March 5, 1963 F. J. KOZACKA 3,080,463

CARTRIDGE FUSES

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Fig. 1.

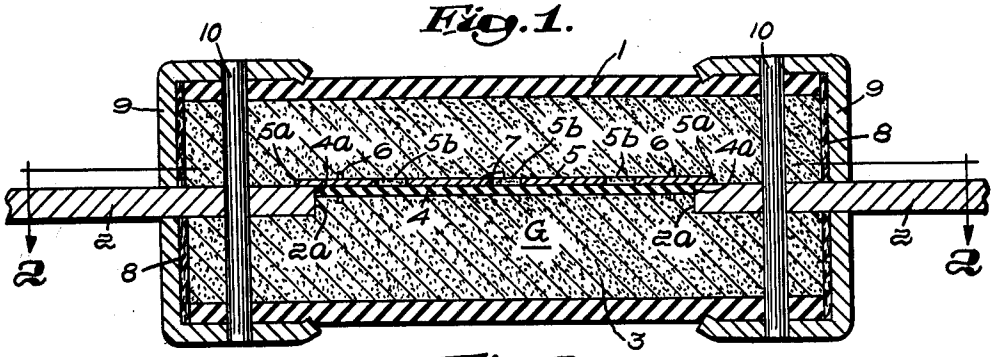


Fig. 2.

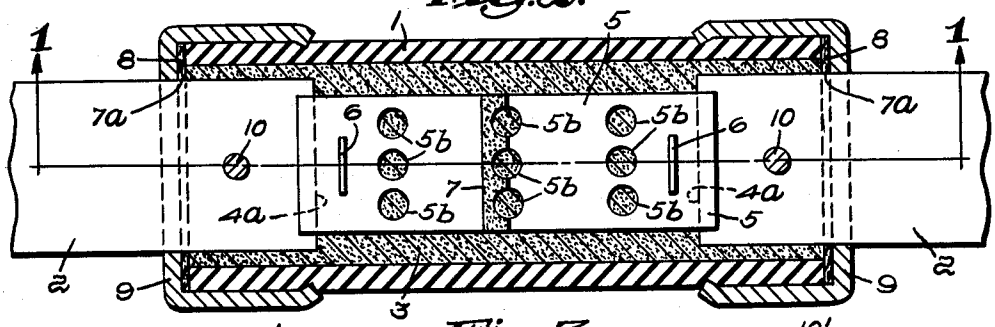


Fig. 3.

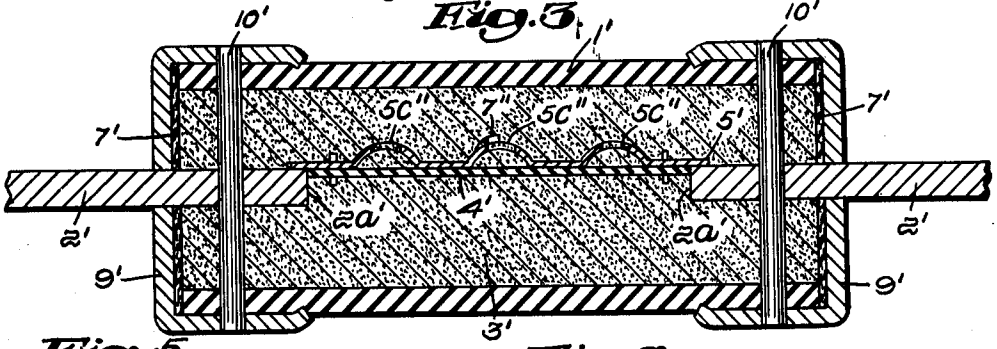


Fig. 5.

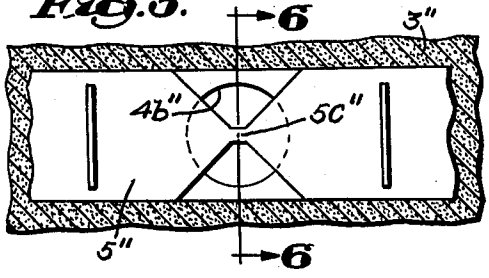
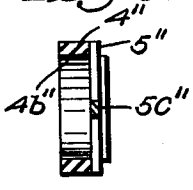


Fig. 6.



