June 30, 1953 F. G. VON HOORN 2,644,060

RENEWABLE FUSE LINK

Filed Sept. 29, 1951

Fig. 1.

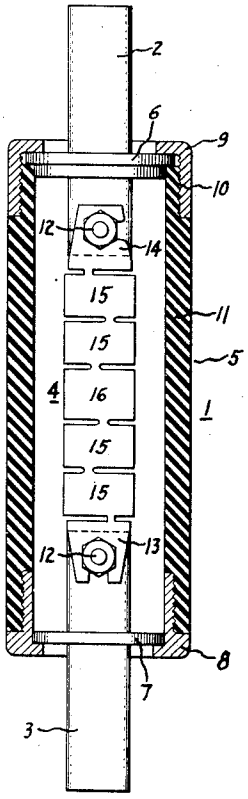



Fig. 2.

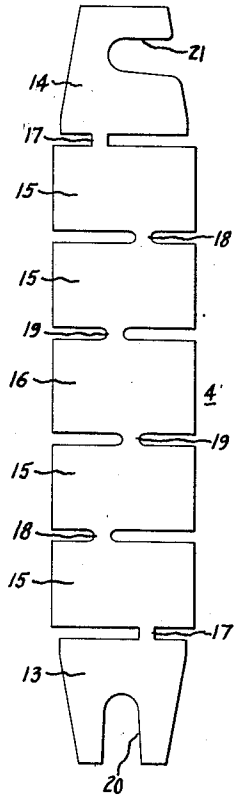
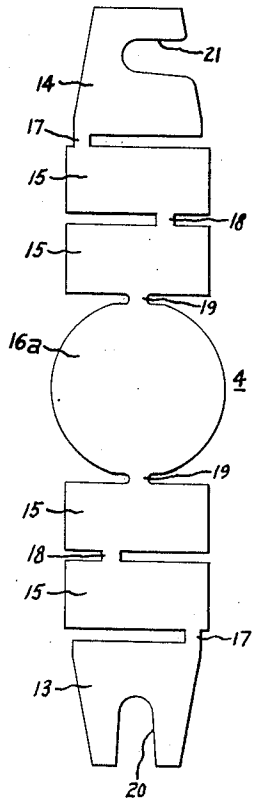



Fig. 3.




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2,644,060

## RENEWABLE FUSE LINK

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5 Claims. (Cl. 200—135)

1

This invention relates to electric fuse links, particularly fuse links of a time delay type; still more particularly the present invention relates to time delay fuse links for renewable enclosed cartridge-type fuses.

Renewal cartridge fuses generally comprise a pair of knife blades supported in spaced axial alignment by an insulating bar, a fuse link electrically connected to each of the knife blades and a cartridge for enclosing the fuse link and insulating bar.

Fuses which are placed in electrical circuits must be able to undergo a certain percentage of overload current for short periods without blowing and yet they must be designed to interrupt a circuit when a slight percentage of current greater than rated passes through the fuse for other than a short period. These are some of the limitations which govern fuse design.

Many schemes and designs have been suggested to provide such a fuse link and while they operate well, there is still room in the art for an improved, less expensive renewable fuse link having time delay characteristics.

It is an object of this invention, therefore, to provide an improved time delay fuse link.

It is a further object of this invention to provide an improved time delay fuse link made from a single thickness of metal.

It is a further object of this invention to provide an improved time delay fuse link wherein additional heat absorbing masses need not be added to the basic link.

In fuse links for renewable fuses, a problem is presented in that the link under certain conditions disintegrates to build up a pressure that might rupture a fuse cartride and produce a fire hazard. The hazardous condition that manifests itself as a high pressure of destructive proportions almost always results from operations associated with short circuit currents (involving several thousand amperes). On the other hand, overload currents (up to five times the rating of the fuse) are usually handled without severe stress or danger. It is much safer if a fuse link merely melts out under short circuit conditions so as to interrupt a circuit between the knife blades rather than sublime and build up pressure within the fuse.

