No. 888,235.

E. S. HALSEY. PATENTED MAY 19, 1908.

LIGHTNING ARRESTER.

APPLICATION FILED DEC. 10, 1904.

2 SHEETS—SHEET 1.

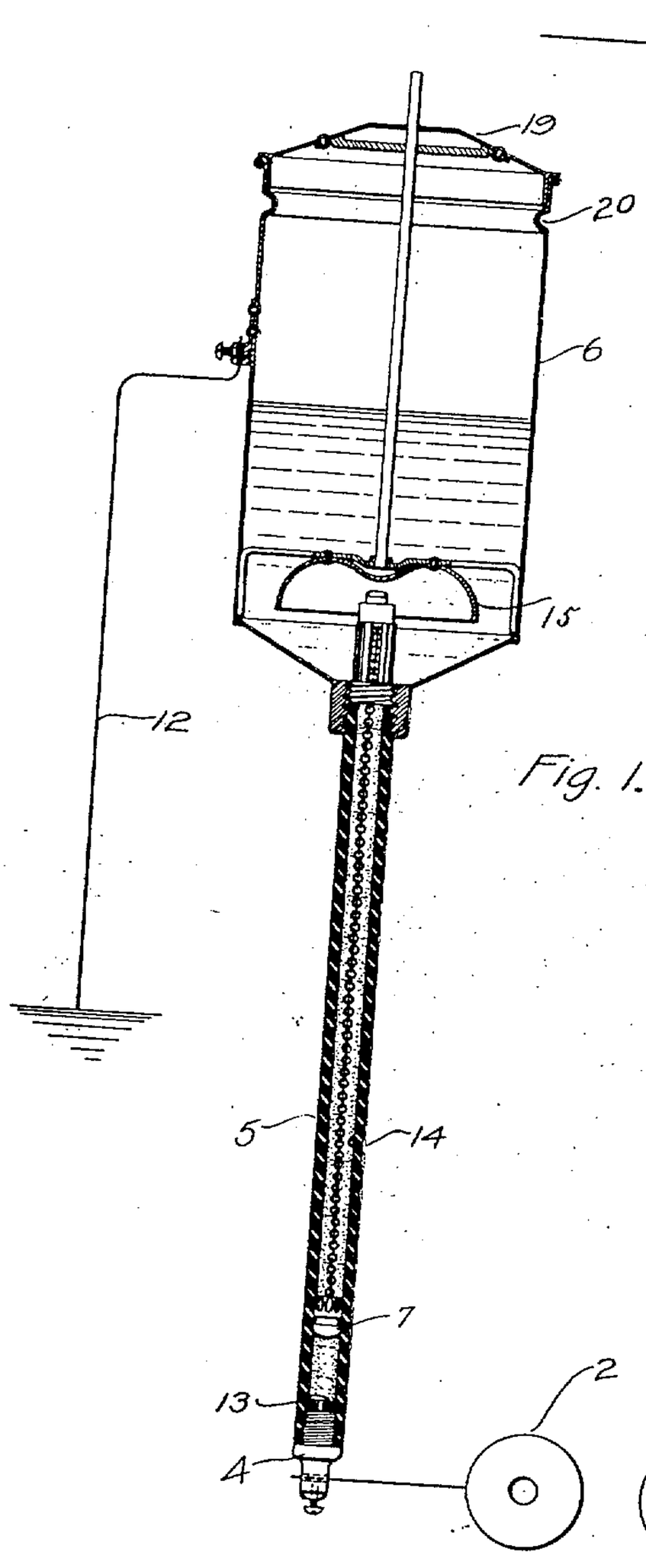


Fig. 1.

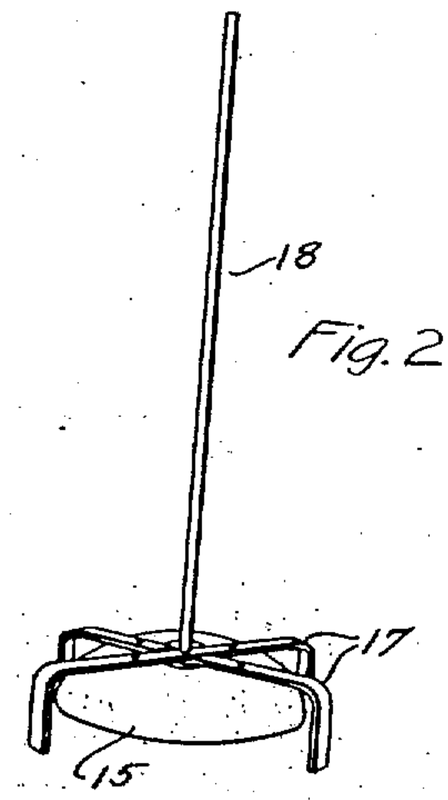


Fig. 2.

