Figure 4 is a view illustrating a modification.

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Referring first to Figures 1, 2 and 3, the numeral 10 indicates, as a whole, a fusible element assembly which includes a pair of spaced fusible links 11 and 12, one end of each of said links being united to a fusible member 13 located between said elements 11 and 12. The elements 11 and 12 may be made of any preferred material which will fuse upon the passage therethrough of electrical current of sufficiently high amperage. The element 13 should preferably be composed of a eutectic alloy, that is, an alloy of relatively low and sharply defined melting point. A sharply defined melting point helps reduce variations in the functioning of the fuse. The element 13 will ordinarily be chosen as a casting and is united to the adjacent ends of the members 11 and 12 in the casting operation, the ends of said members 11 and 12 being tinned before casting so that an electric joint of high conductivity will result.

Each of the fusible elements 11 and 12 has a higher melting point than the alloy member 13 and is illustrated as having a pair of restricted portions 14—14 disposed in series at the two ends of a relatively wide portion 15. Adjacent to one of the restricted portions 14 of each of the elements 11 and 12 is a portion 16 providing a shoulder 17 against which is located a diaphragm 18 of circular contour. Each of said diaphragms 18—18 is disposed upon a tongue 19 of its corresponding link at one extremity of said tongue, the other extremity of which tongue is united to the fusible member 13. In the casting operation the member 13 may be provided with projections or extremities 20—20 adapted to provide abutments for the diaphragms 18—18 whereby said diaphragms are securely held in engagement with the shoulders 17—17. Each of the links 11 and 12 has a portion 20a adapted to be united both physically and electrically with a corresponding terminal blade 21.

The fusible element assembly 10 is adapted to be located within a cylindrical casing 22 provided at each of its ends with a cup-shaped cap 23. Located within each of the caps 23 is a metal plate 24 removably secured to the corresponding terminal blade 21, said plate being insertable and removable in movements transversely of the corresponding blade. The bottom of each of the caps 23 is provided with an aperture 24a to closely receive the corresponding terminal blade 21. Located between each plate 24 and the bottom of the corresponding cap 23 is a washer 25 also

apertured to closely receive the corresponding terminal blade 21.

The space at each end of the fuse between the plate 24 and the adjacent diaphragm 18 may be filled with inert powder to assist in the quenching of any arc formed upon the fusing of one or both of the fusible elements 11, 12 under conditions approximating short circuit.

Figure 4 illustrates a modified construction of fuse, the particular fuse chosen for illustration being of the ferrule type. The cylindrical casing 30 is provided with a cup-shaped ferrule 31 at each end, each of the ferrules having a slip fit with an end of the casing 30. Located intermediate of the length of the casing 30 is a mass of fusible metal 32, preferably in the form of a cylinder with ends disposed in substantially right angular relationship with the axis of said cylinder. The particular metal is preferably a eutectic alloy having a sharply defined melting point such as the mass of metal 13 illustrated in Figures 1, 2 and 3. At the ends of said mass of metal 32 are diaphragms 33 and 34 abutted by said mass 32 and fitting within the interior of the casing 30. The diaphragm 33 is apertured to receive the fuse link 35, which link is united physically and electrically to the mass of metal 32. The left-hand end of the link 35 extends through an aperture in the bottom of the cup-shaped ferrule 31 and said end of the link 35 is soldered to the corresponding ferrule as indicated by the numeral 36. The space between the diaphragm 33 and the bottom of the ferrule 31 is adapted to be filled with an inert powder indicated by the numeral 37. The fact that the end of the link 35 is soldered to the corresponding ferrule will reduce the tendency of the powder to escape from the fuse around the link 35. The link 35 may have any preferred cross sectional contour but in practice it may be preferred to use either a flat ribbon or a round rod. Disposed within the chamber provided by the diaphragm 33 and the left-end ferrule 31 is a coil spring 38 placed under compression such that if the mass of metal 32 be fused, said spring 38 will thrust the diaphragm 33 sufficiently to the right as the parts are viewed in Figure 4 to free the link 35 completely from any globule of metal resulting from the fusing of the mass 32.

The diaphragm 34 may be held against movement to the right as the parts are viewed in Figure 4 by means of abutments 39—39 struck in from the material of the casing 30 or by any other preferred means.

Physically and electrically united to the slug 32 at the right hand thereof is the fuse link 40 which extends through an aperture of the diaphragm 34 and also extends through an aperture in the bottom of the cup-shaped ferrule 31 at the right-hand end of the fuse as the parts are viewed in Figure 4. Preferably the fuse link 40 will have the same characteristics as the fuse link 35 and the fuse link 12 will have the same characteristics as the fuse link 11 so that no material difference in action will occur if the fuse construction should be reversed end for end when being used in a vertical position. The space between the diaphragm 34 and the right-end ferrule 31 may also be filled with an inert powder.

The space between the diaphragms 33 and 34 should preferably be free of powder in order that there may be no interference with the proper functioning of the slug 32 when said slug is fused.

Each of the ferrules 31 may be secured to the cylindrical casing 30 in any preferred way, as for example, by striking in a portion of the peripheral wall of the ferrule into the material of the casing and spinning the extremity of the peripheral wall into the material of the casing.

The details of the fusible links 11, 12 or 35, 40 may be chosen as desired but in any case said links will act as heaters to cause the mass of low melting alloy 13 or 22 to melt if the fuse is subjected to overload for a predetermined length of time. The relatively large mass of low melting point alloy 13 serves as a heat capacity so that overloads of short duration will not heat up the alloy to the melting point.

