March 20, 1951 T. L. DYER, JR 2,545,993

LIGHTNING ARRESTER

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Fig.1.

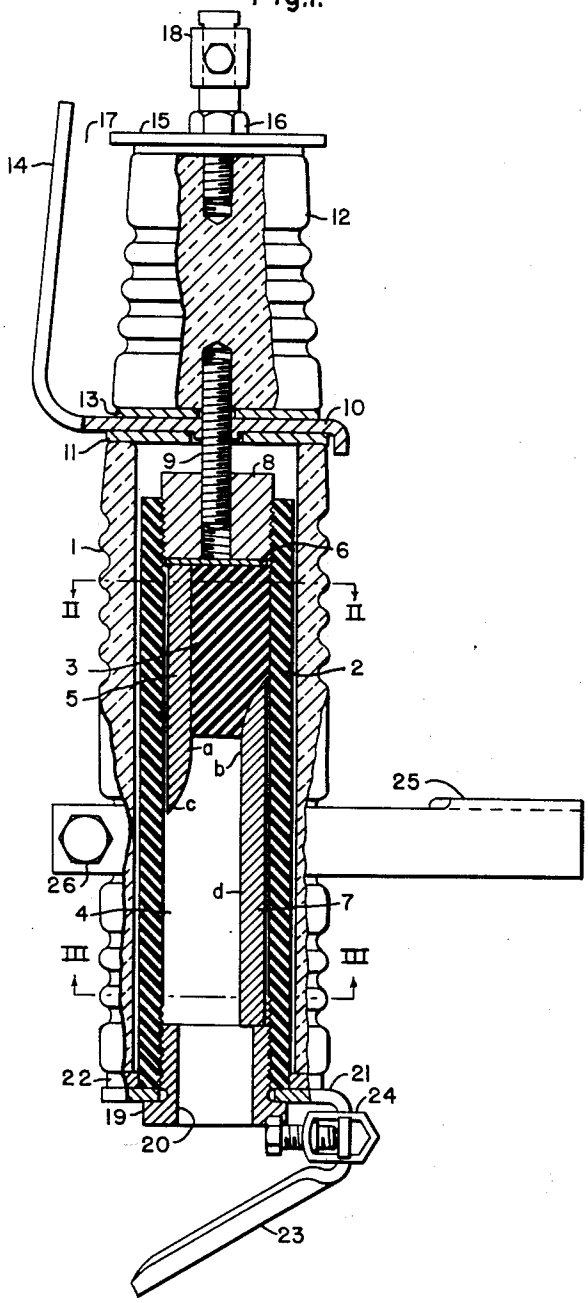


Fig.2.

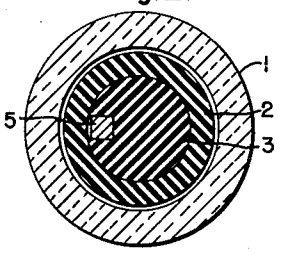
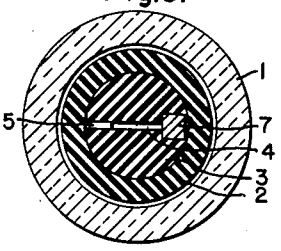


Fig.3.



WITNESSES:

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LIGHTNING ARRESTER

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3 Claims. (Cl. 175—30)

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The present invention relates to lightning arresters and, more particularly, to a lightning arrester of the expulsion type which is especially suitable for relatively low voltage ratings.

Lightning arresters of the expulsion type consist essentially of spaced electrodes disposed in a vented arcing chamber, which is lined with, or contains, insulating material of a type which evolves gas when heated by an arc. When a discharge occurs, an arc is established between the electrodes within the arcing chamber and a large quantity of substantially un-ionized gas is evolved, which is expelled in a blast through the vent, deionizing the arc path and blowing out the arc to interrupt the power current which tends to flow through the arrester after a surge has been discharged. In the usual construction of lightning arresters of this type, the electrodes are disposed at opposite ends of a tubular structure of gas-evolving material, which forms the arcing chamber, a plug or filler often being placed within the tubular structure to restrict the arc path and to increase the amount of gas-evolving material exposed to the arc. Thus, the arc path between the electrodes extends longitudinally of the arrester in this conventional construction, and the arrester is relatively long, and may have a relatively long gap between the electrodes.

The principal object of the present invention is to provide a lightning arrester of the expulsion type which is of relatively small size and low cost, but which has performance and protective characteristics which are as good as, or better than, those of arresters of conventional construction.

Another object of the invention is to provide an expulsion-type lightning arrester in which the arc path between the electrodes extends transversely of the arrester. This construction results in an arrester of relatively small size and low cost, as compared to conventional constructions, but without any sacrifice in performance. The transverse arrangement of the arc path also has the further advantage that it makes possible a relatively short gap between the electrodes, so that the new arrester has a low sparkover or breakdown voltage on surges and very desirable protective characteristics. The new construction is especially suitable for lightning arresters of relatively low voltage rating, such as 3000 volts, for example, but it will be obvious that the invention is not limited to arresters of any particular voltage or range of voltages.