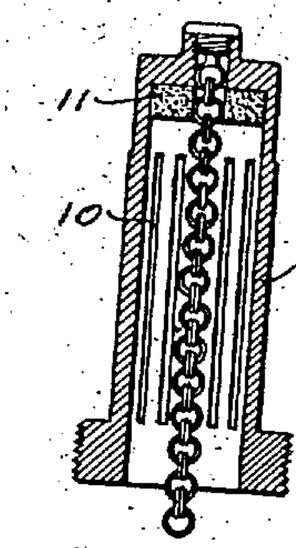


Fig. 3.

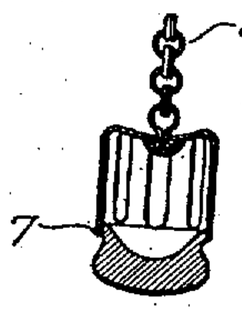


Fig. 4.

Witnesses:
Harold F. Locke.
Helen Orford

Inventor:
Edward S. Halsey.
by Albert G. Davis
Atty.

No. 888,235. PATENTED MAY 19, 1908.

E. S. HALSEY.

LIGHTNING ARRESTER.

APPLICATION FILED DEC. 10, 1904.

2 SHEETS—SHEET 2.

Fig. 5.

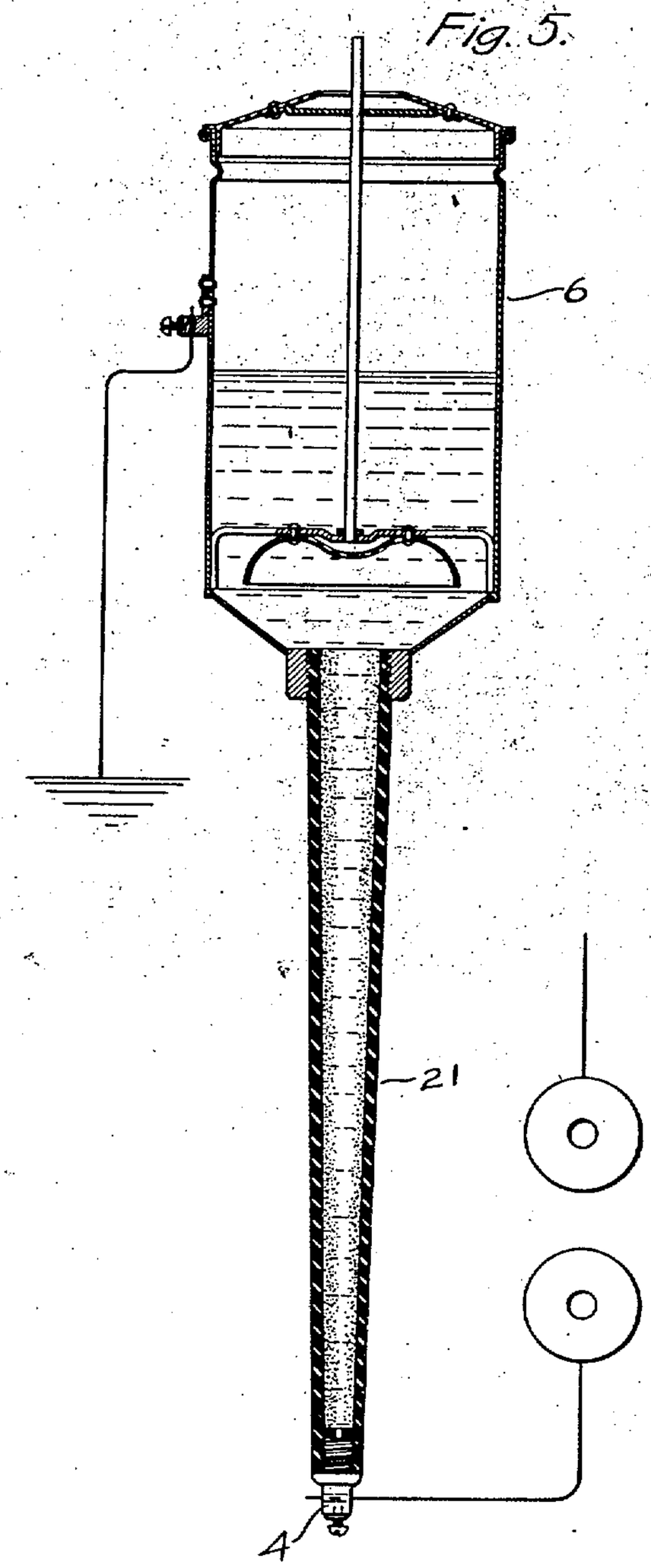
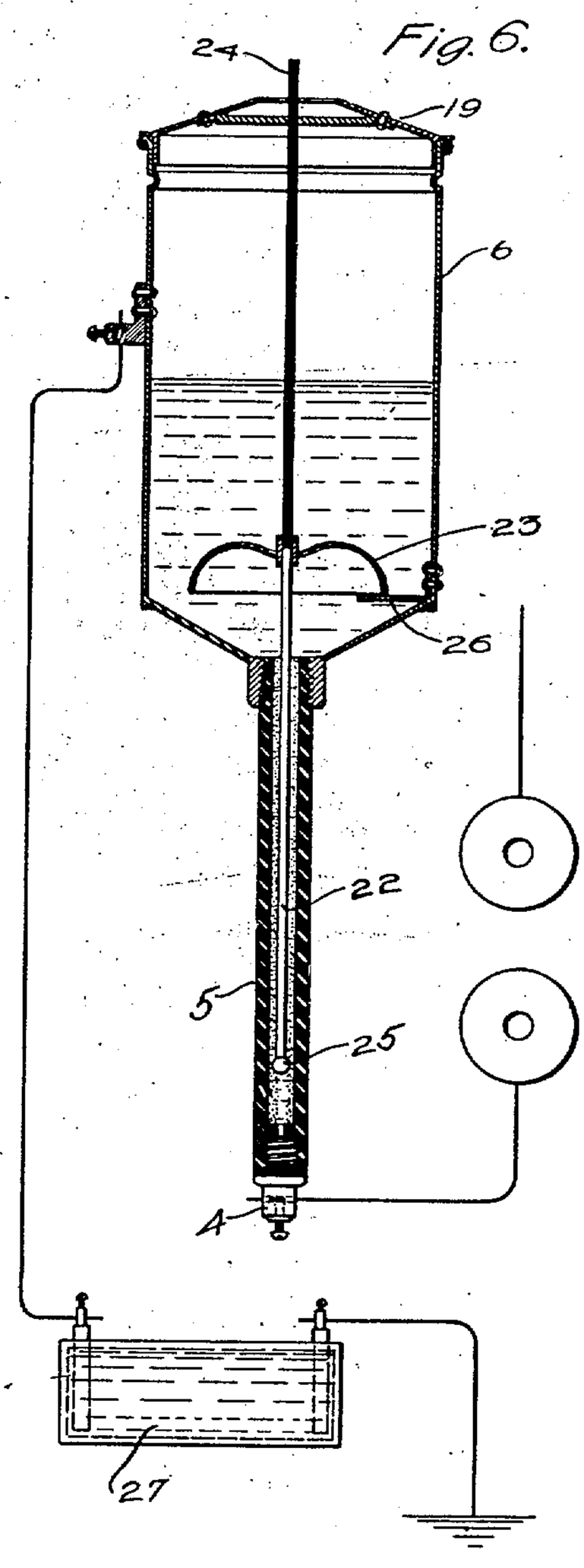


