April 22, 1941. O. H. JUNG ET AL 2,239,390

FUSE

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Fig. 1.

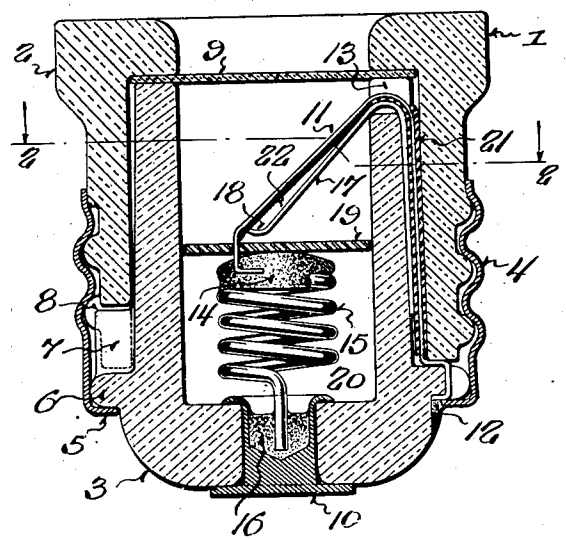
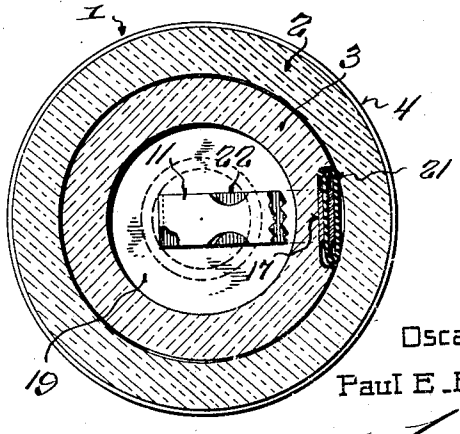


Fig. 2.



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Fig. 3.

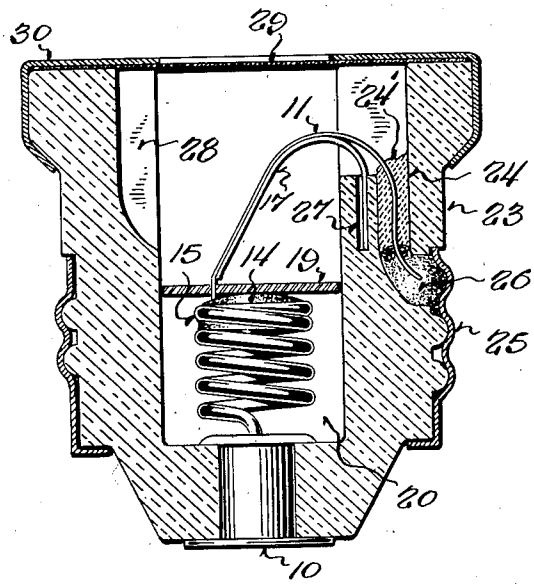
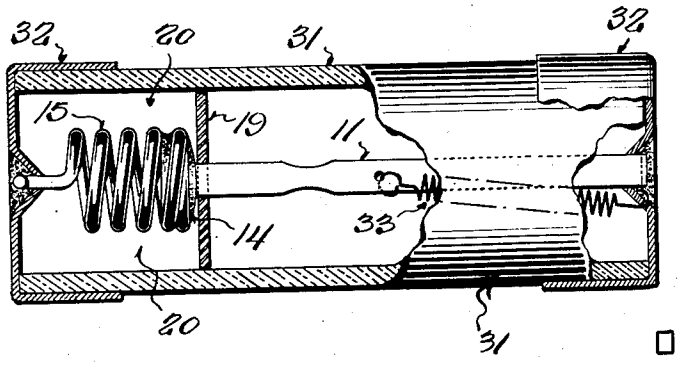


Fig. 4.



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UNITED STATES PATENT OFFICE

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FUSE

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7 Claims. (Cl. 200—123)

This invention pertains to circuit interrupters generally, and while its several features are particularly applicable to fuses of the plug type, certain features may be employed to advantage in cartridge type fuses, thermal cut-outs, and other forms of interrupters.

The invention has primarily for its object the provision of an improved circuit interrupter, in which a minimum quantity of fusible material is volatilized to reduce resultant gas pressure and duration of the arc, to the extent that body ruptures, and fire hazard from ignition, are eliminated.