A further object of the invention is to provide an expulsion-type lightning arrester in which the arc path between the electrodes is disposed transversely of the arrester and in which the arc is moved from its initial path as soon as it is established, so that there is substantially no burning or erosion of the electrodes at the points of initial discharge, and the breakdown and protective characteristics of the arrester remain unchanged throughout its life. The movement of the arc permits the use of a very short initial gap, with low breakdown voltage, since the arc is not extinguished in the initial gap space. Thus, the transverse arrangement of the arc path and the movement of the arc combine to make possible an arrester having low breakdown voltage on surges and superior protective characteristics.

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Other objects and advantages of the invention will be apparent from the following detailed description, taken in connection with the accompanying drawing, in which:

Figure 1 is a longitudinal sectional view of a lightning arrester embodying the invention;

Fig. 2 is a transverse sectional view approximately on the line II—II of Fig. 1; and

Fig. 3 is a transverse sectional view approximately on the line III—III of Fig. 1.

A preferred embodiment of the invention is shown in the drawing, which shows an expulsion-type lightning arrester enclosed in a generally cylindrical housing 1 of porcelain, or other suitable weather-resistant insulating material. The arrester itself includes a tube 2 of insulating material such as hard fiber, or other suitable insulating material having sufficient rigidity and mechanical strength. A cylindrical rod 3 of hard fiber, or other suitable insulating material which is capable of evolving substantially un-ionized gas in the presence of an electric arc, fits tightly in the tube 2. The rod 3 is made of shorter length than the tube 2, so that the tube 2 extends beyond the rod 3 at both ends, and a narrow central slot 4 is cut in the rod 3, which, as shown in Fig. 1, extends from one end of the rod 3 part way to the opposite end, so that the slot is open at the lower end and closed at its upper end, the edges of the slot being closed by the tube 2.

An upper metal electrode member 5 is placed in a groove cut in one side of the rod 3 at the upper end, the electrode 5 extending down into the upper end of the slot 4 as shown. The upper end of the upper electrode 5 engages a metal disc or plate 6 resting on top of the rod 3, and the lower end of the electrode 5 is curved on its inner side towards the edge of the slot 4, as clearly shown in Fig. 1. A lower metal electrode member 7 is placed in a groove cut in the opposite side

of the rod 3, and extends the full length of the slot 4, and preferably somewhat above the upper end of the slot, as shown, so that the two electrodes overlap within the slot 4 at its upper end, and are spaced apart transversely of the arrester. The slot 4 is made relatively narrow in order to provide a restricted arcing chamber, and the electrodes 5 and 7 are considerably wider than the slot in order to have sufficient rigidity and current-carrying capacity, the electrodes being placed in grooves of the proper size cut on opposite sides of the rod 3 as shown in Figs. 2 and 3.

The upper end of the tube 2 is closed by a metal plug or bushing 8 which is threaded into the upper end of the tube 2, and which engages the metal disc 6 so as to be electrically connected to the upper electrode 5. A stud 9 is threaded into the plug 8 and extends above the top of the porcelain housing 1. A metal cap member 10 closes the top of the housing 1, a gasket 11 being interposed between the cap and housing to seal the interior of the housing, and the cap 10 is threaded on the stud 9, or otherwise secured to it, to make a tight closure and to effect electrical contact with the stud 9. A porcelain insulator 12 is placed on top of the cap 10, a gasket 13 being preferably placed between the insulator and the cap, and the insulator 12 may be threaded on the projecting upper end of the stud 9, or otherwise rigidly secured in position. One side of the cap 10 is extended and bent upward past the insulator 12 to form a gap electrode 14, and a terminal plate 15 is secured on top of the insulator 12 by a screw 16 or other suitable means. The electrode 14 and terminal plate 15 form an external spark gap 17 between them which is in series with the internal gap between the electrodes 5 and 7. A terminal device 18 of any suitable type may be secured to the terminal plate 15 for connection of a line lead.

A metal bushing 19 is threaded in the lower end of the tube 2 and engages the lower end of the rod 3 to clamp the assembly tightly together and to effect electrical contact with the electrode 7 which extends to the end of the rod. The bushing 19 has a large central bore 20 to permit unobstructed discharge of the gas generated in the arrester in operation. An annular metal bottom plate 21 is clamped between a shoulder on the bushing 19 and the end of the tube 2, and a gasket 22 is compressed between the plate 21 and the end of the porcelain housing 1 to seal the interior of the housing against the entrance of moisture. If desired, one side of the bottom plate 21 may be extended and bent downwardly at an angle to the axis of the arrester to form a deflector 23 to direct the blast of gas from the arrester in a desired direction away from other conducting devices which may be mounted near the arrester. A terminal device 24 for connection of a ground lead is mounted on the bottom plate 21. The arrester may be mounted in position by means of a bracket 25 of any suitable type clamped on the porcelain housing 1 by means of a screw 26.

