Aug. 14, 1951 G. A. BERTHEL 2,563,812

THERMAL TIME LAG FUSE

Filed Aug. 30, 1948

Fig. 10.

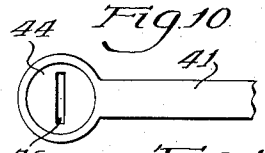


Fig. 11.

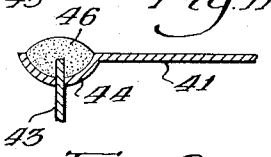


Fig. 1.

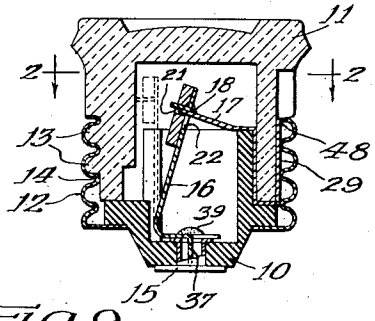


Fig. 2.

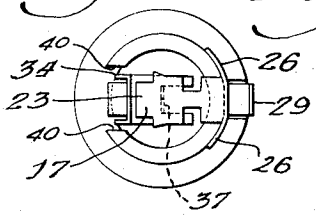


Fig. 9.

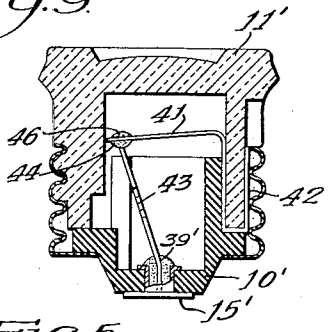


Fig. 3.

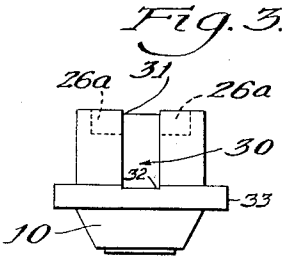


Fig. 4.

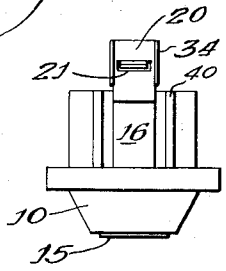


Fig. 5.

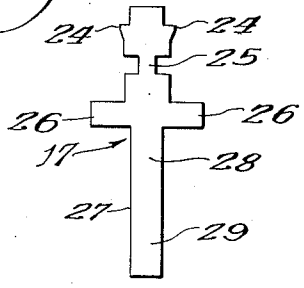


Fig. 6.

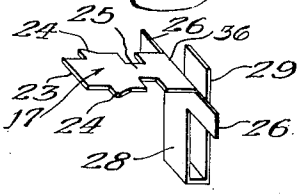


Fig. 7.

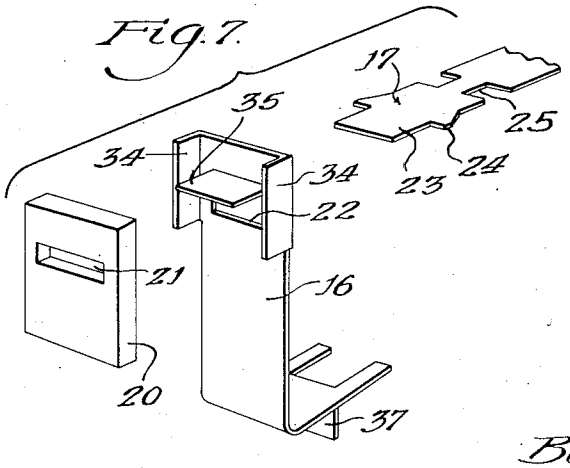
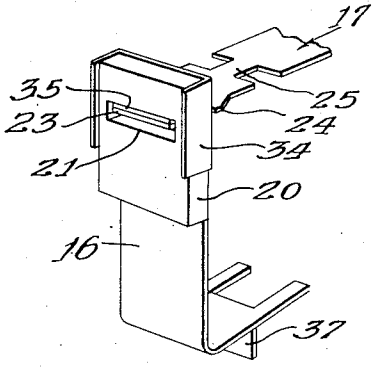


Fig. 8.



Inventor:
Gust A. Berthel

By: Zabel & Dritzbaugh
Attorneys

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THERMAL TIME LAG FUSE

Gust A. Berthel, Chicago, Ill., assignor to Jefferson Electric Company, Bellwood, Ill., a corporation of Illinois

Application August 30, 1948, Serial No. 46,739

12 Claims. (Cl. 200—123)

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This invention relates to an improved thermal time lag fuse of the plug type.

