July 16, 1940. E. A. WILLIAMS 2,208,440

CIRCUIT INTERRUPTING DEVICE

Filed March 25, 1938

Fig. 3.

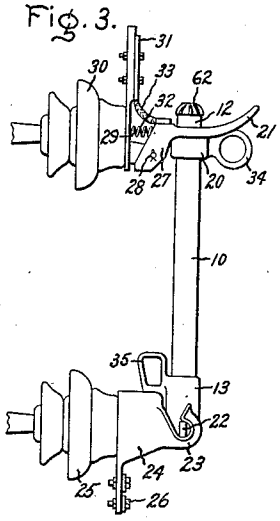


Fig. 4.

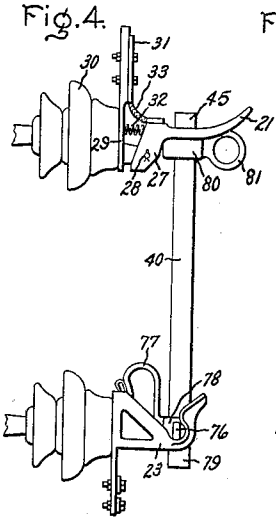


Fig. 1.

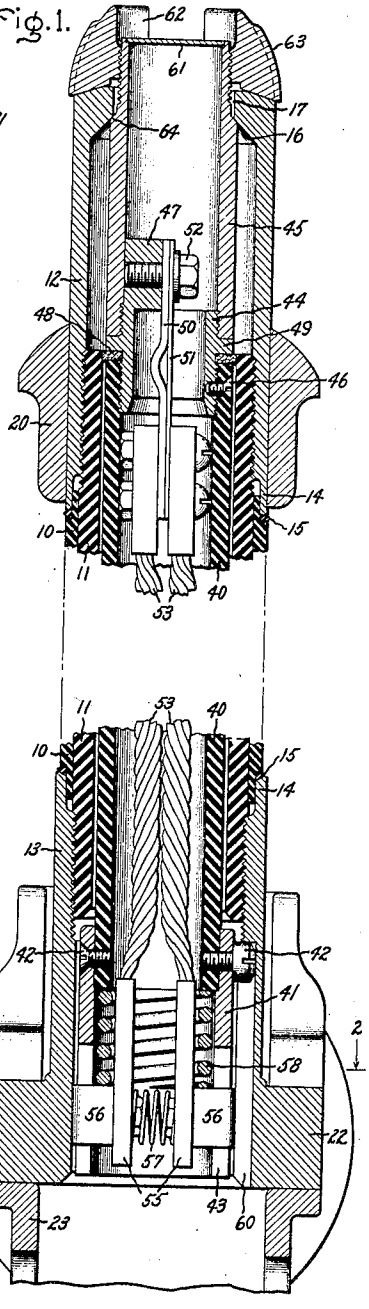


Fig. 7.

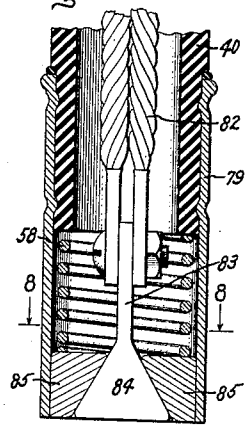


Fig. 5.

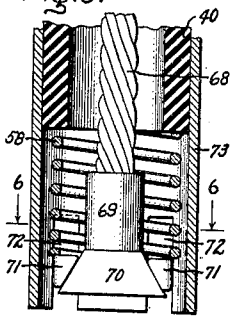


Fig. 6.

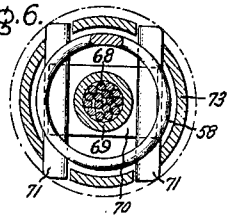


Fig. 8.

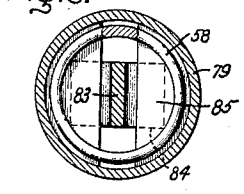
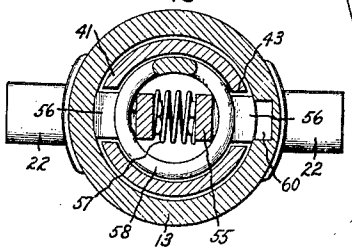


Fig. 2.



