Oct. 15, 1957 M. M. LEAR, JR 2,810,043

DELAY ACTION FUSE LINK AND METHOD OF MAKING

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FIG. 1

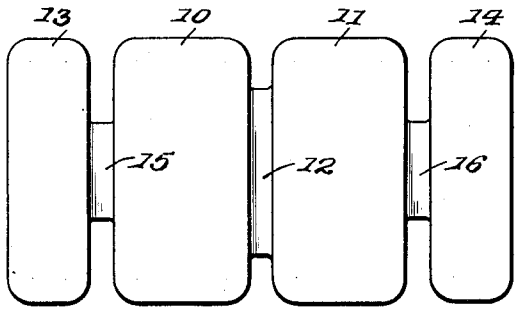


FIG. 2

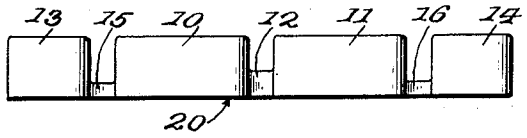
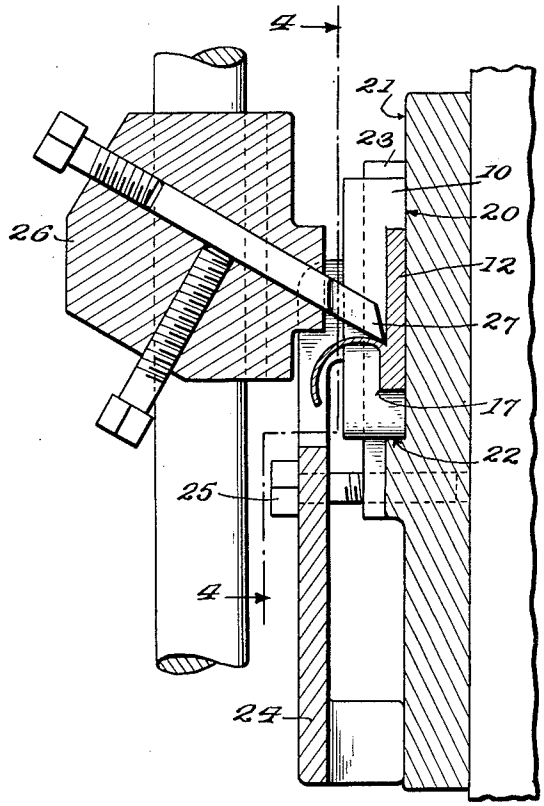