It is an object of my invention to provide an improved delayed action plug fuse, which can be used in combination with circuits, such as motor circuits, where it is desired to accommodate small overloads for a considerable period of time, or a moderate overload for a short period of time, as well as to provide the necessary instantaneous blowing under short circuit conditions.

The ordinary plug fuse is provied with a fuse link, the dimensions of which are such as to provide the necessary protection for small overloads. When such a fuse is used, in motor circuits, for instance, it is found that the fuse will often blow under the moderate overload occasioned by the current drawn by the motor under starting conditions. It is sometimes the practice to substitute a fuse having a higher rating in order to accommodate these moderate overloads. However, this is a highly undesirable practice, and is dangerous because it affords no protection whatsoever for small overloads.

Various means have been proposed to provide a proper time lag characteristic which will overcome these difficulties. However, most of the time lag constructions, by virtue of their dimensions, are not suited for use in a plug fuse, in which the space is necessarily limited. The present improvement contemplates the provision of an improved circuit breaking means in combination with a fuse link of somewhat greater current carrying capacity than that which would ordinarily be used in a fuse of the same rating. The two are connected in series circuit so that on small and moderate overloads the circuit breaking means opens before the fuse link, and on heavy overloads and short circuits, the fuse link blows first.

The circuit breaking means comprises the combination of a resilient element and a releasable connection for holding the resilient element in a deformed and stressed condition.

The time delay on small and moderate overloads is occasioned by the heat absorbing capacity of the parts. Where the parts are small, it is difficult to provide small rating fuses of uniform characteristics since the quantity of solder or fusible metal used in effecting the connection is subject to considerable variation. In other words, in soldering two parts together, it is difficult to apply the same amount of solder to each assembly.

It is another object of my invention to provide an improved fuse construction in which the amount of solder can be readily limited to a predetermined amount. In one form of my invention the heat absorbing capacity is provided primarily by a separate lagging element and the amount of solder required is sufficient only to intimately associate the parts in heat transmitting relationship. In another form of my invention, where less lagging is required as in fuses of lower ratings, the solder itself provides the required heat absorbing capacity.

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In both instances, the heat absorbing means is of comparatively small mass, thus dispensing with the use of a separate heating coil and providing a construction that can be readily supported by the resilient element alone. The construction of the parts is such that the mass of the heat absorbing material can be held within comparatively close tolerances.

Where a separate lagging element is used, it is preferably die cut from strip stock of uniform thickness. Thus the characteristics of a given production run of fuses will be identical to each other. Furthermore, by using a releasable connection of this type, fuses of different ratings can be provided merely by changing the size and shape of the die cut heat absorbing element, and by changing the thickness of the strip material from which this element and certain other elements are formed.

Where the separate lagging element is not used, the end portion of the resilient element may be shaped so as to hold a predetermined quantity of solder.

In both instances, the end portion of the resilient element is slotted and the resilient element is maintained in its deformed and stressed condition by a fuse link which also serves to generate part of the required heat. The end portion of the fuse link passes through the slot in the resilient element, and the parts are secured together in such a manner that the heat absorbing material which is supported by the resilient element is in intimate heat transmitting relationship with both the resilient strip and the fuse link. Thus, localized heating of any part of the solder is avoided which would cause variation in electrical characteristics.

A still further object of my invention is to provide a delayed action plug fuse of comparatively few metal parts, all of which can be manufactured by a punching process thereby providing enhanced uniformity of mechanical and electrical characteristics which results in low unit cost.

Other objects, features and advantages will become apparent as the description proceeds.

With reference now to the drawings in which like numerals designate like parts:

Fig. 1 is a central sectional elevation of a preferred embodiment of my invention;

Fig. 2 is a plan view taken along line 2—2 of Fig. 1 but with the top removed;

Fig. 3 is an elevation of the body member of the fuse before the current carrying elements have been assembled therewith, this elevation being taken from right-hand end of the body member as it appears in Fig. 1;

Fig. 4 is an elevation of the body member of the fuse taken from the left-hand end as the body member is viewed in Fig. 1, and also showing certain of the current carrying parts;

Fig. 5 is an elevation of a fuse link, showing the various portions thereof before the same has been bent so as to fit over the other parts of the fuse;

Fig. 6 is a perspective view of the fuse link after it has been bent;

Fig. 7 is an enlarged exploded perspective view of the releasable connection;

Fig. 8 is a view similar to Fig. 7 but showing the parts in assembled relationship;

Fig. 9 is a view similar to Fig. 1, but showing a modified form of my invention;

Fig. 10 is an enlarged sectional view showing the resilient member and the fuse link in assembled relationship, and

Fig. 11 is a plan view of the end portion of the resilient member prior to assembly.

