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FUSE CONSTRUCTION

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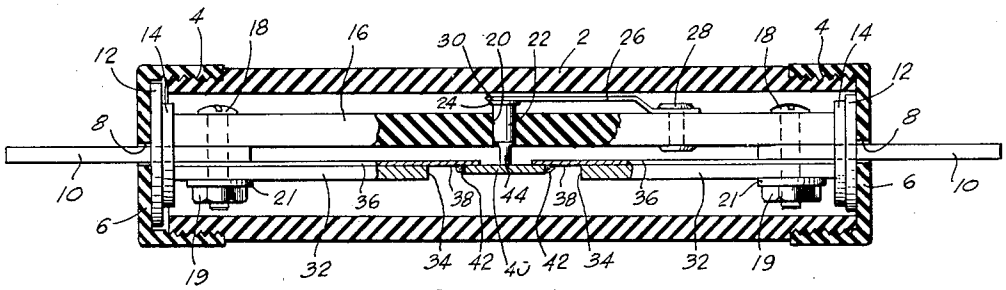


Fig. 1

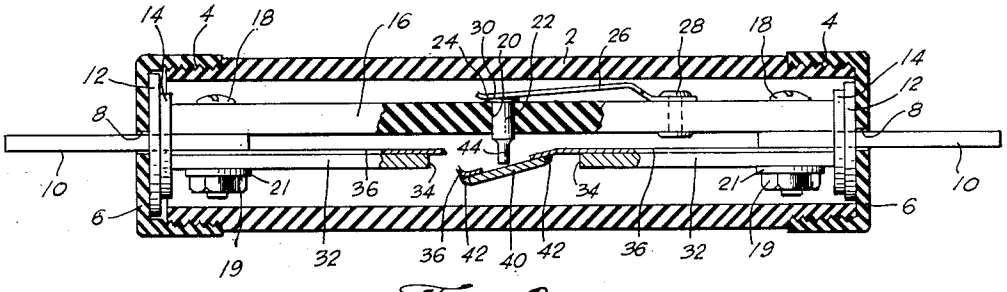


Fig. 2

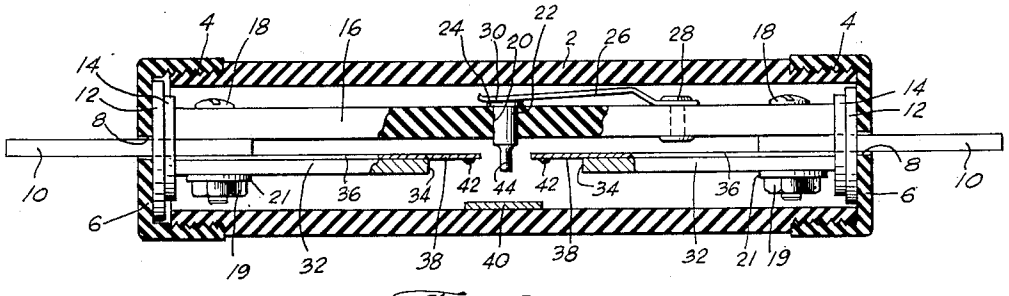


Fig. 3

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FUSE CONSTRUCTION

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The present invention relates to a novel construction for a circuit protective fuse. The type of fuse to which this invention particularly relates is one which is adapted not only immediately to protect the circuit in which it is connected from extreme current overloads, such as might be caused by a short circuit or the like, but also to protect the circuit against minor overloads which persist beyond a predetermined period of time.

Fuses of this particular type generally comprise a conductive link formed of readily fusible material, the link itself therefore being self-destructive so as to open the circuit through the fuse quite promptly upon the occurrence of heavy overloads. A portion of the electrical circuit through the fuse is additionally defined by a material having a fairly low melting point, that material serving to physically and electrically connect two elements together and being held under tension in juxtaposition to a current carrying element having an appreciable electrical resistance. Slight overloads will cause the element of high electrical resistance to heat up sufficiently to melt or soften the connecting material, and because of the tension thereon the junction defined thereby will separate provided that the heating effect of the high resistive element continues at a sufficient magnitude for a sufficient period of time. In this manner if a slight overload should occur the circuit through the fuse will not be immediately opened, but if that slight overload should continue for an excessive period of time, the circuit will be opened. The period of time will of course vary depending upon the magnitude of the overload, the greater the current the greater the heat developed in the element having a high electrical resistance, and consequently the sooner will the junction material be softened or melted.