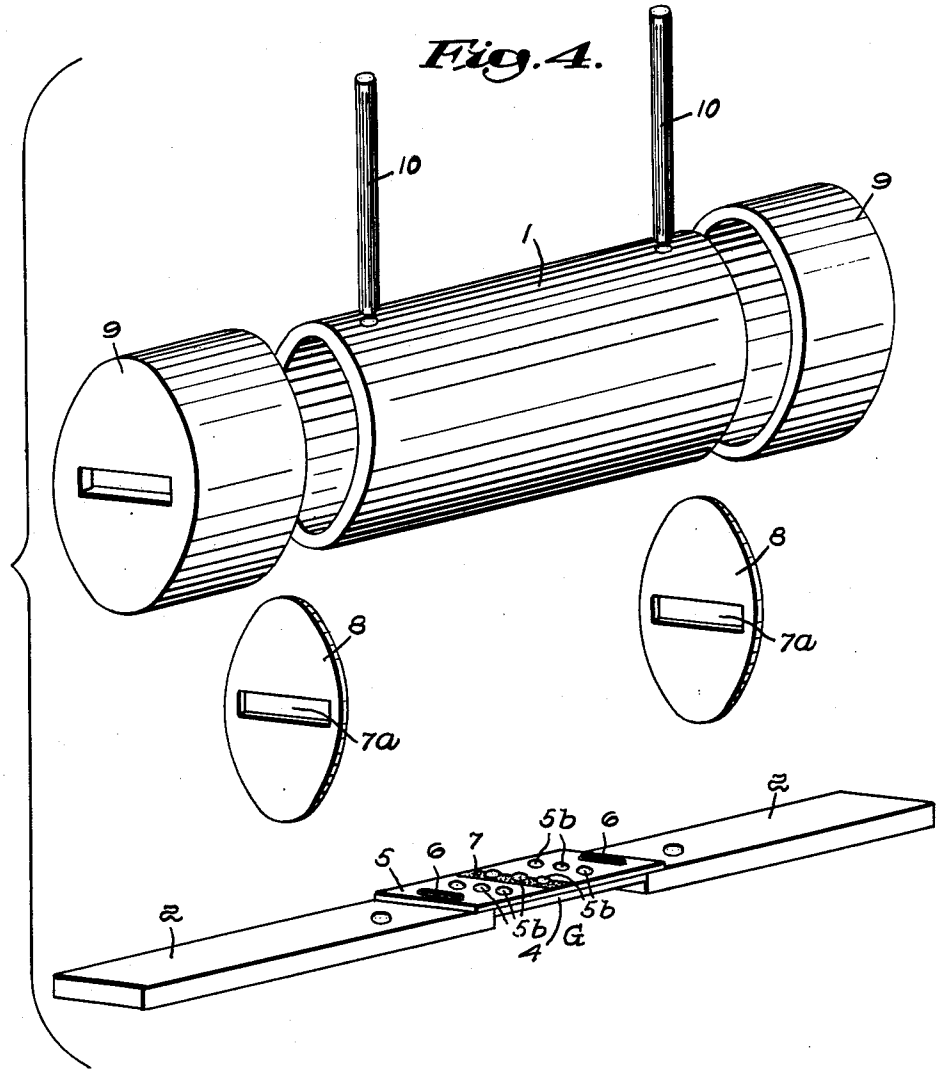
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Fig. 4.



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United States Patent Office 3,080,463 Patented Mar. 5, 1963

3,080,463

CARTRIDGE FUSES

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Filed Dec. 23, 1960, Ser. No. 78,121
5 Claims. (Cl. 200—120)

This invention relates to electric cartridge fuses, and more particularly to cartridge fuses of the blade contact type.