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UNITED STATES PATENT OFFICE

2,208,440

CIRCUIT INTERRUPTING DEVICE

Edwin A. Williams, Lansdowne, Pa., assignor to General Electric Company, a corporation of New York

Application March 25, 1938, Serial No. 198,040

21 Claims. (Cl. 200—117)

My present invention relates to improvements in electric circuit interrupting devices, more particularly of the fused type, and connection means particularly adapted for employment therewith.

One of the objects of the invention is the provision of an improved construction for expulsion fuse devices whereby such devices may be designed for higher ratings than heretofore deemed practical.

Another object is the provision of a fused type circuit interrupting device with an inexpensive refill fuse unit, of simple construction and incorporating all elements necessary for proper fuse operation, which unit after operation may quickly and easily be replaced in the field without the necessity of using special tools or of making critical adjustments. With a refill fuse unit of the present invention, all necessary assembly and adjustment operations are made at the factory where proper equipment is available and where such operations may be performed with greater accuracy and reliability than by a service man in the field.

A further object of the invention is the provision of a refill unit for a fuse device, which refill unit itself is readily adaptable for use as a switching element of a circuit interrupting device.

A still further object of the invention is the provision of improvements in electric connection means.

Other objects and the details of that which I believe to be novel and my present invention will become apparent from the following description and the claims appended thereto taken in conjunction with the accompanying drawing wherein exemplary embodiments of the various features of my invention are illustrated.

In the drawing, Fig. 1 shows a longitudinal cross-section of an expulsion fuse device embodying the invention; Fig. 2 shows a cross-section taken along the line 2—2 of Fig. 1; Fig. 3 illustrates one manner of mounting the fuse device of Fig. 1; Fig. 4 illustrates a similar manner of mounting the refill fuse unit which forms a part of the device of Fig. 1; Fig. 5 illustrates, partially in longitudinal section, a modified form of connection means for use in a fuse device of the type shown in Fig. 1; Fig. 6 is a cross-section along the line 6—6 of Fig. 5; Fig. 7 illustrates partially in longitudinal cross-section a further modification of the connection means; and Fig. 8 shows a section along the line 8—8 of Fig. 7.

The expulsion fuse device illustrated in Fig. 1 includes a strong and weatherproof housing or fuse holder in the form of an elongated tubular casing comprising an insulating tube having upper and lower terminals, in the form of metallic ferrules, secured respectively to the opposite ends thereof. The insulating tube of the exemplary fuse holder shown in the drawing is comprised of an outer tube 10 and an inner tube 11, both of suitable insulating material, assembled and preferably processed during manufacture in such manner that they are mutually reinforcing to provide a strong and rigid structure. Also, the outer tube 10 is so constructed or treated as to render it weatherproof. As shown in the drawing, the upper end of tube 11 extends somewhat beyond the upper end of tube 10 and is exteriorly threaded to provide for securing thereto the upper terminal ferrule 12, the lower end of which is interiorly threaded, while the lower end of tube 11 extends somewhat beyond the lower end of tube 10 and is exteriorly threaded to provide for securing thereto the lower terminal 13, the upper end of which is interiorly threaded. To insure a weatherproof construction, ferrules 12 and 13 have skirt portions 14 which engage annular recesses formed in the upper and lower ends respectively of tube 10 and the junctions between the ferrules and tube 10 are tightly sealed by means of weatherproof gaskets 15. Around the upper end of upper ferrule 12 is formed an inwardly projecting shoulder 16 the inner wall of which defines an opening 17 for a purpose which will become apparent hereinafter, and tightly fitted around ferrule 12 adjacent the lower end thereof is a contact ring or collar 20 having an upper rounded surface adapted to be received between and to be engaged by spaced contact fingers 21 of a switch supporting structure such as that diagrammatically illustrated in Fig. 3. Lower ferrule 13 is provided with hinge trunnions 22 arranged to engage hinge brackets 23 at the lower end of the supporting structure of Fig. 3 for pivotal mounting of the fuse holder. Although in the illustrated embodiment trunnions 22 are formed integral with ferrule 13, they may if desired be made part of a special fitting applicable by clamping or other suitable means to the lower ferrule.