FIG. 3



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FIG. 4

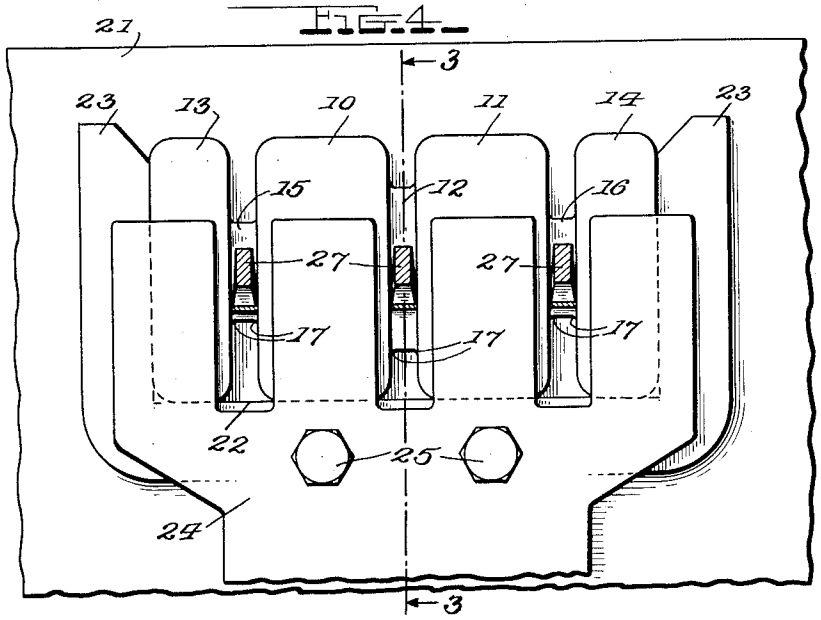


FIG. 5

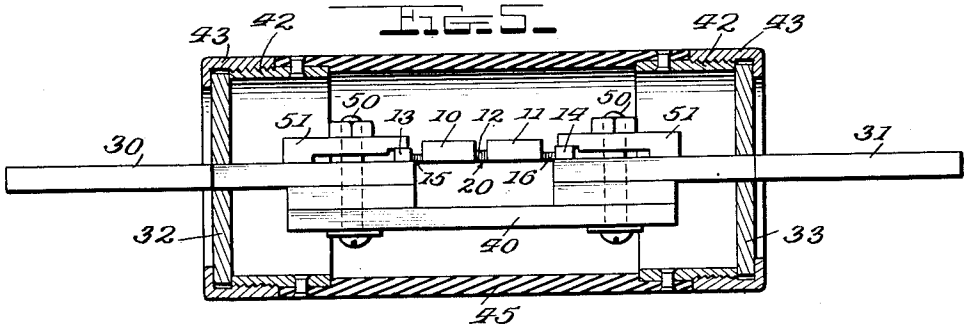
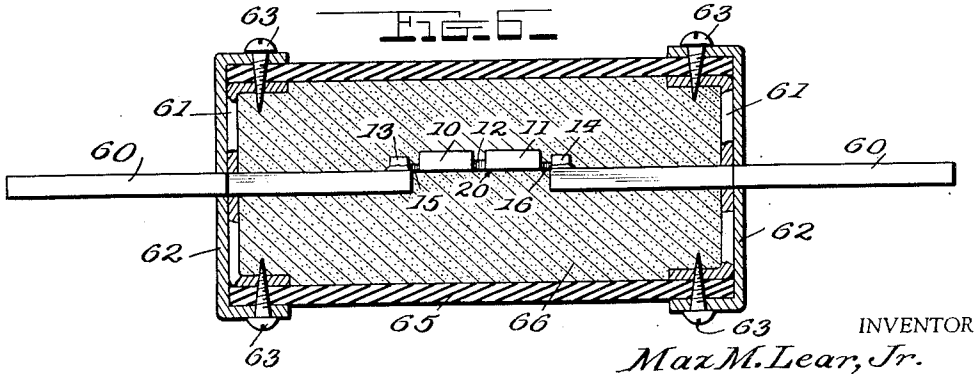


FIG. 6



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DELAY ACTION FUSE LINK AND METHOD OF MAKING

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Application October 6, 1953, Serial No. 384,501

4 Claims. (Cl. 200—135)

This invention relates to an electrical fuse link of delay-action type and to the method of making the same.

It is well-known to provide cartridge fuses with replaceable fuse links. A common practice for fuse devices employed with current intensities of, for example, more than 60 amperes, is to have an assembly comprising an outer sleeve of insulating fiber material which are two end caps; an internal sub-assembly of an insulating strip and two conductive supporting pieces at its ends has terminal blades which project outwardly through the end caps to be received by the supporting clips of the fuse mount, is held between the end caps, and the supporting pieces include bolts or other securing means for engaging the ends of the replaceable fuse link. When the safe current condition is exceeded, the link fuses or "blows"; and the attendant replaces the entire assembly by a like structure, and then prepares the removed assembly for further service by removing an end cap and the sub-assembly, loosening the securing means, removing remaining parts of the destroyed link and replacing them by a new link of the proper current capacity, and re-assembling the parts.

It has likewise been sought to provide a time-delay fuse link at one or more points with a heat-receiving and absorbing body which acts to determine the rate of temperature rise at a smaller adjacent section of the link. Thus, at a sudden high current intensity which is in excess of the maximum or short-circuit rating of the link, the greater resistance at the smaller section causes such heating there that the temperature rise is so fast that the heat does not significantly flow into the body, and hence the smaller section melts at once. On the other hand, with a lesser current intensity, the heating effect is less at the reduced section, and heat flow into the body occurs so that the reduced section does not melt or blow until the body itself has been raised close to the melting temperature at each reduced section, that is, a time delay is attained so that the fuse has the dual functions of opening at once upon a short circuit and of withstanding a current of, say, 50 percent greater than a rated value of 600 amperes for, say, 16 seconds before melting; which, in view of the required safety factor of conductor loading relative to minimum fuse rating, avoids heating of such conductors to damaging temperatures.

