Oct. 31, 1939. R. R. PITTMAN 2,177,744

VOLTAGE LIMITING AND ARC EXTINGUISHING DEVICE

Filed Feb. 23, 1939

Fig. 1

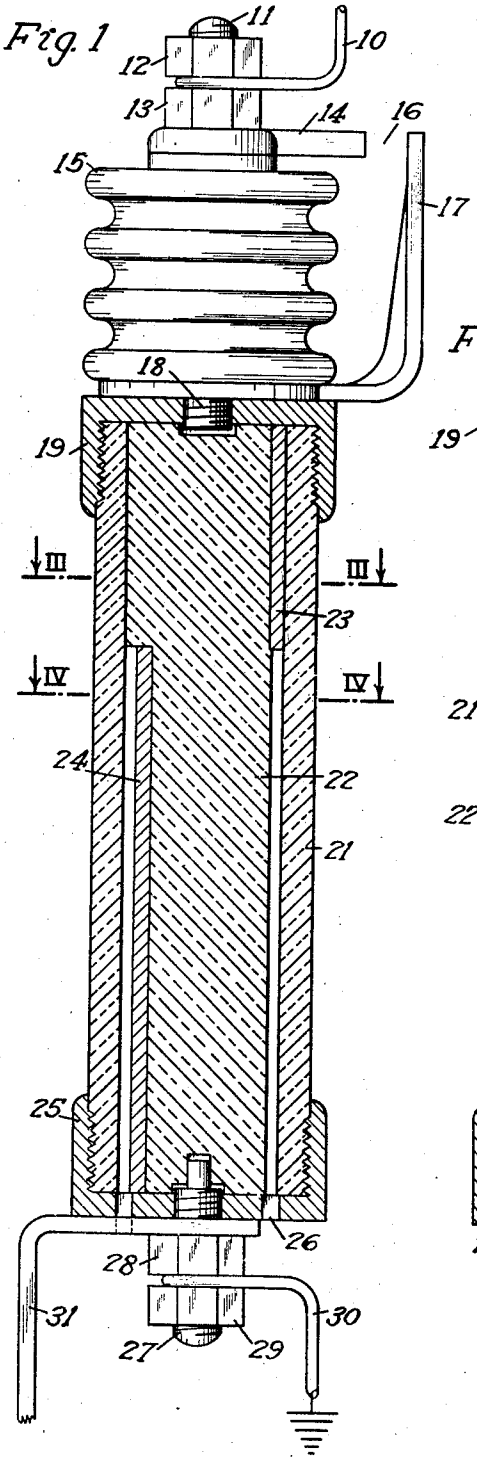


Fig. 3

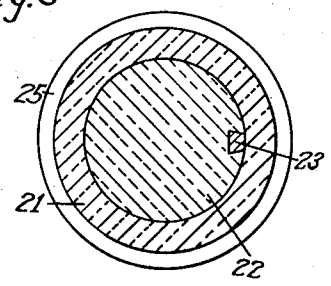


Fig. 2

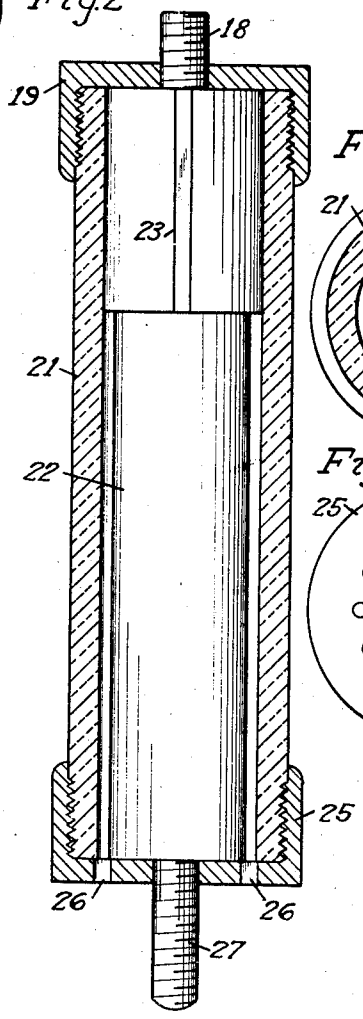


Fig. 4

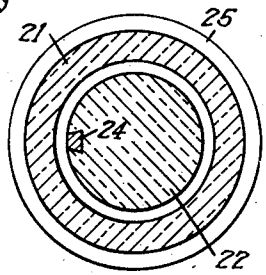
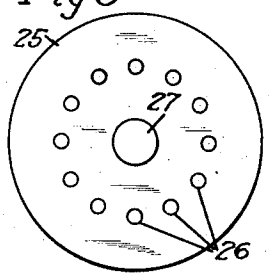


Fig 5



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VOLTAGE LIMITING AND ARC EXTINGUISHING DEVICE

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6 Claims. (Cl. 175—30)

This invention relates generally to devices commonly referred to as lightning arresters, and particularly to devices for the purpose of limiting the rise in voltage of a connected conductor by means of arcing gaps adapted to break down at a predetermined voltage, together with means for quickly extinguishing an arc which may attend break down of the gaps.

The present invention relates to improvements in the arc extinguishing device illustrated in Patent No. 2,065,152, dated Dec. 22, 1936, and granted to the inventor herein, and has for one of its objects the embodiment of means, responsive to the occurrence of an arc, for moving and elongating the arc with respect to its initial path and thereby facilitate its extinction.

More specifically, it is an object of the present invention to provide an improved construction in an arc extinguishing device embodying spaced electrodes within a restricted annular arc space between juxtaposed elements of insulating material, in which the electrodes are so related that sparkover occurs over a predetermined arc path around the annular space, and in which the arc which may attend sparkover is lengthened by the gaseous arc products which pass across the arc toward a vented opening.

Such an organization makes possible a relatively close spacing of the electrodes of the arcing gap, and thus provides a high degree of protection to connected apparatus from overvoltages, without sacrifice of ability to interrupt an arc which may occur between an energized conductor and ground, and this organization is another object of the present invention.