As will be seen from Fig. 3, hinge bracket 23 forms part of a lower terminal structure 24 supported by an insulator 25 and having line connection means 26, while contact fingers 21 form part of a contact 27 pivotally supported at 28 on an upper terminal structure 29 which is sup-

ported by an insulator 30 and is provided with line connection means 31. Contact 27 is biased in a clockwise direction, as viewed in Fig. 3, by means of a coil spring 32, in order to effect good electric conductive pressure engagement of contact fingers 21 with the rounded surface of the contact collar 20 at the upper end of the fuse holder, and contact 27 is connected with terminal structure 29 by means of a flexible braided connector 33. The fuse device may be swung into and out of closed circuit position by engagement of a common form of switch stick with the operating eye of a handle 3 on collar 20. A somewhat similar eyelet handle 35 is provided at the lower end of the fuse holder for engagement by a switch stick to effect removal of the fuse device from hinge bracket 23 when the fuse device is in open circuit position, or for installing the fuse device in the hinge bracket. This handle 35 in the illustrated embodiment is formed integral with lower ferrule 13 but if desired may form part of a special fitting applicable to the lower ferrule. Although the fuse device of the present invention is illustrated in Fig. 3 as forming merely the blade of a switching device, it may by application thereto of special fittings be converted for automatic drop-out operation in the manner described in detail in my previous application Serial No. 4,568, filed February 1, 1935, and assigned to the assignee of the present invention. The fuse device of the present invention is adapted also for non-hinged and non-drop-out mounting in a manner similar to that shown in U. S. Patent 1,635,049 to R. R. McGee, issued July 5, 1927, which patent also is assigned to the assignee of the present invention.

The described fuse holder is adapted to provide an enclosure for the refill fuse unit not only to protect the refill unit from adverse weather conditions, but also to reinforce the refill unit against damage due to internal stresses developed upon fuse operation. This refill unit has an elongated tubular casing which is adapted to telescope relatively snugly within the bore of the fuse holder and the principal part of which casing comprises a tube 40 of fibrous or other suitable insulating material. On the lower end of tube 40 is mounted a metallic ferrule 41 which is held in place on the tube by screws 42 or other suitable means and which has diametrically oppositely disposed longitudinal slots 43 formed in the lower end thereof for a purpose which will become apparent hereinafter. Mounted on the upper end of tube 40 is an intermediate terminal in the form of a tubular metallic element 44 the lower portion of which is exteriorly threaded for engagement with corresponding threads in the inner upper wall of tube 40, and the upper portion of which terminal element is exteriorly threaded for engagement with cooperating threads in the lower inner wall of a tubular metallic extension 45. Terminal element 44 is held in place by means of set screws 46 and has an inwardly and upwardly projecting integral lug 47 adapted for connection of one end of a fuse link thereto.

With some fuse devices of the type employing refill units, there has been encountered the great disadvantage that dirt and arc products accumulate on the inner surface of the enclosing fuse holder, thereby reducing the resistance of the fuse holder to internal flash over. An important feature of the present invention resides in the elimination of this disadvantage by designing the parts of the fuse device so as to provide a relatively close fit between the fuse holder and a refill unit therein without detracting from the ease of assembly, and by providing each refill unit with a wiper device. Thus the possibility of dirt and other foreign matter entering the fuse holder is materially reduced, and any such foreign matter which does accumulate is cleaned from the inner wall of the fuse holder as each refill unit is inserted into or withdrawn from the fuse holder. The wiper device of the illustrated embodiment comprises an annular gasket-like element 48 clamped between the end of tube 40 and a flange 49 formed on the outer surface of terminal element 44. This gasket-like element is arranged to project beyond the exterior of tube 40 so as to engage and scrape the inner wall of the fuse holder as the refill unit is moved longitudinally therein.

Within the casing of the refill unit is accommodated a fuse link having a fusible section comprised of a fusible element 50 and a strain element 51 the upper ends of which elements 50 and 51 are anchored to lug 47 by means of a bolt 52. In the embodiment illustrated in Fig. 1, elements 50 and 51 of the fusible section have two flexible braided extension cables 53 attached to the lower ends thereof, although a single such cable extension may be employed, if desired. Cable extensions 53 have secured respectively to the lower ends thereof terminal elements 55 which extend in parallel side by side relationship and are arranged for relative movement apart substantially radially of the axis of tube 40. These terminal elements are provided with contact projections 56 adapted to be forced outwardly, by means of a coil spring 57 disposed between the two terminal elements, through slots 43 in ferrule 41 of the refill unit and into pressure engagement with the inside wall of lower ferrule 13 of the fuse holder, thereby to provide a highly efficient electric connection between the fuse link and the lower fuse holder ferrule. At the lower end of the casing of the refill unit there is provided also a coil spring 58 disposed in surrounding relation to terminal elements 55 and acting between the lower end of tube and contact projections 56 to tension the fuse link. To prevent turning of the refill unit in the fuse holder during assembly in the manner to be described, a longitudinal slot 60 is provided in the inner wall of lower fuse holder ferrule 13 for engagement by the enlarged head of one of the screws 42 of the refill unit. The relation of the various elements at the lower end of the fuse device is shown clearly in the sectional view of Fig. 2.