The fuse structure of the present invention provides for a simplified yet positively acting arrangement of parts in a device of this character. In particular it provides for a structure in which, when the circuit has been interrupted for either of the reasons above set forth, the major structural portions of the fuse may be reused, it being necessary to replace only one inexpensive sub-assembly therein and the fuse construction being such as to facilitate such replacement. To this end the elements which enable the fuse to function as described are assembled into a unitary structure readily removable as such from the housing, that structure in turn being disassemblable and the elements thereof through which current is adapted to pass comprising a sub-unit insertable as such into the aforementioned unitary structure. That sub-unit comprises a pair of conductors, preferably fusible in nature, between which a conductive and preferably heat absorptive element extends, the element being connected to the conductors by material having a relatively low softening point. The remainder of the fuse structure, apart from the housing, includes supports on which the conductors are mounted in such a way that the conductive element extending therebetween is free to move in a given direction. The structure carries biasing means

active on that conductive element so as to tend to urge it in the direction in which it is free to move, the conductive element normally being prevented from movement in that direction by the material of low softening point which connects it to the ends of the conductors. The biasing means is permanently associated with the supporting structure, so that even after it has been operative, for example, to separate the conductive element from the conductors when a small overload has persisted for an excessive period of time, said biasing means still remains secured to the support and ready to perform its functions anew after a new sub-unit of conductors and attached conductive element has been inserted into the structure to replace the sub-unit previously consumed. The biasing means not only acts to positively separate the conductive element from the conductors when the material of low softening point is sufficiently heated, but also serves to tension the fusible conductors themselves. As a result when an excessive overload causes a conductor to fuse, the biasing means will quickly separate the conductor at the fused area, thus providing for prompt breaking of the current through the fuse, minimizing arcing, and minimizing the generation of gases within the fuse housing.

To the accomplishment of the above, and to such other objects as may hereinafter appear, the present invention relates to a fuse construction as defined in the appended claims and as described in this specification, taken together with the accompanying drawings, in which:

Fig. 1 is a cross sectional view of a fuse made according to the present invention and showing the fuse in normal condition;

Fig. 2 is a view similar to Fig. 1 but showing the manner in which the circuit through the fuse is broken in the event of an excessive overload; and

Fig. 3 is a view similar to Fig. 1 but showing the manner in which the circuit through the fuse is broken in the event that a moderate overload persists for an excessive period of time.

The fuse comprises a tubular housing 2, preferably formed of some insulating material and which may be transparent or not, as desired, the ends 4 of the housing being externally threaded. Caps 6 are adapted to threadedly engage the portions 4 of the housing 2 so as to close the ends of the latter. These caps are provided with central openings 8 through which conductive blades 10 extend, the portions of those blades 10 which extend beyond the caps 6 constituting the means by which electrical connection to the fuse is made. Baffle washers 12 bear against the inner surfaces of the caps 6 and snugly encompass those portions of the blades 10 which pass therethrough, the baffle washers 12 obstructing free passage of gas from the interior of the housing 2 to the exterior thereof. Copper washers 14 abut the inner surfaces of the baffle washers 12 and function to absorb the heat which may be produced when gases are generated within the housing 2.

Mounted between the copper washers 14 is a strut 16 formed of some suitable insulative material, the strut 16 being secured to the inwardly projecting portions of the blades 10 by means of bolts 18. The strut 16 is provided with a vertical opening 20 appropriately positioned along its length through which a pin 22 is slidable, that pin having an enlarged head 24 above the upper surface of the strut 16. A leaf spring 26 is secured to the strut 16 by means of rivet or eyelet 28, and the tip 30 of the leaf spring 26 overlies of the head 24 of the button 22. As may be seen from Figs. 2 and 3, the spring 26 tends to urge the pin 22 downwardly until its head 24 rests on the upper surface of the strut 16. The fact that the pin head 24 is larger than the opening 22 prevents the

pin 22 from separating from the strut 16 under the influence of the spring 26.

Secured beneath the inwardly extending portions of the blades 10 by the bolts 18 are a pair of supports 32 substantially parallel to the strut 16, the tips 34 of the supports 32 being spaced from one another so as to define an opening beneath the opening 20 in the strut 16. A pair of conductors 36 are mounted on the supports 32, also by means of the bolts 18, the outer ends of the conductors engaging the inner ends of the plates 10 and the inner ends 38 of the conductors extending toward one another beyond the tips 34 of the supports 32, a space being defined between the inner conductor ends 38 beneath the opening 20 in the strut 16. One or both of the conductors 36 is preferably formed of fusible material of a type well known in the fuse art, and certain portions of the body thereof may be weakened or cut away in order to ensure that fusing will take place, when an excessive overload is present, at those weakened or cut-away areas.

