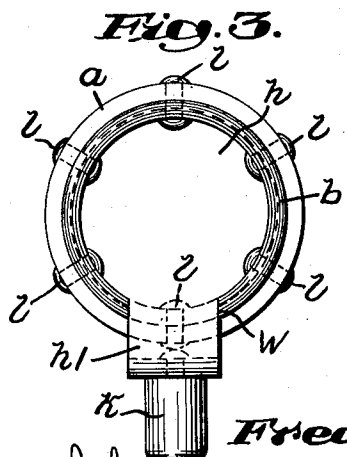
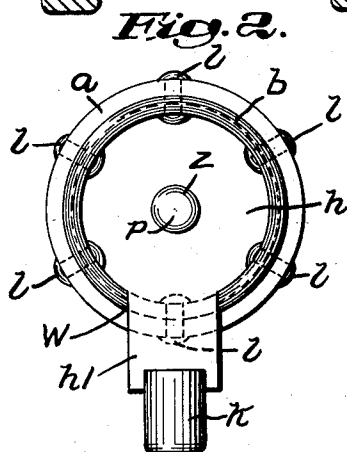
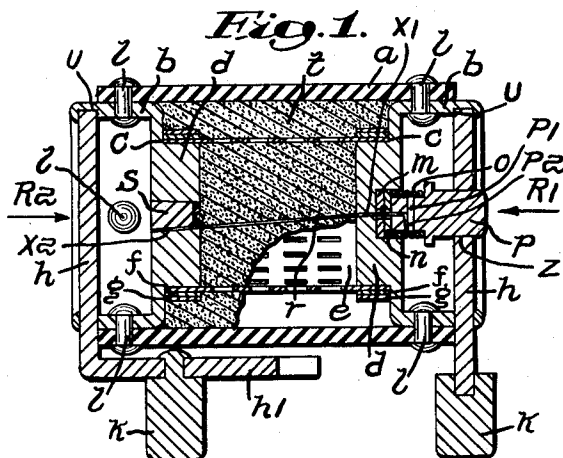


Sept. 4, 1956

F. J. KOZACKA ET AL
FUSE STRUCTURES WITH STRIKER PINS
Filed April 6, 1955

2,761,932



Inventors:
Frederick J. Kozacka
Kenneth W. Swain,
Attorney

by *Samuel Kahn*

1

2,761,932

FUSE STRUCTURES WITH STRIKER PINS

Frederick J. Kozacka, Southampton, and Kenneth W. Swain, Hampton Falls, N. H., assignors to The Chase-Shawmut Company, Newburyport, Mass.

Application April 6, 1955, Serial No. 499,651

12 Claims. (Cl. 200—117)

This invention relates to fuses, and more particularly to fuses of the current-limiting type.

The properties of the material of which the casing of a fuse is made have important effects upon the performance characteristics of the fuse. Among the various materials which have been tried for making the casings of current-limiting fuses synthetic-resin-glass-cloth laminates proved to be particularly desirable because they combine high bursting strength with other desirable properties, such as high resistance to heat shock, minimum tracking, etc.

It is one object of this invention to provide very compact fuse structures having casings of synthetic-resin-glass-cloth laminates, and/or particularly adapted for this type of casing material.

In a series of tests which we conducted with prior art current-limiting fuses having casings made of synthetic-resin-glass-cloth laminates we found upon decreasing the size of the casings and increasing the wall thickness and bursting strength thereof that there was a tendency toward failure due to mechanical breakdowns at the terminal elements of the fuses.

Decreasing the size or internal volume of the casings resulted in an increase of internal pressure incident to blowing of the fuses which increase was compensated for by the increase in bursting strength of the casings. As a result, the casings of the prior art fuses of decreased size remained intact even under very severe interrupting conditions. The terminal elements of the fuses having become the points of least mechanical strength, failures tended to occur at these points.

It is another object of this invention to provide improved fuse structures wherein high bursting strength of the terminal elements is achieved concomitant with great compactness and small weight, and wherein the leakage of hot products of arcing to the space outside of the casings is eliminated, or minimized.

Still another object of the invention is to provide improved fuse structures wherein the casing closing parts of the terminal elements and the conductors for carrying current to and from the casing closing parts are firmly clamped together in abutting relation combining great mechanical strength of the joint and small contact resistance thereof.