Metallic tubular extension or sleeve 45 is readily removable from terminal element 44 to provide for connection of the upper ends of fusible element 50 and strain element 51 to connection lug 47. However, when sleeve 45 is in place it provides an expansion chamber for quickly relieving pressure within the expulsion bore of the refill unit and for increasing the interrupting capacity of the refill unit. The lower end of this expansion chamber is in communication with the expulsion bore of tube 40 through the bore of terminal element 44, and the upper end of the expansion chamber is closed by means of a disk 61 which is releasably secured in such manner that it is responsive to pressure within the expansion chamber. To this end the means, such as solder or cement, for securing the disk in place is so calibrated that it permits the disk

to blow out in case the pressure within the expansion chamber and the bore of tube 40 approaches a dangerous magnitude. In the embodiment illustrated the pressure relief disk forms part of the refill unit so as to eliminate the necessity of depending upon a service man to renew the disk in the field as would be required if the disk were part of the fuse-holder. However, it is contemplated that in some cases slight modifications may be made to incorporate the disk as a part of the fuse-holder.

For securing the refill fuse unit in the fuse holder, the upper end of tubular extension 45, which projects through opening 17 in upper fuse holder ferrule 12, is exteriorly threaded for engagement by an annular screw cap or clamping nut 62. This screw cap is provided with ridges 63 so that it may be grasped readily and turned down tightly, without the necessity of employing any tools, to clamp the refill unit firmly in the fuse-holder. By this means a shoulder 64 on extension 45 is drawn tightly into engagement with shoulder 16 of fuse-holder ferrule 12 so as to provide good electric connection between the upper end of the refill unit and the upper fuse-holder ferrule. This method of securing the refill unit makes for ready installation thereof in the fuse-holder in the field and holds the refill unit independently of the fuse link tensioning spring or any latching means associated therewith. Thus the tension imposed upon the fuse link by the spring 58 which forms part of the refill unit may be adjusted permanently and accurately at the factory, eliminating the necessity for a service man to perform this operation at the time that he replaces a blown refill unit.

When the fusible section, comprised of elements 50 and 51 of the fuse link or conductor, ruptures due to excessive current, such as upon overload or short circuit, spring 58 with some assistance from the gases expelled from the lower end of tube 40, expels terminals 55 and cable extensions 53 from the lower end of the fuse-holder, thereby effecting rapid separation of the ends of the ruptured fusible section for rapid arc extinction in a well-known manner. The expansion chamber within tubular extension 45 serves under relatively normal conditions of fuse operation to prevent the development of dangerously excessive pressures within the refill unit. However, if under certain conditions of fuse operation there are developed within the refill unit pressures which approach a dangerous magnitude, relief disk 61 will be blown out to relieve such pressures before they reach a magnitude which would cause rupture of the casing of the refill unit and the fuse-holder with resultant fuse failure. After fuse operation, screw cap 62 may be unscrewed and the spent fuse unit quickly removed and replaced by a fresh refill fuse unit in the manner previously indicated, the wiper devices 48 of the spent fuse unit and of the replacement fuse unit serving to remove dirt or arc products from the inner wall of the fuse-holder as the fuse units are moved longitudinally therein.