Nuts 19 and washers 21 serve to maintain all of the fuse parts except the housing 2, caps 6 and washers 12 and 14 connected together to define a unitary structure.

A conductive element 40 is positioned between the tips 34 of the supports 32 directly beneath the pin 22 and extends between and is connected to the inner ends 38 of the conductors 36 at their lower surfaces by means of heat sensitive material such as low melting point solder 42 the composition of which is well known to those in the fuse art. The conductive element 40 is of a size such as to be freely passable between the tips 34 of the supports 32. When it is held to the lower surfaces of the inner conductor ends 38 it is engaged by the tip 44 of the pin 22 which extends below the strut 16, forcing the pin 22 upwardly and flexing the spring 26, as shown in Fig. 1. The pin 22, as urged downwardly by the spring 26, biases the heat absorption pad 40 downwardly and at the same time tensions the conductors 36, and particularly those portions thereof which extend beyond the tips 34 of the supports 32. The conductive element 40 is preferably formed of appropriate material and provided with a mass such as to function as a heat absorption pad the temperature of which will rise when heat is generated therein or in the conductors 36, thereby heating the low melting point solder 42.

Should an excessive current overload pass through the fuse (See Fig. 2), one or both of the conductors 36 will quickly fuse, at the weakened or cut-away areas thereof if such are provided. In that event, as shown in Fig. 2, the pin 22 will be moved downwardly by the spring 26 so as to separate the two portions of the fused conductor 36, thus providing for a quick break of the circuit through the fuse, minimizing the possibility of arcing, and minimizing the generation of gases attendant upon the fusing of the material of which the conductor 36 is formed. Some such gases may well be produced, but the baffle washers 14 will permit the escape thereof only very slowly, thus eliminating any possibility of danger.

Should a slight current overload persist for an excessive period of time (See Fig. 3), the passage of current through the conductors 36 and the conductive element 40 will cause the temperature of the low melting point solder 42 to rise. The rate at which that temperature will rise will be determined in part by the magnitude of the current and in part by the electrical resistance of the conductors 36 and the conductive element 40. The temperature of the low melting point solder 42 will be determined in part by the rate at which heat is generated, and in part by the heat absorptive capacity of the element 40. Eventually, if the overload persists long enough, the solder 42 will be sufficiently softened so that the action of the pin 22 in tending to force the element 40 downwardly will overcome the retentive action of the solder 42. When that occurs the element 40 will be positively snapped downwardly, separated from the inner conductor ends 38, and permitted to fall to the bottom of the housing, all this occurring quite rapidly so as to produce an abrupt interruption of the current through the fuse.

Whether the current through the fuse is interrupted because of the presence of an excessive overload (Fig. 2) or because of the persistence of a slight overload for an excessive period of time (Fig. 3), the bulk of the fuse structure may nevertheless be reused upon the replacement of the sub-unit defined by the conductors 36 and the conductive element 40 connected to the inner conductor ends 38 by low melting point solder 42. This replacement may very readily be effected by removing one of the caps 6, sliding the fuse unit out of the housing 2, removing the nuts 19 and washers 21 from the bolts 18, removing the supports 32 from the nuts 18, extracting whatever portions of the conductors 36 and conductive element 40 may remain, replacing them with a new sub-unit of conductors 36 and conductive element 40, replacing the supports 32, reapplying the nuts 19 and washers 21, reinserting the unitary fuse structure into the housing 2, and replacing the cap 6. When the new conductor-conductive element sub-unit is put in place the pin 22 will be lifted and the spring 26 will be flexed to its position shown in Fig. 1, and consequently the fuse will again be ready for use. The operating mechanism of the fuse, apart from the electrical and heat sensitive parts thereof, may be reused time and again, and the only replacement part needed is the relatively inexpensive sub-unit defined by the conductors 36 and the element 40.

While but a single embodiment of the present invention has been here disclosed, it will be apparent that many variations may be made therein, all within the scope of the present invention as defined by the following claims.

I claim:

1. A fuse construction comprising a housing and a unitary structure removable from and insertable into said housing as such, said unitary structure comprising, a pair of conductors the ends of which are separated from one another, a support on which said conductors are mounted and fixed against movement in a given direction, a conductive element extending between said conductors and connected to the ends thereof by a heat sensitive substance, said conductive element being substantially unsupported against movement in said given direction except by its connection to said conductor ends, a member engageable with said conductive element, and biasing means carried by said support and active on said member so as to urge it in said given direction so as to tend to cause said conductive element to separate from said conductor ends.