Cartridge fuses required to have a relatively high interrupting capacity, or required to have a current limiting action, include fuse links of a metal having a relatively high conductivity and a relatively small fusing energy. Silver and copper comply best with these requirements. Fuse links made of such metals are provided with points of restricted cross-sections, or necks, which determine the location where circuit interrupting arcs are kindled along the links when the fuse blows on occurrence of short-circuit currents. The geometry of these points of reduced cross-section, or necks, further determines the $\int i^2 \cdot dt$ required to cause blowing of the fuse on occurrence of short-circuit currents. Fuses which are required to blow fast on occurrence of short-circuit currents require points of restricted cross-sections, or necks, which have but a small fraction of the normal cross-section of the fuse link. Such points of reduced cross-section, or necks, tend to impair the mechanical integrity of fuse links of the aforementioned character, i.e. there is an imminent danger of breakage of links formed by ribbons of silver or copper if such ribbons have very narrow necks to make the fuses relatively fast.

It is, therefore, one object of this invention to provide fast blade type cartridge fuses having link structures whose dimensional stability is sufficiently high to substantially exclude the danger of breakage during handling, or while the product is in transit.

Another object of the invention is to provide blade contact type cartridge fuses comprising ribbon type fuse links of silver or copper directly conductively connected to the blade type contacts, which fuses include means for protecting the points of reduced cross-section, or necks, of the links from bending stresses that normally occur when the spacing between the blade type contacts is accidently slightly reduced during handling of the product, or while the same is in transit.

Another object of the invention is to provide blade contact type fuses comprising an insulating spacer between the blade contacts adapted to evolve an arc-quenching blast of gas when the fuses blow.

The foregoing and other general and special objects of the invention and advantages thereof will more clearly appear from the ensuing particular description of the invention, as illustrated in the accompanying drawings, wherein

FIG. 1 is a longitudinal section along 1—1 of FIG. 2 showing a first embodiment of the invention;

FIG. 2 is a section along 2—2 of FIG. 1;

FIG. 3 is a section similar to that of FIG. 1 showing a modification of the structure of FIGS. 1 and 2;

FIG. 4 is an exploded isometric view of the constituent parts of the structure of FIGS. 1 and 2;

FIG. 5 shows a modified detail of the structure of FIGS. 1 and 2; and

FIG. 6 is a section along 6—6 of FIG. 5.

Referring now to the drawings, and more particularly to FIGS. 1, 2 and 4 thereof, numeral 1 has been applied to indicate a casing of an insulating material, e.g. a synthetic-resin-fiberglass cloth laminate. The laminate may be, for instance, a melamine-fiber-glass-cloth laminate. A pair of aligned blade contacts 2 projects axially outwardly from the axially outer ends of casing 1. Blade contacts 2 have axially inner edges 2*a* arranged inside of casing 1 and defining a gap G therebetween. Casing 1 is filled with a pulverulent arc-quenching filler 3 as, for instance, quartz sand which has been carefully purified. Reference numeral 4 has been applied to indicate a strip of insulating material aligned with blade contacts 2 and arranged in the gap G formed between blade contacts 2. Strip 4 may also be formed by a synthetic-resin-fiber-glass-cloth laminate. The axially outer edges 4*a* of strip 4 are arranged in abutting relation with the axially inner edges of blade contacts 2. Thus strip 4 forms a spacer between the edges 2*a* of blade contacts 2. Ribbon fuse link 5 is arranged substantially parallel to strip 4. It consists of a metal having a relatively high conductivity and a relatively small fusing energy, preferably silver, or possibly copper. Link 5 has axially outer ends 5*a* extending axially outwardly beyond the axially outer edges 4*a* of strip 4. Each axially outer end 5*a* of link 5 is conductively connected to one of blade contacts 2 as, for instance, by brazing or by a mechanical joint (not shown). Fastener means 6 project transversely through strip 4 and fuse link 5 securing strip 4 to link 5. Fastener means 6 are preferably staples as generally used for stapling sheets of paper or cardboard. The stables 6 are of steel but arranged sufficiently far from the arcing zone of the fuse to preclude vaporization thereof by arcing during the interrupting process.

