

Nov. 3, 1942.

G. B. ROLOSON
LIGHTNING ARRESTER

2,300,846

Filed Sept. 20, 1939

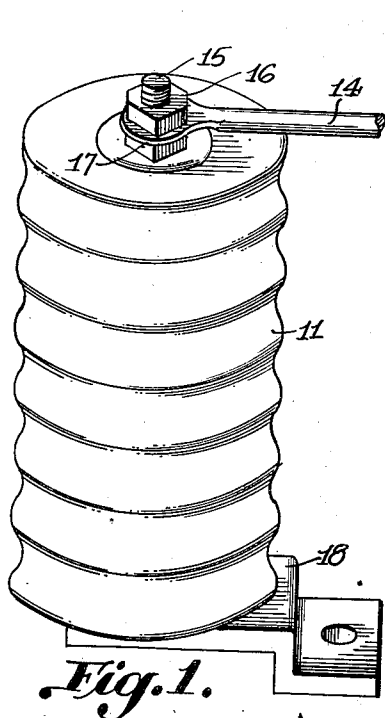


Fig. 1.

Fig. 2.

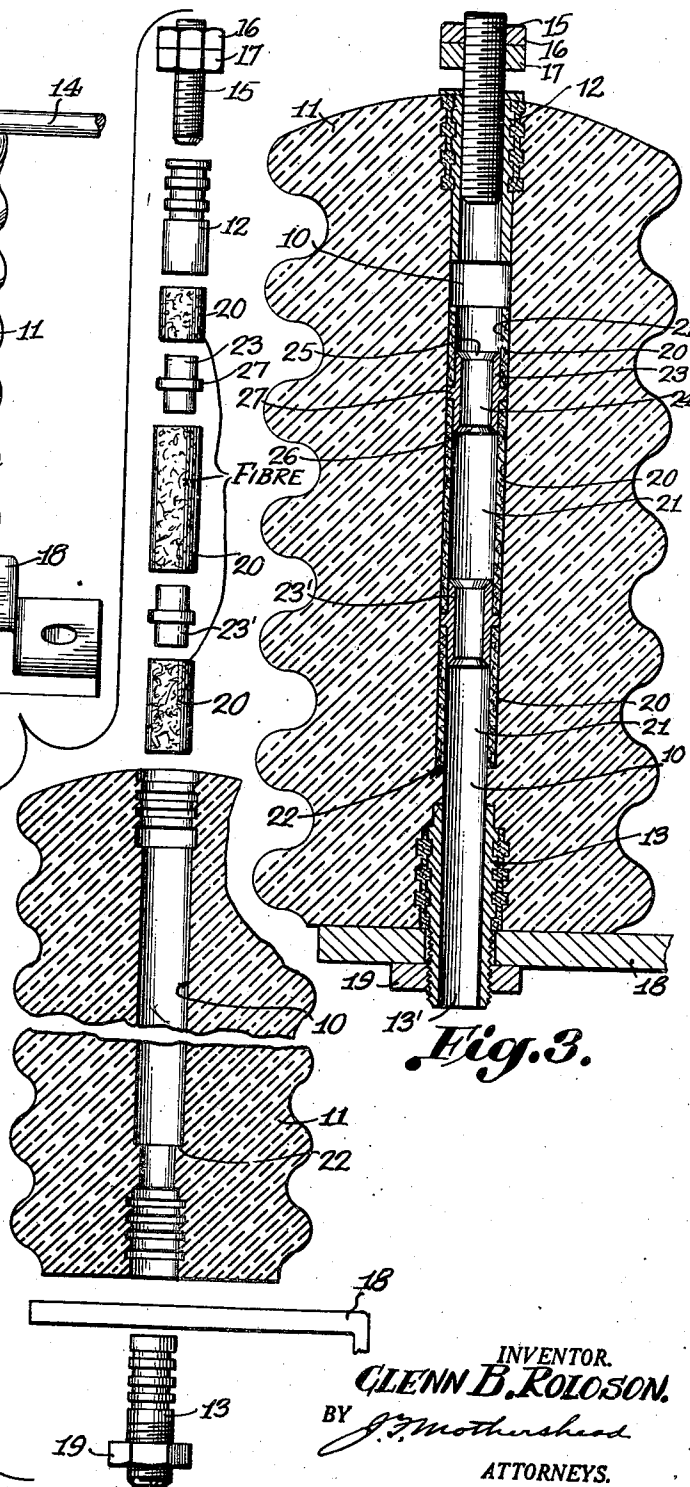


Fig. 3.