Fuse links for such delay action purposes demand close tolerances in manufacture. Particularly with the larger sizes, such as links having a rating of a couple hundred amperes or above, links formed from strip or sheet material of uniform thickness are difficult to design or provide with heat-absorbent bodies. Rivet or bolt connections include fay fitting at abutting surfaces, but minor strains during riveting, or later bending, open gaps so that the intended heat transfer is not attained and thus several fuses of apparently identical physical characteristics may exhibit wide differences in delay action. Hot connections, by soldering, are made at less than the melting point of the link material (normally zinc), and introduce the difficulties of size uncertainty from filleting

or grooving at the body edges along with possible modification of the melting temperature by incorporation of the solder alloy.

When it is sought to make the links by die-casting in accurate molds, it has been found that the necessary structural shapes do not permit the rapid repetitive production of link elements within the necessary tolerance of size and shape. In addition, the die-castings customarily have surface irregularities which differ from unit to unit, with a corresponding difference in the radiation properties: and this is critical at the webs which should be closely identical if they are to behave as specified by schedule.

According to the present invention, fuse links of closely calibrated operating conditions can be quickly and repetitively prepared in quantity by a combination of die casting and trimming operations by which advantage is taken of the cheapness of die-casting in obtaining gross shapes and the accuracy of machine trimming operations in preparing articles of close size tolerance.

A feature of the invention is the provision of a fuse link having heat-absorbing bodies integral therewith and having a reduced section between such bodies of closely defined size and shape.

Another feature is the provision of a fuse link having a plurality of heat-absorbing bodies integral therewith with intervening integral reduced sections of closely defined size and shape.

A further feature is the provision of a fuse link having a heat-absorbing body and a terminal body with an intervening reduced section of closely defined size and shape, the parts being integral.

Another feature is a method of making fuse links of delay action type with closely predetermined size and shape at a reduced section thereof by combined die-casting and trimming operations.

With these and other features as objects in view, an illustrative form of practice is set out on the accompanying drawings, in which:

Figure 1 is a plan view of a fuse link according to this invention;

Figure 2 is a side elevation of the same;

Figure 3 is a diagrammatic sectional view on a larger scale showing a trimming operation; substantially on line 3—3 of Fig. 4;

Figure 4 is a similar view substantially on line 4—4 of Fig. 3;

Figure 5 is a longitudinal sectional view through a fuse link holder of renewable type, with a fuse link according to Figs. 1 and 2 in position;

Figure 6 is a corresponding section showing such a link in position in a non-renewable link holder.

In the drawings a link structure is formed by die-casting, preferably of zinc, whereby two large bodies or masses **10, 11** are provided, with an intervening reduced portion or web **12**. End or terminal bodies **13, 14** are connected to the respective bodies **10, 11** by intervening reduced portions or webs **15, 16** so that transverse grooves exist between the bodies. This structure can be made by die-casting as an integral, i. e. monolithic, unit in a mold which defines the bodies and provides the webs wider and thicker than the required size, and preferably with fillets **17** (Figs. 3 and 4) which assure filling of the mold cavity and homogeneity of the unit. In such casting of the illustrative form, the bottom or lower surface **20** is formed against a plane surface of the die or mold and hence is accurate and smooth.

The die-cast unit is then subjected to shaving operations as shown in Fig. 3. The unit is placed with its smooth die-cast bottom **20** upon a fixture bed having a plane surface **21** with guide or stop ledges **22, 23**, and clamped thereto by the fixture dog **24** with screws **25.**

A reciprocating machine ram **26** with the tools **27**, one for each web groove, then operates to shave the webs and reduce them to the predetermined thickness and shape adjacent the bodies **10, 11, 13, 14**. The tools **27** are of predetermined widths, each being mounted on the ram **26** at a distance from its neighbors which causes them to give the webs the predetermined thickness and spacing. Die-cast units are normally accurate within a thousandth of an inch; and the usual trimming by the shaving operation serves to remove about 0.0005 inch, therewith forming transverse grooves each having as its bottoms a smooth surface of higher luster than the die-cast surface which is matte. As much as 0.010 inch can be removed by a single cutting edge from die-cast blanks with satisfactory tool life and surface finish.

These operations confer smooth and reflective surfaces at the webs, whereby the radiation losses are closely identical for all units of the scheduled group.