Accordingly, it is a further object of this invention to produce a fuse link wherein for currents of short circuit magnitude all fusing sections tend to melt simultaneously.

It is a still further object of this invention to provide an improved fuse link having fusing portions which because of their spaced relationship

2

and relatively large number, break up a short circuit arc into a series of small arcs which results in better energy dispersion and quick interruption before dangerous pressures are developed.

In time delay fuse links, the thermal situation exists wherein the ends of the link are directly connected to the knife blades which serve as heat storage masses to absorb heat generated in the ends of the fuse link. The central portion of the link, however, is not directly connected to any heat dissipating source; consequently, it generally happens that the central portion of the fuse link is that which is melted under conditions of overload.

It is an object of this invention, therefore, to provide an improved time delay fuse link wherein a substantially even distribution of heat is effected so that all parts of the fuse link are maintained at substantially a uniform temperature.

It is a still further object of this invention to provide an improved balanced-temperature fuse link wherein the heating rates per unit of mass are greatest in the end portions and decrease progressively toward the central portion.

Further objects and advantages of this invention will become apparent and the invention will be more clearly understood from the following description referring to the accompanying drawing and the features of novelty which characterize this invention will be pointed out with particularity in the claims annexed to and forming a part of this specification.

Briefly, this invention comprises an improved fuse link for renewable fuses wherein for a given current, less heat is generated in the central link portion than in the outer portions, thereby to effect a fuse link having time delay characteristics, a uniform distribution of heat, and a central portion which cannot be skewed to re-establish a circuit after it has been once interrupted.

Referring to the drawing, Fig. 1 is a front elevation partly in section of the elements of a renewable fuse; Fig. 2 is a front elevation of one embodiment of my improved fuse link while Fig. 3 is a front elevation of a second embodiment of my improved fuse link.

Referring to the drawing, a renewable fuse 1 is shown as comprising a pair of knife blades 2, 3 axially spaced apart and mounted on an insulating bar (not shown), a fuse link 4 and a cartridge or housing 5 which encloses a portion of the knife blades 2, 3, the link 4 and the insulating bar.

Cartridge 5 is so constructed that if a pair of disc shaped end washers 6, 7 are staked to the knife blades 2, 3 respectively, then a bushing 8

at the lower end of the cartridge will engage the outer periphery of washer 7 and a cap collar 9 will engage both the opposite end washer 6 and threads 10 of fiber cylinder 11 to form a closed housing which causes pressures built up within the fuse to be dissipated slowly through spaces formed between adjoining surfaces rather than to let hot gasses escape while having the propensities of doing serious damage.

Knife blades 2, 3 are made of a good electrical and heat conducting material such as copper which might be thinly coated with silver or one of the other precious metals to retard oxidation. The outer, or exposed surfaces of the knife blades are adapted to engage suitable spring clips (not shown) in an electric circuit while the inner portions of the knife blades are mechanically and electrically adapted as by bolts or screws 12 to engage fuse links 4 and the insulating bar (not shown).

With such a fuse structure as described, cap collar 9 may be removed to permit the complete fuse structure including knife blades 2, 3, fuse link 4 and the insulating bar to be removed as a unit. When once removed, screws or bolts 12 can be loosened to disengage the fuse link from the knife blades and new fuse link can then be installed. The knife blades, fuse link combination can then be reinserted into the cartridge 5 to be held by cap collar 9 thereby to provide a rebuilt fuse.

While this invention is not related to the material of the fuse link, but rather to its specific shape which gives it its unique features, yet it is important that fuse link 4 be made from some suitable link material of which one example would be zinc.

Basically, fuse link 4 comprises mounting sections 13, 14, a plurality of substantially identical heat mass sections 15 with a central mass section 16 of slightly larger area than the others, and a number of fusing sections 17, 18, 19 which interconnect the heat mass sections.

