Dec. 22, 1936. R. R. PITTMAN 2,065,152

VOLTAGE LIMITING DEVICE

Filed April 23, 1934 2 Sheets-Sheet 1

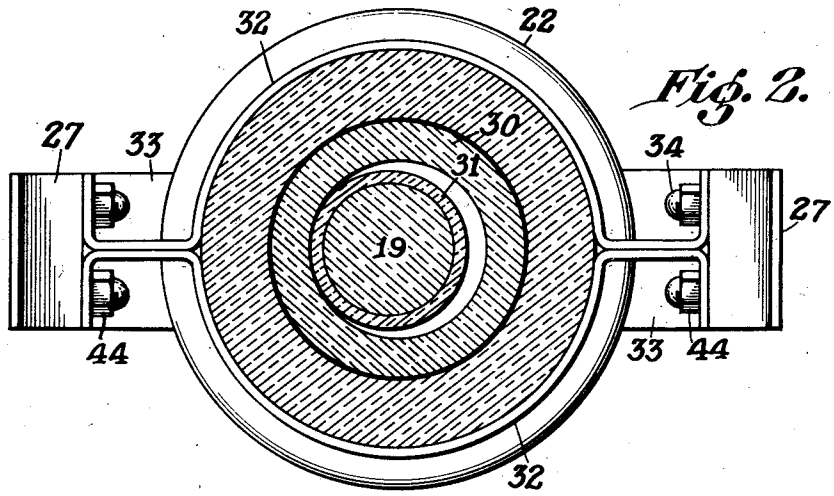



Fig. 2.

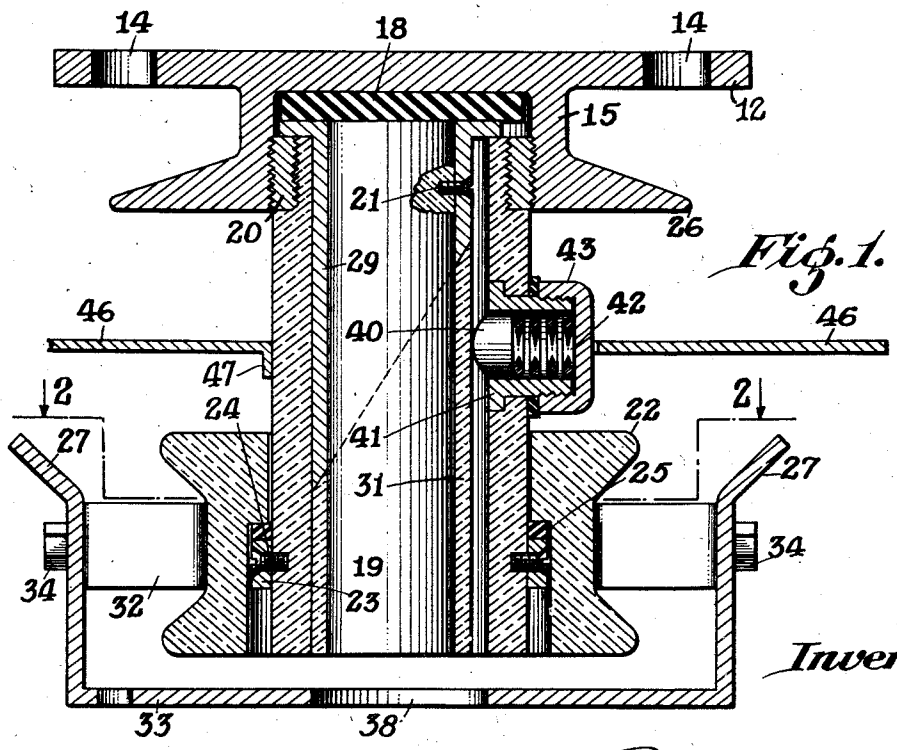



Fig. 1.

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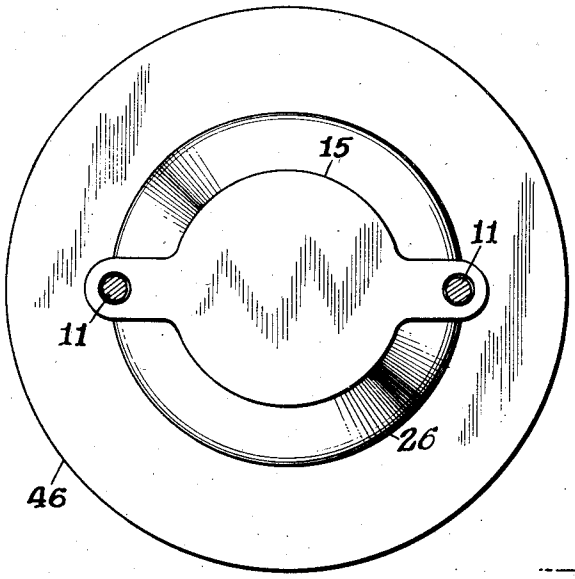



Fig. 4.

