Feb. 3, 1948. C. L. SCHUCK 2,435,472

CIRCUIT INTERRUPTING DEVICE

Filed Nov. 17, 1944

Fig. 2.

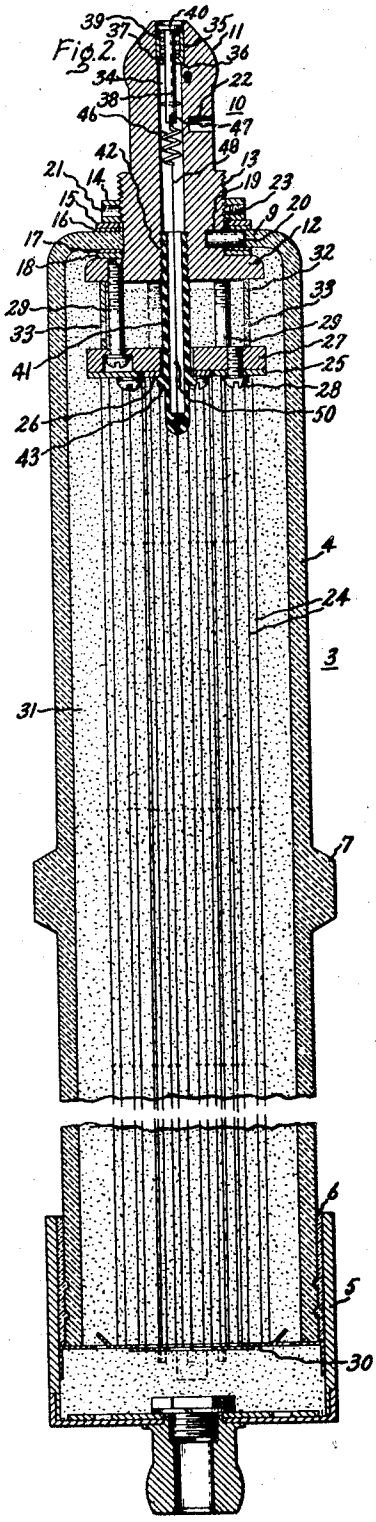


Fig. 1.

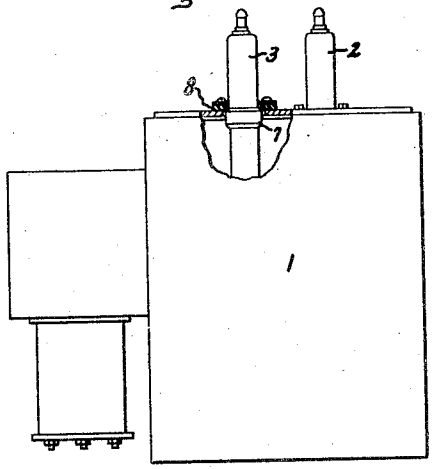
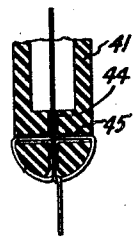


Fig. 3.



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CIRCUIT INTERRUPTING DEVICE

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3 Claims. (Cl. 200—120)

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My invention relates to circuit interrupting devices and specifically to circuit interrupting devices of the current limiting type in which a fusible element is mounted in a casing filled with granular, inert, arc quenching material. My invention is particularly applicable to current limiting fuses which are constructed to act as the conductor stud of switchgear and is an improvement on the invention disclosed and claimed in United States Letters Patent 2,421,658, issued June 3, 1947, to the assignee of this application.

Switchgear employing conductor studs of the type referred to above is generally of the variety commonly referred to as metal-clad switchgear and usually comprises a stationary housing into which electric power circuits are connected. These power circuits are controlled by a cooperating electric circuit breaker mounted in a removable unit which may be of the vertical lift or horizontal draw-out type.

When the conductor stud of such switchgear comprises a fuse of the current limiting type for example, certain problems are encountered. In the first place the current limiting fuse must have a predetermined length commensurate with the voltage conditions involved, and secondly, when used as the conductor stud for metal-clad switchgear it must be provided with one terminal which forms the movable portion of the primary disconnecting devices capable of electrically completing the circuit to the stationary portion of the primary disconnecting devices by a simple plugging operation or by a simple linear motion. The above mentioned copending Strang et al. application is particularly concerned with maintaining the over-all length of the conductor stud which comprises a current limiting fuse at a minimum so that it may be employed in switchgear for use in standard metal-clad units which are already in existence.

