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EXPULSION LIGHTNING ARRESTER

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Fig. 1

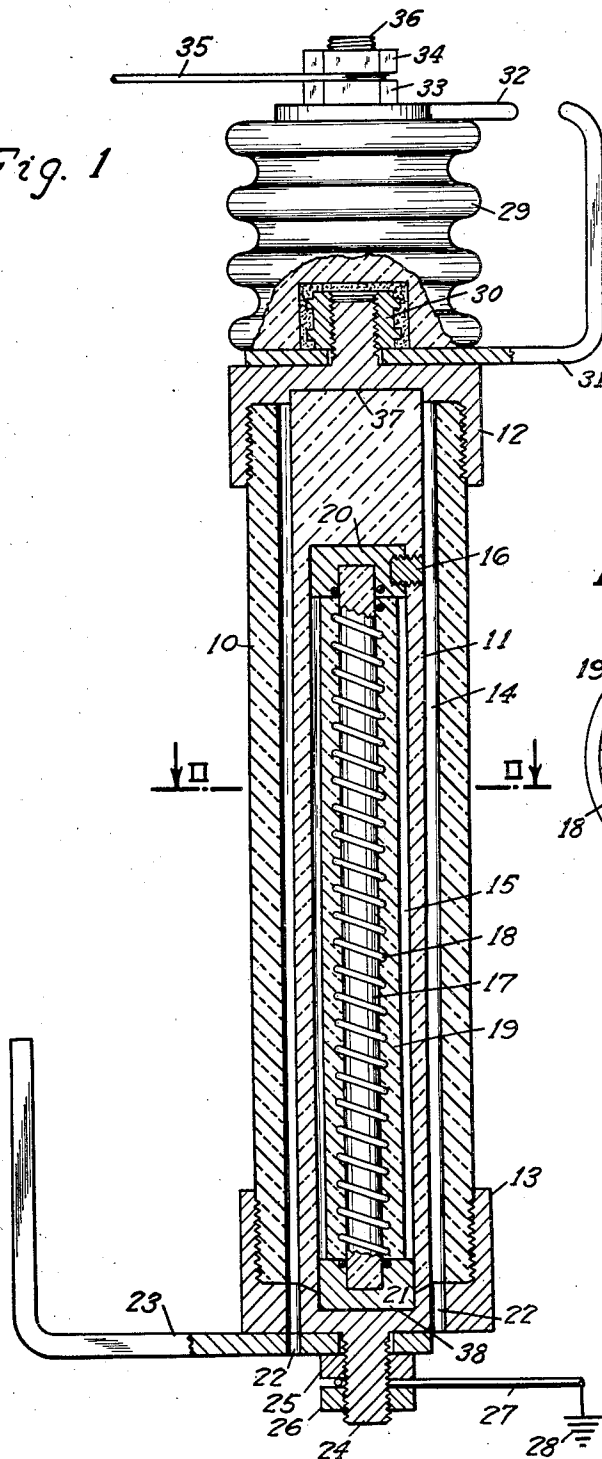
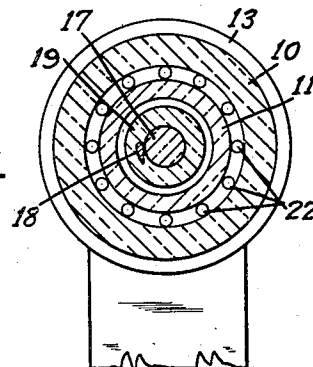


Fig. 2



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EXPULSION LIGHTNING ARRESTER

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6 Claims. (Cl. 175—30)

This invention relates generally to lightning-protection devices, and particularly to that type of lightning arresters in which arcing gaps are provided for the purpose of limiting the voltage of a connected conductor to a predetermined value, and in which an arc following breakdown of the gaps is subsequently extinguished by expulsion action.

Heretofore devices of this character which embody a longitudinally extending arc space of uniform cross-sectional area bounded by gas-evolving insulating material have had a limited range of current interrupting ability determined by the length and area of the breakdown path. In order to extend the range of interrupting ability, impedances, usually resistors, have been used in series with the device, for the purpose of limiting the current due to normal voltage applied to the broken-down path to some maximum value within the operating range of the device. Such impedances have been mounted externally of the device, requiring additional series and shunting gaps also externally mounted.

It is an object of the present invention to provide a construction in which a current-limiting impedance is embodied, and in which the discharge of the inherently conducting gas is utilized in cooperation with the electrodes normally required by the device to provide improved series and shunting characteristics which are variable in accordance with the quantity of electricity passing through the device, thereby reducing the number of parts required, as well as providing a simpler and more compact structure of greater effectiveness.

