Sept. 1, 1942. E. A. WILLIAMS, JR 2,294,766

ELECTRIC CIRCUIT INTERRUPTING DEVICE AND MOUNTING ARRANGEMENT THEREFOR

Filed July 17, 1940

Fig. 1.

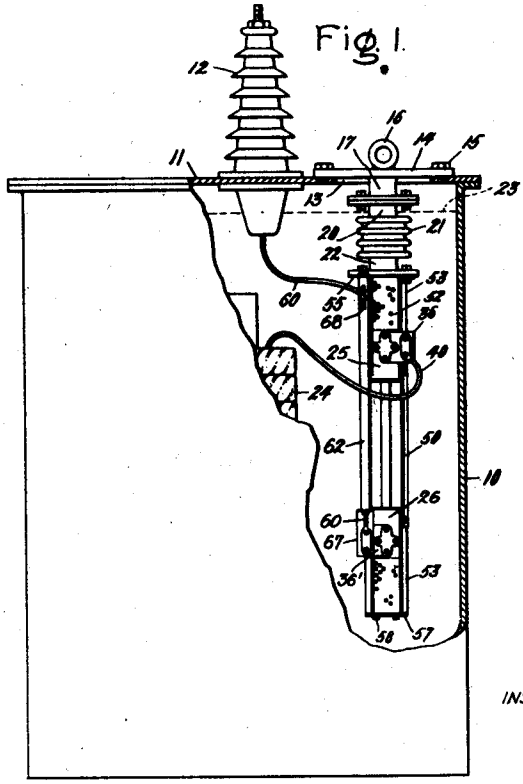


Fig. 2.

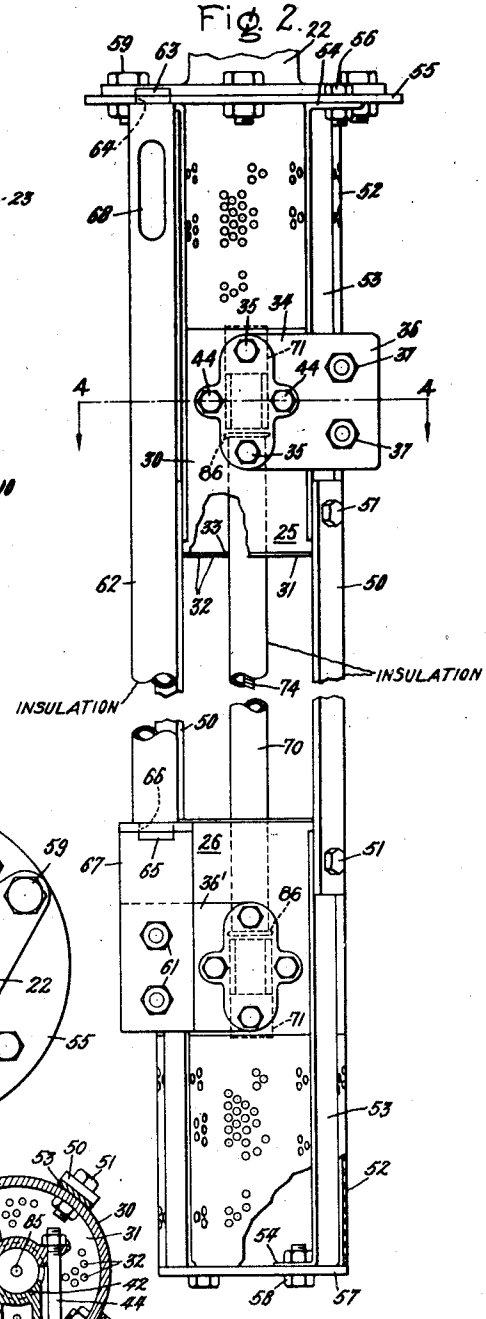


Fig. 5.

