Feb. 27, 1951 G. F. LAING 2,543,245

FUSE CONSTRUCTION

Filed April 12, 1949

Fig. 1.

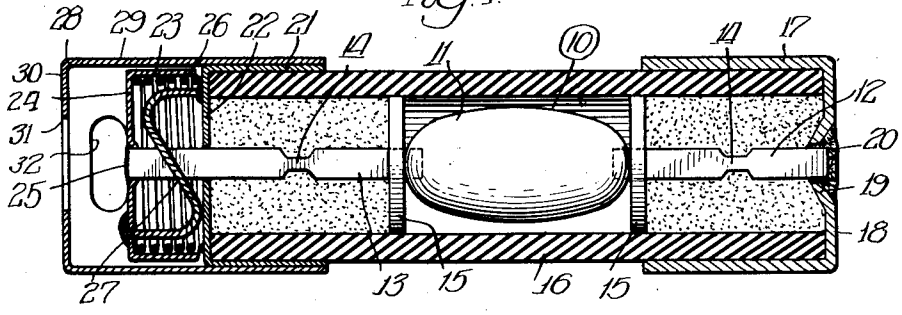


Fig. 2.

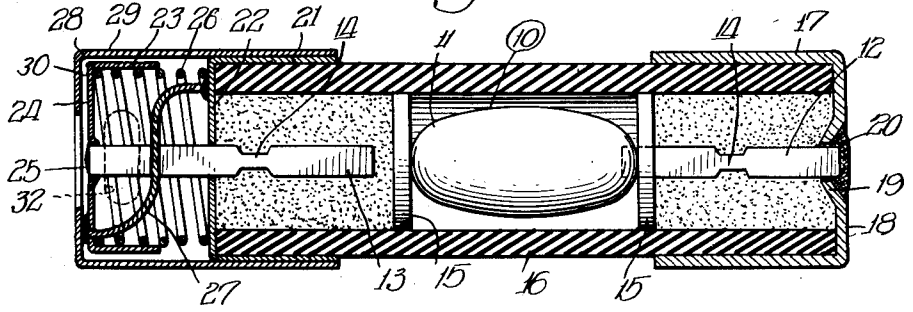


Fig. 3.

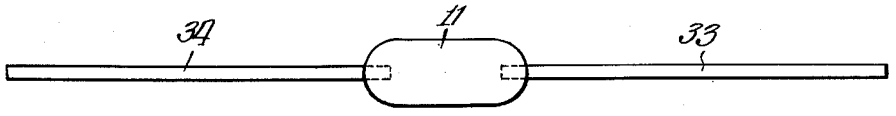
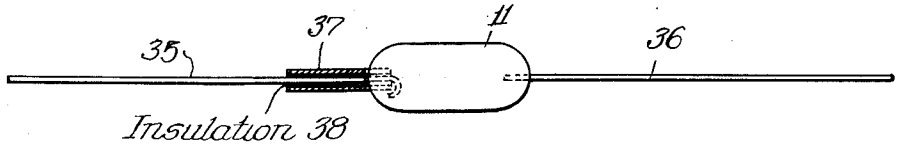


Fig. 4.



INVENTOR.
Gordon F. Laing,
By Wilkinson, Huxley, Byron & Hume
Attys.

Patented Feb. 27, 1951

2,543,245

UNITED STATES PATENT OFFICE

2,543,245

FUSE CONSTRUCTION

Gordon F. Laing, Delavan, Wis., assignor, by mesne assignments, to Economy Fuse and Manufacturing Co., Chicago, Ill., a corporation of Illinois

Application April 12, 1949, Serial No. 87,065

14 Claims. (Cl. 200—131)

1

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 an improved fuse construction embodying an element which will become open circuited under conditions approximating an electric 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 relatively large mass which will melt at a relatively low temperature, and adjoining fuse portions which will fuse at a higher temperature, but which are adapted gradually to communicate heat to said portion of relatively great mass.