In the modification illustrated in Figs. 5 and 6, there is shown a portion of a fuse link which includes only a single braided cable extension 68 to the lower end of which is secured a terminal contact 69 having a pyramidal wedge-shaped portion 70. For cooperation with terminal contact 69 there are provided a pair of intermediate contact bars 71, of relatively rigid construction, disposed respectively on opposite sides of contact 69 and having slanting surfaces for complementary engagement with oppositely disposed slanting surfaces of wedge-shaped portion 70. The ends of these bars are arranged to project through longitudinal slots 72 formed in a metallic sleeve or ferrule 73 secured to the lower end of the insulating tube 40 of the refill unit, and the outermost corners of the bars are arranged to make substantially line contact with the inside surface of a ferrule, indicated in broken lines in Fig. 6, of a fuse-holder enclosing the refill unit. The fuse link tensioning spring 58, the upper end of which engages the lower end of tube 40, bears downwardly on contact bars 71 in such manner as to tension the fuse link and also to cooperate with wedge-shaped portion 70 of terminal contact 69 to wedge the contact bars outwardly so as to effect efficient electrical conductive pressure engagement of the outermost corners of the bars with the inside wall of the ferrule of the enclosing fuse-holder.

With the connection arrangement illustrated in Figs. 5 and 6, release of the tension of the fuse link due to rupture of the fusible section thereof, in turn releases the horizontal force component of the wedging action on the contact bars so as to relieve the pressure engagement of these bars with the inner wall of the ferrule of the enclosing fuse-holder. Spring 58 thereupon becomes effective to expel contact bars 71 along with terminal contact 69 and a portion of the ruptured fuse link from the lower end of the refill unit. Thus quickly releasable high pressure contact is obtainable normally without hindering expulsion of the contact assembly upon fuse operation. Moreover, the contact pressure under normal conditions depends only relatively slightly upon the action of the fuse link tensioning spring since the wedging action serves in the main to produce the desired high contact pressure. In addition to these advantages, the parts of the contact assembly of Figs. 5 and 6 are easy and economical to manufacture and install and close limits and tolerances are not required.

The fuse unit hereinbefore described as employed for refill purposes, also itself is readily adaptable for employment as a blade of a fused disconnecting switch without employing an enclosing fuse holder therefore. To this end there may be secured to the lower end of tube 40 of the fuse unit a terminal sleeve having integral trunnions, for engagement with hinge bracket 23 of the supporting structure illustrated in Fig. 4, and having also an integral eyelet handle for lifting of the fuse unit by means of a switch stick, into and out of engagement with the hinge bracket. However, in the exemplary embodiment illustrated in Fig. 4, the trunnions 76 and eyelet handle 77 are made part of a separate fitting 78 clamped about the lower ferrule or terminal sleeve 79 of the fuse unit. For engagement with the contact fingers 21 of the upper stationary terminal structure, a contact terminal collar 80 is clamped around the metallic extension sleeve 45 at the upper end of tube 40, and such collar preferably has an operating eye 81 for engagement by a switch stick for manual operation of the fuse unit into or out of the closed circuit position.

If the fuse unit is employed alone as above set forth, connection between the lower end of the fuse link therein and the ferrule 79 on the lower end of tube 40 may be accomplished with the terminal and contact assembly of either Figs. 1

and 2 or Figs. 5 and 6. However, a modified form of terminal and contact assembly particularly adapted for this purpose is illustrated in Figs. 7 and 8. In this latter modification, the lower end of the fuse link cable extension 82 is provided with a terminal contact 83 having a wedge-shaped portion 84 the apex of which is toward the fuse link. Disposed on opposite sides of the terminal contact are intermediate contact members 85 which have inner slanting surfaces for complementary engagement with the oppositely disposed slanting surfaces of the terminal contact. These intermediate contact members are of rigid construction and their outer surfaces are rounded, as best seen in Fig. 8, to conform to the shape of the inner wall of ferrule 79. In a manner similar to that described in connection with the embodiment of Figs. 5 and 6, the fuse link tensioning spring 58, the upper end of which abuts against the lower end of tube 40, thrusts downwardly on intermediate contact members 85 to tension the fuse link and cooperate with wedge-shaped portion 84 to force the intermediate contact members into binding engagement with the inner wall of the ferrule 79. Thus there is provided a large area of high pressure contact for effecting efficient electric connection between the lower end of the fuse link and the lower ferrule of the fuse unit. Upon release of the tension of the fuse link, due to rupture of its fusible section, the wedging action in the intermediate contact members is released and the pressure of these members against the inner wall of the ferrule is relieved. Thereupon, terminal contact 83 and the intermediate contact members along with the fuse link extension 82 are rapidly expelled from the lower end of the fuse unit by spring 58 with some assistance from the gases developed from fuse operation.