Fuse link 5 is provided with a plurality of serially related points of reduced cross-section. Each point of reduced cross-section is formed by a transverse line 5*b* of circular perforations. The perforations in each line 5*b* and of all three lines 5*b* are identical. At each line 5*b* of perforations the cross-section of the link decreases progressively from left to right to a point of minimal cross-section, and then increases progressively from left to right. Numeral 7 has been applied to indicate a link-destroying overlay of a relatively low fusing point metal, e.g. tin, extending from a point of link 5 remote from the points of minimal cross-section to one of the points of minimal cross-section but not beyond said one of said points of minimal cross-section. In other words, overlay 7 extends from a point of link 5 to the left of the median plane of the link—which is a point of minimal cross-section—to, but not beyond, the median plane of the link. Hence all three serially related points of reduced or minimal cross-section formed by lines 5*b* have the same fusing $\int i^2 \cdot dt$ the latter being a constant well known in the fuse art which does not need to be explained in this context. Overlay 7 abstracts heat from the median plane of the fuse link where it is generated and thus delays blowing of the fuse at relatively small overloads. On occurrence of short-circuit currents heat generation occurs at such a rapid rate that overlay 7 cannot abstract heat from the median plane of the fuse link where it is generated and, therefore, all three points of reduced cross-section or minimal cross-section fuse substantially simultaneously on occurrence of short-circuit currents. The point of reduced cross-section situated in the median plane of the fuse link has the dual function to form a break on the occurrence of small protracted overloads as well as to form a break on occurrence of short-circuit currents. In the latter case two additional breaks are formed at the two transverse lines 5*b* of circular perforations adjacent the axially outer ends of the fuse link 5. The use of overlays of low fusing point metals such as tin or alloys of tin on fuse links of silver and copper is well known as a means of effecting link destruction by a metallurgical reaction between the overlay metal and the base metal, and the nature of this reaction does, therefore, not need to be described in detail in this context. Suffice it to say that as long as the fuse does not blow no point of the fuse

link can reach a higher temperature than the relatively low fusing temperature of the overlay metal. This is important because it makes it possible to make strip 4 of a material which is not particularly heat resistant as, for instance, a melamine-glass-cloth laminate. If more heat resistance is required one may resort to silicone-glass-cloth laminates. During normal operation, i.e. as long as the fuse does not blow, no point of the structure can ever assume an operating temperature exceeding the fusing point of overlay 7.

As shown in FIGS. 1, 2 and 4, casing 1 is closed by a pair of discs 8 of asbestos or the like having rectangular perforations 7a for the passage of blade contacts 2. Casing 1 is closed by a pair of caps or ferrules 9 mounted on the ends thereof and held in position by pins 10 projecting through blade contacts 2 and casing 1. The nature of this pin mount is more fully described in U.S. Patent 2,939,935 to F. J. Kozacka, Fuse Structures, issued June 7, 1960.

FIG. 3 illustrates a modification of the structure of FIGS. 1, 2 and 4 which admits high spot temperatures on link 5'. These temperatures are sufficiently high to impair the insulating support or strip 4' if the hot spots of link 5' were in physical engagement with strip 4'. According to FIG. 3 link 5' has a plurality of transverse convex portions 5c' spaced from strip 4' each defining one of a plurality of serially related points of reduced cross-section. Each of said plurality of points of reduced cross-section is formed by a transverse line of circular perforations having the centers thereof in the peaks of said convex portions. The spacing between the hottest points of the fuse link structure and strip 4 is sufficient to prevent thermal damage to the latter even if the highest spot temperatures on link 5' are quite high.

In other respects the structure of FIG. 3 is substantially the same as that shown in FIGS. 1, 2 and 4. The tubular casing 1' of insulating material is filled with the pulverulent arc-quenching filler 3' and the two blade contacts 2' project from the axially outer ends of casing 1'. The axially inner edges 2a' of blade contacts 2' abut against the axially outer edges of insulating strip 4'. Casing 1' is closed by washers 7' and ferrules 9', pins 10' projecting through parts 2', 1' and 9'.

