

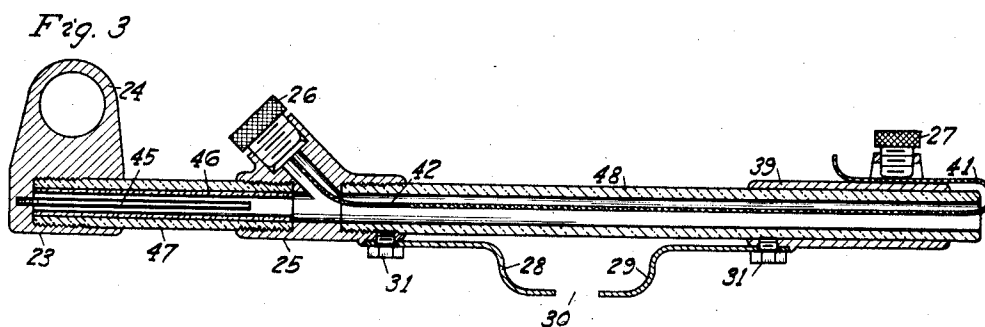
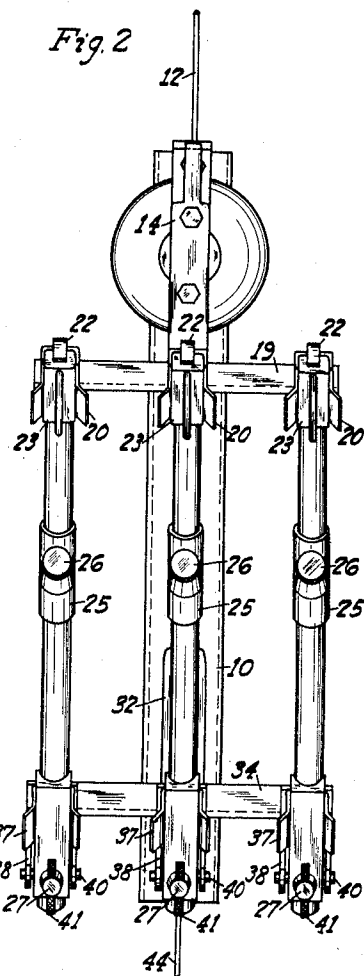
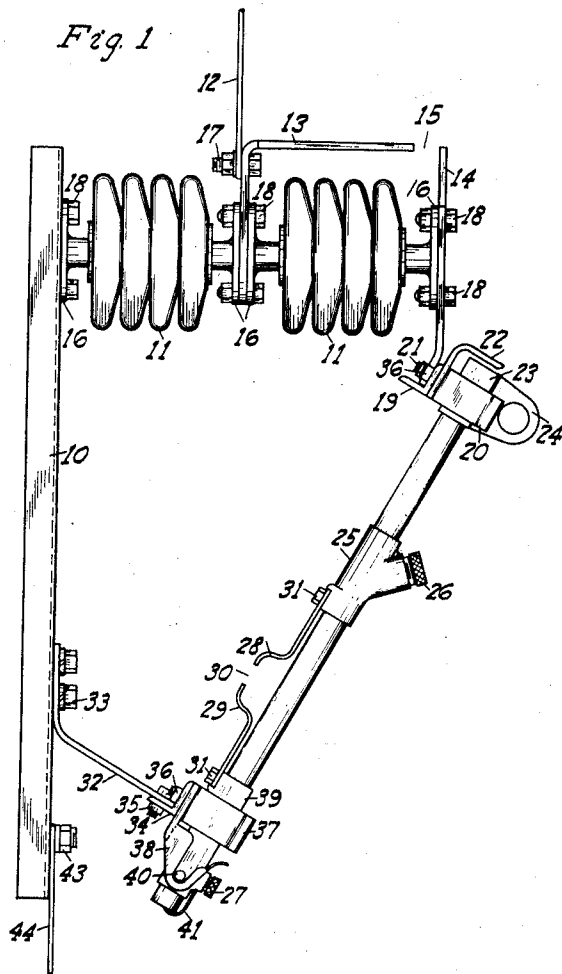
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ELECTRICAL PROTECTIVE APPARATUS

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ELECTRICAL PROTECTIVE APPARATUS

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This invention relates generally to apparatus for protecting electrical equipment from over-voltages such as may be caused by lightning, and particularly to equipment for this purpose which embodies spark-gaps for limiting the magnitude of the applied voltage and fuses for interrupting the flow of current following spark-gap breakdown.

For a great many years it has been generally known that a simple spark-gap in series with a circuit-interrupting fuse is an effective over-voltage protective device. A general use of this arrangement has been prevented for three principal reasons (1) upon the blowing of the fuse, the degree of protection is greatly reduced; (2) the gap may be short-circuited through the body of a bird, animal or other object; (3) the lack of any simple and inexpensive circuit-interrupter which is adapted for this purpose.