More particularly, it is an object to obtain the foregoing advantages in fuses having a predetermined time lag, such as obtained by the use of a thermal element.

Incidental to the foregoing, a more specific object of the invention resides in the provision of a fuse provided with shields formed of electrical non-conducting material, preferably having arc-quenching and deionizing properties, and located on the fusible element with relation to its potential fusing areas to provide quick quenching or interruption of the arc, and consequent volatilization of the element.

Another object of the present invention resides in positioning a shield or disc upon the fusible link to form a compression chamber in the fuse casing, within which a thermal element is positioned, and blowing of the fuse occurs to generate pressure through volatilization of the fusible metal, said pressure exerting itself upon the disc to force it upwardly, and assist resilient means in rapidly spacing the severed portions of the link, thus effecting a quick breaking of the arc, with the result that both the fuse link and thermal element are protected against volatilizing.

A more specific object occurs in connection with plug fuses of the two-piece type, and resides in the provision of an insulating wrapper for that part of the link extending between the telescoped sections of the casing, to quench and cool the arc, thereby reducing volatilization of metal.

A still further object resides in the provision of resilient means normally under tension for separating the link upon fusing, and heat insulating means disposed between the link and said resilient member to prevent over-heating and loss of temper of the resilient member, and also possible welding of the fuse link to the resilient member to create a continued arc subsequent to fusing.

With the above and other objects in view, which will appear as the description proceeds, the invention resides in the novel construction, combination, and arrangement of parts, substantially as hereinafter described, and more particularly defined by the appended claims, it being understood that such changes in the precise embodiment of the herein disclosed invention may be made as come within the scope of the claims.

In the accompanying drawings is illustrated one complete example of the physical embodiment of the present invention constructed according to the best mode so far devised for the practical application of the principles thereof.

In the drawings:

Figure 1 is a vertical section through a conventional type of two-piece plug fuse, with the invention incorporated therein.

Figure 2 is a transverse section taken on the line 2—2 of Figure 1.

Figure 3 is a vertical section of a conventional one-piece plug fuse with a modified form of the invention embodied therein.

Figure 4 is an elevation, partly in section, of a cartridge type fuse, with certain features of the invention applied thereto.

Referring now more particularly to that form of the invention illustrated in Figures 1 and 2, the numeral 1 designates generally a fuse plug casing comprising a sleeve 2, and a thimble 3 telescoped therein. The sleeve 2 and thimble 3 are moulded from insulating material, such as porcelain, or plastic composition. A metallic ferrule 4, threaded upon the sleeve 2, serves as one of the connector members, and, also, by means of the flange 5, which engages an annular projection 6 formed on the thimble, the ferrule 4 serves to lock the sections into assembled position. A lug 7 formed on the thimble, and projecting into a notch 8, provided in the sleeve 2, holds the sections against relative rotary movement. A mica disc 9, clamped between the upper end of the thimble 3 and the head of the sleeve 2, forms a closure for the plug, and also a transparent window, to allow inspection of the condition of the fuse. Mounted in the head of the thimble 3 is a cup rivet 10, which forms the other fuse contact. The structure so far described is more or less conventional, and, therefore, forms no part of the present invention other than in the combination as hereinafter claimed.

Disposed between the telescoping sections 3 and 4 is a fusible link 11, one end of which is electrically connected to the flange of the metal-

lic ferrule 4 by a drop of solder 12. The opposite end of the link, which projects into the thimble through the slot 13, is embedded in a batch of fusible alloy 14 of a lower melting point than that of the fuse link 11. The alloy 14 is carried by a thermal coil 15, the lower end of which projects into the cup rivet 10, and is electrically secured thereto by means of solder or other suitable material 16, preferably having a higher melting point than the alloy 14.

Positioned under the link 11 is a flat spring 17 provided at one end with an offset nose 18, which bears against the fuse link adjacent its connection with the thermal coil 15. The opposite end of the spring 17 extends between the walls of the sleeve 2 and thimble 3 adjacent the link 11.

In carrying out the principles of the present invention, a disc 19 of substantially the same diameter as the interior of the thimble 3 is positioned on the link adjacent its connection with the thermal coil 15, thus forming a shield between the link and coil, and also serving to create a compression chamber 20 within the thimble 3, as well as serving to aline and hold the thermal coil in central position out of contact with the inner wall of the thimble.

