Dec. 6, 1927.

E. E. F. CREIGHTON

1,651,872

PROTECTIVE DEVICE

Filed April 30. 1924

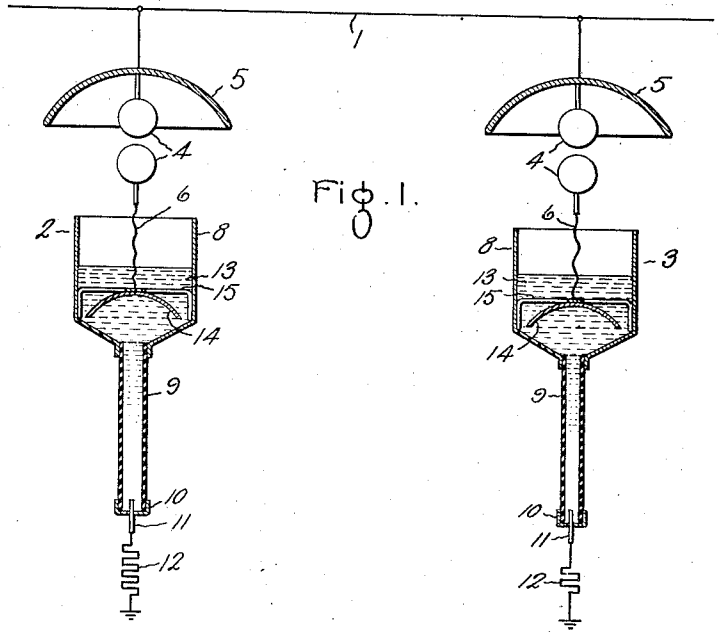


Fig. 1.

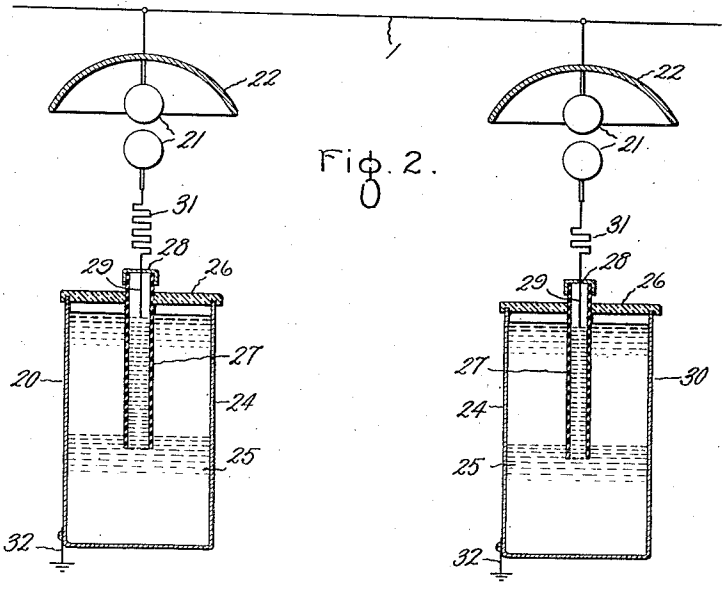


Fig. 2.

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Patented Dec. 6, 1927.

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UNITED STATES PATENT OFFICE.

ELMER E. F. CREIGHTON, OF SCHENECTADY, NEW YORK, ASSIGNOR TO GENERAL ELECTRIC COMPANY, A CORPORATION OF NEW YORK.

PROTECTIVE DEVICE.

Application filed April 30, 1924. Serial No. 710,146.

My invention relates to protective devices for electric circuits and particularly to such devices, commonly termed lightning arresters, which are employed to divert lightning discharges, surges and other potential phenomena around apparatus which might be injured thereby, and more particularly to protective devices of the type disclosed in Letters Patent of the United States to Halsey No. 888,235, dated May 19, 1908.

With arresters of the Halsey type there is a brief interval between the interruption of the discharge by the volatilization of the liquid and the restoration of the arrester to its original condition by the return of the liquid to the tube during which the spark voltage of the arrester is so high that the arrester is unable to afford the same degree of protection against the immediate recurrence of a high potential discharge that it normally affords.