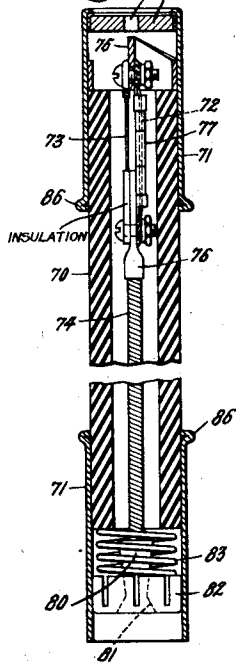


Fig. 3.

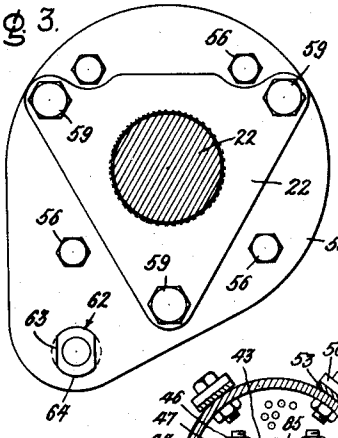
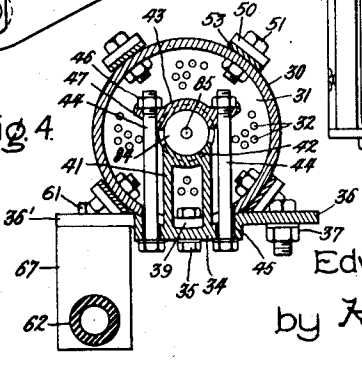


Fig. 4.



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His Attorney.

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UNITED STATES PATENT OFFICE

2,294,766

ELECTRIC CIRCUIT INTERRUPTING DEVICE AND MOUNTING ARRANGEMENT THEREFOR

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Application July 17, 1940, Serial No. 345,959

16 Claims. (Cl. 200—120)

The present invention relates to electric protective devices with reference more particularly to improvements in circuit interrupting devices for use in electric apparatus, such as transformers, employing oil or like insulating medium.

The invention has for one of its objects the provision of an arrangement for mounting a circuit interrupting device, such as a fuse, on a removable closure for a hand-hole or service opening in the housing of a transformer or like electric apparatus, whereby installation and removal of the interrupting device are facilitated and the device is rendered readily accessible without the necessity for disturbance of other elements of the electric apparatus.

Another object of the invention is the provision of an expulsion fuse device capable of safe and efficient operation under oil or like insulating medium.

A still further object is the provision of a fuse support particularly suited for installation of an expulsion fuse in the tank of a transformer or like apparatus, and which support incorporates structure for catching solid matter discharged from the fuse holder on fuse operation, as well as structure for cooling the expulsion gases.

Other objects and the details of that which I consider to be novel and my present invention will be understood from the following description and the claims appended thereto, taken in conjunction with the accompanying drawing wherein an exemplary embodiment of the invention is illustrated.

In the drawing, Fig. 1 is a diagrammatic showing of an electric apparatus, such as a transformer, with the housing of the apparatus partially cut away so as to show the manner of mounting a circuit interrupting device therein in accordance with one feature of the present invention;

Fig. 2 is an enlarged view of the circuit interrupting device shown in Fig. 1;

Fig. 3 is a top plan view, partially in section, of the device of Fig. 2;

Fig. 4 is a transverse section of the interruoting device, taken along the line 4—4 of Fig. 2, and

Fig. 5 shows, in longitudinal section, an improved form of expulsion fuse unit for use under oil or similar liquid insulating medium.