In an effort to solve the problems above presented, various arrangements have been used; the one finding most favor being a scheme in which another fuse is actuated by some mechanical means into position in response to the blowing of the first fuse. While this arrangement may be regarded as a partial solution of problem (1) above, it has the serious defect of permitting an interval of time to elapse when no unblown fuse is in position, this time interval usually being at the very time when the fuse is most needed; i. e., when a series of lightning strokes are occurring.

Among the objects of the present invention is the provision of a satisfactory solution of the problems above set out; that is, to provide in apparatus of this kind (1) means for limiting the over-voltage to a predetermined value at all times regardless of the number of blown fuses, (2) means for preventing unnecessary operations of the device, and (3) a new type of simple and effective circuit-interrupter.

With these and other objects in view as may later appear, my invention resides in the particular arrangement and combination of parts for the purpose, and in the particular construction of the circuit-interrupter.

In the drawing: Fig. 1 is a side elevational view of the apparatus; Fig. 2 is a front elevational view of the apparatus; and Fig. 3 is a side elevational view of the circuit-interrupter, shown partly in section.

Referring now particularly to Figs. 1 and 2, an assembly consisting of two coaxially mounted insulators 11, each provided with the flanged insulator inserts 16, extends outwardly from the upper portion of the metal base 10, this assembly being

rigidly secured in place by means of the bolts 18.

Extending first upwardly and then outwardly from between the adjacent flanged inserts, and rigidly secured by the bolts passing therethrough, is the L-shaped metal member 13, to which is connected the line conductor 12 by means of the line terminal 17. At the outer end of the insulator assembly is mounted the upper assembly supporting metal member 14, secured to the outer insulator by the bolts 18, and extending above and below the outer edges of the insulator.

The upper end of the member 14 is spaced from but in substantial alignment with the outwardly bent portion of the member 13, these two members thus being arranged to form the electrodes 15 of the isolating gap 15.

The lower portion of the member 14 is also bent slightly toward the base 10, and has secured thereto, by means of the bolt 21, the horizontal laterally extending metal angle terminal member 19. A plurality of horizontally spaced upper contact clips 20 are mounted thereon by means of the upper contact clip bolts 36. Similarly, at the lower portion of the base 10, the outwardly bent metal member 32, which is secured to the former 25 by the bolts 33, has attached to its outer end the horizontal laterally extending metal angle terminal member 34 by means of the bolt 35. On the metal member 34 are mounted, in substantial alignment with each of the upper contact clips 30 20, the horizontally spaced lower contact clips 37, the latter being held in position by the lower contact clip bolts 36.

Adjacent the lower end thereof, the base 10 is provided with the ground terminal 43, for convenience in attaching the grounded conductor 44.

The circuit-interrupter arranged for bridging the space between the various pairs of aligned upper and lower contact clips is shown in detail in Fig. 3. This circuit-interrupter includes a housing made up of the coaxially arranged hollow tubes of insulating material 47 and 48, the latter being joined at their adjacent ends, by means of cooperating threads on the respective members, by the intermediate metal electrode 25. Fiber tubing is an inexpensive material for use as the housing members. The upper end of this assembly is closed by means of the upper metal contact 23, and the lower end open but provided with the external sleeve contact 39.

A metal rod 45 is secured to the upper contact 23 by cooperating threads, and extends downwardly into the tube 47 for a sufficient distance to provide a preferential internal discharge gap between its lower end and the inner surface of the

electrode 25. To prevent thermal damage to the tube 47 from the internal arc, its inner surface is provided with the liner 46, of some non-inflammable heat-resistant material, such as asbestos tubing.

To provide means for re-fusing the circuit-interrupter, the electrode 25 is provided with an upwardly and outwardly extending portion through which an opening extends communicating with the hollow of the electrode. An upper fuse terminal 26 is threaded into this opening, and the latter, together with the lower fuse terminal 27, provides means for connecting the electrode 25 to the lower contact 39 through the fusible element 42 of the fuse 41 within the housing.

The opposed spaced metal electrodes 28 and 29 are mounted on the electrode 25 and the lower contact 39, respectively, by the screws 31. These spaced electrodes form an external gap 30 in shunt relation with the lower tube 48, principally to reduce the flashover value of this portion of the housing following the blowing of the fuse 41, but also to prevent damage thereto under the same condition.

For convenience in handling the circuit-interrupter, the lower contact 39 is provided with the laterally extending pivots 40 (Figs. 1 and 2), arranged to cooperate with the hook-shaped bearings 38, the latter being positioned below and attached to the lower contact clip 37. By means of a hook-stick passed through the eye 24 of the upper contact 23, the circuit-interrupter may be manually manipulated into and out of its contact clips by rotating it about the pivots 40.