2. The fuse of claim 1, in which said conductors and the conductive element connected thereto constitute a sub-unit insertable as such into said unitary structure, and means for securing said sub-unit to said unitary structure.

3. A fuse construction comprising a housing, a pair of conductors therein the ends of which are separated from one another, means in said housing for supporting said conductors against movement in a given direction, a conductive element extending between said conductors and connected to the ends thereof by a heat sensitive substance, said conductive element being substantially unsupported against movement in said given direction except by its connection to said conductor ends, a support detachably secured to said housing and located adjacent said conductive element, a member articulately mounted on said support and engaging said conductive element, and biasing means active on said member so as to urge it in said given direction so as to tend to cause said conductive element to separate from said conductor ends.

4. In the fuse of claim 3, means operative between said member and said support preventing separation of the two under the influence of said biasing means.

5. The fuse of claim 3, in which said member comprises a pin slidable with respect to said support toward and away from said conductive element, the tip of said pin extending in said given direction from the body thereof and engaging said conductive element between said conductor ends, said biasing means comprising a spring operatively connected to said pin so as to urge it toward and into engagement with said conductive element.

6. In the fuse of claim 5, means operative between said member and said support preventing separation of the two under the influence of said biasing means.

7. A fuse construction comprising a housing having at least one open end, a cap removably received on said open end, and a removable fuse unit within said housing, said unit comprising a pair of spaced supports, conductors on said supports and restrained thereby against movement in a given direction, one end of each of said conductors extending beyond the respective supports toward and spaced from the corresponding end of the other conductor, terminals electrically connected to said conductors and extending to the exterior of said housing, a conductive element secured to said conductor ends between said supports by a heat-sensitive substance, said conductive element being substantially unsupported against movement in said given direction except by its connection to said conductor ends, a third support operatively connected to said first mentioned supports and extending over said conductive element on the opposite side thereof from said given direction, a member on said third support and engaging said conductive element, and biasing means active on said member so as to urge it toward said conductive element so as to tend to cause said conductive element to separate from said conductor ends.

8. The fuse construction of claim 7, in which said fuse unit is disassemblable, said conductors and/or conductive element being replaceable therein when desired.

9. The fuse of claim 8, in which said member comprises a pin slidable with respect to said support toward and away from said conductive element, the tip of said pin extending in said given direction from the body thereof and engaging said conductive element between said conductor ends, said biasing means comprising a spring operatively connected to said pin so as to urge it toward and into engagement with said conductive element.

10. The fuse of claim 7, in which said member comprises a pin slidable with respect to said support toward and away from said conductive element, the tip of said pin extending in said given direction from the body thereof and engaging said conductive element between said conductor ends, said biasing means comprising a spring operatively connected to said pin so as to urge it toward and into engagement with said conductive element.

11. The fuse construction of claim 3, in which said biasing means is carried by said support.

12. The fuse construction of claim 3, in which said conductors, said means for supporting said conductors, said conductive element and said biasing means are mounted on said support, thereby defining a unitary structure removable as such from said housing.

13. The fuse construction of claim 12, in which said conductors and the conductive element connected thereto constitute a sub-unit insertable as such into said unitary structure, and means for securing said sub-unit to said unitary structure.

14. In the fuse of claim 12, means operative between said member and said support preventing separation of the two under the influence of said biasing means.

15. A fuse construction comprising a housing, a pair of conductors therein the ends of which are separated from one another, means in said housing for supporting said conductors against movement in a given direction, a conductive element extending between said conductors and connected to the ends thereof by a heat sensitive substance, said conductive element being substantially unsupported against movement in said given direction except by its connection to said conductor ends, a support in said housing adjacent said conductive element, a member mounted on said support and engaging said conductive element, and biasing means active on said member so as to urge it in said given direction so as to tend to cause said conductive element to separate from said conductor ends, said member comprising a pin slidable with respect to said support toward and away from said conductive element, the tip of said pin extending in said given direction from the body thereof and engaging said conductive element between said conductor ends, said biasing means comprising a spring operatively connected to said pin so as to urge it toward and into engagement with said conductive element.

16. In the fuse of claim 15, means operative between said member and said support preventing separation of the two under the influence of said biasing means.

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