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UNITED STATES PATENT OFFICE

2,300,846

LIGHTNING ARRESTER

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Application September 20, 1939, Serial No. 295,778

3 Claims. (Cl. 175—30)

(Granted under the act of March 3, 1883, as amended April 30, 1928; 370 O. G. 757)

The invention described herein may be manufactured and used by or for the Government of the United States for governmental purposes without the payment to me of any royalty thereon in accordance with the provisions of the act of April 30, 1928 (ch. 460, 45 St. L. 467).

My invention pertains to lightning arresters for the prevention of interruptions to service and damage to connected apparatus due to surges produced by lightning or other causes.

One of the earliest and simplest forms of protective devices for relieving electric transmission and distribution lines from excess voltage, produced by lightning or other causes, was to bring an electrode connected to the line in close proximity in open air to an electrode connected with the ground. These electrodes were spaced at such a distance apart that the normal line voltage was not sufficient to start a current to flow between the electrodes. However, the electrodes were close enough to each other that when an abnormal voltage appeared between the line and ground the current would discharge between the electrodes, thus reducing the excess voltage between line and ground.

One of the difficulties of the above-described unconfined air gap was that when an arc was once formed between the electrodes the normal line voltage was sufficient to maintain an arc across the electrodes, thus leaving a virtual ground on the line after the device had operated. This current flow across the electrodes, created by an excess voltage surge but maintained by normal line voltage, is referred to as the "follow up current." Various methods have been utilized to interrupt the follow up current, perhaps the most successful being patterned after a common type of the expulsion fuse which has been in use for a considerable period of time. The arc between the electrodes in this fuse was enclosed in a fibre tube which was open at one end. When the arc came in contact with the fibre it produced a non-ionized gas in which it was difficult to maintain an arc. The sudden rush of the gas blew the arc out.

Many lightning arresters have been made which make use of the principle of the above-described expulsion tube. In these arresters the maintenance of line voltage across the fibre or gas-producing material of the tube causes charring or other deterioration of the tube and leakage of current through the tube material. In order to overcome this difficulty, many of these arresters use an external air gap in series with the tube.

The external air gap is a complication which introduces extra hazards, offers more opportunity for birds to short circuit the line and renders the lightning arrester less reliable due to the difficulty of keeping the electrodes in the proper space relation. Also the energy of the arc in the external air gap is of very little benefit in interrupting the follow-up current, whereas, if the entire arc were to take place in a confined space, the energy of all the arc would be available to produce gas to extinguish the follow-up current.

A series of air gaps is used rather than a single gap in some lightning arresters because multiple gaps are quicker in action than single gaps. Also metallic rings have been used for intermediate electrodes, but advantage has not been taken of these rings to direct the flow of gas so as to force the arc against the sides of the gas-producing tube.

With the foregoing and other objects in view, my invention resides in the combination of parts and in the details of construction hereinafter set forth in the following specification and appended claims, certain embodiments thereof having the characteristics of my invention and by which the same may be practiced being illustrated in the accompanying drawing in which—

Figure 1 is a perspective view of the assembled arrester;

Figure 2, detailed views in elevation of the unassembled elements arranged successively in the order of assembly; and

Figure 3, a vertical cross section through the assembled unit.

My invention comprises a suitable hollow or cored body having the insulating or dielectric characteristics of porcelain, glass, etc., the bore or hollow of which is suitably, though not necessarily, elongated and of relatively small cross sectional area. In connection with this body which defines a chamber, I provide suitable electrode means for connecting a lead from a power line and a ground terminal into communication with the chamber at points removed from each other. The chamber or passageway between the line and ground connections is provided with a liner of suitable gas evolving material, and an intermediate electrode spaced with respect to the line and ground electrodes. The intermediate electrode is provided with a somewhat smaller opening or path than that of the lined spark gaps between the intermediate electrode and the line and ground connections.

The intermediate electrode is further char-

acterized by an opening which flares at the mouths thereof to an opening substantially that of the aforesaid spark gap chamber so as to facilitate the flow of gas through the somewhat smaller passageway of the electrode. Gas passing through the electrode is thus caused to flow along the axis of the air gap and in doing so forces arcs within the spark gaps against the gas-evolving liner. If the arc is permitted to flow along the axis of the air gap rather than effectively close to the liner, the rate at which gas will be caused to evolve from the liner may be inadequate to completely nonionize the path and thus fail to destroy the arc.