As shown in Fig. 1, the fuse plug comprises a body member 10, and a top 11. The body member may be formed of any suitable insulating material, such as Bakelite, a cold mold composition, or porcelain, and the top member 11 is preferably formed from glass, thereby permitting inspection of the condition of the fuse. A screw shell 12 is provided exteriorly of the body member 10, and overlaps the lower portion of the glass top 11, the lower part of the glass top being provided with cooperating screw threads 13 which interlock with the threads 14 on screw shell 12.

A center contact 15 is provided in the body member. The current carrying parts of the fuse which establish electrical contact between the center contact 15 and the screw shell 12 comprise a resilient member 16, the lower end of which is suitably anchored to the center contact, a fuse link 17, one end of which engages the shell 12, and solder 18 which secures the fuse link and the resilient member to each other in such a manner that the resilient member is maintained in a stressed condition. When the temperature of the parts, due to overload conditions, increases and approaches the melting point of the solder 18, the resilient member 16 will be released, and thereby open the circuit. The solder is preferably a bismuth solder having a melting point of substantially 280° F., although other low melting point metals may also be used. The resilient member 16 is made of a material which is capable of maintaining its resilience even though it is subjected to considerable heating. As an example of suitable materials, I have found that a heat treated copper beryllium alloy is satisfactory. The fuse link 17 may be punched or die-cut from strip copper of a thickness ranging from .001 to .005 inch, depending upon the rating of the fuse.

The time delay characteristics of the fuse are produced by the use of a heat absorbing lagging element 20 which is in the form of a copper slug having a slot 21 formed therein, as shown in Fig. 7. The slot 21 registers with a slot 22 formed in resilient member 16 and a tongue portion 23 of the fuse link projects through the slots 21 and 22 and the parts are secured together mechanically and electrically and in heat transmitting relationship by means of the solder 18.

The fuse link is shown in Figs. 5 and 6, and in addition to the tongue portion 23, it is shaped to provide a pair of shoulders 24 which abut against the resilient member 16 and limit the penetration of the tongue portion into the slots 21 and 22. The fuse link also includes a notched portion 25 which is adapted to blow under short circuit conditions. Wings 26 are provided which extend laterally along the upper edge of the body member 10. In Fig. 3, the areas 26a are indicated by dotted lines and constitute the areas of the body member which are contacted by the wings 26. The tail portion 27 of the fuse link can be divided into an upper portion 28 which rests in a recess 30 formed in the cylindrical surface of the body member 10 and into a bent-up portion 29 which is adapted to be confined between the skirt portion of the glass top 11 and the screw shell 12 in such a manner that a soldered electrical contact 48 is provided between the fuse link and the screw shell. A notch 31 is provided in the upper edge of the body member 10 to receive that portion of the fuse link which is immediately above the wings 26. This notch and the recess 30 aid in positioning the fuse link with respect to the body member and prevent a shifting of position as the parts are assembled.

Since the fuse link is formed from exceedingly thin stock, it is quite flexible and difficulty is experienced in maintaining the correct spacing between the upper end of the resilent member 16 and the opposite portion of the body member. For this reason, the wings 26 are provided which determine the position of the bend 36, shown in Fig. 6. Thus, the spacing between the bend 36 and the shoulders 24 is predetermined by the shape of the fuse link, and hence a uniform tension can be maintained on the resilient member 16.

As shown in Fig. 3, a notch 32 is provided in flange 33 of the body member 10 so that the portion 28 of the fuse link can be maintained below the upper surface of the flange 33. Thus, the body member 10 and the glass top 11 can be maintained with close tolerances since there are no parts projecting outwardly from the cylindrical surface of the body member.

As shown in Figs. 7 and 8, wings 34 are provided at the upper portion of resilient member 16, and these wings embrace the side edges of the lagging element 20. The solder 18 which secures the fuse link to the resilient member is also caused to flow in between the resilient member and the lagging element, and in particularly between the wings 34 and the side edges of the lagging element so that the parts may be secured together in good heat transmitting relationship. When the slot 22 is formed in resilient member 16, the material is pushed outwardly to form a supporting projection 35 which projects into the slot 21 of the lagging element and serves to hold the parts in position while the soldering is effected.