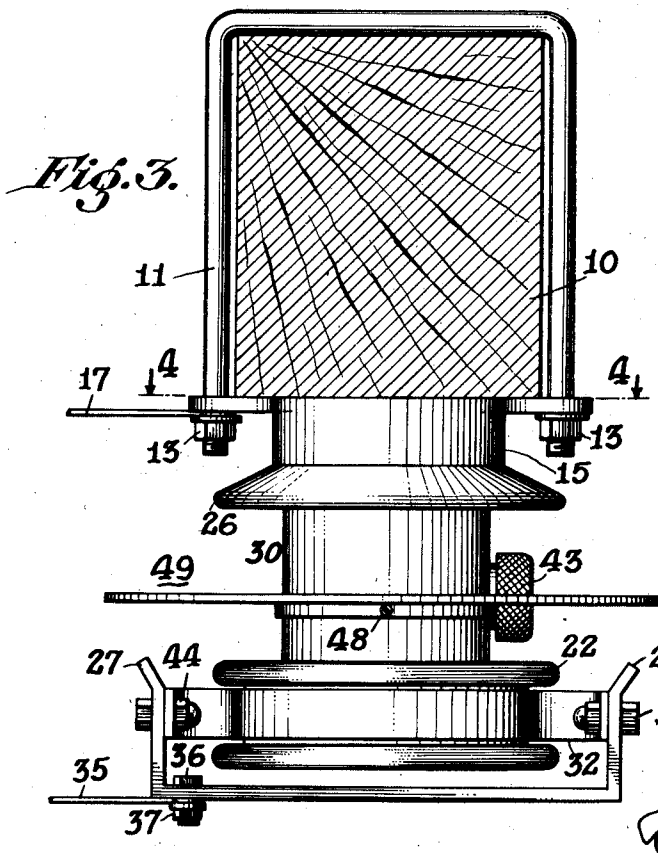



Fig. 3.

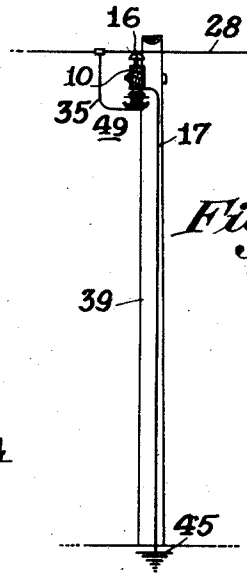



Fig. 5.

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Patented Dec. 22, 1936 2,065,152

# UNITED STATES PATENT OFFICE

2,065,152

## VOLTAGE LIMITING DEVICE

Ralph R. Pittman, Pine Bluff, Ark.

Application April 23, 1934, Serial No. 721,936

1 Claim. (Cl. 175—30)

This invention relates generally to discharge devices for use in connection with overhead transmission and distribution electrical circuits, and has for its primary object the provision of means for positively preventing an excessive superimposed voltage rise on a conductor or connected apparatus, such as might be caused by lightning.

The present invention is a continuation in part of my prior application styled Excess-voltage protective structure, now Patent No. 2,002,042, dated May 21, 1935, and embodies a similar general arrangement of arc extinguishing elements.

A particular object of the present invention is to provide a simplified structure requiring a reduced number of parts, adapted to be installed and removed as a unit.

A further object is the provision of means employing integral portions of the arc extinguishing elements for mounting the device against the lower side of a supporting member to prevent movement of the device due to the recoil when interrupting an arc by virtue of its expulsion action.

Another object is the provision of means carried by the device for preventing the passage under normal conditions of damaging creepage current over the surfaces of the tubular insulator employed in the device. I have found that, while vulcanized fiber is an excellent and inexpensive material for use in arc interrupting devices, it lacks the desired insulating quality to prevent the passage of creepage current under continuously applied voltage thereto.

A further object is to provide, in a device for use out-of-doors, a roof over the tubular insulator incorporated in the device, to reduce the absorption of moisture causing warping, and, in addition, to support the tube from the top in a vertical position to further prevent warping.

A further object is to provide, in a device for the purpose described, a barrier interposed between two normally insulated conducting electrodes, to prevent birds or animals from completing a circuit through their bodies from one electrode to the other.

Another object is the provision of a novel means for supporting the resiliently biased internal insulating element and the conducting member carried thereby, which is employed for directing and maintaining the arc in intimate relation with the inner wall of the tube, so as to provide an unrestricted passageway to the atmosphere for the gaseous products attending a discharge.