The electric apparatus diagrammatically shown in Fig. 1, has a housing comprised of a metal tank 10 and a cover 11 which serves to support one or more bushing mounted terminals such as the one indicated at 12. The tank cover has a service opening 13, sometimes referred to as a hand-hole, which affords access to the interior of the tank. Opening 13 is closed by a cover 14 which is secured removably in place by bolts 15. An eyelet handle 16 is provided on the outer side of cover 14, and on the inner side of this cover is a flanged bracket 17 to which is bolted a hanger 20. This hanger is secured in any suitable manner, such as by cementing, to one end of an insulator 21 which has a similar hanger 22 secured to the other end thereof. A circuit interrupting device embodying the present invention, is attached to hanger 22 in a manner later described, and extends down into a body of oil or other liquid insulating medium 23 within tank 10. This interrupting device is adapted to be connected between terminal 12 and an electric assembly 24, which may be the core and windings assembly of a transformer, submerged in the liquid medium 23.

The circuit interrupting device includes an improved form of fuse support which has two metallic connection heads 25 and 26 joined rigidly in insulated spaced relationship. Since these connection heads are substantially identical, a detailed description of the upper one, 25, will suffice for an understanding of the construction of both. As will be seen best from Fig. 4, connection head 25 comprises a cylindrical metallic member 30 which is open at the upper end, while the lower end is partially closed by a wall 31 having a multiplicity of perforations 32 and a central opening 33. Mounted on one side of member 30 is a terminal assembly including a metallic base plate 34 which is attached to member 30 by means of bolts 35 disposed in vertically spaced relationship. Base plate 34 has an extension 36 which projects to the right, as viewed in the drawing, and which has bolts 37 for attachment of an electric lead 40 in the manner indicated in Fig. 1. The base plate also has an integral extension 41 which projects into the interior of member 30 through an opening 39. The inner end of extension 41 is formed to provide a semi-cylindrical clamping seat 42 arranged for cooperation with a semi-cylindrical clamping element 43 to secure one end of a fuse holder in a manner hereinafter described. Element 43 is supported on two bolts 44 which are disposed in horizontally spaced relationship and which are mounted at one end in socket openings 45 provided in plate 34. The other ends of bolts 44 are in screw-threaded engagement with nuts 46 which are brazed or otherwise secured to ears 47 on element 43.

A plurality of relatively stiff insulating strips

50 serve to maintain connection heads 25 and 26 in spaced alinement with the end walls 31 of the connection heads facing each other. In the illustrated embodiment four such spacing strips 50 are employed, although more or less than four may be employed if desired. Opposite ends of the strips are secured respectively to connection heads 25 and 26 by means of bolts 51. Since the lower connection head 26 occupies an inverted position relative to the position of connection head 25, the lateral extension of the lower terminal assembly projects to the left, as viewed in the drawing, and thereafter is designated 36' for convenience of later description. Supported in alinement with, and respectively forming continuations of the outer open ends of connection heads 25 and 26, are two cylindrical perforated metal shells 52 which are held in place by straps 53. These straps are secured at one end to the connection heads by means of the bolts 51. The other ends of these straps have right angle portions 54 which, in the case of the upper group of straps, are turned outwardly. In the case of the lower group of straps, the right angle portions 54 project inwardly. A metal plate 55 is secured to the right angle portions 54 of the upper group of straps 53, by means of bolts 56, and serves to close the open end of the upper perforated shell 52. A smaller plate 57 is secured to the inturned right angle portions 54 of the lower group of straps 53, by means of bolts 58, and serves to close the open end of the lower perforated shell 52.

The above described fuse support provides means for removably mounting a fuse unit in tank 10 and for the making of the necessary electric circuit connections to the fuse unit. Upper closure plate 55 of the fuse support is attached to flanged hanger 22 by means of bolts 59 so that the support hangs in a substantially vertical position, immersed in the insulating liquid 23. The lead 40, attached at one end to extension 36 of the upper terminal assembly as previously described, is connected at the other end in any suitable manner with the electric assembly 24. The lower terminal assembly is connected with bushing supported terminal 12 by means of a second lead 60 which is attached at one end to bolts 61 carried by extension 36' of the lower terminal assembly. A considerable portion of the length of lead 60 is accommodated in an insulating tube 62 which is carried by the fuse support and which extends past the upper terminal assembly from a point adjacent the lower terminal assembly. The upper end of this tube has a reduced diameter portion 63 which is received in and supported by an opening 64 in plate 55. The lower end of the tube has a reduced diameter portion 65 which is received in and supported by an opening 66 in the horizontal portion of a right angle bracket 67, which bracket is attached to terminal extension 36' by means of bolts 61. Lead 60 extends from the lower terminal assembly up through tube 62 and out of a slot 68 which is adjacent the upper end of the tube and substantially above the upper terminal assembly. Thus lead 60 is conducted past and insulated from the upper terminal assembly, and is made conveniently accessible for connection purposes adjacent the upper end of the fuse support.