In the construction illustrated in the above-mentioned patent, sparkover is established over a vertical path longitudinally along the tube which houses the arc space. The principle or idea of the present invention is distinguished by a new and radically different arrangement of electrodes which are so related to each other and the other elements of the device that sparkover occurs over a substantially horizontal path extending around an annular arc space. This latter arrangement is such that the gaseous arc products move normally across the arc, instead of along or past the arc as in the former, thereby accomplishing a reduction in arc energy due to quicker extinction and more effective cooling.

The above mentioned patent also illustrates a construction in which sparkover occurs along a vertical line of abutment between two curved elements. This is an effective arrangement for obtaining low initial breakdown, but requires a very strong structure to resist the impact accompanying the discharge of a high surge current through the restricted path. The present invention provides a sparkover path for lightning currents which is relatively open, and makes possible a more economical construction without sacrifice of surge capacity, which is a further object of the present invention.

These and other objects will be apparent from the following description taken in connection with the accompanying drawing and claims forming a part of this application.

In the drawing: Fig. 1 is a side elevational view of the structure, in which the arc extinguishing device is shown in section; Fig. 2 is another elevational view, shown partly in section, of the arc extinguishing device; Figs. 3 and 4 are sectional views taken along the lines III—III and IV—IV of Fig. 1, respectively, and Fig. 5 is an end view of the structure of Fig. 2, as viewed from below.

As shown in Figs. 1 and 2, a hollow tube of insulating material 21, preferably of hard fiber, is closed at its upper end by means of the metal cap 19, the latter being secured to the tubular insulator 21 by means of internal threads in cooperation with external threads on the tube. In a similar manner, the lower metal cap 25 is secured to the lower end of the tubular insulator 21, the cap 25 being provided with a plurality of vent openings 26 in communication with the interior of the hollow tube 21.