A yet further object is the provision of a simple, inexpensive and effective device for the purpose above described.

With the above and other objects in view which will appear from the description, my invention resides in the novel arrangement for mounting the device and the elements thereof, in the novel construction provided for insulating the line electrode of the device, and in the combination and construction of the elements of the device to the end that many of them perform a plurality of necessary or desirable functions.

In the drawings:

Fig. 1 is an elevational view of the device, shown in section.

Fig. 2 is a sectional view of the device taken along a plane indicated by the line 2—2 of Fig. 1.

Fig. 3 is an elevational view of the device, shown mounted on a supporting member or cross arm.

Fig. 4 is a sectional view of the device, as seen from the plane indicated by the line 4—4 in Fig. 3.

Fig. 5 is an elevational view of an electric line structure of a common type, showing the device mounted thereon in the service position.

Referring now in particular to Figs. 1, 2, 3, and 4, the upper electrode 15 is provided with a pair of laterally extending integral portions 12, the latter being provided with the holes 14. A U-bolt 11, of substantially the shape of the supporting member or cross arm 10, extends downwardly from the top thereof and through the holes 14 of the integral portions 12 of the metal cap or upper conducting electrode 15, the latter being rigidly secured to the lower surface of the arm 10 by means of the nuts 13 cooperating with the threaded ends of the U-bolt 11. One of the nuts 13 provides a convenient means for connecting the ground wire 17 to the upper electrode 15, thereby maintaining the latter at substantially ground potential. An outwardly and downwardly extending flange 26 is formed integral with the upper electrode 15, to provide a roof for the lower portions of the device.

The inside of the cap or upper electrode 15 is provided with threads for cooperating with similar threads on the outside of the metal ring 20, and the tube of insulating material, or tubular insulator 30, is provided with external threads adjacent the upper end thereof for cooperating with similar internal threads of the ring 20. A supporting ring 23, of any material adapted as a support, surrounds the tube 30, and is rigidly secured thereto by means of the screws 24. An insulator 22, of porcelain or other material having high dielectric and creepage strength, is sup-

ported by the ring 23, a resilient washer 25 being interposed between these members.

The insulator 22 has the shape of a flattened spool, in the circumferential groove of which is fitted the pair of semi-circular metal rings 32, each of which is provided with outwardly extending end portions bent away from each other to present a substantially flat surface across both bent end portions. A lower conducting electrode 33 is rigidly attached to the outwardly bent portions of the members 32 by means of the bolts 34 extending through both members, and the cooperating nuts 44. The electrode 33 is substantially U shaped, the lower portion of the U extending across the axis of the tube 30, in spaced relation thereto, and is provided with a circular opening 38, of approximately the same diameter as the internal diameter of the tube 30, and substantially aligned with the opening therein. The upper ends of the U shaped lower electrode 33 have their end portions 27 bent upwardly and outwardly toward the roof 26 of the upper electrode 15, thus forming a spark gap externally of the tube 30. The bolt 36, extending through the lower portion of the lower electrode 33, in cooperation with the nut 37, provides a convenient means for connecting a line conductor thereto.

To prevent birds or animals or other objects from completing a circuit through their bodies from the upper electrode 15 to the lower electrode 33, a conducting barrier 46 is interposed therebetween, the latter extending circumferentially about the tube 30 and laterally thereof for a substantial distance beyond the two electrodes. The band 47, substantially encircling the tube 30, provides a support for the barrier 46, and is held in place by means of the screw 48, the latter extending into but not through the wall of the tube 30.

An element of insulating material extends downwardly from the top of the tube 30 to the bottom end thereof, this element consisting of a rod of insulating material 19, together with a hollow cylindroid of insulating material 31, the latter extending upwardly over the rod 19 from the lower end thereof. In matched relation thereto, and extending downwardly over the rod 19 from the upper end thereof, is fitted the hollow metal cylindroid or conducting member 29, the latter being secured to the rod 19 by means of the screw 21. The upper end of the hollow conducting member 29 is provided with an integral outwardly extending flange for engaging the upper end of the tube 30, thereby supporting the internal insulating element from its upper end. This flange is electrically connected to the upper electrode 15, through the metal ring 20 so that the lower end of the conducting member 29 is maintained substantially at ground potential. A resilient cushioning member 18, of rubber or other suitable resilient material, is interposed between the lower surface of the cap 15 and the flange of the conducting member 29 to prevent permanent longitudinal displacement of the latter with respect to the lower electrode 33.

The element of insulating material including the hollow cylindroids 31 and 29 is normally arranged to be resiliently held in eccentric relation with the tube 30, with the outer surface of the element abutting the inner surface of the tube along a line extending vertically through the lowermost point of the conducting member 29.