With this and other objects in view which appear from the description, my invention resides in the novel form, construction and arrangements of the parts constituting the device, and the scope of the invention will be indicated in the appended claims.

The invention is illustrated in the accompanying drawing, in which Fig. 1 is a longitudinal elevation shown principally in section, and Fig. 2 is a section taken along the line II—II of Fig. 1.

As shown in the embodiment illustrated, an outer hollow tubular insulator 10, of uniform diameter, is fitted at its respective ends with the upper and lower electrodes of conducting material 12 and 13, by means of cooperating threads on these members, the upper electrode 12 closing the upper end of the insulator 10. The insulator 10 contains the hollow tubular insulator 11, also of uniform diameter, the latter

being secured in spaced coaxial relationship with the former by the extension of the upper end portion of the member 11 into the recess 37 of the upper electrode 12, and the extension of the lower end portion of the member 11 into the recess 38 of the lower electrode 13. The outer diameter of the insulator 11 is less than the inner diameter of the insulator 10, the longitudinally extending annular space therebetween being designated by the reference character 14.

The hollow 15 of the insulator 11 contains an impedance member, here shown as a wound type resistor which extends coaxially upward from the lower end of the insulator 11 toward and in spaced relationship with the upper electrode 12. The resistor includes the rod of insulating material 17, around which is helically wound the resistance wire 18, the latter being connected at its respective ends to the conducting terminals 20 and 21. A coating 19, of vitreous enamel or other suitable heat-resistant insulating material, may be provided over the conductor 18. The lower terminal 21 of the resistor engages the lower conducting electrode 13, and the upper terminal 20 is engaged by the intermediate electrode 16, the latter extending outwardly and laterally in threaded engagement through the wall of the inner tubular insulator 11 its outer end being exposed to the annular space 14 at a point spaced from both the upper electrode 12 and the lower electrode 13.

In accordance with common practice, a leakage-gap arrangement is provided at the upper end of the device, including the insulator 29, of ceramic material, in which the cemented insert 30 is arranged to cooperate with an externally threaded, upwardly extending portion of the upper electrode 12, the outwardly and upwardly extending lower leakage-gap electrode 31 being conveniently held in place by clamping a portion thereof between the insulator 29 and the upper electrode 12. At the upper end of the insulator 29 an upwardly extending threaded stud is secured in any suitable manner, and the upper leakage-gap electrode 32 arranged to extend toward and in spaced relation to the lower leakage-gap electrode 31, the clamping nut 33, fitting the stud 36, holding the electrode 32 in place. The device is shown connected to a line conductor 35, the latter being clamped between the nuts 33 and 34, both of which cooperate with the threads of the stud 36.

At the lower end of the device, the lower electrode 13 is provided with the centrally positioned, downwardly extending threaded portion 24, and

a mounting bracket 23 may be clamped between the lower surface of the lower electrode 13 and the nut 25, the latter engaging the threaded portion 24. The lower electrode 13 is connected to the ground 28 by means of the grounding conductor 27, one end of the latter being clamped between the terminal nut 26 and the clamping nut 25.

The material from which the insulators 10 and 11 are constructed is one which evolves gases which are highly ionized and electrically conducting at or near atmospheric pressures in response to an arc, one such material being hard fiber. The vent openings 22 of the lower electrode 13, in communication respectively with the annular space 14 and the outside of the outer tube, provide the only means of egress for the gases formed within the annular space.

From the arrangement above described, it will be apparent that the weakest initial or preferential arc path through the device is from the upper electrode 12 to the intermediate electrode 16, and thence through the resistor to the lower electrode 13. It will also be clear that any gases evolved as a result of an arc initiated between the electrodes 12 and 16 will move along the annular space 14 to the vents 22. These gases, being highly conducting, provide a gaseous conducting path electrically connecting the electrode 16 to the lower electrode 13, thereby shunt-circuiting the resistor.

The current carrying capacity of the resistor should be such that it will carry the superimposed current and the line-to-ground current available from the connected circuit without damage for the short interval prior to initiation of the shunting arc between the electrodes 16 and 13, and the spacing and restriction of the arc path between the electrodes 12 and 16 such that circuit interruption will occur when the follow current is limited only by the resistor. If the lightning current is severe, that is, great in magnitude and/or duration, the gases due only to the surge current may cause the desired shunt-circuiting of the resistor, the device thus tending to be self-protecting in that the elapsed time for initiating the shunting arc is decreased as the need for so doing is increased.

