E. E. F. CREIGHTON.

PROTECTIVE DEVICE.

APPLICATION FILED JAN. 10, 1918.

1,396,559.

Patented Nov. 8, 1921.

Fig. 1.

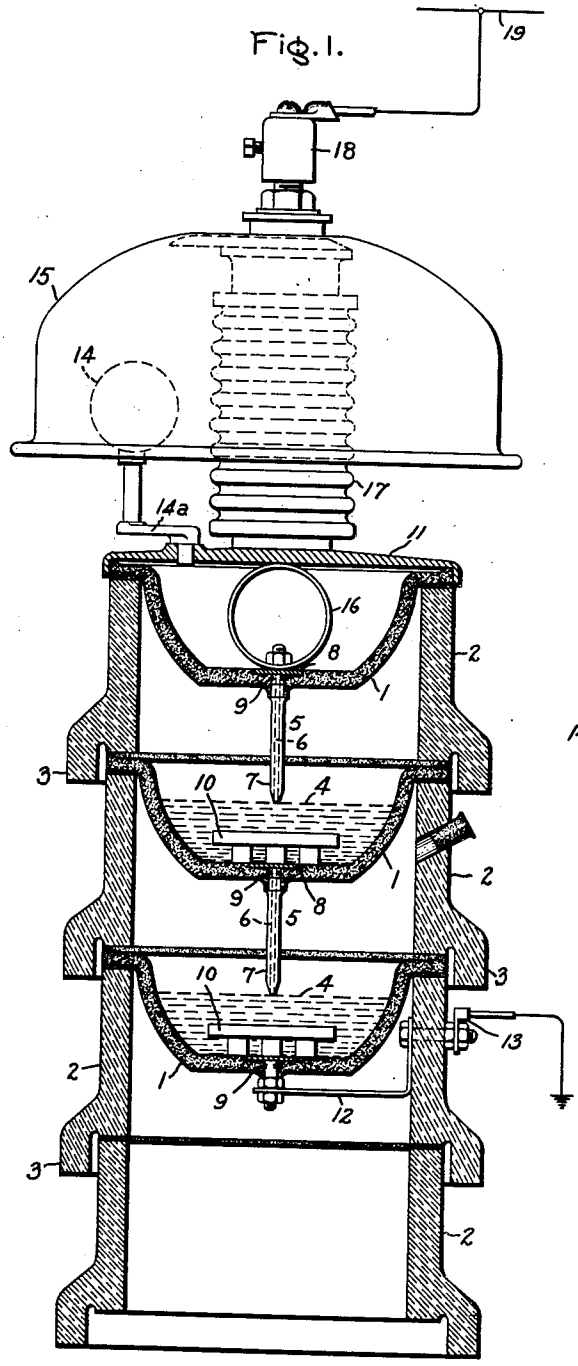


Fig. 2.

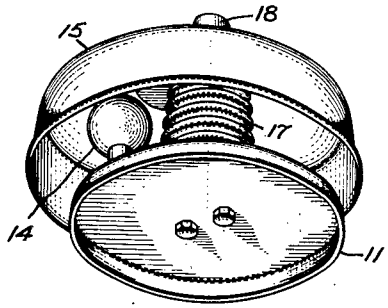
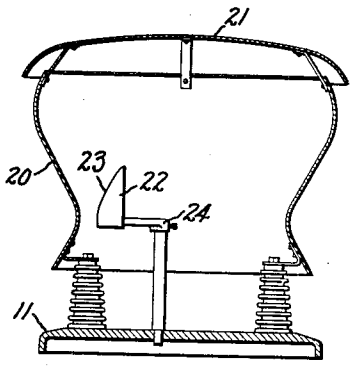


Fig. 3.



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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.

1,396,559. Specification of Letters Patent. Patented Nov. 8, 1921.

Application filed January 10, 1918. Serial No. 211,112.

To all whom it may concern:

Be it known that I, ELMER E. F. CREIGHTON, a citizen of the United States, residing at Schenectady, in the county of Schenectady, State of New York, have invented certain new and useful Improvements in Protective Devices, of which the following is a specification.

My invention relates to protective devices and particularly to devices for protecting a system of distribution from conditions of excess voltage, and has for its object to provide a protective device which is relatively cheap, reliable in its operation, which operates to relieve a conductor of high potential discharges with great rapidity and embodies a spark gap means which is easily adjustable, the arc over voltage of which may be maintained substantially constant independent of weather conditions and which is in general an improvement over similar devices heretofore known in the art.