For this purpose, a hollow metal cylinder 41 is mounted in the wall of the tube 30 in a plane passing through a diameter of the tube 30 and the line of contact of the conducting member 29 with the inner wall of the tube 30, to provide a mounting for a resilient biasing means arranged to urge the insulating element in a lateral direction. The metal cap 43 is secured to an outwardly extending portion of the cylinder 41 by means of cooperating threads on the respective members. The coil spring 42, having one end engaging the cap 43, and the other the slidable member 40, is housed within the cylinder 41, and the slidable member 40 engages the outer surface of the tube 31, to resiliently urge the insulating element in a lateral direction.

From the above description, it will be seen that the path of lowest dielectric strength is along a line extending vertically from the lowermost point of the conducting member 29 to the lower electrode 33, and in a space between the inner surface of the tubular insulator 30 and the outer surface of the internal insulating element. It will also be seen that the pressure resulting from an arc following this path will be the highest per unit length of path, since this is the path of maximum arc restriction. The pressure incident to an arc over this path urges the insulating element in a lateral direction, this motion being opposed by the spring 42. Following such a movement, the arc may follow any path within the tube 30, but, due to the novel arrangement of the electrodes, as the restriction of the arc becomes less as it moves around the periphery of the insulating element, the length of the arc becomes correspondingly greater. The device is in this manner arranged to extinguish the arc regardless of the path taken within the tube.

Obviously one of the principal advantages of the arangement lies in the fact that the device is adapted to spark-over at a very much lower initial voltage than would be possible in a device having an arc path of constant arc length and constant cross-sectional area of arc path, this result being accomplished without sacrifice of arc-extinguishing qualities. In addition, the impact attending the operation of the device, due to the resilient mounting of the insulating element, is much less than that of a rigid structure of the same arc-extinguishing effectiveness.

The tubes 30 and 31 are preferably constructed of some material which will evolve gas in the presence of an arc, as hard fiber, since the device depends for its arc-extinguishing qualities upon the pressure resulting from an arc within the device. The vent 38 in the lower electrode 33 is provided to relieve the stress due to such pressure, and the circumferential band 23, located between the ends of the tube 30, is desirable for providing additional wall strength to enable the device to withstand the heavy pressures attending the interruption of large currents.

The hard fiber, mentioned specifically above as a suitable material for use in constructing the tube 30 and the internal insulating element, is, in common with numerous other suitable materials of organic base, quite susceptible to damage from creepage currents, particularly if subjected to high voltages for long periods of time. To prevent such damage, the device embodies the insulator 22 for supporting one electrode of the device in spaced relation to the tube 30.

It will be seen from the above description that the important considerations in applying the device for operation on a circuit having a given normal voltage are (1) the weakest electrical path must be internally of the housing or tubular

insulator 30, and in the space between the tubular insulator and the internal insulating element, and (2) the length of any path between the conducting member 29 and the lower electrode 33 must be sufficient that, under the conditions of operation, the normal circuit voltage will be incapable of sustaining an arc over any path within the tubular insulator.

The external or open gaps formed by the outwardly extending portions of the upper and lower electrodes of the device are provided as coordinating gaps, and are intended to be so spaced that they will flash over just under the impulse strength of the apparatus to be protected. These gaps thus protect the apparatus regardless of the condition of the arc-extinguishing arrangement, but being open gaps, they are not inherently self-extinguishing. The arc-extinguishing or internal gap embodied in the device is therefore arranged to flash over at a voltage substantially under that required to flash over the external gaps, for all intervals of applied voltage.

Fig. 5 illustrates the device in the service position, as it appears on a common type of conductor supporting structure. In this illustration the device is designated in its entirety by the numeral 49, and shown supported from the cross arm or supporting member 10, the latter being attached to the pole 39 in any suitable manner. The pole 39 is anchored in the earth 45, and the ground wire 17 extends from the top electrode 15 of the device down the pole 39 into the earth 45. The insulator 16 supports the line conductor 28 on the cross arm 10 in any suitable well known manner, and the lower electrode 33 of the device is connected to the line conductor 28 by means of the conductor 35.

From the embodiment of my invention herein described, other equivalent arrangements will be readily apparent, and it is to be understood that the invention herein disclosed is to be limited only as is necessitated by the prior art and the appended claim.

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

In a voltage limiting device, a hollow tube of insulating material open at one end, an insulator secured to said tube externally thereof, a substantially cylindrical element of insulating material having a diameter less than that of the hollow extending therein, means holding said element of insulating material in lateral abutting engagement with the inner surface of said tube, and structural means for causing sparkover to occur along the line of abutment of said tube with said insulating element, said structural means including a conducting member extending downwardly along a portion of the length of said line of abutment and an electrode carried by said insulator in spaced relationship with both said tube and said element.

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