In use, the line terminal 18 of the arrester is connected to a line conductor, or other device to be protected, and the ground terminal 24 is connected to ground. When a lightning surge, or other excess voltage surge, occurs which exceeds the breakdown or sparkover voltage of the arrester, the external series gap 17 and the internal gap between the electrodes 5 and 7 break down to discharge the surge to ground. The internal discharge path between the electrodes 5 and 7

extends transversely of the arrester through the narrow slot 4, and the arc between the electrodes 5 and 7 will be initially established between points such as *a* and *b*, where the surfaces of the electrodes are closest together. This is at the upper end of the slot 4, and since the arc is closely confined between walls of gas-evolving material, large quantities of substantially un-ionized gas are evolved, and high pressures are developed, causing a strong blast of gas downward through the slot which moves the arc from its initial position substantially as soon as it is established. The arc is thus moved downward through the restricted arcing chamber formed by the narrow slot 4 until one terminal of the arc reaches the point *c* at the lower tip of the electrode 5, while the other arc terminal moves down along the electrode 7 until the arc is finally extinguished, when it has reached some point such as *d*, by the combined effects of elongation of the arc and deionization of the arc path. The restriction of the arc path in the narrow slot 4 also facilitates extinguishment of the arc, and insures generation of adequate amounts of gas since the arc is always in contact with surfaces of gas-evolving material.

It should now be apparent that an expulsion-type lightning arrester has been provided which is of relatively small size and low cost, as compared to expulsion arresters of conventional construction, but which has protective characteristics as good as, or better than, those of arresters of conventional design. The new arrester has high surge current capacity and is capable of interrupting high power currents, and has long life. The transverse arrangement of the internal arc path makes possible the compact construction, and the transverse arrangement, together with the movement of the arc, permits the use of a relatively short gap between the electrodes, so that the arrester has a low breakdown voltage and very desirable protective characteristics. The movement of the arc also prevents burning or erosion of the electrodes at the points of initial discharge, so that the protective characteristics remain unchanged throughout the life of the arrester.

A preferred embodiment of the invention has been shown and described for the purpose of illustration, but it is to be understood that various modifications may be made within the scope of the invention, and the invention includes all equivalent embodiments and modifications which come within the scope of the appended claims.

I claim as my invention:

1. A lightning arrester comprising a tubular structure of insulating material, a cylindrical member fitting tightly for its entire length within said tubular structure, said cylindrical member being made of an insulating material capable of evolving gas when exposed to an electric arc and having a narrow longitudinal slot of uniform width passing through the axis of the cylindrical member, said slot being closed at the upper end of the cylindrical member and extending to the bottom of the cylindrical member, a first electrode member disposed at one side of the upper part of the cylindrical member, said first electrode member extending a substantial distance down into the upper part of said slot, and a second electrode member disposed in the slot on the opposite side of the cylindrical member so as to be spaced from the first electrode member transversely of the cylindrical member, said second electrode

member extending continuously from top to bottom of the slot.

2. A lightning arrester comprising a tubular structure of insulating material, a cylindrical member fitting tightly for its entire length within said tubular structure, said cylindrical member being made of an insulating material capable of evolving gas when exposed to an electric arc and having a narrow longitudinal slot of uniform width passing through the axis of the cylindrical member, said slot being closed at the upper end of the cylindrical member and extending to the bottom of the cylindrical member, a first electrode member disposed at one side of the upper part of the cylindrical member, said first electrode member extending down into the upper part of said slot and having a continuous arcing surface extending a substantial distance into the slot, and a second electrode member disposed in the slot on the opposite side of the cylindrical member so as to be spaced from the first electrode member transversely of the cylindrical member, said second electrode member extending continuously from top to bottom of the slot.

3. A lightning arrester comprising a tubular structure of insulating material, a cylindrical member fitting tightly for its entire length within said tubular structure, said cylindrical member being made of an insulating material capable of evolving gas when exposed to an electric arc and having a narrow longitudinal slot of uniform width passing through the axis of the cylindrical member, said slot extending from the bottom of the cylindrical member part way to the top, so that the slot is closed at the top and open at the bottom, a first electrode member disposed at one side of the upper part of the cylindrical member and extending into the upper part of said slot at one side thereof, said first electrode member having a continuous arcing surface extending a substantial distance into the slot, said arcing surface being curved away from the axis of the cylindrical member, and a second electrode member disposed in the slot on the opposite side of the cylindrical member so as to be spaced from the first electrode member transversely of the cylindrical member, said second electrode member extending continuously from top to bottom of the slot.

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