Although employable for the mounting of various forms of fuse devices, the previously described fuse support is particularly adapted for the mounting of a fuse unit of the form shown in Fig. 5. This fuse unit fundamentally is the same as that disclosed in my Patent 2,043,024, issued June 2, 1936, and assigned to the same assignee as the present invention. However, the illustrated fuse unit embodies certain special features which make it particularly suitable for safe and efficient operation under oil or similar insulating medium. Sufficient of the details of construction and operation of the fuse unit will be given herein to insure a proper understanding of the special features referred to. The fuse holder of the fuse unit comprises an insulating tube 70 having metallic terminal ferrules 71 mounted on opposite ends thereof. Within the fuse holder there is disposed a fuse link comprising, in the main, a fusible conductor 72, a strain wire 73, and a flexible connection cable 74. Conductor 72 is mechanically and electrically connected between a terminal 75, disposed in upper ferrule 71, and a terminal 76 secured on the upper end of cable 74. Strain wire 73 is mechanically connected between terminal 75 and terminal 76, but is electrically insulated from terminal 76 so that it normally does not carry current, as described in detail in my patent previously identified. Also, for reasons set forth in my previous patent, fusible conductor 72 is provided with an insulating covering 77. The lower end of cable 74 is provided with a contact 80 having a wedge-shaped portion 81 which engages a metallic and somewhat flexible contact shoe 82. This contact shoe is biased by means of a spring 83 for movement out of the lower end of the fuse holder, but is maintained in tight conductive engagement with ferrule 71 by the combined action of spring 83 and wedge portion 81 of contact 80.

During the process of circuit interruption, cable 74, contact elements 80 and 82, and spring 83 are expelled from the lower open end of the fuse holder. In order to prevent the development of excessive and dangerous pressures within tube 70 during the interruption of extremely high currents, the upper end of the fuse holder is closed by a pressure relief cap 84. This cap is secured in place in any suitable manner, such as, for example, by spinning the outer rim of ferrule 71 slightly over the edge of the cap and by the application of a small amount of solder around the cap. The joint is so calibrated that the cap is blown out in case the pressure within the tube exceeds a predetermined safe magnitude. A small aperture 85 is provided in the pressure relief cap, and this aperture, together with the opening in the lower end of the fuse holder, insures complete filling of tube 70 with liquid insulating medium and also permits circulation of the liquid through the tube. The resultant effective cooling of the conductive parts within the tube, improves the current carrying capacity of the fuse unit, and it has been found, also, that the liquid in the tube increases the volts per inch interrupting capability of the fuse.

For installation of a fuse unit such as that shown in Fig. 5, in the fuse support, the lower closure plate 57 of the support is removed and the clamping bolts 44 of the upper and lower terminal assemblies are loosened so as to provide sufficient clearance between clamping elements 43 and their corresponding clamping seats 42. The fuse holder then is inserted into the lower end of the support, and through the openings 33 in the connection heads, until the fuse holder ferrules are in position for engagement respectively by the terminal clamping devices, whereupon bolts 44 are tightened so as to securely to

hold the fuse holder in place and provide the proper contact pressure between the clamping devices and terminal ferrules. It is important that the upper terminal ferrule, having pressure relief cap 84, be clamped in the upper connection head 25, while the lower terminal ferrule, having contact parts 82 and 83, is clamped in the lower connection head 26. The terminal ferrules are provided with beads 86 to properly locate the fuse holder in the terminal clamps. For proper positioning of the fuse unit, the bead on the lower terminal ferrule should be in engagement with the upper side of the lower terminal clamp, and the bead on the upper terminal ferrule should be in engagement with the lower side of the upper terminal clamp.