Another object of the invention is to provide improved fuse structures having mechanically strong relatively light terminal elements particularly adapted to be, and being, conductively interconnected by tubular high-current-carrying-capacity fuse links.

Still another object of the invention is to provide fuse structures comprising improved so-called striker pins, i. e. parts acted upon by a considerable force released upon blowing of the fuse to trip a circuit breaker, or to perform an equivalent mechanical task.

The novel features that are characteristic of the invention are set forth in particular in the appended claims. The invention itself, however, both as to structure and operation together with additional objects and advantages thereof will best be understood from the following

2

detailed description of a preferred embodiment thereof when read in connection with the accompanying drawing in which,

Fig. 1 is substantially a longitudinal or axial section of a fuse embodying our invention, a portion of the fuse link and of the casing being shown in front view;

Fig. 2 is a side elevation of the structure shown in Fig. 1 seen in the direction of the arrow R₁; and

Fig. 3 is a side elevation of the structure shown in Fig. 1 seen in direction of the arrow R₂.

Referring now to the drawing, reference character *a* has been applied to indicate a tubular casing of insulating material, preferably a synthetic-resin-glass-cloth laminate, Either silicones or other suitable synthetic resins may be used to form the tubular glass-cloth laminate of which casing *a* consists. A pair of terminal caps *b* is inserted into casing *a* in such a way that each protrudes with the bottom end thereof into casing *a* and projects with the opposite end thereof outside of casing *a*. Each cap *b* comprises a relatively thick and rigid bottom portion *d* and a relatively thin resilient lateral wall portion. Reference character *c* designates a shoulder formed between the two aforementioned portions of terminal caps *b*. The bottom portion *d* of each cap *b* defines a cylindrical surface having a smaller diameter than the internal diameter of casing *a*. The multiperforated tubular fuse link *e* is supported by, or mounted on, the small diameter bottom portion of caps *b*. The required contact pressure between caps *b* and tubular fuse link *e* is established by a pair of inner split rings *f* upon each of which a non-split ring *g* is pressure-mounted. If desired, soldering may be substituted for this type of pressure connection between caps *b* and linke *e*. Link *e* consists preferably of silver. As an alternative, tubular links of copper may be used. Other than these low resistivity, low fusing energy metals are not particularly suitable for forming tubular link *e*. The inside of casing *a* is filled with a silicious arc-quenching filler *t* such as chemically fairly pure quartz sand. The portion of each cap *b* situated outside of casing *a* forms a shoulder *u* and each of a pair of substantially circular plates *h* rests against one of the two shoulders *u*. The two shoulder surfaces *u* are substantially at right angles to the longitudinal axis of casing *a* and form substantially circular contact surfaces for the plates *h*. Contact surfaces *u* are only engaged by the outer periphery of plates *h*, and plates *h* are firmly clamped against contact surfaces *u* by a substantially circular bend of about 90 degrees of the axially outer ends of caps *a*. Each plate *h* is provided with a substantially radial extension or tab *h*₁. Extensions or tabs *h*₁ project through gaps *w* of limited width interrupting the circumference of the circular edges of caps *b* situated outside of casing *a*. These edges are being bent down upon, and rolled against, the outer surfaces of plates *h*, whereby plates *h* are tightly locked between surfaces *u* on caps *b* and the bent and rolled edges of caps *b*. The extension or tab *h*₁ of left plate *h* is bent 90° around casing *a* and provided with a plug contact *k* adapted to cooperate with a suitable hollow contact (not shown), generally known as a tulip-type contact. The extension or tab *h*₁ of right plate *h* is likewise provided with a plug contact *k* adapted to cooperate with a suitable hollow contact (not shown). The 90 degree bend in extension or tab *h*₁ of left plate *h* enables to space plug contacts *k* a shorter distance than the length of casing *a*, which is conducive to great compactness. Terminal caps *b* are secured to casing *a* by a plurality of angularly displaced rivets *l* having upset heads on both ends of the shanks thereof or, in other words, standard rivets as distinguished from special rivets for blind riveting.

