Nov. 28, 1950 G. A. BERTHEL 2,532,081

THERMAL TIME LAG FUSE

Filed Aug. 8, 1945

Fig. 1

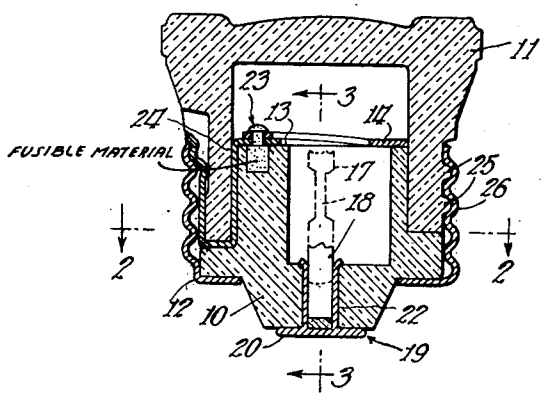


Fig. 3

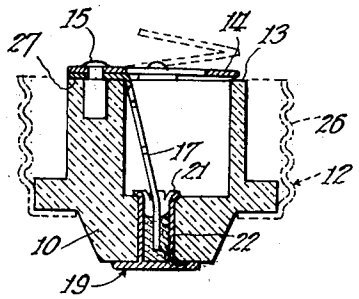


Fig. 2

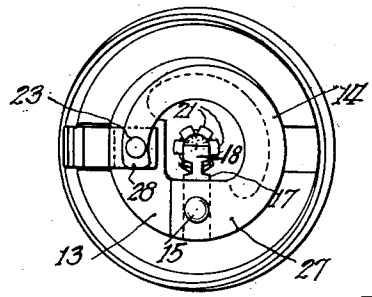


Fig. 4

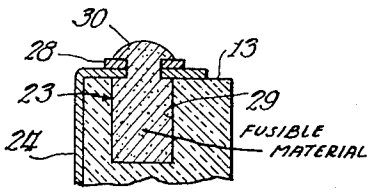
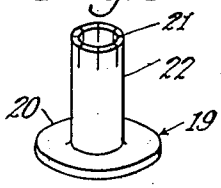


Fig. 5



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THERMAL TIME LAG FUSE

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7 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 a 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 provided 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, however, 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, the fuse link blows first.

The circuit breaking means comprises a resilient element which is maintained in a deformed and stressed condition by a fusible member.

It is another object of my invention to provide in a fuse of this type, a resilient element which also serves as a heating element for the fusible member which maintains it in deformed condition. Thus, the number of parts of the device is reduced to a minimum, and the assembly and structure is simple. These considerations are particularly important in a plug fuse, the type most frequently found in domestic use, because price is a more important factor in domestic fuses than in industrial types.

A further object of my invention is to provide a resilient member for the purpose above mentioned, which is designed so as to provide a comparatively large cross section to the end that it may serve as a current carrying element, and which is designed to fit within the limited space provided by a plug fuse, and still have considerable throw, and which can be manufactured by a punching process, thereby providing enhanced uniformity of mechanical and electrical characteristics at low unit cost.

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A still further object is to provide a fuse construction of the general class referred to above, in which the parts are arranged so as to provide a substantial heat absorbing action, thereby contributing to the lag characteristics of the fuse.

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

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

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

Fig. 2 is a plan view of the lower portion thereof, the view being taken along line 2—2 of Fig. 1;

Fig. 3 is a section of the lower portion, taken along line 3—3 of Fig. 1;

Fig. 4 is an enlarged sectional detail of the fusible anchoring means shown in Fig. 1; and

Fig. 5 is a detail view of the rivet which forms the center contact of the fuse plug.

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 25 which interlock with the threads 26 on screw shell 12.

The upper portion of the body member 10 presents an upwardly facing surface or shelf 13, which is disposed within the confines of the glass top 11. A spring strip 14 is disposed on the surface 13, the spring strip being spirally shaped and extending through 270 degrees, more or less. One end of the spring strip is secured to the surface 13 by means of a stud or shoulder rivet 15 which may be either insert-molded or force fitted into the body member 10. Also anchored to the surface 13 by the rivet 15 is one end of a fuse link 17, the fuse link and spring strip being in electrical contact with each other. The fuse link is notched to provide a restricted fusing

section 18, as shown in Fig. 2, and in broken lines in Fig. 1.