The voltage of the line upon which the device is intended to be used is a determinative factor for the diameter, length and area of the spark gaps. The present invention renders external gaps unnecessary. Therefore, the spacing of the intermediate electrode with respect to the line and ground connections should be considerably less than the space between the line and ground connections to insure the passage of arcs through the device rather than across the terminals outside of the insulator body.

By reference to an embodiment, exemplifying the application of my invention, illustrated in the accompanying drawing it will be seen as comprising an expulsion tube type of arrester. The bore 10 of the insulator body 11 is provided, at the mouths thereof, with suitably secured hollow electrodes 12 and 13. As a suitable method of securing a lead from a power line 14 to the terminal electrode 12, a stud 15 is threaded into the electrode. This stud may in turn be provided with suitable securing means, such as a pair of nuts 16 and 17, between which the lead may be clamped as shown. In order that the passageway of the ground connecting electrode 13 remain unobstructed for the free expulsion of gases, the ground terminal may be secured to the outer walls of the electrode. This may be satisfactorily accomplished by the utilization of a mounting bracket 18 provided with a hole through which a protruding end of the electrode may extend and upon which extending end a securing nut 19 may be applied. The ground terminal may be suitably secured to the mounting bracket or clamped to the electrode by the nut 19.

Within the bore 10 of the insulator body and spaced from the respective terminal electrodes 12 and 13 there is mounted a liner 20 of suitable material, of minimum conductivity, yet gas-evolving, of the type conventionally used in the art of the class to which this invention pertains. This liner lines a portion of the walls of the bore 10 and provides a centrally disposed unobstructed arc path 21. Though the device is ordinarily to be positioned in an upright manner and though the stud 15 will ordinarily close the bore 10 to the entrance of water, and though the liner is preferably of nonconductive material, it is spaced from the respective terminal electrodes to prevent its serving as a current conductor from one electrode to the other. In the alternative, if it is preferable to have the liner in contact with the terminal electrodes it may be provided with a separation elsewhere to prevent a bridging over from one electrode to the other. The liner may be retained in spaced position by any suitable means, one of which is shown in the drawing as comprising a shoulder 22 within the bore 10 upon which the liner is brought to rest.

Within ends of the liner 20 is positioned an intermediate electrode 23 having a somewhat

smaller passageway 24 than that of the lined path 21, though preferably coaxial or in axial alignment therewith. It will be noted, however, that the mouths 25 and 26 of the intermediate electrode passageway 24 flare to substantially the size of the passageway 21 for the performance of the unique functions set forth elsewhere in this specification.

Suitable means or arrangements may be provided or made for maintaining the position of the intermediate electrode 23. For example, the overall diameter or cross sectional area of the electrode may be substantially that of the bore 10 of the insulator body 11 and project through and rest upon the penetrated surface of the liner 20. A suitable arrangement is shown in the illustrated embodiment wherein it will be seen that the electrode is provided with a circumscribing annular flange 27 which extends through a separation in the liner 20 and may either rest thereon or extend into frictional contact with the walls of the bore 10. By such an arrangement of the flange 27 it will be seen that the length of the spark gap between the intermediate electrode and either terminal electrode is shorter within the lined passageway than the space between the flange 27 and either terminal electrode. It follows, therefore, that an arc is more apt to flow within the lined passageway than between the liner and the wall of the bore 10. The liner may be spaced from the intermediate electrode rather than from the terminal electrodes but by the use of an intermediate electrode of the character just described it is believed more desirable to space the same from the terminal electrodes or provide a separation in the liner between the terminal electrodes and the intermediate electrode in order to permit the ends of the liner to pass behind and be retained by portions of the electrode 23.

A plurality of intermediate electrodes 23 and 23' may be provided, as shown in the embodiment illustrated, to insure the destruction of an arc in the event that the air of the spark gap fore and aft of the first intermediate electrode 23 is not sufficiently non-ionized or deprived of its conductivity by gas from the liner to extinguish the arc. It is also known that an arc will flash over a series of short spark gaps sooner than over a single gap of a length substantially the same as the sum of the length of the series of short gaps.