After the fuse unit is clamped in the fuse support as above described, plate 57 is replaced and the circuit interrupting device, comprising the fuse unit and support, is ready for installation in tank 10. With the interrupting device and its supporting cover 14 in a partially withdrawn position, connection of leads 40 and 60 may be made through the service opening or hand-hole 13. After such connections are made, cover 14 is secured in place by bolts 15 so that the fuse unit and its support hang down into the body of insulating medium 23. Replacement of a blown fuse may be accomplished very easily by reversal of the installation procedure just described, and without the necessity for removal of the tank cover 11 or disturbance of any of the other elements of the electric apparatus.

From the foregoing, it will be seen that when a fuse holder is supported in a position extending between connection heads 25 and 26 in the manner described, each end of the fuse holder is completely enclosed in a housing formed by a respective one of the connection heads together with its cooperating perforated shell 52 and the corresponding closure plate 55 or 57. The receptacle portion of the lower housing, formed by the lower shell 52 and plate 57, serves to catch the fuse link cable, contact elements, spring, and other solid matter expelled from the lower end of the fuse holder on fuse operation. Also, the perforated metal walls of the receptacle cool the expulsion gases and condense the metallic vapors so as to lessen the danger of contamination of the surrounding insulating medium. The same desirable safety functions are performed by the upper receptacle, formed by upper shell 52 and plate 55, in case cap 84 is blown out due to excessive pressure in the fuse tube.

As a result of the improvements hereinbefore described it is made possible to secure the desirable characteristics of an expulsion fuse unit in an oil immersed installation with assurance of safe and efficient operation under all conditions. Also, the installation of the electric protective device in a transformer or the like, and the replacement of blown fuses, are accomplished in a very simple manner and with a minimum of effort.

Although a preferred embodiment of the invention has been disclosed in detail so as to insure a complete understanding of the invention, it is contemplated that details of the disclosed structure are capable of modification, and that other applications of features of the invention may occur to those skilled in the art. Hence it is intended in the appended claims to cover such other modifications and applications as do not depart from the true spirit and scope of the invention.

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

1. In an electric apparatus including a tank for containing insulating medium and having a cover provided with a service opening affording access to the interior of the tank; a removable closure for said opening, a fuse unit including a tubular insulating holder having terminal ferrules respectively adjacent opposite ends thereof and a fuse link in said holder electrically connected between said ferrules, and a unitary fuse supporting structure mounted on the inner side of said closure and having spaced terminal means for connecting said fuse unit in an electric circuit, which said terminal means include clamps releasably gripping said ferrules so as to support said holder in said tank.

2. In an electric apparatus including a tank for containing insulating medium and having a cover provided with an opening affording access to the interior of the tank; a removable metallic closure for said opening, an insulator mounted on the inner side of said closure, a unitary fuse support joined to and supported by said insulator, a fuse unit carried by said support and comprising a tubular insulating fuse holder having a fuse link therein, and spaced terminals carried by said support and employable for connecting said fuse unit in an electric circuit, said support having means releasably engaged with and supporting said holder with said fuse link electrically connected between said terminals.

3. In an electric apparatus including a tank having a cover provided with a service opening affording access to the interior of the tank, a removable closure for said opening, and liquid insulating medium in said tank; an electric protective assembly carried by said closure so as to be removably supported in said tank, said assembly comprising an expulsion fuse unit including a tubular insulating holder having a fuse link therein and designed for expulsion of gases from at least one end of the holder upon fuse operation, and a fuse supporting structure mounted on the inner side of said closure and having means releasably engaged with said holder so as to support the holder in a position depending substantially vertically from said closure and immersed in said liquid medium, said assembly also including spaced terminal means employable for connecting said fuse unit in an electric circuit.