As shown in Fig. 1, the end 37 of the resilient member 16 is bent over and is received within a well formed in the center contact 15, and is secured into the well by means of solder 39. Thus electrical contact is provided, and the lower end of the resilient member is anchored in order to permit the same to be maintained in stressed condition by the fuse link and releasable connection.

In operation a short circuit will cause the notched portion 25 of the fuse link to blow. On small or moderate overloads, however, the heat developed in the resilient member 16 and the fuse link 17 and in particular, in the notched portion 25 of the latter will be conducted to the lagging element 20 and will serve to maintain the solder 18 below its melting point for a predetermined period of time. When this overload condition continues beyond this predetermined period of time, however, the solder 18 will be raised to its melting point and cause release of the resilient member 16. It will be observed in Fig. 2 that a portion of the body member is cut away as indicated by the reference numeral 40 to permit additional movement of the resilient member 16, thus insuring that the electrical connection is completely broken.

Since the lagging element 20 is of relatively small mass with respect to the stiffness of the resilient member 16 on which it is carried, there will be no vibration, thereby assuring a fuse of long life. By utilizing the heat developed in the elements 16 and 17, instead of by the use of a separate heating coil, I have found that a lagging element of comparatively small mass will provide the desired time delay characteristics.

The fact that the lagging element is spaced from the wall of the body member contributes to this result since the spacing causes it to be thermally insulated from the body member since the solder flows between the lagging element and the free end portion of the resilient strips and coats all of these parts, including the end of the fuse link, the three separate elements are all associated in such heat transmitting relationship that the temperature of each element with respect to the others will be the same. Thus localized heating of the solder will be avoided, which contributes to the uniformity of electrical characteristics of the fuse.

In the modified form of my invention shown in Figs. 9 to 11 inclusive, the parts which are substantially the same as the parts shown in Fig. 1 are indicated by the same reference numerals primed. These figures show a type of construction which has a small heat absorbing capacity and hence which is more adaptable for fuses of smaller rating than the fuse shown in Figs. 1 to 8 inclusive. Here the separate lagging element is omitted and the heat absorbing capacity is provided by the solder 46 alone.

As shown in Fig. 9, a resilient member 41 is disposed within the hollow body member 10' and glass top 11', the resilient member including a portion 42 which is gripped between the screw shell 12' and the glass top 11'. The fuse link 43 is disposed more or less vertically, the bottom portion thereof being suitably secured to the center cap 15'. The upper end of the fuse link passes through a slot 45 formed in the end portion 44 of the resilient member 41. The end portion 44 is cup shaped, as shown in Fig. 10 so that the amount of solder 46 which is used in securing the parts together may be readily predetermined.

In this embodiment, as in the embodiment shown in Figs. 1 to 8 inclusive, the heat absorbing material is spaced from the body member of the fuse so as to be thermally insulated therefrom. Also, the end portion of the resilient strip is slotted to receive the end of the fuse link, and the parts are secured together in heat transmitting relationship on the opposite side of the resilient element. Thus, there is less likelihood

of the parts pulling away from each other until all of the parts in the vicinity of the end portion 44 have been uniformly raised to the temperature of the fusing point of the solder.

I claim:

1. A fuse comprising a body member, two strips of metal each being secured to said body member so as to provide a free end portion for each of said strips, one of said strips being flexurally resilient and being maintained in flexurally stressed condition by the other of said strips, the free end portion thereof being apertured to receive the free end portion of the other of said strips, and means securing said free end portions to each other in heat transmitting relationship, said means including a fusible metal which is adapted to release said resilient strip under small overload conditions, said second mentioned strip constituting a fuse link which is adapted to blow under short circuit conditions, and means for connecting the outer ends of each of said strips into a circuit whereby said strips will be in series circuit with each other.

2. A fuse as claimed in claim 1 in which the apertured free end portion of said flexurally resilient strip is cup shaped, and wherein said fusible metal is disposed in said cup shaped end portion.

3. A fuse comprising a body member, two strips of metal each being secured to said body member so as to provide a free end portion for each of said strips, one of said strips being flexurally resilient and being maintained in stressed condition by the other of said strips, the free end portion thereof being apertured to receive the free end portion of the other of said strips, said second mentioned strip constituting a fuse link, and means securing said free end portions to each other in heat transmitting relationship, said means including a body of metal fusibly secured to both of said free end portions of said fuse strip and disposed on the side of said resilient strip which is opposite from the side facing said fuse link so as to interlock with said resilient strip, said apertured free end portion being shaped so as to form a support for said body of metal during assembly.