From the foregoing description and the illustrated embodiment it will be seen that the construction of the intermediate electrode is such as to direct the expulsion gases along the axis of the passageway and thereby force electric arcs against or close to the fibre liner whereby the heat of the arcs will be more effective upon the liner to produce a greater volume of non-ionized gas. The non-ionized gas first of all destroys conductivity and second the downward force of the gas to the exit 13' tends to extinguish the arcs. Except for an opening in the bottom of the device, the operative elements are completely shielded from weather and foreign objects which may destroy their effectiveness. Even though the operative elements of the device are shielded from foreign objects which may destroy the effectiveness of the elements the spacing of the liner from the terminal electrodes, or the separation of the liner at some point between the terminal electrodes is considered essential to interrupt a more or less conductive bridge across the terminal electrodes.

Although the gas evolving material of conven-

tional lightning arresters and fibre tubes of conventional expulsion tubes are usually considered non-conductive and insulating, the known fact remains that they are more or less conductive and subject to charring, deterioration and destruction by reason of the contact of this material with terminal electrodes having a difference of potential constantly impressed across them. The prevention of any current flow, from one terminal electrode to the other, through the liner also precludes the possibility of radio interference.

It will also be seen that the device herein described provides for an unobstructed exit for the gas to prevent the building up of pressure sufficient to burst the device.

Having thus described my invention what I claim is:

1. A vented electric discharge device of the expulsion tube type comprising a pair of terminal electrodes, an insulator body having the insulating characteristics of porcelain or glass and having a passageway therethrough into which said electrodes extend in spaced relation, said body being the sole structure completely bridging the space between said electrodes, the inwardly extending ends of said electrodes presenting annularly arranged opposed surfaces substantially coaxial with said passageway and providing a plurality of substantially uniform arc discharge paths wholly within said passageway and between the various points on the respective annular surfaces of said electrodes, means between said electrodes comprising gas evolving material having an open passageway therethrough substantially coaxial with said body passageway and with surfaces of said material on planes substantially coincident with said arc paths where arcs will have their greatest heat effect on said material for the production of gases, and said device having between said electrodes, in addition to said means, a gap structurally bridged only by said insulator body having less current conductive characteristics than said gas evolving material and of a length adequate to stand normal line voltage without discharge thereacross, whereby said gas evolving material is out of electrical circuit with said terminal electrodes and current leakage through said gas evolving material under normal line voltage is blocked.

2. A vented electric discharge device of the expulsion tube type comprising a pair of terminal electrodes, an insulator body having the insulating characteristics of porcelain or glass and having a passageway therethrough into which said electrodes extend in spaced relation, the inwardly extending ends of said electrodes presenting annularly arranged opposed surfaces substantially coaxial with said passageway and

providing a plurality of substantially uniform arc discharge paths wholly within said passageway and between the various points on the respective annular surfaces of said electrodes, means between said electrodes comprising an auxiliary conducting body mounted in spaced relation to said electrodes, said means also comprising gas evolving material having an open passageway therethrough substantially coaxial with said body passageway and with surfaces of said material on planes substantially coincident with said arc paths where arcs will have their greatest heat effect on said material for the production of gases, and said device having between said electrodes, in addition to said means, a gap structurally bridged only by said insulator body having less current conductive characteristics than said gas evolving material and of a length adequate to stand normal line voltage without discharge thereacross, whereby current leakage through said gas evolving material under normal line voltage is blocked.

3. A vented electric discharge device of the expulsion tube type comprising a pair of terminal electrodes, an insulator body having the insulating characteristics of porcelain or glass and having a passageway therethrough into which said terminal electrodes extend in spaced relation, the inwardly extending ends of said terminal electrodes presenting annularly arranged opposed surfaces substantially coaxial with said passageway and providing a plurality of substantially uniform arc discharge paths wholly within said passageway and between the various points on the respective annular surfaces of said terminal electrodes, tubular gas evolving material between said terminal electrodes having an inner cross sectional area substantially that of the annular surface of one of said electrodes and mounted within said passageway intermediate of and substantially coaxial with said electrodes and with inner surfaces thereof on planes substantially coincident with said arc paths where arcs will have their greatest heat effect on said material for the production of gases, an auxiliary conducting body mounted between said electrodes, said auxiliary body having an orifice therethrough substantially coaxial with said passageway and of smaller cross sectional area than the inner cross sectional area of said tubular gas evolving material whereby gases flowing through said auxiliary conducting body are directed axially of said passageway, said gas evolving material and auxiliary body being out of electrical contact with said terminal electrodes to provide a gap therebetween which is structurally bridged only by said insulator body, whereby current leakage through said gas evolving material under normal line voltage is blocked.

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