Feb. 21, 1950 R. R. PITTMAN 2,498,575

HIGH-VOLTAGE FUSE CONSTRUCTION

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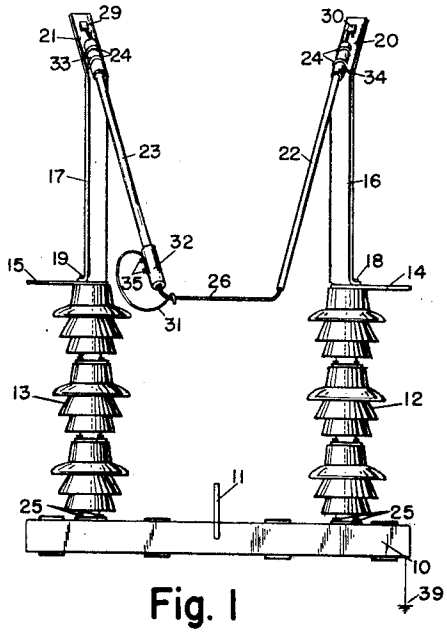


Fig. 1

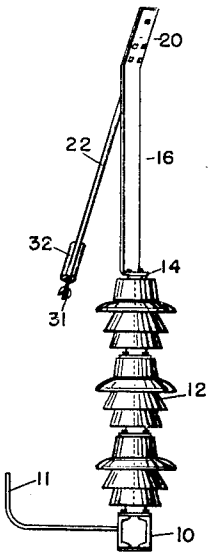


Fig. 2

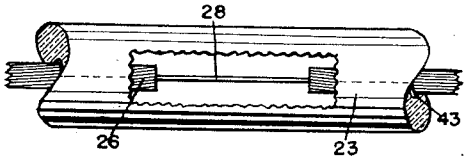


Fig. 5

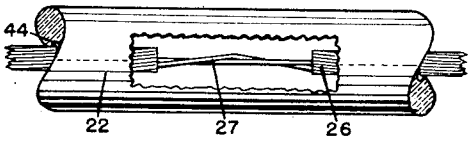


Fig. 4

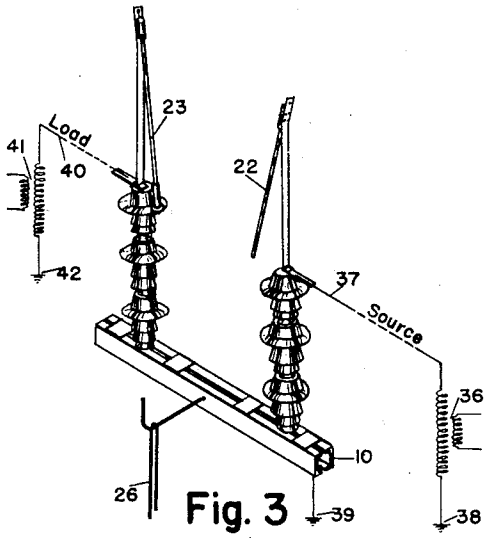


Fig. 3

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HIGH-VOLTAGE FUSE CONSTRUCTION

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5 Claims. (Cl. 200—113)

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This invention relates generally to fuses for electric circuits, and more specifically to a fuse construction suitable for use on circuits operating on voltages commonly classified as transmission line voltages; e. g. 66 kv. and greater.

The objects of the invention include the provision of a relatively inexpensive fuse construction adapted for high voltage circuits which is at the same time effective for the interruption of current over a wide range extending from a few amperes to several thousand amperes; the provision of a fuse construction of the above-mentioned ability which is particularly adapted to application to circuits provided with a grounded source; the provision of a fuse construction embodying two expulsion fuse barrels in series arrangement in which a predetermined sequence of melting of the fusible elements of the fuse link within the respective barrels is caused to occur in response to passage of a predetermined current through the fuse link; and the provision of a construction utilizing the conducting discharge gas attending operation to effect certain definite and favorable alteration of the fault current to be interrupted by the fuse. Other objects will be obvious from the description to follow, or pointed out therein.

In the accompanying drawing, Fig. 1 is a side elevational view of a fuse construction constructed in accordance with the present invention; Fig. 2 is an end elevational view; Fig. 3 is a diagrammatic sketch illustrating the application of the invention to a single phase circuit; Fig. 4 is a fragmentary view of a portion of one of the fuse barrels of the device, with a portion broken away to show the contained fusible element; and Fig. 5 is a similar view of a portion of the other fuse barrel.