In operation, any voltage impressed upon the line conductor 12 which is of a character to spark over the isolating gap 15 and one of the internal discharge gaps between the electrodes 45 and 25 will be discharged to ground through the fuse 41 and the ground conductor 44. Should this occurrence cause sufficient dynamic current to pass through the fuse 41, it will be blown, and in so doing cut off the passage of current from line to ground, thus preventing an outage of service on the connected line.

Despite the fact that the circuit-interrupters are all substantially identical, and constitute a group in parallel circuit relation, this group being in series with the single isolating gap 15, I have found that only one of the group will operate on a single discharge. The effect of position with respect to other energized parts of the apparatus, together with very slight differences in shape and/or spacing of electrodes, is apparently sufficient to obtain this selectivity without substantial difference in breakdown voltage. It is therefore not necessary to move the circuit-interrupters from one position to another, thus providing a very simple and effective protective apparatus.

In the event that all of the fuse in the apparatus are blown, the over-voltage discharges are directed across one of the external gaps 30, these gaps having a breakdown only slightly in excess of the arc-voltage of the fuse tube 48 during the blowing of a fuse therein.

The circuit-interrupter itself, in addition to providing an internal discharge gap which cannot be short-circuited by birds fluttering about the apparatus, has this gap so positioned and the parts forming it so arranged that it provides a compression chamber for the fuse tube. The effect of this chamber is to provide high interrupting capacity of the fuse tube without the necessity of an undesirable opening at the top

of the circuit-interrupter. To assist in retaining the circuit-interrupter in position while discharging heavy currents, the member 22 has its upper end bent over the upper end of the circuit-interrupters, and its lower end secured between the contact clip 20 and the angle member 19.

To facilitate a clear understanding of my invention, I have herein shown and described an embodiment in specific terms. It will be understood, however, that my invention will be limited only as required by the prior art and the appended claims.

What I claim as new, and desire to secure by Letters Patent, is:

1. A circuit-interrupter comprising a tubular housing of insulating material having one end open and the other end closed, contacts secured to said housing adjacent the respective ends thereof, a hollow electrode of conducting material secured to said housing between said contacts and insulated therefrom, said electrode being arranged to provide a continuous opening throughout the length of said housing, elements constituting a preferential discharge path within said housing and between said electrode and the contact adjacent the closed end of said housing, and a fuse within said housing connecting said electrode to the contact adjacent the open end of said housing.

2. A circuit-interrupter comprising a tubular housing of insulating material having one end open and the other end closed, contacts secured to said housing adjacent the respective ends thereof, a hollow electrode of conducting material secured to said housing between said contacts and insulated therefrom, said electrode being arranged to provide a continuous opening throughout the length of said housing, elements constituting a preferential discharge path within said housing and between said electrode and the contact adjacent the closed end of said housing, a fuse within said housing connecting said electrode to the contact adjacent the open end of said housing, and externally positioned fuse terminals for engaging the respective ends of said fuse.

3. A circuit-interrupter comprising a tubular housing of insulating material having one end open and the other end closed, contacts secured to said housing adjacent the respective ends thereof, an electrode of conducting material interposed between said contacts and insulated therefrom, elements constituting a preferential discharge path within said housing and between said electrode and the contact adjacent the closed end of said housing, and a fuse within said housing connecting said electrode to the contact adjacent the open end of said housing.

4. A circuit-interrupter comprising a tubular housing of insulating material having one end open and the other end closed, contacts secured to said housing adjacent the respective ends thereof, an electrode of conducting material interposed between said contacts and insulated therefrom, elements constituting a preferential discharge path within said housing and between said electrode and the contact adjacent the closed end of said housing, and a fuse removably supported within said housing, said fuse connecting said electrode to the contact adjacent the open end of said housing.

5. A circuit-interrupter comprising a tubular housing of insulating material susceptible to thermal damage, said housing having one end open and the other end closed, contacts secured

to said housing adjacent the respective ends thereof, an electrode of conducting material interposed between said contacts and insulated therefrom, elements constituting a preferential discharge path within said housing and between said electrode and the contact adjacent the closed end of said housing, a fuse within said housing connecting said electrode to the contact adjacent the open end of said housing, and a lining of non-inflammable material surrounding said discharge path.

6. A circuit-interrupter comprising a tubular housing of insulating material susceptible to thermal damage, said housing having one end

open and the other end closed, contacts secured to said housing adjacent the respective ends thereof, an electrode of conducting material interposed between said contacts and insulated therefrom, elements constituting a preferential 5 discharge path within said housing and between said electrode and the contact adjacent the closed end of said housing, a removably supported fuse within said housing connecting said electrode to the contact adjacent the open end of said hous- 10 ing, and a lining of non-inflammable material surrounding said discharge path.

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