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

A further object is to provide an improved fuse construction of the kind immediately above referred to, having positive means for open-circuiting the fuse elements under either short circuit conditions or after a predeterminable time lag under overload conditions.

A further object is to provide an improved fuse construction having means for positively open-circuiting the fuse elements thereof, together with indicating means to show clearly when the fuse construction has blown.

Further objects will appear as the description proceeds.

Referring to the drawings—

Figure 1 is a sectional view illustrating one embodiment of the present invention, said view illustrating the fuse elements in their normal operative positions;

Figure 2 is a view similar to Figure 1, but showing the fuse elements after the fuse construction has been open-circuited due to a long continued overload.

Figure 3 is a view in elevation illustrating a modified fusible element assembly which may be used instead of that illustrated in Figures 1 and 2; and

Figure 4 illustrates a modification of the structure shown in Figure 3.

Referring first to Figures 1 and 2, the numeral 10 indicates as a whole a fusible element assembly which includes a fusible member 11 having

2

united thereto at its two ends the fusible strips 12 and 13. The element 11 should preferably be composed of a eutectic alloy, that is, an alloy of relatively low and sharply defined melting point.

The element 11 will ordinarily be chosen as a casting and is united to the adjacent ends of the strips 12 and 13 in the casting operation, said ends of the members 12 and 13 being tinned before casting, so that a joint of high conductivity will result. The element 11 has relatively great mass compared to each of the members 12 and 13 and constitutes a reservoir for heat.

Each of the fusible strips 12 and 13 is illustrated as having a restricted portion 14. It will be understood, however, that the design of each of the strips 12 and 13 may be modified within wide limits without departing from the invention. Said strips may be composed of copper or other non-rusting electrical conducting metal.

Disposed upon the strips 12 and 13 are diaphragms 15—15, which may be fiber washers, said diaphragms being apertured to receive rather closely the strips 12 and 13. Said diaphragms 15—15 are preferably cylindrical and fit rather closely within the tubular casing 16, which may be of fiber or other insulating material. Said diaphragms 15—15 with said casing 16 form a chamber for housing the fusible member 11.

One end of the tubular casing 16 is closed by means of the cup-shaped cap 17 which envelopes one end of said casing 16. The bottom wall 18 of said cap 17 may be swedged inwardly at its central portion as indicated by the numeral 19, the portion 19 being apertured for receiving the fusible strip 12. The cap 17 and the fusible strip 12 should be physically and electrically united, as, for example, by means of solder indicated by the numeral 20. The other end of the casing 16 is closed by means of the cup-shaped cap 21, the bottom wall 22 of which is apertured for rather closely receiving the fusible strip 13. Said caps 17 and 21 may be secured to the casing 16 by any preferred means.

Disposed co-axially of the cap 21 but exteriorly thereof is the cup 23 having the bottom wall 24. The strip 13 is united to said bottom wall 24, as, for example, by means of solder indicated by the numeral 25.

Disposed within the cup 23 is the coil spring 26 adapted to react between the wall 22 of the cup 21 and the wall 24 of the cup 23, urging said cup 23 to the left as the parts are viewed in Figures 1 and 2.

The numeral 27 indicates a flexible electrical

conductor, one extremity of which is electrically connected to the cap 21, and the other end of which is connected to the cup 23, thereby electrically connecting the fusible strip 13 with the cap 21.