The diaphragms 18—18 and 33—34 together with the enclosing casing provide a pocket for melted material when the mass 13 or 32 fuses and serve two useful purposes. First, in the event that powder is provided at the two ends of the fuse, these diaphragms will serve to keep the powder away from the allow member 13 or 32, respectively. It will be understood that if sufficient powder should be disposed below the alloy member 13 or 32, it might remain suspended in the powder after it has been melted in which case the fuse would fail to open. Secondly, when the alloy element 13 or 32 melts (as it will after a prolonged overload) if the fuse is in a horizontal position with the links 11 and 12 in the vertical position as illustrated in Figure 2, a circuit might be reestablished between the wide parts 15—15 of the links by the pool of molten alloy.

The diaphragms 18—18 and 33—34 retain the alloy in the center section of the fuse and make sure that once a circuit is broken, it will remain open.

The embodiment of the invention illustrated in Figure 4 will be found advantageous for small sizes of fuse. In small fuses it may be found that there is not sufficient room for a large heat capacity mass of metal 13 or 32 to melt down and reliably break the circuit. The effect of surface tension on the molten alloy may cause it to tend to assume a spherical shape and adhesion may cause it to stick to the ends of the fuse links so that in certain instances the circuit may not be reliably broken on overload. The construction illustrated in Figure 4 overcomes these difficulties. The fuse links 35—40 may be made of copper in the case of a high amperage fuse or of some higher resistance alloy if a low amperage fuse is desired in order to reduce the amount of current required to melt the slug 32. The coil spring 38 fitting the inside of the tube and bearing against the diaphragm 33 has the advantage that when the alloy member 32 melts, the diaphragm 33 will be forced toward the right as the parts are viewed in Figure 4 until the link 35 is free from the hole in the diaphragm 33, thereby assuring that circuit will be broken. Tests indicate that powder used around the link 35 has no appreciable effect on the operation of the spring 38.

The constructions illustrated in all of the figures have the further advantage that they are simple to manufacture because the two fuse links 11—12 or 35—40 in the form of strips or wires may be united with the slug 13 or 32 in the casting operation of said slug. For this purpose the two fuse links may have their ends disposed within a mold (the fiber washers of Figures 1 and 2 being located outside of the mold) and the molten metal may be poured into fusing relationship with said ends to form an integral assembly. The links may be trimmed to the proper length and/or contour in the same operation or in a subsequent operation.

A eutectic alloy which may be used in the element 13 or the element 32 consists of—

	Percent
Tin	Approximately 50
Lead	Approximately 32
Cadmium	Approximately 18

This alloy has a melting point of approximately 297 degrees F. and has the advantage of a sharply defined melting point. A mixture such as most solders may start to soften as the temperature increases and some of the elements may not be melted until the temperature is increased 20 or 30 degrees above the first softening point. A sharp melting point is desirable for the element 13, thereby helping to reduce variations in the functioning of the fuse.

Though certain preferred embodiments of the present invention have been described in detail, many modifications will occur to those skilled in the art. It is intended to cover all such modifications that fall within the scope of the appended claims.

What is claimed is:

1. In an electric fuse, in combination, a cylindrical casing, a fuse element located within said casing, said fuse element including a member having two ends and having a relatively low melting point, said member having connected thereto at each of its ends a heat communicating link, at least one of said links having a higher melting point than said member, said one link being adapted to be fused upon a sudden rush therethrough of electric current of high amperage, said links being adapted to communicate heat to said member sufficient to fuse said member upon prolonged passage through said fuse element of electric current of a predetermined overload, said member having a relatively great mass as compared to the mass of said one link, diaphragms fitting the interior of said casing, surrounding and engaging said links and dividing said casing into three compartments, of which the center compartment contains said member and each of the other two compartments contains one of said links and a spring biasing one of said diaphragms out of engagement with one of said links whereby said last mentioned link will be electrically disconnected from said member when said member is melted.

2. In an electric fuse, in combination, a cylindrical casing, a fuse element located within said casing, said fuse element including a member having two ends and having a relatively low melting point located intermediate of the length of said casing, said member having connected thereto at each of its ends an electric conductor, at least one of which conductors is a fusible link having a higher melting point than said member, said link being adapted to be fused upon a sudden rush therethrough of electric current of high amperage, said link being adapted to communicate heat to said member sufficient to fuse said member upon the prolonged passage through said fuse element of electric current of a predetermined overload, said fuse element being provided with a pair of diaphragms located thereon adjacent to the two ends of said member and fitting said casing to provide a pocket located between said electric conductors, and a spring disposed within said casing biasing one of said diaphragms toward said member whereby when said member is melted, said diaphragm is moved by said spring to positively break electric connection between said member and the remainder of said link and to confine melted material from said member to said pocket.

3. In an electric fuse, in combination, a cylindrical casing, a fuse element located within said casing, said fuse element including a member having two ends and having a relatively low melting point, said member having connected thereto at each end thereof a fusible link, each having a higher melting point than said member, each of said links being adapted to be fused upon by a suddent rush therethrough of electric current of high amperage, each of said links being adapted to communicate heat to said member sufficient to fuse said member upon the prolonged passage through said fuse element of electric current of a predetermined overload, said member having relatively great mass compared to the mass of either of said links, a pair of diaphragms each located upon one of said fusible links, said pair of diaphragms being located adjacent to the two ends of said member, said diaphragms fitting the interior of said casing to provide a pocket located between said links and a spring biasing one of said diaphragms out of engagement with its corresponding link to definitely open-circuit said fuse upon the melting of said member and to confine melted material from said member to said pocket.

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