This last described connection arrangement has, among others, the advantages of economy, simplicity of manufacture and assembly, and high current carrying ability without danger of deterioration of the parts thereof. A further advantage of the described arrangement is that the high pressure contact is secured without hindering the rapid expulsion of the contact assembly from the fuse unit upon fuse operation, and that such high contact pressure, due to the rigidity of the parts, is maintained unimpaired throughout long periods of service.

It will be evident from the foregoing description that certain aspects of my invention are not limited to the details of the exemplary constructions illustrated, and I contemplate that various modifications and applications of the invention will suggest themselves to one skilled in the art. It is my intention, therefore, that the appended claims shall cover such modifications and other applications as do not depart from the true spirit and scope of my present invention.

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

1. In a circuit interrupting device, a tubular fuse holder having spaced terminals, a fuse unit disposed in said holder and adapted to be removed therefrom for replacement purposes, said fuse unit including a fuse link and an elongated expulsion tube, means for electrically connecting said fuse link between said terminals, said expulsion tube having one end arranged for the discharge of gases therefrom at one end of said holder upon fuse operation, means providing a pressure relief opening at the other end of said holder in communication with the other end of said expulsion tube, and releasable closure means for said opening operative to permit discharge of gases therethrough upon development of pressure within said expulsion tube in excess of a predetermined magnitude.

2. In a circuit interrupter, an insulating housing having spaced terminals, a unitary fuse device within said housing and supported so as to be readily removable from the housing for replacement purposes, said device including a fuse link and casing means providing an expulsion bore, means for electrically connecting said fuse link between said housing terminals, one end of said expulsion bore being arranged for discharge of gases at one end of said housing upon fuse operation, means providing an expansion chamber adjacent the other end of the housing in communication with the other end of said bore, and pressure relief means operative to afford an opening for discharge of gases at said other end of the housing in case the pressure in said chamber exceeds a predetermined magnitude.

3. In a circuit interrupting device, telescoped tubular casing means constructed at least partially of insulating material, spaced terminal means mounted on the outer of said casing means, a fuse link carried by the inner of said casing means, said fuse link and inner casing means constituting part of a fuse unit which is readily removable from said outer casing means for replacement purposes, means electrically connecting said fuse link between said terminal means, said inner casing means including an expulsion bore having one end arranged to expel gases at one end of said outer casing means upon fuse operation, means providing an expansion chamber in communication with the other end of said expulsion bore, and pressure relief means operative to afford an opening for the expulsion of gases at the other end of said outer casing means upon development within said chamber of pressure in excess of a predetermined magnitude.

4. In a circuit interrupting device, the combination with an elongated tubular fuse holder having spaced terminals, of a fuse unit renewably disposed in said holder and comprising an elongated tubular casing partially of insulation and having a fuse link supported therein, a portion of said casing defining an expulsion bore having a discharge end adjacent one end of said holder for the expulsion of gases therefrom, the other end of said casing having a discharge opening communicating with said bore and arranged for the expulsion of gases from the other end of said holder, means for electrically connecting said fuse link with said terminals, and pressure responsive means normally releasably closing the discharge opening in said other end of said casing.

5. In a circuit interrupting device, an elongated tubular fuse holder having spaced terminals, means providing an expulsion tube removably telescoped within said holder with one end of the tube arranged for the expulsion of gases from one end of the holder, a fuse link in said tube, said fuse link and tube constituting part of a fuse unit which is readily removable from said holder for replacement purposes, electric connection means between said fuse link and said terminals, a tubular extension on the other end of said expulsion tube providing an expansion chamber and having an opening for the expulsion of gases at the other end of said holder, and a closure element normally releasably sealing said opening, said element being arranged to be expelled by gas pressures within said chamber in excess of a predetermined magnitude.

6. In a circuit interrupting device, an elongated tubular fuse holder having spaced terminals, an elongated tubular casing removably telescoped within said holder and constructed at least partially of insulation, a fuse link supported in said casing and electrically connected between said terminals, said fuse link and casing constituting part of a fuse unit which is readily removable from said holder for replacement purposes, one end of said casing having an expulsion bore arranged to discharge gases from one end of said holder upon fuse operation, the other end of said casing having a portion projecting through an opening in the other end of said holder and provided with a gas discharge opening, pressure responsive means normally releasably closing said gas discharge opening, and means cooperative with said projecting portion of said casing for releasably securing the casing in said holder.