Disposed in enveloping relationship with the cap 21 and the cup 23 and in electrical communication with the cap 21 is the cup-shaped cap 28, having the peripheral wall 29 and the bottom wall 30. Accordingly the fuse strip 13 is in electrical communication with the cap 28. The peripheral wall 29 of the cap 28 should be of substantially the same outside diameter as the peripheral wall of the cap 17, and to this end the material in the peripheral wall of the cap 21, as well as the material in the peripheral wall of the cap 28, should be of lighter gauge than that of the peripheral wall of the cap 17. In other words, the combined thicknesses of the peripheral walls of the cap 21 and the cap 28 should be substantially equal to the thickness of the peripheral wall of the cap 14. The bottom wall 13 of the cap 28 may be apertured as indicated by the numeral 31, to permit the ready escape of air between the cup 23 and the cap 28 when the cup 23 is thrust suddenly toward the left upon the blowing of the fuse connection. The peripheral wall 29 of the cap 28 is provided with the peephole 32, through which the cup 23 may be observed when said cup is in its left-hand position, as the parts are viewed in Figure 2, that is, when the fuse construction has blown. In order to make it easy for an observer to see when the fuse construction is blown, the exterior wall of the cup 23 should contrast sharply in appearance with the exterior wall of the cap 28.

As indicated above, the details of the fusible strips connected with the fusible element 11 may be varied within wide limits.

Referring to Figure 3, the fusible strips 12 and 13 have been replaced by short lengths of wire 33 and 34 which may be of copper or other nonrusting electrical conducting metal.

The construction illustrated in Figure 4 is particularly useful in low amperage fuses. Secured to the fusible member 11 at the end adjacent to the spring 26 (illustrated in Figures 1 and 2, but not illustrated in Figure 4) is a wire or strip 35. Secured to said fusible member 11 at the other end thereof is the wire or strip 36. Said wire or strip 35 should preferably have a greater heating effect than the wire or strip 36. Surrounding the end of the wire or strip 35 at the end thereof adjacent to the fusible member 11 is the tube 37 of a metal which is a good conductor of heat, such as brass. The end of the wire or strip 35 may be bent over the inner extremity of the tube 37 to guard against the possibility that the parts may be pulled apart accidentally. Located between the wire or strip 35 and the tube 37 is an insulating member 38 which should be a good conductor of heat, but a poor conductor of electricity, such for example, as porcelain.

The fuse link adjacent to the spring should be released from the fusible member 11 before the other fuse link is released; otherwise, the fuse construction would be uncertain in its action. To this end the flexible conductor 27 and its adjacent fuse link should be so proportioned with respect to the fuse link at the other end of the fuse construction that they will develop a higher temperature than the other fuse link. This may be accomplished in a number of ways, among which may be mentioned:

(a) Make the left hand fuse link as viewed in Figures 1 and 2 longer than the right hand fuse link;

(b) Reduce the cross section of the restricted portion 14 of the left hand link to a smaller dimension than the cross-section of the corresponding restricted portion in the right hand link;

(c) Position the restricted portion of the left hand link closer to the fusible member 11 than is the restricted portion of the right hand link;

(d) Provide the flexible member 27 with sufficient resistance to develop a material amount of heat for transmittal to its adjacent fuse link;

(e) Provide the left hand link (as the parts are viewed in Figures 1 and 2, at its end which is united to the fusible member 11) with tinning material having a lower melting point than the tinning material on the corresponding part of the right hand link;

(f) Reduce the cross-section of the left hand link below that of the right hand link.

As noted above the construction illustrated in Figure 4 presents features which are useful particularly in low amperage fuses. The time of delay may be regulated by choosing among a number of factors as follows:

(a) The heat capacity of the fusible member 11;

(b) The amount of heat developed in the wire or strip 36;

(c) Radiation factor from the fusible member 11;

(d) Heat conductivity of the tube 37 (ordinarily this should be high).

(e) The cross-sectional area of the tube 37;

(f) The heat developed in the resistance wire or strip 36;

(g) The heat insulating properties of the insulating material 38 between the resistance wire 35 and the tube 37.

The above described embodiments of the present invention have the practical advantage in manufacture that the molten metal to be embodied in the fusible member 11 may be flowed over the adjacent ends of the wires or strips to be united thereto or the metal tube 37, heating them and promoting the casting operation.

From an electrical standpoint, the fuse constructions illustrated and described have the advantage that the said fuse constructions will be open-circuited with certainty upon short circuit. Furthermore, they may be accurately calibrated to be open-circuited after the lapse of a predetermined time interval upon the passage of a long continued overload.