To prevent possible damage from creepage currents to the tube 21, a leakage gap arrangement is provided at the upper end thereof, which includes the insulator 15, preferably of ceramic material. The latter is secured, in coaxial relationship with the tube 21, to the cap 19 by means of the stud 18, the outwardly and upwardly extending leakage gap electrode 17 being clamped between the insulator 15 and the cap 19. A threaded stud 11 is secured to the upper end of the insulator 15 in any suitable manner, and the leakage gap electrode 14 is held by means of the nut 13, in spaced relationship with the leakage gap electrode 17 to provide the leakage gap 16. Another nut 12 engaging the threads of the stud 11 provides a terminal for conductor 10.

To provide a mounting for the device, a stud 27 threadedly extends upwardly into a centrally positioned opening in the lower cap 25, and a mounting bracket 31, of any suitable design, is clamped between the cap 25 and the nut 28. A second nut 29 on the stud 27 provides a terminal for the ground conductor 30.

The tube 21 contains the cylindrical element

of insulating material 22, which may also be of hard fiber, and which has for a substantial portion of its length, a diameter less than the internal diameter of the tube 21. As a convenient means for holding the element 22 in coaxial relationship with respect to the hollow of the tube 21, and for another reason to be subsequently mentioned, the upper portion of the element 22 snugly fits into the upper portion of the hollow, and at the lower end of the element 22, an unthreaded integral portion of the stud 27 extends upwardly into a centrally positioned recess at the lower end of the element 22.

Within the tube 21, a first conducting electrode 23, in electrical contact at its upper end with the cap 19, extends vertically downward along the element 22 to the top of that portion of the element 22 which is spaced from the tube 21, and a second conducting electrode 24, in electrical contact at its lower end with the lower cap 25, extends vertically upward along the diametrically opposite side of the element 22, preferably to the elevation of the lower end of the electrode 23. The electrical strength of the horizontally positioned path in the annular space around the element 22 from one electrode to the other is purposely made the weakest electrical or preferred path from the cap 19 to the cap 25, so that sparkover occurs over this substantially horizontally positioned path rather than over any other path between the caps.

The series arrangement of the internal and external arcing gaps has an electrical strength which is so coordinated with the insulating elements of the device that the weakest electrical path from the conductor 10 to the ground conductor 30 is through the series arrangement of these gaps, and electrical breakdown in response to an excessive difference in potential between conductor and ground therefore includes the arcing gap between the electrodes 14 and 17, and the arcing gap between the lower end of the electrode 23 and the upper end of the electrode 24. While the shortest distance between the electrodes 23 and 24 is through a diameter of the element 22, electrical breakdown does not occur over this path for the reason that the flashover value of the element 22 is substantially less than the puncture value.

As mentioned above, the tubular insulator 21 and the element 22 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 movement of the gaseous products of the arc. Assuming that the gaps have broken down in response to an overvoltage with respect to ground on a connected conductor, such as might be caused by lightning, the initial path of the current which may attend or follow from an energized conductor is through a horizontally positioned arc which extends around the element 22 from one side to the other, in the annular space between the element 22 and the tube 21, and along the lower surface of that portion of the element 22 which snugly fits the upper portion of the tube 21. Immediately the gaseous arc products, in response to the pressure due to the arc, move downwardly through the annular space toward and out of the vent openings 26. In so doing, the arc is subjected to a downwardly directed gas blast over its entire length, the gases moving across the arc in a direction normal to that of the arc. Since an arc has little weight, it is easily deflected by laterally applied gas pressure, and it is thereby stretched over the relatively cool element 22 in a downward direction to extinguishment.

It will be observed that the arrangement described herein makes possible the use of an internal arcing gap in a relatively open arc space without sacrifice of protective or arc extinguishing ability, thereby enabling the structure to withstand much greater lightning discharge current and energy than is possible in a highly restricted structure of the same wall strength.

Although the invention has been shown in but one form, it will be evident to those skilled in the art that other forms and modifications may be employed without departing from the spirit of the invention as described above or as set forth in the appended claims.