4. A fuse comprising a body member, two strips of metal each being secured to said body member so as to provide a free end portion for each of said strips, fusible means securing the free end portions of said strips to each other, and a lagging element secured to the free end of at least one of said strips by said fusible means and being spaced from said body member, one of said strips being flexurally resilient and being maintained in stressed condition by the other of said strips, the other one of said strips being provided with a portion of reduced cross section adapted to blow under short circuit conditions and adapted to generate heat under small overload conditions, said fusible means comprising a low melting point solder which connects said lagging element and said strips together in heat transmitting relationship, whereby said lagging element will receive and absorb the heat generated by said fuse link in order to maintain the connected portions of said strips and said solder at substantially uniform temperature with respect to each other.

5. A plug fuse comprising a body member having a center contact, a resilient member anchored to said center contact and extending generally parallel to the longitudinal axis of said body member, said body member being provided with a substantially cylindrical wall portion, a fuse link having one portion disposed along the outer surface of said wall portion and having a second por-

tion extending inwardly from the upper edge of said wall portion toward the free end portion of said resilient member, said free end portion being slotted to receive the end of said fuse link, solder connecting the ends of said fuse link and resilient member whereby said resilient member is maintained in a flexurally stressed condition, and a lagging element mounted on said resilient strip at the point where it is engaged by said fuse link.

6. A fuse as claimed in claim 5 in which said fuse link as provided with a substantially right angle bend at the upper edge of said wall portion, said fuse link being provided with laterally extending wing portions engaging the upper edge of said wall portion and serving to determine the position of said bend, said fuse link also being provided with a laterally extending tongue engaging said resilient member at a point adjacent to said slot to determine the extent of penetration of the end of said fuse link into said slot, whereby the spacing between the free end portion of said resilient member and said wall portion is determined.

7. A fuse comprising a flexurally resilient member anchored at one end, a fuse link anchored at one end, fusible means securing the free ends of said resilient member and said fuse link so as to maintain said flexurally resilient member in a flexurally stressed condition, means for connecting the outer ends of said resilient member and said fuse link into an external circuit, and a lagging element carried by said resilient member at the point where said resilient member and said fuse link are secured to each other, said lagging element being secured to said resilient member by said fusible means, the resilience of said flexurally resilient member constituting the sole means for causing separation of said fuse link and said flexurally resilient member when said fusible means becomes softened under overload conditions.

8. A fuse as claimed in claim 7 in which said lagging element is in the form of a metallic slug having a mass which is great with respect to the mass of said fusible means.

9. A fuse as claimed in claim 7 having a casing of insulating material and in which said lagging element is spaced from said casing in order to be thermally insulated therefrom.

10. A fuse as claimed in claim 7 in which said fuse link is provided with a portion of reduced cross section which is adapted to blow under short circuit conditions.

11. A fuse comprising a body member, two strips of metal each being secured to said body member so as to provide a free end portion for each of said strips, one of said strips being flexurally resilient and being maintained in flexurally stressed condition by the other of said strips, the free end portion thereof being apertured to receive the free end portion of the other of said strips, means securing said free end portions to each other in heat transmitting relationship, said means including a fusible metal which is adapted to release said resilient strip under small overload conditions, said second mentioned strip constituting a fuse link which is adapted to blow under short circuit conditions, the apertured free end portion of said flexurally resilient strip being provided with wings, and said means for securing said free end portions to each other including a separate lagging element engaged by said wings, said fusible metal being disposed between said lagging element and said wings and between said lagging element and the free end portion of said fuse link.

12. A fuse comprising a body member, two strips of metal each being secured to said body member so as to provide a free end portion for each of said strips, one of said strips being flexurally resilient and being maintained in flexurally stressed condition by the other of said strips, the free end portion thereof being apertured to receive the free end portion of the other of said strips, means securing said free end portions to each other in heat transmitting relationship, said means including a fusible metal which is adapted to release said resilient strip under small overload conditions, said second mentioned strip constituting a fuse link which is adapted to blow under short circuit conditions, and said resilient strip including a first portion disposed substantially parallel to a surface portion of said body member and anchored against angular displacement with respect thereto, and a second portion disposed between said first portion and said free end portion, said second portion being provided with a bend, the free end portions of said strips being substantially perpendicular to each other whereby the movement of the free end portion of said resilient strip is in a direction substantially parallel to the axis of the free end portion of said fuse link strip.

GUST A. BERTHEL.

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