The construction illustrated in Figure 4 has the advantage that the conductive tube 37 (being a good conductor of heat and having greater cross-sectional area than its adjacent resistance wire) will conduct heat efficiently into the fusible member. The electrical insulating means 38 is interposed between the resistance wire 35 and the tube 37 in order that the end of said resistance wire adjacent to the fusible member 11 shall not be short-circuited. Said insulating member 38 should therefore be a good insulator for electricity but not a good insulator for heat. An example of such material is porcelain.

The material of the wire or fuse link which is to be released from the fusible member 11 will be chosen to correspond to the amperage at which the fuse construction is to be open-circuited. On low amperage fuses this wire or fuse link should have a high resistance to electrical flow. In fuses which are to blow at higher amperages, said fuse

link should be of a material having lower electrical resistance.

Although 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.

It is claimed:

1. In a fuse construction, in combination, a tubular casing, diaphragms fitting within said casing and providing a chamber, a fusible assembly including a fusible member of relatively great mass adapted to be located within said chamber, said fusible member having heat communicating strips extending from opposite ends thereof, said strips extending through said diaphragms, and spring means for withdrawing one of said strips from said fusible member upon the softening of said fusible member, said one strip being provided with a tube electrically insulated from said one strip but providing a heat conductor between said one strip and said fusible member.

2. In combination, a mass of fusible metal, a pair of heat communicating members united to said mass at opposite sides thereof, one of said members at its end adjacent to said mass being provided with a heat conducting member electrically insulated from said one member for communicating heat from said one member to said mass.

3. In combination, a mass of fusible metal, a pair of heat communicating members united to said mass at opposite sides thereof, one of said members at its end adjacent to said mass being provided with a heat conducting member electrically insulated from said one member for communicatin heat from said one member to said mass, and spring means for withdrawing said one member from said mass upon the softening of said mass.

4. In combination, a mass of fusible metal, a pair of heat communicating members united to said mass at opposite sides thereof, one of said members at its end adjacent to said mass being provided with a heat conducting member electrically insulated from said one member for communicating heat from said one member to said mass, and spring means for withdrawing said one member from said mass upon the softening of said mass, said one member having a greater heating effect than the other of said members.

5. In combination, a mass of fusible metal, a pair of heat communicating members united to said mass at opposite sides thereof, one of said members at its end adjacent to said mass being provided with a heat conducting member electrically insulated from said one member for communicating heat from said one member to said mass, and spring means for withdrawing said one member from said mass upon the softening of said mass, said one member having a greater releasing effect than the other of said members.

6. In a fuse construction, in combination, a cylindrical casing, diaphragms fitting within said casing and providing a chamber within said casing, a fuse assembly including a fusible member disposed within said chamber, and a pair of strips united to said fusible member and extending through said diaphragms, closure means for the ends of said casing providing chambers for receiving said strips, one of said strips extending through one of said closure means, and spring means for urging said one strip out of contact with said fusible member, said closure means being cup-shaped members, said one closure means having a wall of less external diameter than the other of said closure means and other cup-shaped means enveloping said one cup-shaped means and said spring means, said other cup-shaped means having substantially the same diameter as the other of said closure means.

7. In a fuse construction, in combination, a cylindrical casing, diaphragms fitting within said casing and providing a chamber within said casing, a fuse assembly including a fusible member disposed within said chamber, and a pair of strips united to said fusible member and extending through said diaphragms, closure means for the ends of said casing providing chambers for receiving said strips, one of said strips extending through one of said closure means, and spring means for urging said one strip out of contact with said fusible member, said closure means being cup-shaped members, said one closure means having a wall of less external diameter than the other of said closure means and other cup-shaped means enveloping said one cup-shaped means and said spring means, said other cup-shaped means having substantially the same diameter as the other of said closure means, said cup-shaped means having an aperture in its side wall through which the effect of said spring means may be observed.