What is claimed is:

1. An arc extinguishing device comprising a longitudinally extending hollow tubular insulator closed at one end and open at the other end, a substantially cylindrical element of insulating material having a diameter less than the internal diameter of said insulator within said insulator, means holding said element of insulating material within said tube to provide a single annular space therebetween, and a first conducting and a second conducting electrode spaced apart to provide a preferential spark path therebetween within said annular space, said first and second electrodes being normally insulated from each other and extending along said element on opposite sides thereof in spaced parallel relationship from the closed end and from the open end of said tubular insulator respectively, said electrodes being so arranged that the weakest electrical path is therebetween and extends peripherally around the curved surface of said element and transversely with respect to the axis of said tubular insulator.

2. In a voltage limiting and arc extinguishing device, a vertically extending hollow tube of insulating material closed at the upper end and open at the lower end, a substantially cylindrical element of insulating material having a diameter less than the internal diameter of said tube within said tube, means holding said element of insulating material within said tube to maintain a single annular space therebetween, a first conducting electrode carried by said element and extending vertically downward from the closed end of said tube toward but in spaced relationship with the open end of said tube, a second conducting electrode carried by said element and extending vertically upward along said element in the plane passing through said first electrode and the axis of said element, the electrodes being normally insulated from each other and so related that the weakest electrical path therebetween is in a substantially horizontal plane passing through the adjacent ends of said electrodes which extends circumferentially around the surface of cylindrical element of insulating material.

3. An arc extinguishing device comprising a tubular insulator closed at the upper end and open at the lower end, a substantially cylindrical element of insulating material within said insulator, means supporting said element of insulating material in coaxial relation with said insulator, a first conducting electrode carried by said element and extending downwardly along one side thereof from the closed end of said insulator and a second conducting electrode carried by said element and extending upwardly along the

other side thereof from the open end of said insulator, said electrodes being normally insulated from each other and so related that the weakest electrical path therebetween is along the line extending around the curved surface of said element from one side to the other and transversely with respect to the axis of said tubular insulator.

4. In a voltage limiting and arc extinguishing device, a hallow tube of insulating material having at least one end open, a substantially cylindrical element of insulating material having a diameter less than the internal diameter of said tube within said tube to provide a single annular space therebetween, means holding said element of insulating material in coaxial relationship with said tube, and normally insulated conducting electrodes spaced apart to provide a preferential sparkover path therebetween within said annular space, said electrodes extending longitudinally along diametrically opposite sides of said element and being so arranged that the weakest electrical path therebetween extends peripherally around the surface of said cylindrical element of insulating material.

5. In a voltage limiting and arc extinguishing device adapted for connection between a conductor and ground, a vertically extending hollow tube of gas evolving insulating material having a closed upper end and an open lower end, a substantially cylindrical element of gas evolving insulating material having a diameter less than that of said hallow extending in said tube from the open end toward the closed end, means supporting said element within said tube to provide an annular space therebetween, a first conducting electrode extending downwardly along the outer surface of the other side of said element from the upper end of said tube and in parallel relationship with the axis of said tube and a second conducting electrode extending upwardly along the outer surface of said element in the vertical plane passing through said first electrode and the axis of said element, said electrodes being normally insulated and so positioned that the weakest electrical path through the device is along a curved line extending transversely around said element from the lower end of said first electrode to the upper end of said second electrode and within said annular space, the arrangement being such that the gas attending sparkover between said electrodes moves both laterally across said weakest electrical path and longitudinally along said element toward the open end of said tube.

6. In a voltage limiting and arc extinguishing device adapted for connection between a conductor and ground, a hollow tube of gas-evolving insulating material having a closed upper and an open lower end, a substantially cylindrical element of gas-evolving insulating material having a diameter less than that of said hollow extending in said tube from the open end toward the closed end, means supporting said element within said tube to provide a single annular space between said tube and said element, and structural means for causing sparkover between conductor and ground to initially occur within said space over a predetermined weakest electrical path which extends transversely with respect to the axis of said tubular insulator around the curved surface of said element, the arrangement being such that the gas attending sparkover moves laterally across said weakest electrical path as it moves longitudinally along said element toward the open end of said tube.

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