The bottom end of right cap *b* is provided with a relatively narrow central aperture *x*₁ and the bottom end of left cap *b* is provided with a relatively wide central

3

aperture x_2 . Wire-type fuse link r is made of a material having a relatively high tensile strength such as, for instance, steel wire. It is arranged substantially in the center of, or coaxially with, casing a and tubular fuse link e and conductively interconnects both terminal caps b . To this end the left end of wire-type fuse link r is inserted into aperture x_2 into which wedge element s is being driven for firmly wedging fuse link r therein. The other or right end of fuse link r is threaded through two washers m and n and firmly secured to a plunger p known as striker pin projecting through center hole z in the right plate h . There are several different ways in which link r may be secured to plunger p as, for instance, by wedging or soldering. Soldering has been found to be a desirable mode of connecting parts r and p , provided that wire r is not very thin. For very thin wires r a wedge type connection between wire r and plunger p such as shown in Fig. 1 is preferable. Wire r is inserted into a pair of bores p_1 in plunger p arranged at right angles and held therein by wedge pin p_2 . Helical spring o rests with one end against washer n consisting of a relatively hard material such as, for instance, fiber and with the other end against a collar on plunger p and thus biases plunger p from left to right, as seen in Fig. 1. Washer m consists of a relatively soft material such as an elastomer. Since relatively high temperatures may be encountered at the point where washer m is located, the material of which washer m is made ought to be heat resistant. In view of these conditions washer m should preferably be made of a soft silicone rubber.

When assembling the fuse structure, first a subassembly is made comprising link wire r and plunger p firmly attached to one end of link wire r . Thereupon link wire r is threaded through washers n and m , narrow hole x_1 , tubular fuse link e and wide hole x_2 , and wedge s is being driven into hole x_2 while link wire r is being held taut.

It appears from the foregoing that the way in which link wire r is secured to plunger p is optional but that it is essential that it be secured by wedge action to the left terminal cap b .

When the fuse is connected into an electric circuit link wire r is shunted by tubular fuse link e , and the amount of current then carried by link wire r is negligible. The current path through link wire r is as follows: part d of left cap b , wedge element s , wire r , plunger p , helical spring o , part d of right cap b . A few turns of helical spring o are inserted into a recess in part d of right cap b accommodating the two washers m and n . These turns are in frictional engagement with part d of right cap b and conduct current from plunger p to part d of right cap b .

Washer n upon which helical spring p rests compresses washer m made of an elastomer, as a result of which washer m establishes a gastight seal between the arcing chamber of the fuse, i. e. the space within which tubular link e is situated, and the space outside of said chamber.

In the process of assembling the fuse, before riveting the terminal caps b to casing a and securing circular plates h to caps b , an expandible mandrel may be inserted into the latter to produce a close pressed fit between caps b and casing a .

If desired, the spaces or chambers formed between bottom parts d of caps b and plates h may be adapted to receive limited quantities of products of arcing allowed to leak from the aforementioned arcing chamber into these spaces. Controlled leakage of arc products may provide some pressure relief within the arcing chamber without resulting in the slightest emission of hot gases from the fuse structure to the outside.

On occurrence of major fault currents series breaks are formed by fusion of tubular fuse link e . As the resistance of the gaseous arc-path taking the place of fuse link e increases with progressive cooling thereof, wire link r is caused to carry current and to fuse. Thus plunger p is no longer restrained by wire link r and spring o is in a

4

position to push plunger p from left to right until the collar on plunger p abuts against the inside of the right plate h .

A particular advantage of the construction shown consists in that the area of contact between plates h and caps b is relatively large and in that the current density is not particularly high at any point of the structure, except the necks of the fuse link e , where the current density ought to be high.

It will be understood that we have illustrated and described a preferred embodiment of our invention and that various alterations may be made in the details thereof without departing from the invention as defined in the appended claims.

We claim:

1. A fuse comprising in combination a tubular casing of insulating material, fuse link means within said casing, a pair of terminal caps inserted into said casing and conductively interconnected by said fuse link means, each of said pair of caps protruding with the bottom end thereof into said casing and projecting with the opposite end thereof outside of said casing, a portion of each of said pair of caps forming a contact surface at substantially right angles to the longitudinal axis of said casing, a substantially circular pair of plates each abutting with the outer periphery thereof against said contact surface on one of said pair of caps and each clamped against said contact surface by a bend on one of said pair of caps.

2. A fuse comprising in combination a tubular casing of insulating material, fuse link means within said casing, casing closing means on both ends of said casing conductively interconnected by said fuse link means, said closing means including a terminal cap protruding with the bottom end thereof into said casing and projecting with the opposite end thereof outside of said casing, a portion of said cap defining a contact surface at substantially right angles to the longitudinal axis of said casing, and a substantially circular plate engaging said contact surface with the outer periphery thereof and clamped against said contact surface by a bend on said cap.