Mounting portions 13 and 14 of the link are formed to have the same uniform thickness of the fusing portions. The mounting portions are notched out as at 20 and 21 to engage the screws or bolts 12 to provide for locking the link to the knife blades to establish an intimate thermal and electrical relationship.

Heat mass sections 15 may be of a uniform surface area and have the same thickness as the rest of the fuse links 4 while the heat mass section 16 has a slightly larger surface area but the same thickness as the rest of the fuse link.

Fusing portions 17 which interconnect the mounting portions with an adjacent heat mass section 15 are oppositely displaced from the axial center line of the link by a uniform distance. With such a structure, it is to be noted that there is no mechanical unbalance in the intervening link portions; that is, there is no tendency for the fuse link to rotate relative to the fusing portions 17 when they become soft, since the displaced fusing portions 17 are positioned to be on an axis that equally divides the mass of the intervening link.

Fusing portions 18 which join a pair of juxtaposed heat mass portions 15 are likewise displaced on opposite sides of the axial center line of the fuse by an equal distance; but a displacement less than that for fusing portions 17. Once again, a balanced mechanical condition exists which prevents rotation of the intervening portions of the fuse link about the fusing portions 18.

Fusing portions 19 which connect the inner heat mass sections 15 with heat mass section 16 are also oppositely displaced from the axial center line of the fuse a pre-determined distance which is less than that for the fusing portions 17 and 18. Once again, there is no mechanical unbalance on the central heat mass section 16 relative to the fusing portions 19.

It is to be particularly noted that the distance between fusing portions 17 and 18 is greater than the distance between portions 18 and 19 which, in turn, is greater than the distance between the two fusing portions 19. Such a structure provides a longer current path and hence a greater resistance at the outer fuse sections, which current path becomes progressively shorter towards the center of the link. Accordingly, a higher heat generation is produced at the outer portions of the fuse link than in the central portion.

It is to be further noted that the fusing portions 17 are square-cut and provide a high resistance spot while the fusing portions 18 and 19 have round ends to provide somewhat less electrical resistance. This difference in shape of fusing portions further aids in balancing the even distribution of the heat within the fuse link; that is, this structure tends to produce a greater heat in the outer link portions than that generated in the central portions. Accordingly, since the knife blades 2, 3 present a high heat absorbing mass for the outer link portions, while the central link portions have no external heat absorbing mass, the greater heat generated in the outer sections is absorbed by the knife blades 2, 3, thereby tending to create a uniform temperature in the fuse link.

In the embodiment shown in Fig. 2, the central heat mass portion 16 is somewhat similar in structure, but has a greater area than the other heat mass portions. In Fig. 3, however, a central heat mass portion 16*a* is shown which has a rounded contour which serves the function of preventing the possibility of re-establishment of electrical contact across adjacent central heat mass portions 15 after the fusing portions 19 have been melted. Even if a skewing effect is produced which twists the central heat mass portion 16*a*, there will be no electrical contact across the central heat mass portions 15, since no diameter of the heat mass portion 16*a* is great enough to establish contact between them. Ideally the fuse link structure should be such that heat mass portion 16*a* has a greater area than the other heat mass portions.

When the fuse links as shown in Figs. 2 and 3, current in passing from mounting portions 13 to 14 follows a longer path across the outer heat mass portions 15 than it does across the central heat mass portions 15 which in turn is greater than the path across the central heat mass portion 16. Accordingly, a greater heat is produced in the outer link portions than in the central portions, and this heat unbalance is offset by the heat storage mass produced by the knife blades 2, 3 whereby a link having a somewhat substantially uniform temperature is produced. With this link arrangement, there is a tendency for all the fusing portions 17, 18, and 19 to melt at a pre-determined condition of overload rather than just one fusing portion. So too with a short circuit; instead of having just one fusing portion melt, all the fusing portions are melted to produce freely floating bodies which assures good interrupting characteristics for the fuse link without causing sublimation. That is to say the

short circuit arc is divided into a number of smaller arcs because of the spacing and number of fusing sections. This structure results in a better energy dispersion and a quick arc interruption before dangerous pressures are developed.