7. In a circuit interrupting device, the combination with a fuse holder comprising an elongated insulating tube having metallic ferrules secured respectively to the upper and lower ends thereof; of a fuse unit renewably disposed in said holder and comprising an elongated expulsion tube having one end arranged to expel gases from the lower end of said holder, a tubular metallic element secured to the other end of said tube and having a portion arranged to extend through an opening in the upper one of said ferrules, a fuse link electrically connected at one end to said element, and means for electrically connecting the other end of said fuse link with the lower one of said ferrules; and means including a clamping nut in screw-threaded engagement with cooperating threads on said element for releasably anchoring said fuse unit in said holder.

8. A circuit interrupting device comprising a tubular fuse holder having metallic ferrules respectively on the upper and lower ends thereof; a fuse unit renewably disposed in said holder and comprising an expulsion tube having one end arranged to expel gases from the lower end of the holder, a tubular metallic element mounted on the other end of said tube and having a portion extending outwardly through an opening in the upper one of said holder ferrules, pressure responsive means releasably closing the outer end of said element and operative to afford a gas vent upon development of excess pressure of predetermined magnitude within said expulsion tube, a fuse link electrically connected at one end to said element, and means for electrically connecting the other end of said fuse link with the lower one of said holder ferrules; and means cooperating with said outwardly extending portion of said element for releasably anchoring said fuse unit in said holder.

9. In a circuit interrupting device, the combination of a tubular fuse holder having an open-ended metallic ferrule fixedly secured on one end thereof, a fuse unit removably disposed in said holder and including a fuse link and an insulating tubular casing having on one end thereof a metallic sleeve electrically connected with said fuse link, said casing being telescoped in said holder with said sleeve projecting outwardly through said ferrule and said sleeve having a shoulder arranged for engagement with a cooperating shoulder on said ferrule, and a clamping nut in readily removable screw-threaded engagement with cooperating threads on the outwardly projecting portion of said sleeve for anchoring said fuse unit in said holder, said fuse unit being readily removable from said holder through the end of the holder opposite to said ferrule upon removal of said nut from said sleeve.

10. An expulsion fuse unit including in combination, an expulsion tube at least partially of insulation adapted to receive a fuse link and having a gas discharge opening at one end, a substantially annular metallic terminal element secured to the other end of said tube, fuse link attachment means carried by said element, a metallic sleeve removably mounted on said element and extending outwardly substantially coaxially of said tube a considerable distance beyond said element to provide an expansion chamber, and pressure responsive means releasably closing the outer end of said sleeve.

11. In a circuit interrupting device, the combination with an elongated tubular fuse holder having spaced terminals, of a fuse unit renewably disposed in said holder and comprising an elongated tubular casing arranged to telescope relatively snugly within the bore of said holder, a fuse link supported within said casing, means for electrically connecting said fuse link with said terminals, and a wiper device carried by said casing and arranged to scrape the walls of said bore to clean the same as said casing is inserted into or removed from said holder.

12. In a circuit interrupter, in combination with a tubular fuse holder having upper and lower terminals; a fuse unit removably disposed in said holder and comprising a tubular casing telescoped within said holder and having an expulsion bore arranged for discharge of gases at the lower end of the holder, a conductor supported by and disposed in said casing and having a fusible section, means connecting one end of said conductor with said upper holder terminal, a contact mechanically and electrically associated with the other end of said conductor adjacent the lower end of said casing and directly and freely engaging said lower holder terminal, said contact being a distinct element apart from said casing, and resilient means operative to effect pressure engagement between said contact and said lower holder terminal.

13. In a circuit interrupter, in combination with a tubular fuse holder having upper and lower terminals; a fuse unit removably disposed in said holder and comprising a tubular casing relatively snugly telescoped within said holder and having an expulsion bore arranged for discharge of gases at the lower end of the holder, a conductor supported by and disposed in said casing and having a fusible section, means connecting one end of said conductor with said upper holder terminal, a contact mechanically and electrically associated with the other end of said conductor adjacent the lower end of said casing, and in direct pressure engagement with said lower holder terminal, and a spring operative normally to tension said conductor and operative upon rupture of said fusible section to eject said contact with a portion of said conductor.