For proper operation of current limiting fuses of the type mentioned above, it is essential that the fusible elements be embedded from end to end in an inert, granular, arc quenching material. Even though the casings of the current limiting fuses are completely filled with the inert, granular, arc-quenching material when the fuse is constructed, settling occurs with use and handling. Such settling might cause the ends of the fusible element to be exposed and my invention is specifically concerned with an arrangement for insuring that any settling of the granular material will not expose the fusible element.

Accordingly it is object of my invention to provide a new and improved current limiting fuse

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construction comprising a casing filled with a granular, arc quenching material.

It is another object of my invention to provide a new and improved conductor stud for switchgear.

It is another object of my invention to provide a current limiting fuse of the type in which the fusible element is embedded in granular, inert, arc quenching material with means for automatically compensating for settling of the main body of granular material to insure that the fusible element is completely embedded in the arc quenching material at all times.

Further objects and advantages of my invention will become apparent as the following description proceeds and the features of novelty which characterize my invention will be pointed out with particularity in the claims annexed to and forming a part of this specification.

For a better understanding of my invention reference may be had to the accompanying drawings in which Fig. 1 is an elevational view partly in section of metal-clad switchgear employing a conductor stud embodying my invention; Fig. 2 is a sectional view of a circuit interrupting device embodying my invention, and Fig. 3 is an enlarged view of a portion of the device of Fig. 1.

Referring now to the drawing, I have illustrated in Fig. 1 the removable unit for metal-clad switchgear which includes an electric circuit breaker of the vertical lift type sometimes referred to as of the drop-down type wherein disconnection is accomplished merely by bodily lowering the removable unit and associated circuit breaker. It should be understood that my invention is equally applicable to draw-out type switchgear. This removable unit is designated by the reference numeral 1 in Fig. 1 and includes a plurality of conductor studs 2 and 3, the number of such studs depending upon the number of phase conductors which the circuit breaker is adapted to control. In accordance with the arrangement disclosed in the above mentioned Strang et al. copending application, the conductor stud 3 is essentially a current limiting fuse having a tubular insulating casing 4 formed of glass or other suitable material, upon which is mounted a lower terminal 5 of conducting material. Lower terminal 5 is suitably sealed to the lower end of casing 4 as by sealing means 6. Lower terminal 5 is constructed in substantially the manner disclosed in copending application Serial No. 545,100, Spiro, filed July 15, 1944, and assigned to the same assignee as the present application and is adapted to be removably con-

nected with a terminal (not shown) mounted in the housing of removable unit 1 so that if the fusible element of the combined conductor stud and fuse 3 is ruptured the entire conductor stud and fuse combination 3 may be replaced by a new fuse and conductor stud combination in which the fusible element is intact. The casing 4 of the conductor stud and fuse combination 3 is preferably provided with a thickened portion forming a shoulder 7 which is engaged by a flange 8 to prevent inadvertent removal of the conductor stud 3 from removable unit 1. The construction of the shoulder 7 and flange 8 is disclosed and claimed in the copending Spiro application referred to above.

The other end of tubular insulating casing 4 which is preferably formed of glass or ceramic material is provided with a shoulder or shelf 9 essentially comprising a turned-in portion partially closing the end of the casing or housing 4. This shoulder or shelf 9 provides means by which a conducting member, generally indicated at 10 and including an elongated portion 11 in the form of a plug-type contact which can be fastened to the housing while maintaining the overall length of the device at a minimum. Conducting member 10 is illustrated as having a lower head in the form of an annular portion 12 which is adapted to engage the shoulder 9 inside tubular casing 4. Conducting member 10 is further provided with a threaded portion 13 to threadedly engage a nut 14 preferably round in form so that the shoulder 9 of casing 4 may be suitably clamped between annular member 12 and nut 14. Suitable washers such as 15, 16, 17, and 18 may be provided adjacent the surfaces of the shoulder 9 to take care of any unevenness in the material of which insulating casing 4 is formed. The conducting member 10 with the washers 17 and 18 mounted thereon is inserted into the tubular casing 4 from the lower end thereof so that the elongated portion 11 extends outwardly from casing 4 and washers 15 and 16 and nut 14 may then be applied firmly to clamp the conducting member 10 to the shoulder 9 and consequently seal the upper end of tubular casing 4.