8. In a fuse construction, in combination, a tubular casing, diaphragms fitting within said casing and providing a central chamber and two end chambers, a fusible assembly disposed within said central chamber, said fusible assembly including readily fusible metal, heat communicating strips located within said end chambers, said strips being elcctrically connected to said readily fusible metal and extending through said diaphragms, spring means for withdrawing one of said strips from electrical connection with said readily fusible metal upon softening of said readily fusible metal, said one strip being provided with a tube electrically insulated from said one strip but providing a heat conductor between said one strip and said fusible members.

9. In combination, a pair of heat communicating members, means for electrically connecting said heat communicating members, said connecting means embodying readily fusible metal, one of said heat communicating members at its end adjacent to said readily fusible member being provided with a heat conducting member electrically insulated from said one member for communicating heat from said one member to said readily fusible metal.

10. In combination, a pair of heat communicating members, means for electrically connecting said heat communicating members, said connecting means embodying readily fusible metal, one of said heat communicating members at its end adjacent to said readily fusible member being provided with a heat conducting member electrically insulated from said one member for communicating heat from said one member to said readily fusible metal, and spring means for withdrawing said one member from electrical connection with said readily fusible metal upon the softening of said readily fusible metal.

11. In combination, a pair of heat communicating members, means for electrically connecting said heat communicating members, said connecting means embodying readily fusible metal, one of said heat communicating members at its end adjacent to said readily fusible member be-

ing provided with a heat conducting member electrically insulated from said one member for communicating heat from said one member to said readily fusible metal, and spring means for withdrawing said one member from electrical connection with said readily fusible metal upon the softening of said readily fusible metal, said one member having a greater heating effect than the other of said heat communicating members.

12. In combination, a pair of heat communicating members, means for electrically connecting said heat communicating members, said connecting means embodying readily fusible metal, one of said heat communicating members at its end adjacent to said readily fusible member being provided with a heat conducting member electrically insulated from said one member for communicating heat from said one member to said readily fusible metal, and spring means for withdrawing said one member from electrical connection with said readily fusible metal upon the softening of said readily fusible metal, said one member having a greater releasing effect than the other of said members.

13. In a fuse construction, in combination, a cylindrical casing, diaphragms fitting within said casing and providing a chamber within said casing, a fuse assembly including readily fusible metal disposed within said chamber, a pair of strips electrically connected to said readily fusible metal and extending through said diaphragms, closure means for the ends of said casing providing chambers for receiving said strips, one of said strips extending through one of said closure means, spring means for urging said one strip out of electrical connection with said readily fusible metal, said closure means being cup-shaped members, said one closure means having a wall of less external diameter than the other of said closure means, another cup-shaped means enveloping said one cup-shaped means and said spring means, said other cup-shaped means having substantially the same diameter as the other of said closure means.

14. In a fuse construction, in combination, a cylindrical casing, diaphragms fitting within said casing and providing a chamber within said casing, a fuse assembly including a readily fusible member disposed within said chamber, a pair of heat communicating strips electrically connected to said readily fusible metal and extending through said diaphragms, closure means for the ends of said casing providing chambers for receiving said strips, one of said strips extending through one of said closure means, spring means for urging said one strip out of electrical connection with said readily fusible metal, said closure means being cup-shaped members, said one closure means having a wall of less external diameter than the other of said closure means, another cup-shaped means enveloping said one cup-shaped means and said spring means, said other cup-shaped means having substantially the same diameter as the other of said closure means, said other cup-shaped means having an aperture in its side wall through which the effect of said spring means may be observed.

GORDON F. LAING.

REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
1,122,478	Cole	Dec. 29, 1914
1,280,478	Horton	Oct. 1, 1918
1,898,099	Sandin	Feb. 21, 1933
2,111,749	Bussmann	Mar. 22, 1938
2,281,795	Pittman et al.	May 5, 1942
2,300,620	Duerkob	Nov. 3, 1942
2,400,491	Duerkob	May 21, 1946