That end of the link extending between the telescoped walls of the sleeve 2 and the thimble 3 is provided with an insulating wrapping or cover 21, which extends at 22 to provide a complete insulation between the fuse link 11 and spring 17.

Figure 3 illustrates the present invention applied to a conventional type of one-piece plug, provided with a body 21 formed of moulded insulating material, and in which the link 11 extends through an opening 24 formed in the body. The link is electrically connected to the metallic ferrule or contact 25 by solder 26. Above the solder the link is surrounded by suitable insulating material 24' poured into the opening 24. In this form of the invention one end of the flat spring 17 extends into a recess 27 formed in the casing 23 adjacent the opening 24. A notch or groove 28 is formed in the inner wall of the casing opposite the recess 27 to allow movement of the spring 17 and link 11 upon fusing, as will be hereinafter described. The top of the casing 23 is closed by a mica window 29 held thereon by a cap 30 crimped over the head of the casing.

Figure 4 illustrates the invention applied to a cartridge type fuse, comprising a casing 31 formed of insulating material, and provided with metallic end caps 32, which serve as contacts for reception in a conventional fuse clip. The thermal coil 15 is soldered or otherwise electrically connected to one of the caps 32, while the fuse link 11 is connected to the opposite cap. A contractile coil spring 33, connected to the link 11 adjacent its restricted potential fusing portion, and to the cap 32 with which the opposite end of the link is secured, serves to space the severed ends of the link upon fusing, as will be later described.

Considering now the operation of the present invention, with particular reference to that form disclosed in Figures 1 and 2, upon conditions of initial overload to which circuits are subjected upon the starting of a motor, or other electrical appliances, the link 11 is prevented from blowing, in that it is proportioned to fuse within the range of approximately five times the full load rating of the device in the circuit, and upward to and including short circuit conditions. In the event of overloads below the foregoing values, the fusible alloy 14 softens and allows the spring 17 to withdraw the end of the fuse strip from the alloy, thus opening the circuit. When a short circuit occurs, the fuse element 11, which is heavy enough to withstand starting currents or harmless overloads, will open in the manner described, and possibly in other exposed portions between the disc 19 and the insulating wrapper 21. At the same time, the disc 19 will obstruct any tendency of the arc to burn upwardly on the link, and should the fusing occur in the link above the disc; as upon short circuit or heavy overloads, the latter affords protection against the arc carrying over to the thermal coil, thereby holding volatilization to a minimum.

While the disc 19 may be formed of any insulating material, in practise the most desirable results have been obtained in the use of a material having arc-quenching and deionizing properties. In this respect black fibre has been found to be superior to white fibre, believed to be due to its ability to absorb and retain a greater amount of moisture.

Inasmuch as the spring 17 is spaced and insulated from the link 11, there is no tendency of the link welding itself to the spring upon fusing intermediate its ends, nor of the spring carrying the arc along the link. A further advantage determined in insulating the link from the spring resides in the fact that harmless overloads heat the link 11 to such an extent that the spring becomes overheated when in contact with the same, thus affecting its temper to the extent that its resiliency is destroyed.

Heretofore, in conventional fuse structures of the type disclosed in Figure 1, it has been customary to merely project the bare fuse link between the telescoping walls of the casing sections, and under such conditions it has been found that the arc frequently has a tendency to travel the entire length of the link, causing the same to burn and volatilize, all of which creates excessive pressure, which either ruptures the casing or creates ignitions, causing the fuse to weld in the fuse holder due to a flash-over.

The foregoing objections have been entirely overcome by the provision of the insulating wrapper 21, which surrounds that portion of the fuse link extending between the telescoping portions of the shell 2 and thimble 3. The wrapping may be of any pliable insulating material, such as paper, asbestos, or the like. However, it is preferred to use a hygroscopic material, such as paper impregnated with a deionizing ingredient. Satisfactory results have even been obtained with gummed paper, which has a tendency to retain a sufficient amount of moisture to effectively cool or quench the arc so that portion of the link extending between the sections of the casing will not volatilize.

Inasmuch as a slightly tapered fit is provided between the outer shell 2 and the thimble 3, a clamping or wedging action between the two apparently increases the smothering effect of the insulating wrapper, due to forcing the same into tight, intimate contact with the fuse strip.