According to my invention I connect a plurality of arresters of the above mentioned type in parallel and modify the construction of one or more of them or their connections in the circuit to be protected so that during the aforesaid brief interval at which each arrester has its spark voltage abnormally high another arrester will be in condition to provide the desired protection by reason either of its slower response or its recovery from an earlier response.

Another feature of my improved construction comprises the arrangement of the tube of electrolyte within the metallic container with the lower end of the tube beneath the level of the electrolyte in the container and with an insulating liquid in the space above the electrolyte to increase the dielectric strength between the tube and the inner surface of the container.

My invention will be better understood from the following description taken in connection with the accompanying drawing, and its scope will be pointed out in the appended claims.

In the drawing Fig. 1 is a diagrammatic representation of one form of my invention and Fig. 2 is a similar representation of a modification.

Referring first to Fig. 1, the line 1 to be protected is shown connected to earth by two similar arrester units 2 and 3. Each unit is represented as comprising the sphere gap 4 having a protective cover or rain shield 5, the sphere gap being connected in series by conductor 6 with an electrolytic member of the type disclosed in the above mentioned Halsey patent. This member comprises the metallic container 8 to the bottom of which is secured the tube 9 of insulating material. The lower end of the tube 9 is shown closed by a cap 10 extending through which is the electrode 11 by which connection is made to ground through the resistance 12. The container is partially filled and the tube is entirely filled with electrolyte 13 which may be water as in the above mentioned Halsey patent, and within the container is shown a baffle plate 14 supported on a frame work 15 also as in that patent.

Various means may be employed for insuring that the two units 2 and 3 shall not respond simultaneously to the same high potential impulse and that the second to respond shall not completely open its discharge path to ground until after the first unit to respond shall have operated and again been restored to its original condition or substantially so. One way of effecting this result is to employ two units 2 and 3 having electrolytic members of identical form but which have different rates of expenditure of dynamic energy. This difference may be brought about as a result of a difference of resistance, for example the electrolyte of one tube may have a resistance differing from that of the other tube, or external resistances of different values may be used in series with the two tubes. Fig. 1 illustrates the latter expedient where unit 2 is shown having a larger resistance 12 in its ground connection than unit 3.

A second means of obtaining a difference in the time of action of the two units is by using tubes 9 of different sizes for the two units. The same amount of energy expended upon the different quantities of electrolyte will result in a difference in the time of the response of the two units. Fig. 1 illustrates this means in that the tube 9 of unit 2 is shown larger than the corresponding tube 9 of unit 3. While this means is shown in Fig. 1 in addition to different resistances 12 in the ground connections, it is to be understood that these two expedients

need not necessarily be used together but that either may be used separately if desired.

When a lightning or other high potential discharge on the line 1 reaches the arrester units 2 and 3 two parallel paths are provided thereby to ground. Unit 3 having the smaller resistance 12 in series therewith will take a larger proportion of the discharge or of the power current following the initial breakdown than unit 2 and as a result the electrolyte in the tube 9 of unit 3 will be volatilized or blown out, thus breaking the arc. As soon as the arc is broken, however, electrolyte will be restored in the tube and this will occur before the smaller proportion of current through unit 2 will have had time to cause this unit to interrupt its discharge path. The same result would follow were the resistances 12 to be of equal value and were the two units to differ only in the size of the tubes 9. Unit 3 having the smaller tube and consequently the less quantity of electrolyte would be the first to respond.