In order to prevent conducting member 10 from turning relative to casing 4, or in other words relative to the turned in end of the tube 4, shoulder 9 is provided with a notch which cooperates with a radial hole 19 in conducting member 10 adapted to be mounted opposite the notch. A small pin 20 preferably formed of resilient material, such as fiber or the like, projects from hole 19 and engages the notch to prevent turning of the contact or conducting member 10. The pin 20 is completely covered by the washers 15, 16, 17, and 18 so as to not interfere with the sealing of the upper end of casing 4. As was mentioned above, the nut 14 is made round instead of the usual hexagonal form to discourage tampering with its adjustment. In order that a wrench may be applied to tighten nut 14 on conducting member 10, nut 14 is provided with a radial hole 21 and similarly conducting member 10 is provided with a second radial hole 22. Suitable wrenches may be applied so as to engage the holes 21 and 22 in nut 14 and conducting member 10 respectively. To further discourage tampering a set screw 23 may also be provided in nut 14 to engage the threaded portion 13.

Conducting member 10 and terminal 5 form the two terminals of the fuse 3 which is of the

current limiting type. Current limiting fuses generally comprise a long fusible conducting section surrounded by an inert, refractory, granular material of high dielectric strength. The form, composition and arrangement of this material and conducting section are such that upon dissipation of the conducting section by severe short circuit current, there is in effect inserted into the current path a high resistance which halts the current rise and produces a rapid current decay resulting in final current interruption in an extremely short period of time not exceeding a half cycle in the case of alternating current. During the circuit interrupting operation the fusible element of the current limiting fuse dissipates throughout a section of considerable length as distinguished from dissipation at a point of reduced cross section only. Usually a plurality of parallel wires are provided for the fusible element, the number depending upon the current rating of the fuse. The reason for using a plurality of wires is that it has been found that most effective current limiting action is produced when conductors of thin cross section are employed. Hence when the current rating demands a relatively large cross section, it is desirable to divide this total cross section into a number of parallel conductors having a thin cross section such as a plurality of fine silver or zinc wires.

In Fig. 2 I have shown the fusible element as comprising a plurality of fine wires 24, preferably arranged in pairs, each pair comprising a single wire returned upon itself so as to form a U in the same manner as is disclosed in the above mentioned Strang et al application. The majority of the U-shaped wires are preferably strung through openings in an annular conducting plate 25 and a number of U-shaped wires are strung through openings in a smaller conducting plate 26 adapted to fit within the opening in annular plate 25. After the wires 24 have been threaded through the openings in plates 25 and 26, plate 25 is fastened to a conducting member 27 by suitable fastening means such as screws 28, while smaller plate 26 is also fastened thereto by means to be described hereinafter.

Conducting plate 27 is fastened as by suitable screws 29 to conducting member 10 holding in compression a tubular conducting member to be described hereinafter whereby the fusible element is electrically connected through plate 27 with the upper terminal 10. The other ends of the wires 24 forming the fusible element are electrically connected to lower terminal 5, as by means of a conductor 30. The wires 24 comprising the fusible element are embedded in an inert, granular, arc extinguishing material, generally indicated at 31, which completely fills casing 4. Preferably granular, arc extinguishing material 31 comprises finely divided quartz or sand.

In accordance with my invention conducting plate 27 is spaced a predetermined distance from annular portion 12 of conducting member 10, the space being determined by a tubular conducting member or element 32 mentioned above which with annular portion 12 and conducting plate 27 defines a reservoir above the upper ends of the fusible element comprising wires 24. This reservoir is also filled with the inert, granular, arc extinguishing material 31 and is perforated to provide a plurality of openings 33 through which the granular material may flow in the event of settling of the main body of sand to insure that the fusible element comprising wires 24 is always

completely embedded within the granular arc quenching material. The openings 33 are preferably near the bottom of the reservoir which is hereinafter referred to as a sand reservoir so that when the level of the sand or granular material 31 falls throughout the tube or casing 4, sand from the reservoir flows out through the openings 33 maintaining coverage of the fusible element.

When the removable unit 1 of Fig. 1 is lowered from the metal-clad unit of the switchgear with which it is associated, the elongated portion 11 of conducting member 10 which forms the plug-type contact engageable with the primary disconnecting devices is immediately visible. In order to indicate the operating condition of the fuse, it is desirable to provide indicating means which may be associated with the conducting portion 10. I have illustrated an indicating means which is substantially identical with the indicating means disclosed in the above mentioned Strang et al copending application. To accommodate this indicating means conducting member 10 is provided with a passageway 34 therethrough, or in other words is in effect a hollow, conducting member. A cup-shaped member 35 is supported on a shoulder or ledge 36 in passageway 34, the lowermost position thereof being determined by ledge 36. Cup-shaped member 35 is provided with an opening 37 through which extends a reciprocatingly mounted indicating plunger 38 biased for upward movement by means of a compression spring 39. Compression spring means 39 is mounted in the cup-shaped member 35 around the plunger 38 so as to be compressed between a head 40 on the plunger 38 and the bottom of the cup-shaped member 35. When the indicating plunger 38 is in the completely retracted position shown in Fig. 2, the head 40 is flush with or below the top of the elongated portion 11 of the conducting member 10.