14. In a circuit interrupter, in combination with a tubular fuse holder having upper and lower terminals, the lower of which terminals comprises a metallic ferrule; a fuse unit removably disposed in said holder and comprising a tubular casing telescoped within the holder and having an expulsion bore arranged for discharge of gases at the lower end of the holder, the lower end of said casing having longitudinal slots in the side walls thereof, a conductor supported in the casing and having a fusible section, means connecting one end of the conductor with said upper

holder terminal, terminal means for the other end of the conductor having contact portions projecting laterally through said slots in the lower end of the casing, and means forcing said contact portions into pressure engagement with the inner walls of said ferrule.

15. In a circuit interrupting device, in combination with a tubular fuse holder having spaced terminals, at least one of which includes a metallic ferrule; a fuse unit removably disposed in said holder and comprising a tubular casing at least partially of insulation telescoped within the holder, a conducting element supported by and disposed in the casing and including a fusible section, terminal means for one end of the conductor arranged for electric connection with the other of said fuse holder terminals, terminal means for the other end of the conductor including a contact mechanically and electrically associated with said conductor and having a portion arranged for direct engagement with the inside of said ferrule, said contact being distinct from said casing, and means operative to effect substantially radially outward pressure engagement of said portion of said contact with the inner wall of said ferrule.

16. In a circuit interrupting device, the combination with a tubular fuse holder having spaced terminals one of which terminals comprises a metallic ferrule; of a replacement fuse unit for said holder including a tubular casing at least partially of insulation adapted to telescope within the holder, a conductor in said casing including a fusible section, terminal means for one end of the conductor adapted for electric connection with the other of said fuse holder terminals, and terminal means for the other end of the conductor, including a contact which is distinct from said casing and has a portion exteriorly of the casing in direct pressure engagement with the inner wall of said ferrule.

17. A fuse unit adapted to be disposed within a tubular fuse holder having spaced terminals at least one of which terminals includes a metallic ferrule; said fuse unit comprising in combination a tubular casing at least partially of insulation, a conducting element in said casing including a fusible section, terminal means for one end of the conductor, terminal means for the other end of the conductor including a contact element distinct from and movable relative to said casing and arranged for engagement with the inside of a ferrule of a fuse holder enclosing said casing, and means including a spring arranged to effect pressure engagement of said contact element with the inner wall of such ferrule.

18. In a fuse device, the combination of an insulating casing, a conducting element therein including a fusible section, a pair of terminal contact members attached to one end of the conducting element and supported for relative movement apart, terminal means for the conducting element including a metallic sleeve supported in surrounding relation to said contact members, and a spring disposed between the contact members and operative to force the same substantially radially apart into pressure engagement with the inside of said sleeve.

19. In a fuse device, the combination of an insulating casing having spaced terminal means, a conducting element in said casing including a fusible section and having one end electrically connected with one of said terminal means, the other of said terminal means including a metallic sleeve, connection means for the other end of the conducting element including a contact member arranged to engage the inside of said sleeve, means including a spring operative to force said contact member into frictional pressure engagement with the inner wall of the sleeve, and a spring operative normally to tension said conducting element and operative upon rupture of said fusible section to expel the contact member and a portion of the conducting element from said casing.

20. In a fuse device, the combination of a tensioned conducting element including a fusible section and having a terminal contact secured thereto, terminal means for the conducting element including a metallic sleeve in substantially surrounding relation to said terminal contact, intermediate contact means interposed between said terminal contact and the inside of said sleeve and including a metallic bar of rigid construction, and means thrusting on said bar counter to the tension of said conducting element, said terminal contact and said bar having engaging portions, at least one of which is wedge-shaped, cooperative under the influence of said thrusting means to wedge the bar into pressure engagement with the inner wall of said sleeve.

21. In a fuse device, the combination of a conducting element including a fusible section and having a terminal contact secured thereto, said contact having a wedge-shaped portion the apex of which is toward the conducting element, terminal means for the conducting element including a metallic sleeve in substantially surrounding relation to said wedge-shaped portion, a pair of intermediate contact bars supported in engagement respectively with oppositely disposed slanting surfaces of said wedge-shaped portion and extending substantially transversely of said sleeve, and means thrusting on said bars counter to the tension of said conducting element for cooperation with said wedge-shaped portion to force the bars outwardly so as to effect pressure engagement of the ends of the bars with the inner wall of said sleeve.

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