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2,313,373

ELECTRIC FUSE

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Fig. 1

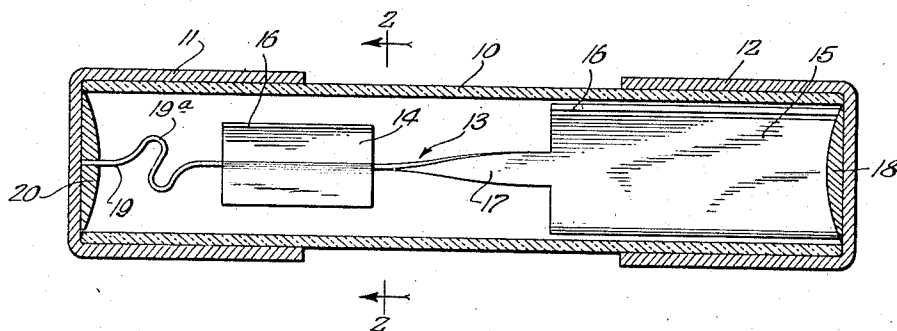


Fig. 2

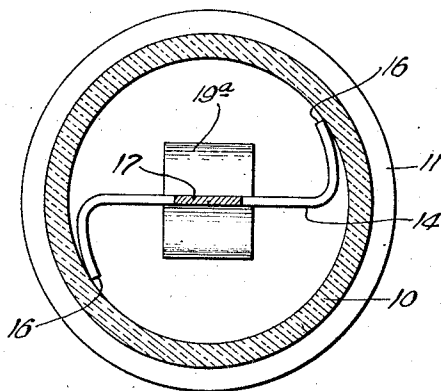
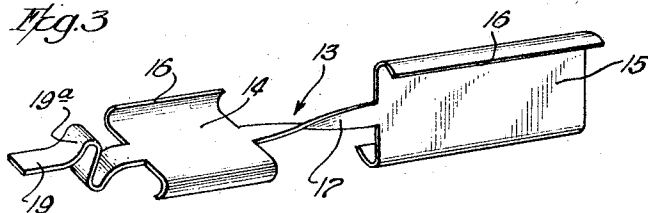


Fig. 3



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ELECTRIC FUSE

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6 Claims. (Cl. 200—131)

This invention relates to improvements in electric fuses. In electric fuses comprising fusible elements or links having the ends attached to terminals or end caps of cartridge or capsule-like casings, failure of the elements frequently occurs due to crystallization resulting from repeated heating and cooling of the element. Generally such an element has a portion of minimum cross-section which determines the current carrying capacity of the fuse and which, upon momentary overloads, is heated to a relatively high temperature but below the fusion temperature of the fusible link material. As a result of the crystallization due to such repeated heating and cooling of the fuse link in use and the metal fatigue caused by the accompanying expansion and contraction of such links, breakage of the same when subjected to exteriorly imposed vibrations or shocks such as occur in use in aircraft and other installations is quite common. Where the ends of such a link are affixed to end caps or fuse terminals with no provision made for accommodating longitudinal expansion as in conventional cartridge fuses, the link generally buckles or bends at the hottest portion thereof which is also usually the weakest structural portion of the link, and hence the period of usefulness of such fuse frequently is terminated by breakage due to shocks or vibrations rather than to fusion under current overloads. Such breakage of fuse elements is particularly troublesome where the links are formed of low temperature metals such as zinc which, at temperatures at or above 350° C., become relatively weak structurally.

The object of the present invention is to provide a fuse having means which accommodates thermal expansion and contraction of the fuse element in such manner as to avoid flexing of the hottest and hence generally the most highly crystallized and weakest portion of the element for avoiding breakage thereof due to externally originated vibrations or to stresses set up in the element by the expansion and contraction thereof.

In the accompanying drawing,

Figure 1 is a broken elevation of a fuse structure illustrative of the present invention;

Fig. 2 is a sectional view taken on line 2—2 of Fig. 1;

Fig. 3 is a perspective view of a detached fuse element of the type shown in Figs. 1 and 2.

In the drawing a cartridge or capsule-type fuse is illustrated comprising a glass or other protective tubular casing 10, and caps 11 and 12, and a fuse element indicated generally by numeral 13.

In the particular embodiment of the element 13 shown in the drawing, two pairs of wings 14, 15 are shown, each pair of which in end view are generally of Z shape. The outer longitudinal edges 16 of the wings 14 and 15 slidably contact the interior wall of the casing 10, and by supporting the element intermediate the ends thereof assist in reducing breakage of the element due to exteriorly imposed vibrations or shocks. The intermediate portion of the fuse element 17 is shown as being of reduced cross-sectional area and is the portion which determines the current carrying capacity of the fuse and which, in case of excessive current overloads, is the portion that fuses and opens the circuit. The portion 17 of the fuse is therefore structurally the weakest portion of the fuse.