The lower end of the fuse link is secured to a center contact which is made in the form of a hollow rivet 19, either round or square, shown in detail in Fig. 5. The rivet comprises a base 20 and a hollow shank 32, the upper end of which is split into fingers 21. The bottom wall of the body member 10 is provided with an aperture into which the rivet is inserted, and the fingers 21 are headed over. The lower end of the fuse link 17 is received within the hollow shank 22 and anchored by a drop of solder to provide good electrical contact.

The spring strip 14 is preferably made of resilient metal 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 suitable; also an alloy sold under the trade name "Inconel." The spring strip 14, at the time that it is stamped out of suitable sheet material, is deformed in the manner shown in broken lines in Fig. 3, that is, it is not flat, but one end is axially displaced with respect to the other end. The end 27, as shown in Fig. 2, is of somewhat greater dimensions than the end 28, and the end 27 is the one which is anchored to the surface 13 by rivet 15.

The end 28 is anchored to the surface 13 by means of a plug 23 of bismuth solder or other suitable low melting point metal. This plug 23 of fusible material serves to maintain the spring strip 14 in a stressed position, the operation of the device being such that when the temperature of the plug 23 has been raised to approach the melting point of the fusible material, the end 28 will spring away from the surface 13. A conducting strip 24 extends from the plug 23 to the screw shell 12, the upper end of the conducting strip 24 being disposed in surface contact with the free end 28 of the spring strip. In the preferred construction, the free end 28 and the conducting strip 24 are both provided with aligned apertures so that the fusible material may actually interlock with these two members, thereby positively maintaining them in electrical contact. The body member 10 is provided with a bore 29, as shown in Fig. 4, and the fusible material is caused to run into the bore 29 in the molten state after the parts have been arranged in their desired position. Thus the fusible material is caused to assume the shape of the plug 23, a small excess of the fusible material serving as a head 30 which provides the desired positive interlocking. By virtue of this construction it will be seen that there is a considerable mass of solder which must be elevated to the softening temperature before the free end 28 will be released from contact with the conducting strip 24.

In operation, the heat developed by the spring strip 14 on a small or moderate overload, is conducted to the fusible plug 23, causing the same to soften. The dimensions of the parts are such that on a 100% overload of the rated capacity of the fuse, the release of the free end 28 will be effected in not less than thirty seconds and in not more than one hundred and twenty seconds.

The proximity of the spring strip 14, which also serves as the heating element for the proper operation of the device to the surface 13, causes an additional time lag due to the potential heat absorption capacity of that portion of the body member 10 which is adjacent the surface 13.

The fuse link 17, and in particular, the restricted fusing section 18, are so proportioned as to give substantial instantaneous blowing action under short circuit conditions.

It will be seen therefore that the spring strip 14, together with the plug 23 comprise the circuit breaking means which is connected in series with the fuse link 17. On small or moderate overloads, the circuit through the fuse is opened by the operation of these elements, whereas on heavy overloads, the desired instantaneous action is provided with the fuse link 17. It is obvious that the parts may be proportioned as to give any desired operating characteristics. It is evident that the utility of this device resides in the fact that for a given fuse link, the characteristics of the circuit breaking means on small and moderate overloads are quicker acting than that of the fuse link. Therefore the fuse link used is of a substantially greater rating than that which would ordinarily be used in a plug fuse not embodying separate circuit breaking means. The combined characteristics of these elements are such that a considerable delay in the action of the fuse which forms the subject matter of my invention is obtained over the ordinary plug fuse of comparable rating. In general, I have found it desirable to proportion the parts so that the change over from the circuit breaker operation to the fuse link operation occurs between 500 and 600 per cent of load.

Although I have disclosed herein only a preferred embodiment of my invention, it will be apparent that various modifications and changes may be made therein without departing from the scope of my invention as defined by the appended claims.