In the modification illustrated by Fig. 2 two similar arrester units 20 and 30 are shown connected in parallel to the line 1. Each of the two units comprises a sphere gap 21 covered by a shield 22 as in Fig. 1 and a metallic container 24 partially filled with electrolyte 25. Suspended from the cover 26 which is of insulating material is a tube 27 also of insulating material which contains the same electrolyte and has a tight fitting cap 28 through which extends the electrode 29. A resistance 31 connects the sphere gap 21 with the electrode 29 and the container 24 is grounded at 32. Above the electrolyte 25 is placed a quantity of insulating oil 33 to nearly fill the container, the oil thereby serving to increase the dielectric strength between the tube of electrolyte and the walls of the container. Although the arrangement of parts is somewhat different from that in Fig. 1, the operation is substantially the same. A heavy current to ground following a breakdown of the sphere gaps causes a rapid volatilization and expulsion of the electrolyte in the tubes 27 whence the circuit is interrupted. Cooling of the volatilized electrolyte following an interruption of the discharge permits the electrolyte to return up the tube. As in Fig. 1, the two units 20 and 30 are shown provided with resistances 31 of different values and the tubes 27 are also shown of different diameters. Moreover, if desired, the electrolyte in the two units may be different. By any or all of these means the two units shown in Fig. 2 may be caused to respond at different times in the same manner and for the same purpose as has already been described in connection with the form shown by Fig. 1.

While I have described certain embodiments of my invention, I do not wish to be limited to the particular forms shown and described as it will be apparent that many modifications therein may be made without departing from the scope of my invention as set forth in the appended claims.

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

1. A protective system comprising a plurality of units connected to provide parallel discharge paths, each of said units including means actuated by a discharge therethrough for interrupting the discharge path provided by said unit, said units being constructed to have different times of response when subjected to the same high potential impulse, whereby a subsequent impulse quickly following a first impulse may be discharged by a unit of slower response.

2. A protective system comprising a plurality of units connected to provide parallel discharge paths, each of said units including means actuated by a discharge therethrough for interrupting said discharge path and adapted subsequently to restore said path, one of said units being constructed to interrupt the discharge path therethrough and subsequently to restore the same before another of said units shall have interrupted its discharge path.

3. A protective system comprising a pair of parallel connected units, each comprising volatilizable means arranged in the path of a discharge therethrough and adapted to interrupt said discharge path and subsequently to re-establish the same, the characteristics of one of said units being such that the proportion of the discharge traversing it is insufficient to cause it to interrupt its discharge path until the discharge path through the other of said units shall have been interrupted and re-established.

4. A protective system comprising a unit including a vessel containing an electrolyte and spaced electrodes therein, said vessel having a tubular portion containing one of said electrodes and a similar unit connected in parallel with said first unit, the resistance of said second unit being less than the resistance of said first unit whereby the discharge path through said second unit will be opened and reclosed before the discharge path through said first unit will be opened.

5. A protective system comprising a pair of similar parallel connected units each including a tube containing an electrolyte, a pair of electrodes spaced thereby, and a resistance, one of said resistances being greater than the other whereby when said units are simultaneously subjected to a high potential discharge one of the units will interrupt the discharge path provided thereby and restore the same before the other of said units shall have interrupted the discharge path provided by it.

6. In combination a pair of lightning arresters connected in multiple whereby discharges may take place through both of said arresters from the same line, means in each arrester for breaking the discharge circuit by producing a gap in the discharge circuit and for restoring the arrester to normal operative condition after the discharge circuit has been so broken, and for delaying the time of breaking the circuit in one arrester until after the other arrester has been so restored.

7. In combination a pair of lightning arresters connected in multiple whereby discharges may take place through both of said arresters from the same line, means in each arrester for breaking the discharge circuit by producing a gap in the discharge circuit and for restoring the arrester to normal operative condition after the discharge circuit has been so broken, and for delaying the time of breaking the circuit in one arrester until after the other arrester has been so restored, said arresters being of the electrolytic cell type, said means comprising a column of electrolytic material in each arrester, said columns being of different volume.

8. In combination a pair of lightning arresters connected in multiple whereby discharges may take place through both of said arresters from the same line, means in each arrester for breaking the discharge circuit by producing a gap in the discharge circuit and for restoring the arrester to normal operative condition after the discharge circuit has been so broken, and for delaying the time of breaking the circuit in one arrester until after the other arrester has been so restored, said arresters being of the electrolytic cell type, said means comprising a column of electrolytic material in each arrester, said columns being of different volume, the column in each arrester standing a substantial height above the level of the electrolyte in the cell and a layer of oil above the surface of the electrolyte in the cell and surrounding said column.

In witness whereof, I have hereunto set my hand this 29th day of April 1924.

ELMER E. F. CREIGHTON.