In the drawing the portion 17 is shown as being twisted through an arc of about 90° to give it a spiral form for stiffening it against flexing and thereby reducing or altering its tendency to vibrate. The free end of the wing sections 15 of the fuse link or element is shown electrically connected to the end cap 12 preferably by solder 18. At the other end of the fuse element the wings 14 terminate short of the end of the element which has a terminal portion 19 attached to the cap 11 preferably by solder 20. The portion 19 is greater in cross-sectional area than the portion 17 and hence is heated less than the latter by current flowing through the link. The portion 19 is provided with a formation that enables it to accommodate the longitudinal expansion and contraction of the link that occurs when the link is subjected to temperature changes, the formation being shown as a reverse bend or "goose-neck" 19^a.

Expansion of the conventional fuse link results in flexing or buckling of the structurally weakest portion, that is, the portion of smallest cross-sectional area, which portion during the flow of current is also the hottest portion of the link. This hottest and weakest portion, therefore, tends to crystallize, which tendency is augmented by the flexing action that occurs in said portion during expansion and contraction of the fuse, hence such portions of the fuses frequently are broken by physical shock or vibration to which the fuses are subjected in use. In the present construction, while the portion 17 of the fuse link becomes hottest in use, the bend or goose-neck portion 19^a permits the section 19 to flex to accommodate the expansion of the link, and hence any crystallization or fatigue of the metal that occurs due to flexing take place not

in the structurally weakest portion 17 of the link but in the more rugged section 19 which is also cooler in use due to heat radiation from the cap 11.

The helical twisting of the section 17 above referred to not only stiffens the section and thereby reduces the tendency of that portion to vibrate, but it reduces the tendency of that portion to flex or sag or buckle upon expansion due to heating and thereby renders such portion better able to transmit the expansive forces to the resilient bend 19^a, which, due to the flexibility imparted to the latter section, responds readily in accommodating longitudinal expansion of the link. While the bend or formation 19^a has been termed a "goose-neck" due to the particular shape of the same shown in the drawing, it will be apparent that the object of such formation is to enable it to flex readily under the expansive and contractile forces exerted by the element as it becomes heated or as it cools and thereby reduces or eliminates the flexing and buckling movements and greater stresses that would otherwise occur in the structurally weaker portion 17. It will be apparent that formations of other shapes which will accommodate longitudinal expansion or contraction of a fuse link for protecting a structurally weaker portion against flexing or buckling or rupture by reason of expansion and contraction of the link that occurs upon heating and cooling thereof may be employed without departure from the object and spirit of the present invention.

The use of non-integral springs attached to one end of a fuse link for accommodating expansion and contraction of the element has been avoided by the present improvements and a simple one-piece element is provided which can as readily be assembled within the cartridge or casing as a conventional one-piece element. However, the flexible spring-like formation 19^a substantially decreases fatigue of that portion of the fuse which becomes hottest and most highly crystallized and brittle during use and hence reduces the susceptibility of the element to breakage by externally imposed vibrations and shocks as well as from stresses imposed on that portion of the element by longitudinal expansion and contraction of the element during use.

I claim:

1. A fuse of the capsule type comprising a casing and a one-piece fuse element therein, said element comprising a fusible portion of minimum cross-sectional area and a portion of greater cross-sectional area having a greater current carrying capacity than said other area and provided with an integral formation rendering said latter portion sufficiently flexible to accommodate the longitudinal expansion and contraction of the

element resulting from the heating and cooling thereof.

2. A fuse comprising a casing, end caps therefor, a one-piece fuse element therein having the ends attached to said caps, said element comprising a portion of reduced cross-sectional area that fuses upon excessive current overload and a portion of greater current carrying capacity, and means integral with the latter portion for accommodating the longitudinal expansion and contraction of the element accompanying the heating and cooling thereof.

3. A fuse comprising a casing, end caps therefor, a one-piece fuse element therein having the ends attached to said caps, said element comprising a portion of reduced cross-sectional area that fuses upon excessive current overload and a portion of greater current carrying capacity, and a reverse bend in said latter portion of the fuse element rendering the same sufficiently flexible to accommodate longitudinal expansion and contraction of the element for avoiding the flexing of said first mentioned portion upon expansion and contraction of the element.

4. A fuse comprising a casing, end caps therefor, and a fuse element in said casing having ends secured to said caps, said element being provided with a portion designed to fuse upon predetermined current overload and an integral formation in another portion thereof rendering the same sufficiently flexible to accommodate longitudinal expansion and contraction of the element for avoiding flexing of said first mentioned portion of the element.

5. A fuse comprising a casing, end caps therefor, and a fuse link in the casing attached at the ends thereof to said caps, said link comprising a weakened portion that fuses upon predetermined maximum current overload, said portion being spirally shaped for stiffening the same structurally, and an integral portion provided with a formation rendering said portion sufficiently flexible to accommodate longitudinal expansion and contraction of the link upon the heating and cooling thereof respectively for avoiding flexing of said weakened portion upon such expansion and contraction.

6. A fuse link having a fusible portion relatively weak structurally as compared with the current carrying remainder of the link, and an integral spring-like formation in a structurally stronger portion thereof rendering such latter portion sufficiently flexible to accommodate longitudinal expansion and contraction of the link for avoiding the flexing of said weaker portion during the expansion and contraction of the link that occurs upon the heating and cooling thereof.

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