In order to maintain the plunger 38 in the nonindicating position shown in Fig. 1, it is necessary to compress spring 39 within cup-shaped member 35. In order to accomplish this, I provide a tubular member 41 of insulating material preferably formed of fiber or the like, which is threadedly mounted in passageway 34 as is indicated at 42. Tubular member 41 extends through the sand reservoir described above and is provided with an annular flange 43 which engages the conductor plate 26 and holds it in position against conducting plate 27 so as to provide contact pressure against the U-shaped ends of wires 24 passing through openings in plate 26. The lower end of tubular member 41 is substantially closed as is best shown in Fig. 3, except for a small axial passageway 44 and an additional passageway 45 substantially perpendicular to axial passageway 44. A suitable tension spring 46 has one end thereof fastened to plunger 38 as is clearly indicated at 47, while the other end thereof is fastened to indicator element or wire 48. This indicator element extends axially through tubular member 41 and axial passageway 44 therein. The indicator wire then passes through passageway 45 as is clearly indicated in Fig. 3 and forms a half hitch with itself where it first emerges from passageway 44. In this way indicator wire 48 is securely moored to the lower end of the tubular member 41. The openings 44 and 45 are closed to prevent the ingress of the filler material by any suitable means such as a suitable cement or the like. The lower end of the indicator wire 48 passes along the axis of the casing 4 and is fastened to conductor 30. In order

to be sure that the portion of the indicator wire 48 within tubular member 41 melts first to release the indicator, the indicator wire 48 is preferably made of two diameters of wire, the junction of which is indicated at 50. The smaller diameter wire is next to spring 46 to insure that this section will melt first releasing the indicator rather than having the interruption take place farther down in casing 4 so that the indicator is not operated.

The operation of the combined conductor stud and fuse described above will be obvious and no further discussion will be included therein. It will be apparent that the provision of the reservoir containing the granular material insures that the fusible element is completely embedded in this granular material at all times. Furthermore it will be observed that a very compact conductor stud which also is a fuse device is provided and which can be satisfactorily incorporated in a circuit interrupting device for use with metal-clad switchgear.

While I have disclosed a specific embodiment of my invention, it should be understood that my invention is not limited to the specific details and construction thereof herein illustrated, and I intend in the appended claims to cover all such changes and modifications as fall within the true spirit and scope of my invention.

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

1. In an electric circuit interrupting device comprising a tubular casing, an upper terminal for said casing, a lower terminal for said casing, a hollow perforated container formed of conducting material supported from said upper terminal, a fusible element comprising a plurality of conductors connected between said container and said lower terminal, a body of granular inert arc quenching material in said casing embedding said conductors and substantially filling said container, said arc quenching material flowing from said container to said casing in the event of settling of the material in the casing to insure that said conductors remain completely embedded in said material.

2. In an electric circuit interrupting device comprising a tubular casing, an upper stud terminal for said casing, a lower terminal for said casing, a perforated hollow cylindrical container supported from said upper terminal, a fusible element comprising a plurality of conductors connected between said container and said lower terminal, means for electrically interconnecting the upper ends of said conductors with said upper terminal, a body of granular inert arc quenching material in said casing embedding said conductors and substantially filling said container, said arc quenching material flowing from said container to said casing in the event of settling of the material in the casing to insure that said conductors remain completely embedded in said material.

3. In an electric circuit interrupting device comprising a tubular insulating casing, an upper stud-like terminal member axially positioned relative to said casing and having a head portion within the casing at the upper end thereof, a lower terminal member, a conducting plate-like member in the upper part of said insulating casing, a perforated hollow cylindrical conducting element positioned between said plate-like member and the head portion of said stud, means securing said plate-like member, said conducting element and said stud together as a unit, a fusi-

ble element mounted within said casing and connected between said plate-like member and said lower terminal member, granular inert arc quenching material in said casing and substantially filling said first-mentioned element, said material flowing from said first-mentioned element to said casing in the event of settling of the material in the casing whereby to insure that said fusible element is completely embedded in said material.

CARL L. SCHUCK.

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