It is well known that a fixed bore expulsion fuse may be readily constructed as an effective circuit interrupting device for any circuit voltage if the current to be interrupted is not too great to burst the expulsion barrel from internal pressure, or is not too small to cause sufficient gas generation to extinguish the arc playing within the barrel; that is, within well defined limits of current to be interrupted, the expulsion fuse is an efficient device. However, as a protective device for the high voltage side of transformers operating at transmission line voltages the expulsion fuse has not been satisfactory because the current to be interrupted may vary, from a few amperes due to a fault on the low voltage side, to a high current value equal to the line-to-ground fault current, often several thousand amperes. Since the line-to-ground fault current is relatively constant at any point on a transmission system, an arrangement assuring that this current would pass through an expulsion barrel regardless of the current causing the fusing of a fusible element of the fuse link solves the variable current problem and results in an efficient and inexpensive interrupting device. The manner in which the present invention solves the problem above described, which has existed from the first time expulsion fuses were used on high voltage circuits, will be clear from the following description.

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Referring to Fig. 1 of the drawing, a metal base 10, which in common practice is grounded as indicated symbolically at 39, has rigidly secured thereto, as by welding, an outwardly extending conducting member 11. Mounted at the respective ends of the base 10 are the insulator stacks 12 and 13, by means of the bolts 25. At the top of stack 12 is mounted, by means of the bolts 18, the source terminal 14 and the upwardly extending source fuse barrel mount 16, the latter being formed of conducting material and disposed in conductive relation with the source terminal 14. Similarly, at the top of the stack 13 is mounted, by means of the bolts 19, the load terminal 15 and the upwardly extending load fuse barrel mount 17, the latter being also formed of conducting material and mounted in conductive relation with the load terminal 15.

The source expulsion fuse barrel 22 has rigidly fastened thereto at its upper end the metal ferrule 34, and is rigidly secured to the inclined portion 20 of the source fuse mount 16 by the U bolts 24 in such a position that the barrel extends downwardly and outwardly from the upper end of the fuse mount 16 and is pointed toward an outwardly extended portion of the conducting member 11. Similarly, the load expulsion fuse barrel 23 is provided with the ferrule 33 at the upper end thereof, and the latter clamped to the inclined portion 21 of the load fuse mount 17 by the U bolts 24 in such a position that the load fuse barrel extends downwardly and outwardly from the upper end of the fuse mount 17 in the direction toward and spaced from both the outwardly extending conducting member 11 and the lower end of the source fuse barrel 22. Preferably the fuse barrels are arranged, as shown, so that the longitudinal axis of each if produced intersects the conducting member 11 at a common point. The fuse barrels are open at each end, and formed from material commonly used in the construction of expulsion fuses, such as hard fiber, or other

material capable of producing a gas blast when an arc occurs within the barrel.

The fuse link 26 has one end thereof connected to the source fuse mount 16 at the terminal 30, extending first downwardly through the source fuse barrel 22, thence across the space separating the respective lower ends of the fuse barrels to the lower end of the load fuse barrel 23, thence upwardly therethrough to the terminal 29 at the upper end of the fuse mount 17, and thereby electrically connecting the terminal 14 to the terminal 15 through the fuse link 26. Two longitudinally spaced fusible elements 27 and 28 are provided in the fuse link 26, as shown in detail in Figs. 4 and 5, the higher current element 27 being contained by the source fuse barrel 22, and the lower current element by the load fuse barrel 23. Under certain conditions it may be desirable that the bore 43 of the load fuse barrel be smaller than the bore 44 of the source fuse barrel, although this is not essential to correct operation of the device under other conditions. Also, under certain conditions, more particularly those in which load current is of substantial magnitude, the fusible elements may approach each other as to fusing current, or even equal in this respect.

In situations where load currents are too small to provide the desired expulsion of the fuse link 26 from the load fuse barrel 23, a fuse link extractor 31 is mounted on the lower ferrule 32 and arranged to continuously urge the fuse link in endwise direction out of the bore of the barrel. The fuse extractor 31 is formed of a strip of a resilient material one end of which is rigidly secured to the ferrule 32 by the screws 35, and the other end hooked over the fuse link 26 when the strip is deformed, to urge the fuse link in endwise direction away from the fuse barrel.

Fig. 5 illustrates diagrammatically an application of the invention to a single phase circuit, although it is clear that it may be similarly employed in a three phase circuit. The high voltage winding of the source transformer 36 is grounded at 38, and the other end of the high voltage winding connected through the source conductor 37 to the source end of the fuse construction. In like manner, the high voltage winding of the load transformer 41 is connected to ground at 42, and the load conductor 40 extended to the load side of the fuse construction. Assuming that a fault occurs on the low voltage winding of the transformer 41 while the fuse link 26 is in the position illustrated in Fig. 1, the relatively small excess current as limited by the impedance of the transformer fuses the low amperage element 28 within the load fuse barrel 23. The fuse extractor 31 urges the fuse link 26 out of the load fuse barrel 23, and in falling, the fuse link 26 contacts the grounded fuse link interceptor 11, having moved to the position shown by the dashed line of Fig. 1. Since the source transformer is also connected to ground, full line-to-ground shirt circuit current now passes through the fusible element 27 of the source fuse tube 22, fusing the fusible element and causing effective expulsion action within the latter for interrupting the circuit. An arc, if any exists within the load fuse barrel 23 prior to contact of the fuse 26 with the grounded interceptor 11, is of course instantly extinguished by such contact, since ground voltage is then impressed across both terminals of such arc. A portion of the fuse link 26 may take the position shown in Fig. 3, or may fall to the ground, this matter being of no importance in the operation of the device.