4. In an electric apparatus including a tank having liquid insulating medium therein, an electric protective device including a fuse unit immersed in said liquid, which said fuse unit comprises a tubular expulsion fuse holder having a fuse link therein and designed for expulsion of gases from at least one end of the holder upon fuse operation, and means for supporting said device in said tank and being removable from the exterior of said tank, said means providing a housing substantially completely enclosing said end of said holder, said housing including a receptacle arranged to catch solid material discharged from said end of the holder upon fuse operation and the housing having perforated metal wall portions designed to cool the expulsion gases.

5. In an electric apparatus including a tank containing liquid insulating medium, a fuse unit comprising a tubular insulating holder having a fuse link therein and designed for expulsion of gases from at least one end of the holder upon fuse operation, a unitary fuse supporting struc-

ture removably disposed in said tank and having means releasably engaged with said holder so as to support said fuse unit immersed in said insulating medium, said structure also having spaced terminal means employable for connecting the fuse unit in an electric circuit, and a receptacle forming part of said structure and disposed adjacent and in line with said one end of said holder for catching material expelled from the holder upon fuse operation, said receptacle having perforated metal wall portions for cooling expulsion gases.

6. In an electric apparatus including a tank having liquid insulating medium therein; an electric protective device supported in said tank and including a tubular expulsion fuse holder immersed in said liquid, a fuse link in said tube and spaced terminals for connecting said fuse link in an electric circuit, said holder being open at one end for expulsion of gases therefrom upon fuse operation, the other end of said holder being partially closed by a pressure relief element calibrated to blow out in case the pressure in said holder exceeds a predetermined magnitude, said pressure relief element having a relatively small aperture therein so as to permit circulation of said liquid into and through said holder.

7. In an electric apparatus including a tank having liquid insulating medium therein, a unitary fuse supporting structure disposed in said tank and having fuse holder clamping means, a fuse unit comprising an insulating tubular fuse holder having a fuse link therein and designed for expulsion of gases from both ends under certain current interrupting conditions, said holder being releasably gripped by said clamping means and being immersed in said liquid, and spaced terminal means on said structure for connecting said fuse unit in an electric circuit, said structure having receptacles respectively disposed adjacent and in line with the ends of said holder and means including said receptacles providing housings substantially completely enclosing the ends of the holder, which said housings have perforated metal wall portions.

8. In an electric apparatus including a tank having insulating liquid therein, and a cover for said tank having a service opening provided with a removable closure; a unitary fuse support carried by said closure and comprising two end structures joined in insulated spaced relationship, one of which end structures is joined to the inner side of said closure so that said support hangs down in said tank, a fuse unit carried by said support and immersed in said liquid, said unit comprising a tubular insulating holder having a fuse link therein and designed for expulsion of gases from both ends under certain current interrupting conditions, said holder extending between said end structures and being releasably gripped by clamping devices respectively on said end structures, and fuse terminal means carried respectively by said end structures, which terminal means are employable for connection of said fuse unit in circuit with other electric means in said tank, each of said end structures including means providing a housing substantially completely enclosing the corresponding end of said holder and each of which housings has a perforated metal wall portion.

9. A unitary device for supporting a fuse unit of the type which includes a tubular expulsion fuse holder designed for expulsion of gases from both ends thereof; said supporting device comprising two housing structures joined substantially rigidly in insulated spaced relationship and each designed to receive and substantially completely enclose one end of a tubular expulsion fuse holder extending between said structures, means for supporting such holder removably in an operative position extending between said structures, and spaced terminal means employable for making electric connections to a fuse unit carried by the supporting device, said housing structures being designed to catch material discharged from the ends of such expulsion fuse holder and each of said structures having perforated metal wall portions.