In protective devices, especially for outdoor service, in which spark gaps are used, such gaps are usually unprotected or exposed to the weather. Spark gaps of this character have a different arc over voltage for the same gap setting, depending on the weather conditions, that is during a rain, for instance, the gap will break down on lower voltages than when dry conditions exist. Under such conditions the discharge of the gap at a lower voltage is due to a film of moisture or drops of water which deposits on the electrodes especially those of the spherical type, sufficiently to appreciably decrease the gap length or striking distance and cause corona by projecting above the smooth surface of the sphere. Outdoor gaps, especially sphere gaps, which are extensively used due to their many advantages, have, therefore, a dry arc over voltage and a wet arc over voltage, dependent on weather conditions which causes a constant source of trouble in setting the gap to properly protect a conductor.

In the protective device of my invention, I provide a plurality of cells arranged in stack formation, each cell having coöperating solid and liquid electrodes in surface engagement and arranged to form a series circuit. Embodied in this device and connected in the series circuit I provide a spark gap which is protected from all weather conditions and which has therefore an arc over voltage independent of weather conditions and in which one of the electrodes itself acts as the protecting member or shield for the gap. One of the electrodes, preferably the lower electrode, furthermore is adjustably mounted in such a manner that by revolving the same, the distance between the electrodes forming the spark gap can be easily varied or adjusted at will.

The novel features which I believe to be characteristic of my invention will be definitely indicated in the claims appended hereto, while the features of construction and mode of operation will be understood by reference to the following description taken in connection with the accompanying drawings which show the preferred embodiments of my invention and in which—

Figure 1 is a side elevation, partly in section, of a protective device embodying my invention, and Fig. 2 is a perspective view of the spark gap device shown in Fig. 1, and Fig. 3 is a modification of my spark gap device.

The protective device shown in Fig. 1 is of the liquid electrode or electrolytic type, the construction of which, *per se*, is covered in a corresponding application, Serial No. 211,113, filed January 10, 1918, in the name of Fred R. Shavor and myself. This device comprises a plurality of receptacles 1 of insulating material mounted one above the other and separated by insulating spacing members 2 to form a stack, the members 2 coöperating with the receptacles to form closed compartments or cell units. These compartments or cell units are made air and water tight by providing annular gaskets impregnated with bituminous material, between the edges of the receptacles and the spacing members to provide air tight joints or junctions. These junctions are also protected by overhanging portions 3 integral with the spacing member 2 which portions extend over and partially inclose the junctions. The receptacles comprising each cell unit, except that at the top of the stack, contain an electrolyte 4 of good conductivity, preferably a strong solution of sodium carbonate, which forms a liquid electrode. Coöperating with the liquid electrodes 4 for each cell or within each compartment, are solid electrode members 5 positioned to just engage the surface of the coöperating liquid electrodes, contact between the same being

accomplished by the capillary attraction of the electrolyte. The solid electrode members 5 comprise metal rods 6 surrounded by insulating sleeves 7 which have preferably beveled or pointed end portions. The electrodes 6 are removably or detachably secured to the lower side, receptacles 1, depending therefrom into engagement or in close proximity with the surface of the electrolyte in the adjacent receptacle below. The receptacles also carry conducting plates 8 preferably integrally related therewith and carried at the bottom thereof which are immersed in the electrolyte 4 and in conductive relation with the rods 6 of the electrode members 5 depending from their respective receptacles through, for instance, metal inserts 9 carried by the receptacles which are threaded to engage the electrode members 5. Immersed within the electrolyte of the receptacles 1 are intercepting or baffle members 10, of insulating material, which are preferably separate from the receptacles and provided with suitable legs to assume a position intermediate the bottom of the receptacles or contact plates 8 and the surface of the electrolyte 4 or the end of electrodes 5. The top of the stack is provided with a metallic cover plate 11 which coöperates with the top receptacle to effectively close the same. From the foregoing description, it is apparent that a series circuit is provided through the cells, the surface engagement of the comparatively solid electrodes 5 and electrolyte 4 comprising each cell, forming a normally closed conducting path. In conductive relation with the electrolyte 4 in the bottom receptacle for the stack through its conducting plate 8, is a conducting rod 12, which is connected to a ground terminal member 13 carried by the spacing member 3 for the bottom receptacle.