In the event of a direct load conductor-to-ground fault, both fusible elements will be fused at substantially the same time, and in certain situations the conducting gas expelled from the fuse barrels will effect the desired source conductor-to-ground fault current through the source fuse barrel 22 to assure circuit interruption therein. It will also be clear that it is not essential that the conducting member 11 be physically contacted by the fuse link 26; it is sufficient that conducting gas attending expulsion action bridge the space between the lower end of the source fuse tube 22 and the grounded member 11, and further, this gas may originate in either of the fuse barrels.

It may be observed that the construction herein not only assures sufficient fault current to effect efficient circuit interruption, but also assures that both of the fusible elements will be fused and thereby provides a definite open circuit in air between the lower ends of the fuse barrels after operation. The latter feature becomes an important consideration when the fuse construction is applied to polyphase circuits, because of the possible feed-back through a high voltage winding of a load transformer connected to an unaffected phase conductor.

I claim as my invention:

1. A high voltage fuse construction for use between a grounded source and a load; comprising a metal base, a grounded conducting member rigidly mounted thereon and extending laterally therefrom, spaced insulators carried by said base and extending upwardly therefrom, source and load terminals mounted respectively on said spaced insulators, upwardly extending fuse barrel mounts fastened at their respective lower ends to each of said spaced insulators in conductive relationship with the source and load terminals respectively, expulsion fuse barrels mounted on the respective upper ends of said fuse barrel mounts and extending outwardly and downwardly therefrom in spaced relationship and each in the direction toward and spaced from said grounded member, the respective lower ends of said fuse barrels being open, and the grounded member positioned in the path of gas expelled from the respective open ends of said expulsion fuse barrels, and a fuse link extending serially through said expulsion fuse barrels and electrically connecting said fuse barrel mounts, said fuse link being provided with two longitudinally spaced fusible elements, one of said fusible elements being positioned within one fuse barrel and the other of said fusible elements being positioned within the other fuse barrel.

2. The construction recited in claim 1, characterized by said fusible elements having unlike fusing characteristics.

3. A high voltage fuse construction for use between a grounded source and a load; comprising a metal base, a grounded conducting member rigidly mounted thereon and extending outwardly therefrom, spaced insulators carried by said base and extending upwardly therefrom, source and load terminals mounted respectively on said spaced insulators, upwardly extending fuse barrel mounts fastened at their respective lower ends to each of said spaced insulators in conductive relationship with the source and load terminals respectively, expulsion type source and load fuse barrels mounted on the respective upper ends of said fuse barrel mounts and extending downwardly and outwardly therefrom in spaced relationship, each of said fuse barrels being open

at their respective lower ends and pointed toward and spaced from said grounded member, and a fuse link electrically connecting said fuse barrel mounts, said fuse link extending first downwardly through said source fuse barrel, thence across the space between the respective lower ends of said fuse barrels, and thence upwardly through said load fuse barrel, said fuse link being provided with a load fusible element located within said load fuse barrel and a source fusible element located within said source fuse barrel, said load fusible element being adapted to fuse upon passage of a predetermined load current therethrough, and said source fusible element being adapted to remain unfused upon passage of said predetermined load current therethrough and to fuse upon passage of a source-to-ground current therethrough which is greater than said predetermined load current, said grounded member being positioned in the path of gas expelled from the respective lower ends of said expulsion fuse barrels.

4. In a high voltage fuse construction, a conducting base, insulating means thereon supporting spaced terminals, spaced downwardly extending open-ended expulsion fuse barrels mounted on said insulating means and so positioned that the direction of gas discharge from each barrel converges at a common point, a fuse link embodying one fusible element within one barrel and another fusible element within the other barrel, said fuse link extending serially through said expulsion fuse barrels and electrically connecting said spaced terminals, a grounded conducting

member rigidly secured to said base and extending to said common point, and a fuse link extractor associated with said fuse link and arranged to eject a portion of said fuse link from one of said barrels when the fusible element therein fuses, said grounded member being positioned in the path of the ejected portion of said fuse link.

5. In a high voltage fuse construction, a conducting base, insulating means thereon supporting spaced terminals, spaced downwardly extending open-ended expulsion fuse barrels mounted on said insulating means and so positioned that gas discharge from each barrel converges at a common point, a fuse link embodying one fusible element within one barrel and another fusible element within the other barrel, said one fusible element fusing at a predetermined current less than the fusing current of said another fusible element, said fuse link extending serially through said expulsion fuse barrels and electrically connecting said spaced terminals, and a grounded conducting member rigidly secured to said base and extending to said common point.

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