In the modification of the invention shown in FIGS. 5 and 6 the insulating strip 4'' is supposed to be arranged in the same way as the insulating strips 4 and 4' in FIGS. 1–4. Fuse link 5'' has one single point of reduced cross-section or neck 5c''. Strip 4'' is provided with a circular opening 4b'' giving access of pulverulent arc-quenching filler 3'' to neck 5c''.

It will be apparent that in all embodiments of the invention the spacing strip 4, 4', 4'' of insulating material and the ribbon fuse link 5, 5', 5'' form a sub-assembly making it possible to readily handle the fragile link during the process of manufacturing the fuse without any danger of bending, or otherwise damaging, the link at the narrow neck portion or portions thereof.

It will be understood that I have illustrated and described herein preferred embodiments of the invention, and that various alterations may be made in the details thereof without departing from the spirit of the invention as defined in the appended claims.

I claim:

1. An electric cartridge fuse comprising in combination a tubular casing of insulating material; a pulverulent arc-quenching filler inside of said casing; a pair of terminal caps closing the ends of said casing; a pair of aligned blade contacts projecting transversely across said pair of caps and having axially inner edges arranged inside said casing defining a gap therebetween; a strip of insulating material aligned with said pair of blade contacts, arranged in said gap, and having axially outer edges in abutting relation with said axially inner edges of said pair of blade contacts; a ribbon fuse link of a metal having a relatively high conductivity and a relatively small fusing energy arranged substantially parallel to said strip, said link being submersed in said filler and having axially outer ends extending axially outwardly beyond said axially outer edges of said strip each overlapping and conductively connected to the outer surface of one of said pair of blade contacts; and fastener means projecting transversely through said strip and said link securing said strip to said link.

2. An electric cartridge fuse as specified in claim 1 comprising a link having points of reduced cross-section and aperture means in said strip adapted to give to said filler access to said points of reduced cross-section.

3. An electric cartridge fuse comprising in combination a tubular casing of insulating material; a pulverulent arc-quenching filler inside of said casing; a pair of aligned blade contacts projecting axially outwardly from the axially outer ends of said casing and having axially inner edges arranged inside of said casing defining a gap therebetween; a strip of organic insulating material evolving a gas under the heat of an arc aligned with said pair of blade contacts, arranged in said gap, and having axially outer edges in abutting relation with said axially inner edges of said pair of blade contacts; a ribbon fuse link of a metal having a relatively high conductivity and a relatively small fusing energy submersed in said filler, said link being arranged substantially in the plane defined by said strip and having a plurality of serially related identical points of minimal cross-section and axially outer ends extending axially outwardly beyond said axially outer edges of said strip each conductively connected to one of said pair of blade contacts; a link-destroying overlay of a metal having a relatively low fusing point on said link extending from a point thereof remote from said plurality of points of minimal cross-section to one of said plurality of points of minimal cross-section but not beyond said one of said plurality of points of minimal cross-section whereby said plurality of points of minimal cross-section are caused to have substantially the same fusing $\int i^2 \cdot dt$ in spite of the presence of said overlay; and fastener means projecting transversely through said strip and said link securing said strip to said link.

4. An electric cartridge fuse comprising in combination a tubular casing of insulating material; a pulverulent arc-quenching filler inside of said casing; a pair of aligned blade contacts projecting axially outwardly from the axially outer ends of said casing and having axially inner edges arranged inside of said casing defining a gap therebetween; a strip of insulating material aligned with said pair of blade contacts, arranged in said gap, and having axially outer edges in abutting relation with said axially inner edges of said pair of blade contacts; a ribbon fuse link of a metal having a relatively high conductivity and a relatively small fusing energy submersed in said filter, said link being arranged substantially parallel to said strip, said link having a plurality transverse convex portions spaced from said strip each defining one of a plurality of serially related points of reduced cross-section, said link further having axially outer ends extending axially outwardly beyond said axially outer edges of said strip each being conductively connected to one of said pair of blade contacts; and fastener means projecting transversely through said strip and said link securing said strip to said link.

5. An electric cartridge fuse as specified in claim 4 wherein each of said plurality of points of reduced cross-section is formed by a transverse line of circular perforations having the centers thereof in the peaks of said convex portions.

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