I claim:

1. A plug fuse comprising a body member having two spaced recesses therein, a resilient strip overlying a portion of said body member, a rivet disposed in one of said recesses for anchoring said resilient strip at one end to said body member, a body of metal of comparatively low melting point disposed in the other one of said recesses and engaging the free end of said resilient strip to maintain the same in stressed condition, a fuse link connected in series circuit with said resilient strip, contacts at the outer surface of said body member, and means for connecting said resilient strip and said fuse link in series circuit with said contacts.

2. A plug fuse comprising a body member having a portion presenting a substantially flat surface, a resilient strip anchored at one end to said surface, fusible means disposed on said surface opposite the free end of said resilient strip, an intermediate portion of said resilient strip being held against said surface against the resilience of said strip by said fusible means, a fuse link connected in series circuit with said resilient strip, two contacts at the outer surface of said body member, and two separate means for connecting said resilient strip and said fuse link in series circuit with said contacts, said resilient strip being maintained in contact with one of said connecting means by said fusible means.

3. A plug fuse comprising a body member having a portion presenting a substantially flat surface, a resilient strip anchored at one end to said surface, a recess in said surface opposite the free end of said resilient strip, a conductor overlying said recess, said conductor and said free end being provided with aligned apertures which register with said recess, a body of fusible metal disposed in said recess and extending through said

aligned apertures whereby said resilient strip is maintained in stressed condition, and a fuse link in series circuit with said resilient strip.

4. In a fuse, a support, a resilient strip, means for anchoring one end of said resilient strip to said support, said support being extended beyond said end to underlie the intermediate portion of said strip so as to form a backing for said resilient strip when held in stressed condition, a body of fusible metal countersunk in another portion of said support and engaging the free end of said resilient strip and maintaining the same in stressed condition, and a fuse link in series circuit with said resilient strip.

5. In a fuse, a ring shaped support, an arc shaped resilient strip anchored at one end to said support, and formed so that the other end tends to spring away therefrom, a conductor disposed on said support, fusible means for maintaining said resilient strip in a stressed condition in electrical contact with said conductor, and a fuse link in series circuit with said resilient strip.

6. In a fuse of the type described, a support of insulating material presenting a substantially flat surface, a resilient strip, means for anchoring one end of said strip to said support, said strip being formed so that the opposite end of said strip tends to spring away from said surface, said support at a point opposite the free end of said strip being recessed, a body of fusible metal disposed within said recess and engaging the free end of said resilient strip so as to maintain it in a stressed, substantially flat configuration in which an intermediate portion thereof lies against said surface, means for connecting the opposite ends of said strip in a circuit whereby said strip serves as a heating element when small overload currents are passed therethrough, said body of fusible metal being of such volume that the amount of heat absorbed thereby from said resilient strip before said body is raised to the softening point will provide a time delay in the release of the free end of said resilient strip, and a fuse link in series circuit with said resilient strip and adapted to blow under heavy overload conditions prior to the time that said resilient strip is released.

7. In a plug fuse, a cup shaped body member of insulating material, the upper edge of which forms a support presenting a substantial flat surface, an arc shaped resilient strip, means for anchoring one end of said strip to said support, said support at a point opposite the free end of said strip being recessed, a conductor overlying said recessed portion, a body of fusible metal disposed within said recess and engaging the free end of said resilient strip so as to maintain it in a stressed, substantially flat configuration, in which an intermediate portion thereof lies against said surface and said conductor, means for connecting said conductor and the opposite end of said strip in a circuit whereby said strip serves as a heating element when small overload currents are passed therethrough, said body of fusible metal being of such volume that the amount of heat absorbed thereby from said resilient strip before said body is raised to the softening point will provide a time delay in the release of the free end of said resilient strip, and a fuse link in series circuit with said resilient strip disposed within said cup-shaped body member. said fuse link being provided with a portion of reduced cross section which is adapted to blow under heavy overload conditions prior to the time that said resilient strip is released and which is also adapted not to blow under small overload conditions prior to such time.

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