This improved fuse link presents something new and much needed in the fuse link art. It has been found through tests to exceed all the properties required by the Underwriters' Laboratories, Inc., and it presents a less expensive, more efficient renewable fuse link.

Modifications of this invention will occur to those skilled in the art and it is desired to be understood, therefore that this invention is not intended to be limited to the particular embodiment disclosed, but rather it is intended to cover all modifications which are within the true spirit and scope of this invention.

What I claim as new and desire to secure by Letters Patent of the United States is:

1. An improved renewable electric fuse link comprising a bar of uniform thickness notched to provide mounting portions, a plurality of similar heat mass portions with the central one of said portions having a larger area than the others, and a plurality of fusing sections interconnecting said heat mass portions with one another and with said mounting portions, said fusing sections being arranged in pairs on opposite sides of the axial center line of the link with pairs closer to said central portion being displaced a lesser distance from the axial center line than pairs closer to the ends of said link whereby a current flow path is produced wherein the current travels a greater length across outer heat mass portions than across the central mass portions to effect a greater heat production in the outer of said heat storage masses than in the central one thereof.

2. An improved renewable electric fuse link comprising a bar of uniform thickness notched to provide mounting portions, a plurality of similar heat mass portions with the central one of said portions having a larger area than the others, and a plurality of fusing sections interconnecting said heat mass portions with one another and with said mounting portions, said fusing sections being arranged in pairs on opposite sides of the axial center line of the fuse with pairs closer to said central portion being displaced a lesser distance from the axial center line of the link than pairs closer to the ends of said link whereby a current flow path is produced wherein the current travels a greater length across outer heat mass portions than across the central mass portions to effect a greater heat production in the outer of said heat storage masses than in the central ones thereof, said outermost fusing sections joining said mounting portion with a contiguous heat mass portion having a square cut to effect a resistance spot whereby a greater heat is generated in passing through said outermost fuse sections than in the other of said fuse sections.



3. An improved renewable electric fuse link comprising a bar of uniform thickness notched to provide mounting portions, a plurality of similar heat mass portions including a central one, and a plurality of fusing sections interconnecting said heat mass portions with one another and with said mounting portions, said fusing sections being arranged in pairs with one of each pair being positioned on opposite sides of the axial center line of said link with each fusing section of the pairs closer to said central mass portion being displaced a lesser distance from the axial center line than each fusing section of the pairs removed a greater distance from said central mass portion.

4. An improved renewable electric fuse link comprising a bar of uniform thickness notched to provide mounting portions, a plurality of similar heat mass portions with the central one of said portions having a larger area than the others, and a plurality of fusing sections interconnecting said heat mass portions with one another and with said mounting portions, said fusing sections being arranged in pairs with one of each pair being positioned on opposite sides of the axial center line of said link with each fusing section of the pairs closer to said central mass portion being displaced a lesser distance from the axial center line than each fusing section of the pairs removed a greater distance from said central mass portion.

5. An improved renewable electric fuse link comprising a bar of uniform thickness notched to provide mounting portions, a plurality of similar heat mass portions with the central one of said portions having a larger area than the others, and a plurality of fusing sections interconnecting said heat mass portions with one another and with said mounting portions, said central mass portion being circular thereby preventing accidental re-establishment of an electrical circuit through said link through skewing of said central mass portion, said fusing sections being arranged in pairs with one of each pair except said pair nearest said central mass portion being positioned on opposite sides of the axial center line of said link with each fusing section of the pairs closer to said central mass portion being displaced a lesser distance from the axial center line than each fusing section of the pairs removed a greater distance from said central mass portion.

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