The sequence of events when discharging relatively large surge currents follows: (1) breakdown of leakage-gap and preferential arc path from electrode 12 to electrode 16; (2) passage of current from electrode 12 to electrode 16 and thence to ground through the resistor; (3) discharge of conducting gas from preferential arc path through the vents 22 to electrically connect the electrode 16 to the electrode 13; (4) continued discharge of surge current through the parallel arrangement of resistor and shunting gas path until reduced to substantially zero; and (5) extinguishment of the arc maintained by the follow current and limited by the resistor 18 at the first current zero by expulsion action occurring along the arc path between the electrodes 12 and 16. Certain values of surge current may be too small to cause the above-described shunting effect, arc extinguishment in such cases being due simply to the effect of the resistor 18 in limiting the follow current to a value readily extinguished by the expulsion action between the electrodes 12 and 16. All of the above events occur with great rapidity, the entire sequence requiring a maximum of 1/2 cycle.

From the above description, it will be noted that I provide an organization in which the con-

ducting gases inherently discharged from an expulsion chamber are utilized to establish a protective gaseous current-carrying path in shunt with the resistor, the conductivity of the path varying directly with the magnitude and duration of the current to be discharged or interrupted. The operation of the device therefore automatically adjusts itself to the imposed conditions, and the abrupt change resulting from the use of an open-air gap in shunt with the resistor is avoided.

The above description of the invention is intended to be illustrative, rather than limiting.

I claim, as my invention:

1. A lightning arrester comprising two hollow tubular insulators which differ in diameter, upper and lower normally insulated conducting electrodes associated with said insulators, means including said electrodes for supporting said insulators in coaxial spaced relationship one within the other to provide an annular space therebetween, means including a resistor supported within the hollow of the insulator of lesser diameter for providing a preferential arc path within said annular arc space, and means responsive to the occurrence of an arc over said path for shunt-circuiting said resistor.

2. A lightning arrester comprising two hollow tubular insulators which differ in diameter, upper and lower normally insulated conducting electrodes associated with said insulators, means including said electrodes for supporting said insulators in coaxial spaced relationship one within the other to provide an annular space therebetween, means including a resistor supported within the hollow of the insulator of lesser diameter for providing a preferential arc path within said annular arc space, and means responsive to the occurrence of an arc over said preferential arc path for establishing a gaseous conducting arc path in shunt circuit relation with respect to said resistor and in series circuit relation with respect to said preferential arc path.

3. A lightning arrester of the expulsion type comprising two hollow tubular insulators of differing diameter, spaced upper and lower conducting electrodes at the respective ends of said insulators, means including said electrodes for supporting said insulators in coaxial spaced relationship one within the other to provide a uniform longitudinally extending annular space therebetween, means including a resistor positioned within the hollow of the insulator of lesser diameter for providing a preferential arc path within said annular space, said resistor having its lower end electrically connected to and supported by the lower electrode and extending upwardly therefrom in normally insulated spaced relation with the upper electrode, and means responsive to the occurrence of an arc over said preferential arc path for establishing a gaseous arc path within said annular space in shunt relation with said resistor, said last-named means including vent means for said annular space only in said lower electrode in communication with the outside of the outer tube.

4. A lightning arrester of the expulsion type comprising two hollow tubular insulators of differing diameter, spaced upper and lower conducting electrodes at the respective ends of said insulators, means including said electrodes for supporting said insulators in coaxial spaced relationship one within the other to provide a uniform longitudinally extending annular space therebetween, means including a resistor positioned within the hollow of the insulator of lesser

diameter for providing a preferential arc path within said annular space, one end of said resistor engaging the lower electrode and extending upwardly therefrom in normally spaced insulated relation with the upper electrode, and vent means in said lower electrode for said annular arc space.

5. A lightning arrester of the expulsion type comprising two hollow tubular insulators of differing diameter, spaced upper and lower electrodes at the respective ends of said insulators, means including said electrodes for supporting said insulators in coaxial spaced relationship one within the other to provide a uniform longitudinally extending annular space therebetween, vent means in said lower electrode for communication respectively with said annular space and the outside of the outer tube, a resistor positioned within the hollow of the insulator of lesser diameter, one end of said resistor engaging the lower electrode and extending upwardly therefrom in spaced relationship with the upper electrode, said resistor providing means for initiating a primary arc within said annular space in

series circuit relation with said resistor, and means responsive to the initiation of said primary arc for initiating a secondary arc within said annular space in shunt with said resistor and in series circuit relation with said primary arc.

6. In a lightning arrester of the expulsion type, a tubular dielectric structure comprising two concentric hollow cylindrical tubes of gas-evolving wall-material, means for providing an annular space therebetween, said means including spaced normally insulated conducting electrodes at the respective ends of said insulators, means including a resistance member contained within the hollow of the insulator of lesser diameter for initiating a primary arc within said annular space and in series circuit relation with said resistance member, and means responsive to the evolution of electrically conducting gas attending said primary arc for providing a secondary arc within said annular space in shunt circuit relation with said resistance member and in series circuit relation with said primary arc.

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