10. A unitary fuse supporting device comprising two fuse holder connection heads joined substantially rigidly in insulated spaced relationship and each having terminal means for connecting a fuse in an electric circuit, fuse holder clamps mounted respectively on said connection heads and engageable respectively with opposite ends of a tubular expulsion fuse holder for supporting such holder removably in a position extending between said connection heads, and receptacles mounted respectively on said connection heads and cooperative therewith to provide housings for enclosing the opposite ends respectively of a tubular expulsion fuse holder extending between the connection heads, said receptacles being designed to catch material expelled from the ends of such holder and each receptacle having a perforated metal wall portion, the outer end of at least one of said receptacles having a closure which is removable to provide for withdrawal of a tubular fuse holder longitudinally from said supporting device.

11. A unitary fuse supporting device comprising two fuse holder connection heads maintained substantially rigidly in spaced relationship by a plurality of relatively stiff insulating members joined between said connection heads, terminal means carried respectively by said connection heads for making electric circuit connections to opposite ends of a fuse unit carried by said supporting device, fuse holder clamps mounted respectively on said connection heads and releasably engageable with opposite ends respectively of a tubular expulsion fuse holder for supporting such holder removably in a position extending between said connection heads, and metallic receptacles mounted respectively on said connection heads and cooperative therewith to provide housings for enclosing the opposite ends of such fuse holder, said receptacles being designed to catch material expelled from the ends of the fuse holder upon fuse operation and each receptacle having perforated metal wall portions.

12. In a unitary fuse supporting device including terminal structures supported in insulated spaced relationship and means for supporting a fuse unit removably in a position connected between said terminal structures, means for connection of an electric lead to one of said terminal structures, and an elongated insulating tube mounted on said supporting device and extending past the other of said terminal structures from a point adjacent said one terminal structure, said tube being arranged to receive an electric lead which is connected at one end to said one terminal structure, and to conduct such lead to a locality adjacent said other terminal structure while maintaining the lead insulated from said other terminal structure.

13. A unitary fuse supporting device comprising two fuse holder supporting and terminal

structures joined substantially rigidly in insulated spaced relationship; at least one of said structures comprising a connection head having terminal means and a clamp releasably engageable with an end of a tubular expulsion fuse holder for supporting such holder removably in a position extending between said structures, and a perforated metal receptacle mounted on said connection head and cooperative therewith to provide a housing for enclosing an expulsion end of a tubular expulsion holder supported as aforesaid, the outer end of said receptacle having a closure which is removable to provide for withdrawal of the tubular holder from said supporting device.

14. A unitary fuse supporting device comprising a housing structure having perforated metal wall portions and which said structure is designed to receive and enclose an expulsion end of a tubular expulsion fuse holder, a fuse holder mounting structure substantially rigidly joined in insulated spaced relationship to said housing structure, said mounting structure having terminal means including a clamping device for gripping engagement with a fuse holder terminal ferrule, means including said clamping device employable for supporting a tubular expulsion fuse holder removably in a position extending between said structures with an expulsion end of such holder extending into said housing structure, and terminal means carried by said housing structure.

15. A unitary fuse supporting device comprising two fuse holder supporting and terminal structures joined substantially rigidly in insulated spaced relationship, at least one of said structures including means providing a housing arranged to receive and substantially completely enclose an expulsion end of a tubular expulsion fuse holder removably supported in a position extending between said structures, said housing having a combination terminal and fuse holder clamp removably mounted on a wall thereof, and which said clamp is supported in the housing for releasable engagement with the end of a tubular fuse holder extending into the housing.

16. In a fuse supporting structure, a hollow tubular member having an open end and a partially closed end, said partially closed end having an opening for receiving one end of a tubular expulsion fuse holder, a combination terminal and fuse holder clamping device removably mounted on a wall of said member, the clamping part of which device is arranged for releasable engagement with one end of a tubular fuse holder extending into said member through said opening, a perforated metallic tubular member supported in alinement with and forming a continuation of said open end of said first mentioned member, and a removable closure for the outer end of said perforated tubular member.

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