In that form of the invention shown in Figure 3, the insulating filler 24' likewise serves to smother burning of the link, and prevents the arc from discharging or flashing past the casing.

In a cartridge type fuse, such as shown in Figure 4, the disc functions as heretofore described, and due to the inherent structure of the cartridge type fuse, no necessity is present for insulating portions of the link as required in plug type fuses.

From the foregoing explanation, considered in connection with the accompanying drawings, it is believed that the advantages of the present invention will be apparent, in that the same provides for the reduction of metal volatilized, thereby reducing the gas pressures generated, as well as the duration of the arc, which, because of the shields provided, is quickly quenched, and prevented from spreading to other parts of the connection between the fuse contacts, all of which reduces damage to the fuse casing, and the possibility of fire hazard from ignitions and flashovers to a minimum.

Inasmuch as the resilient means provided, instantaneously spaces the severed portions of the connection between the contacts upon fusing, and in so doing raises the disc 19, with the assistance of pressure generated within the chamber or compartment 20, the raised position of the disc serves as an indicator of the condition of the fuse. Also, under all conditions of fusing, the link itself is slapped against the mica window by the spring, which affords an additional and plainly visible indicator.

We claim:

1. A circuit interrupter comprising, a casing of insulating material, a pair of terminals carried by the casing, a heat generating element of relatively high resistance connected to one of said terminals, a fusible link having one end connected with said heat generating element by a low melting point fusible material and its opposite end connected to the other of said terminals, said link being of lower resistance than said heat generating element and of greater resistance than said low melting point fusible material and a fibre disc located on said strip adjacent said thermal element to form a closed compression chamber within which the thermal element is located.

2. A circuit interrupter comprising, a casing of insulating material, a pair of terminals carried by the casing, a fusible link connecting said terminals, a flat metallic spring positioned under said link and normally under stress to part the severed portions of said link upon fusing, and heat insulation disposed between said link and spring.

3. A circuit interrupter comprising, a casing of insulating material, a pair of terminals carried by the casing, a fusible link connecting said terminals, a flat metallic spring positioned under said link and normally under stress to part the severed portions of said link upon fusing, said spring being spaced from said link throughout substantially the entire portion of the link disposed within the interior of the casing and bearing upon the link adjacent its inner end, and insulation disposed between said link and spring.

4. A circuit interrupter comprising, a casing of insulating material, a pair of terminals carried by the casing, a heat generating element connected to one of said terminals, a fusible link connecting said heat generating element and the other of said terminals, said fusible link being of less resistance than said heat generating element, a flat metallic spring positioned under said link and normally under stress to part the link from the thermal element when the link is released therefrom, said spring being spaced from said link throughout substantially that portion of the link disposed within the interior of the casing and bearing against the link adjacent its connection with said thermal element, and insulation disposed between said link and spring.

5. A circuit interrupter comprising a casing of insulating material, a pair of terminals carried by the casing, a thermal element connected to one of said terminals, a fusible link connecting said thermal element and the other of said terminals, a fibre disc located on said link adjacent its connection with said thermal element, said disc forming a closed compartment within which the thermal element is located, a flat metallic spring positioned under said link and normally under stress to part the link from the thermal element when the link is released therefrom, said spring being spaced from said link throughout substantially that portion of the link disposed within the interior of the casing and bearing against the link adjacent said disc, and insulation disposed between said link and spring.

6. A circuit interrupter comprising, a casing consisting of a pair of telescoping sections formed of insulating material, a terminal carried by each of said sections, a thermal element connected to the terminal carried by the inner section, a fusible link connecting said thermal element and the other of said terminals, said link extending between the walls of the telescoping sections, a wrapper formed of pliable sheet insulating material surrounding that part of the link extending between the telescoping sections whereby the wrapper is forced into intimate contact with the link, a fibre disc located on said link adjacent said thermal element, and forming a closed compression chamber within which the thermal element is located, a flat metallic spring positioned under said link and normally under stress to part the link from the thermal element upon release from the same, said spring being spaced from said material throughout substantially that portion of the link disposed within the interior of the casing, and bearing against the link adjacent said disc, and insulation disposed between said link and spring.

7. A circuit interrupter comprising, a casing of insulating material, a pair of terminals carried by the casing, a fusible link connecting said terminals, and a flat metallic spring positioned under said link and normally under stress to part the severed portions of said link upon fusing.

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