3. A fuse comprising in combination a tubular casing of insulating material, fuse link means within said casing, closing means on both ends of said casing conductively interconnected by said fuse link means, said closing means including a terminal cap protruding with the bottom end thereof into said casing and projecting with the opposite end thereof outside said casing, a portion of said cap forming a contact surface at substantially right angles to the longitudinal axis of said casing, a substantially circular plate engaging said contact surface and clamped against said contact surface by a bent portion on said cap, an aperture in said plate, a plunger arranged in the space between said bottom end of said cap and said plate projecting through said aperture, a spring resting against said bottom end of said cap biasing said plunger to move within said aperture, and fusible restraining means for said plunger releasing said plunger upon fusion of said fuse link means.

4. A fuse comprising in combination a tubular casing of insulating material, fuse link means within said casing, a pair of terminal caps arranged within and riveted to said casing and conductively interconnected by said fuse link means, each of said pair of caps protruding with the bottom end thereof into said casing and projecting with the opposite end thereof outside of said casing, a shoulder defined by said opposite end of each said pair of caps, and a substantially circular pair of plates each engaging said shoulder on one of said pair of caps and clamped against said shoulder by a bent portion on each of said pair of caps.

5. A fuse comprising in combination a tubular casing of insulating material, a ribbon-type fuse link having a relatively high current-carrying capacity arranged within said casing, a wire-type fuse link having a relatively small current-carrying capacity arranged within said casing, a

5

plunger attached to one end of said wire-type fuse link, a spring biasing said wire-type fuse link and said plunger in a direction longitudinally of said casing, closing means on both ends of said casing conductively interconnected by said ribbon-type fuse link and by said wire type fuse link, said closing means including a terminal cap protruding with the bottom end thereof into said casing and projecting with the opposite end thereof outside of said casing, a substantially circular shoulder defined by said opposite end of said cap, a substantially circular plate having an aperture in the center thereof engaged by said plunger, said plate resting against said shoulder of said cap and being clamped against said shoulder by a substantially circular bent portion on said opposite end of said cap overlapping the periphery of said plate.

6. A fuse comprising in combination a tubular casing of insulating material, a fuse link within said casing, a pair of terminal caps inserted into and riveted to said casing conductively interconnected by said fuse link, said pair of caps protruding with the bottom ends thereof into said casing and projecting with the opposite ends thereof outside of said casing, substantially circular shoulder portions on the inner surfaces of said pair of caps, and contact means for insertion of the fuse into a fuse holder including a pair of substantially circular plates resting against said shoulder portions and held in position by bends of about 90 degrees of the lateral sides of said pair of caps overlapping said pair of plates.

7. A current-limiting fuse comprising in combination a tubular casing of a synthetic-resin-glass-cloth laminate, a fuse link of a high-conductivity low fusing energy metal within said casing, a pulverulent silicious arc-quenching filler surrounding said fuse link, a pair of terminal caps conductively interconnected by said fuse link riveted to said casing, said pair of caps having substantially closed ends protruding into said casing and substantially circular edge portions situated outside of said casing, each of said edge portions having a gap in the circumference thereof, said pair of caps further having substantially circular shoulder portions coaxial with said edge portions, and contact means associated with said pair of caps, said contact means including a pair of substantially circular plates each having a substantially radial extension, said pair of plates abutting against said shoulder portions on said pair of caps and each projecting with the radial extension thereof through said gap, said pair of plates being held in position by said edge portions on said pair of caps bent around about 90 degrees to overlap said pair of plates.

8. A current-limiting fuse comprising in combination a tubular casing of a synthetic-resin-glass-cloth laminate, substantially tubular fuse link means coaxially arranged within said casing, a pair of terminal caps each comprising a relatively thick and rigid bottom portion and a relatively thin and resilient lateral wall portion, said bottom portion of each said pair of caps including a cylindrical surface having a smaller diameter than the internal diameter of said casing and supporting said fuse link, said lateral wall portion of each of said pair of caps having an outer diameter substantially equal to the inner diameter of said casing and supporting said casing, and a plurality of rivets upset on both ends of the shanks thereof extending transversely across said casing and said lateral wall portion of each of said pair of caps.