Carried by the cell stack and connected in series with the circuit through the cells is a novel and improved spark gap device comprising coöperating electrodes 14 and 15. Electrode 14, which is preferably spherical in configuration, is mounted on the metal cover 11 for the stack near the edge thereof and in conductive relation therewith. This electrode may be stationary or mounted on an arm 14^a which is pivotally supported on the cover 11. The electrode is connected to the circuit through the cells by means of a flexible conductor 16, connected to the contact plate 8 of the top receptacle and held in spring pressed engagement with the cover 11. The coöperating electrode 15 is bell-shaped or in the shape of a hood or umbrella and is supported by the cover 11 but insulated therefrom by insulating bushing 17 set eccentrically to the umbrella. This electrode carries a terminal member 18 which is adapted to be connected to the conductor 19 to be protected. The umbrella electrode 15 is of rugged construction and is positioned to extend over the spherical electrode 14 and partially inclose the same to form a spark gap between the spherical electrode and the inner spherical surface of the umbrella 15. The electrode 15 therefore affords a shielding means for the spark gap and sufficiently incloses the spherical electrode so that rain or other weather conditions has no effect on the gap. Due to the heavy and rugged construction of the umbrella, it will remain in any position without danger of being moved by wind or other elements. In order to provide a means for adjusting the gap setting I prefer to maintain the umbrella electrode 15 stationary and revolve the spherical electrode 14 by its arm 14^a but the gap may be varied by other means. The spark gap itself may be considered of the sphere gap type, the arc occurring from the inner concave or spherical surface of electrode 15 to the sphere of electrode 14. As the spark gap is protected by the umbrella electrode 15, the arc over voltage is substantially constant independent of the weather conditions, and the setting for the gap may be considered the dry arc over voltage setting.

In the operation of my device the spherical electrode 14 is rotated until the gap between the electrodes is of the required distance, which depends on the excess potentials to be relieved. The series circuit through the cells in conductive relation with the electrode 14 and in series with the gap, comprises a plurality of cell units depending in number on the operating voltage of the conductor 19 to be protected. When an excess potential occurs on the conductor 19 above that required to break down the gap between the electrodes 14 and 15, the gap discharges and the discharge passes from the depending electrode to the liquid of the cells, to terminal 13 and thence to ground. The passage of the discharge between the coöperating solid and liquid electrodes of each cell comprising the series circuit, pushes away a quantity of electrolyte near the metal tips and form a plurality of arcs in series between the solid electrodes 6 to the electrolyte 4. These arcs cause vaporization of the electrolyte and the arcs impinging upon the baffle or intercepting members 10 cause a splashing or displacement of the electrolyte 4 upwardly, thereby increasing the length of the gaps. Due to the lengthening of the gaps and the unstability of the arcs with liquid as an electrode, the arcs in series are thereby extinguished with great rapidity, the extinguishment occurring in substantially one-half of a cycle. With the interruption of the circuit in this short interval, the dynamic current does not continue to follow the discharge and the electrolyte returns to normal position or surface

engagement with the coöperating electrodes to again close the series circuit through the cells in preparation to relieve the conductor from another discharge when the gap between the electrodes 14 and 15 breaks down.

In Fig. 3 I have shown a modified form of spark gap device which may be mounted on the cover plate 11 or connected between a conductor to be protected and a protective device or ground in which the umbrella electrode 20 is of a configuration having flaring sides. The umbrella is open at the top to provide an exit for arc gases but is covered by a hood portion 21 to protect the gap from the weather. The coöperating electrode 22 mounted beneath the umbrella and inclosed thereby, is of a configuration to provide a horn shaped arcing surface 23 and is supported and rotatably movable by an arm 24 which is eccentrically pivoted on the plate 11 in conductive relation therewith. The inner surface of the flaring or diverging sides of the umbrella electrode 20 form a horn arcing surface which coöperates with the arcing surface 23 of the electrode 22 to form a horn gap for the rapid extinguishment of the arc, the arc gases having a ready exit out through the opening at the top of the umbrella electrode. For adjustment of the gap, the electrode 22 may be rotated by means of its arm 24.

It is of course understood that the spark gap device of my invention it not limited to its embodiment in protective devices of the electrolytic type but may be embodied in protective devices of various types or may be used as a spark gap *per se*.

In accordance with the provisions of the patent statutes, I have described the principle of operation of my invention, together with the apparatus which I now consider to represent the best embodiment thereof; but I desire to have it understood that the apparatus shown is only illustrative, and that the invention can be carried out by other means.

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

1. A protective device having break-down characteristics of a sphere gap and provided with an electrode constructed and arranged to furnish protection from the weather so as to insure to said device a substantially constant break-down voltage irrespective of weather conditions.

2. The device set forth in claim 1 characterized by the fact that adjusting means is provided whereby the break-down voltage may be varied.

3. A protective device having break-down characteristics of a sphere gap and comprising two coöperating electrodes spaced apart to form a spark gap, one of said electrodes having a configuration to protect the gap from weather conditions.

4. In combination, a plurality of receptacles adapted to contain an electrolyte and mounted one above the other, spacing members between said receptacles forming therewith closed compartments, coöperating electrodes carried by said receptacles and depending therefrom to form a discharge path with the electrolyte, means connecting said coöperating electrodes to form a series circuit, an arcing electrode connected to said series circuit, and a coöperating arcing electrode adapted to be connected to the conductor to be protected and shaped to partially inclose said first mentioned arcing electrode being spaced away from the same to provide a protected spark gap.