In an example of practice of a 600 ampere link (250 volt rating) illustrated in the drawing, the bodies **10, 11** are each 1.000 inch wide, 0.5312 inch long, and 0.250 thick, with a volume of about 0.078 cu. in. The end webs **15, 16** are identical; each being 0.375 inch wide, 0.09375 inch long and 0.050 inch thick. The central web **12** is 0.625 inch wide, 0.09375 inch long, and 0.070 inch thick. The end bodies **13, 14** are 1.000 inch wide, 0.3125 inch long, and 0.125 inch thick. The upright corners of the bodies are at 0.093 inch radius, as shown in Figure 1. Such a link responds accurately (1) by holding a 110 percent load (660 amperes) without rising 50 degrees C. over the ambient temperature; (2) by opening the circuit at 135 percent load (710 amperes) in about 14 minutes; (3) by opening the circuit at 200 percent load (1200 amperes) in about 68 seconds; (4) by opening the circuit at 250 percent load (1500 amperes) in about 28 seconds.

Such fuse links of the stated tolerances, have cross sections well within 1 percent of nominal size and thus all will operate within negligible departures from the nominal schedule.

The method of manufacture also permits the production of the die-cast units in quantity; and the shaving thereof by sets of tools set at differing spacings, whereby to obtain from the units, cast in a single die, with differing specifications of behavior at stated current intensities. for example, the illustrated form has a central web **12** of greater width and thickness than the end webs **15, 16**: such a structure usually fails at one or the other end web when subjected to currents slightly above the nominal rating, and at all three webs upon short circuit. A fuse link of lesser nominal capacity at a given web can be made from the same die-cast blank by having the corresponding tool **24** set closer to the bed **21** during the shaving operation of Figure 3.

Such links may be employed in a renewable link holder as shown in Fig. 5 or in the non-renewable link holder as shown in Fig. 6.

In Fig. 5, the link is positioned with its end blocks or bodies **13, 14** on the terminal blades **30, 31** which extend through end disks **32, 33**. Clamp blocks **51** are held by bolts **50** which pass through the blades and also through an insulating spacer bar **40**. Threaded end pieces **43** retain the end disks and are engaged on threaded sleeves **42** carried by the insulating cartridge sleeve **45**.

In Fig. 6, the link is positioned with its end blocks soldered to the terminal blades **60** which extend through the metal stirrups **61** and the end caps **62**. Screws **63** pass through the skirts of the caps **62**, through the insulating cartridge sleeve **65** and through the legs of the stirrups **61** to hold the assembly together. The interior of the cartridge sleeve may have a filling **66** of non-combustible porous material such as fullers earth.

The illustrated form of practice is not restrictive, and various forms may be employed within the scope of the appended claims.

I claim:

1. An electrical fuse link consisting of a metal structure having along its length spaced heat-absorbing bodies of large cross section with intervening webs between and connecting the bodies, two of said bodies providing terminal end portions for the link, said webs each being of lesser width and lesser thickness than any of said bodies, said bodies and webs being integral and of fusible metal with transverse grooves between the bodies at the regions of the webs, each said groove being of uniform dimension in the direction of length of the link for the length of the groove, said webs each providing the bottom of a respective groove with a smooth reflective surface of high luster and predetermined radiation ability.

2. An electrical fuse link as in claim 1, in which the webs adjacent the terminal bodies are of lesser width and lesser thickness than a web intervening between two intermediate bodies, and the terminal bodies are of smaller length and thickness thna the intermediate bodies.

3. The process of making fuse links of differing individually controlled amperage ratings, which comprises die-casting a plurality of unitary metal structures of fusible metal, said structures being of the same size and shape and surface characteristics within die-casting tolerances, each said structure having along its length heat-absorbing bodies of larger width and larger thickness with intervening webs of lesser width and lesser thickness whereby transverse grooves exist between the bodies at the regions of the respective connecting webs, and thereafter individually shaving the said structures in the grooves and thereby reducing the web sections to predetermined dimensions effective to establish the amperage ratings for the individual link with each web thereof having essentially the same width and thickness for its entire dimension along the length of the link, said shaving being effective to provide each web with a smooth reflective surface of high luster and predetermined radiation ability.

4. The process of making fuse links of differing individually controlled amperage ratings, which comprises die-casting a plurality of unitary metal structures of fusible metal, said structures being of the same size and shape and surface characteristics within die-casting tolerances, each said structure having along its length heat-absorbing bodies of larger width and larger thickness with intervening webs of lesser width and lesser thickness whereby transverse grooves exist between the bodies at the regions of the respective connecting webs, and thereafter individually shaving the said structures simultaneously in said grooves thereof and thereby producing selected differing thicknesses of said webs for thereby determining the amperage ratings of the individual link under different overloads, with each web thereof having essentially the same width and thickness for its entire dimension along the length of the link, said shaving being effective to provide each web with a smooth reflective surface of high luster and predetermined radiation ability.

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