9. In a fuse the combination of a tubular casing of insulating material, a ribbon-type fuse link having a relatively high current-carrying capacity arranged within said casing, a wire-type fuse link having a relatively small current-carrying capacity arranged within said casing, a pair of terminal elements conductively interconnected by said ribbon-type fuse link closing the ends of said casing, one of said pair of terminal elements having a relatively narrow central aperture and the other of said pair of terminal elements having a relatively wide central aperture, one end of said wire-type fuse link being

6

threaded through said relatively narrow aperture, a spring-biased plunger attached to said one end of said wire-type fuse link, the other end of said wire-type fuse link being inserted into said relatively wide aperture, and a wedge element driven into said relatively wide aperture for firmly wedging said other end of said wire-type fuse link therein.

10. A fuse comprising in combination a tubular casing of insulating material, a ribbon-type fuse link having a relatively high current-carrying capacity arranged within said casing, a wire-type fuse link having a relatively small current-carrying capacity arranged within said casing, a pair of terminal elements on said casing conductively interconnected by said ribbon-type fuse link and by said wire-type fuse link, an aperture in one of said pair of terminal elements, a first washer of an elastomer having an aperture and arranged adjacent said one of said pair of terminal elements, a second washer of a relatively hard material having an aperture and arranged in abutting relation to said first washer, a plunger, one end of said wire-type fuse link being threaded through said aperture in said one of said pair of terminal elements, through said aperture in said first washer and through said aperture in said second washer and attached to said plunger, and a helical spring arranged in abutting relation to said plunger and to said second washer to compress said first washer and to move said plunger upon fusion of said wire-type fuse link.

11. A fuse comprising in combination a tubular casing of insulating material, a substantially tubular fuse link of sheet metal arranged substantially coaxially within said casing, a wire-type fuse link arranged substantially coaxially within said tubular fuse link, a pair of terminal caps inserted into said casing and conductively interconnected by said tubular fuse link and by said wire-type fuse link, each of said pair of caps protruding with the bottom end thereof into said casing, a plurality of angularly displaced rivets having shanks upset on both ends thereof securing said pair of caps to said casing, one of said pair of caps having a relatively narrow central aperture and the other of said pair of caps having a relatively wide central aperture, a first washer of an elastomer having a relatively narrow central aperture and arranged immediately adjacent to said one of said pair of caps, a second washer of a relatively hard material having a relatively narrow central aperture and arranged in abutting relation to said first washer, a plunger, one end of said wire-type fuse link being threaded through said aperture in said one of said pair of caps, through said aperture in said first washer and through said aperture in said second washer and attached to said plunger, a spring arranged in abutting relation to said plunger and to said second washer tending to stress said wire-type fuse link, and a wedge element driven into said relatively wide aperture on said other of said pair of caps for securing therein the other end of said wire-type fuse link against the action of said spring.

12. A fuse comprising in combination a tubular casing of insulating material, a ribbon-type fuse link and a wire-type fuse link both arranged within said casing, a pair of terminal caps inserted into said casing and conductively interconnected by both said fuse links, each of said pair of caps protruding with the bottom end thereof into said casing and projecting with the opposite end thereof outside of said casing, a contact surface at substantially right angles to the longitudinal axis of said casing formed by a portion of each of said pair of caps, a substantially circular pair of plates each abutting with the outer periphery thereof against said contact surface on one of said pair of caps and each clamped against said contact surface by a bend formed on said opposite end on each said pair of caps, one of said pair of plates having an aperture in the center region thereof, a plunger normally restrained in position by said wire-

type fuse link slidably arranged within said aperture, and a spring accommodated in the space bounded by said one of said pair of plates and by one of said pair of caps immediately adjacent thereto biasing said plunger axially outwardly of said casing.

1,246,105
1,396,297
2,405,929
2,572,901
5 2,639,350

References Cited in the file of this patent

UNITED STATES PATENTS

1,046,705 Young ----- Dec. 10, 1912

370,092

Jung ----- Nov. 13, 1917
Steele ----- Nov. 8, 1921
Wald ----- Aug. 13, 1946
Yonkers ----- Oct. 30, 1951
Cox ----- May 19, 1953

FOREIGN PATENTS

Great Britain ----- Apr. 7, 1932