5. In combination, a plurality of receptacles adapted to contain an electrolyte and mounted one above the other, spacing members between said receptacles forming therewith closed compartments, coöperating electrodes carried by said receptacles and depending therefrom to form a discharge path with the electrolyte, means connecting said coöperating electrodes to form a series circuit, an electrode connected to said series circuit, an umbrella electrode partially inclosing said first mentioned electrode and spaced away from the same to form a spark gap, one of said electrodes being adjustable to control the length of said spark gap.

6. In combination, a plurality of receptacles adapted to contain an electrolyte and mounted one above the other, spacing members between said receptacles forming therewith closed compartments, coöperating electrodes depending from said receptacles to form a discharge path with the electrolyte, means connecting said electrodes to form a series circuit, a spark gap having an arc over voltage independent of weather conditions, and means for connecting said gap in said series circuit.

7. In combination with a plurality of receptacles, mounted one above the other, spacing members between said receptacles forming therewith closed compartments, an electrode member carried by said receptacles and depending therefrom, said receptacles adapted to contain an electrolyte forming with said electrodes a discharge path, means adapted to connect the electrolyte and corresponding electrodes in a series circuit, an arcing electrode connected to said series circuit, and a member coöperating with said arcing electrode to form a spark gap which has an arc over voltage independent of the weather conditions.

8. In a protective device comprising a plurality of cells mounted in stack formation, coöperating solid and liquid electrodes in said cells forming a discharge path, means for connecting said electrodes to form a series circuit through said cells, a metal cover for the top cell of said stack included in said

series circuit, a stationary electrode carried by said cover and electrically connected thereto, an umbrella electrode partially inclosing said stationary electrode and separated therefrom to form a spark gap.

9. In combination with an electrical conductor, a device forming a discharge path to ground, a spark gap connected between said device and said conductor comprising an umbrella electrode, a coöperating electrode partially inclosed by said umbrella electrode, one of said electrodes being adjustable to vary the gap.

10. In combination with an electrical conductor, a device forming a discharge path to ground, an umbrella electrode adapted to be connected to said conductor and supported eccentrically, a coöperating electrode beneath and partially inclosed by said umbrella electrode and separated therefrom to form a spark gap, and means for connecting said coöperating electrode in said discharge path, said spark gap being adjusted in response to the rotation of said coöperating electrode.

11. In combination with a plurality of cells mounted to form a stack, coöperating liquid and solid electrodes forming a discharge path, means connecting the electrodes of said cells to form a series circuit, coöperating arcing electrodes carried by said stack and spaced apart to form a spark gap, means for connecting said spark gap in said series circuit, one of said arcing electrodes forming a shielding means to protect said gap from the weather.

12. In combination with a plurality of cells mounted to form a stack, coöperating liquid and solid electrodes forming a discharge path, means connecting the electrodes of said cells to form a series circuit, a spark gap connected in series with said circuit, and means for maintaining the arc over voltage of said gap substantially constant independent of weather conditions.

13. A device comprising an eccentrically supported umbrella member, a coöperating member mounted beneath said umbrella member and coöperating therewith to form a spark gap, one of said members being movable to vary said gap as desired.

14. A protective device comprising a supporting insulator, an umbrella electrode mounted on said insulator to cover part of it, and a coöperating electrode mounted within the inclosure of said umbrella electrode intermediate said insulator and said umbrella electrode and spaced apart from said umbrella electrode to form a spark gap.

15. A device comprising a base, an insulator carried by said base, an umbrella electrode mounted on said insulator to cover it, and a coöperating electrode mounted on said base beneath said umbrella electrode and spaced apart from the inner surface thereof to form a spark gap protected by said umbrella electrode.

16. A device comprising a spherical electrode, a coöperating umbrella electrode partially inclosing said spherical electrode and spaced away to form a spark gap between said spherical electrode and the inner surface of said umbrella electrode, said spherical electrode being mounted for rotative movements in an eccentric path to vary the length of said spark gap as desired.

17. A protective device comprising two relatively rotatable coöperating electrodes having their axes of rotation eccentric, one of said electrodes having an umbrella shape and the other of said electrodes being mounted beneath said umbrella, said other electrode being spaced apart from the inner surface of said umbrella electrode to form a spark gap which is adjustable by relative rotation of said electrodes.

18. A device comprising an umbrella electrode provided with openings at the top to permit the exit of arc gases, a coöperating electrode beneath said umbrella and spaced away therefrom to form a spark gap, the arcing surfaces of said electrodes being of a configuration to produce a horn effect.

In witness whereof, I have hereunto set my hand this 8th day of January, 1918.

ELMER E. F. CREIGHTON.