Fig. 6.



Witnesses:
Harold F. Locke
Helen Alford

Inventor:
Edward S. Halsey.
by Albert G. Davis
Att'y.

UNITED STATES PATENT OFFICE.

EDWARD S. HALSEY, OF PALMETTO, FLORIDA, ASSIGNOR TO GENERAL ELECTRIC COMPANY, A CORPORATION OF NEW YORK.

LIGHTNING-ARRESTER.

No. 888,235. Specification of Letters Patent. Patented May 19, 1908.

Application filed December 10, 1904. Serial No. 236,289.

To all whom it may concern:

Be it known that I, EDWARD S. HALSEY, a citizen of the United States, residing at Palmetto, in the county of Manatee and State of Florida, have invented certain new and useful Improvements in Lightning-Arresters, of which the following is a specification.

This invention relates to an improved form of lightning arrester or protective device for removing static charges from electrical circuits and for protecting such circuits from lightning and other abnormal potentials.

The invention comprises a column of fluid, such for instance as a liquid, retained within an inclosed space and so arranged that a discharge of current will suddenly vaporize or otherwise expand the fluid, and thus automatically interrupt the circuit and rupture the arc formed by the escaping charge.

The invention will be better understood by reference to the following description taken in connection with the drawing forming a part of this specification.

Figure 1 is a sectional view of one form of my improved lightning arrester showing the method of connecting to the power circuit; Fig. 2 is a detail view of the movable dash plate or baffle; Fig. 3 is a sectional detail showing the chain suspension and the rubber impact cushion; Fig. 4 is a sectional detail of an aluminum basket which acts as a plunger, as shown in Fig. 1; Fig. 5 is amodification in which the column of liquid increases in cross-section toward the top so that the heating effect of the current is concentrated near the lower end of the liquid column; and Fig. 6 shows a modification in which oil is used as the liquid to be volatilized and in which an auxiliary break is provided beneath the surface of the oil.

In Fig. 1 the lightning arrester is connected through a spark gap to the conductor 1 which may be one of the conductors of a high-potential transmission line. The two electrodes 2 and 3 of the spark gap consist preferably of aluminum disks located at such a distance apart that the normal voltage of the transmission line will just fail to force current across the gap. The disk 2 is connected to the binding post 4 screw-threaded into the lower end of the hard rubber or other insulating tube or chamber 5. This binding post serves as one electrode from which the lightning discharge may pass. The insulating tube 5 carries at its upper end a copper tank 6 and the tube and a part of the tank are filled with a conducting solution such, for instance, as water containing a small percentage of salt or acid. A second electrode consisting of a light aluminum plunger or basket 7 is suspended a few inches above the electrode 4 by a brass chain 8. This chain consists preferably of circular links of brass wire wound in spirals, as I have found that such a chain has little tendency to tangle, and that when packed into a confined space it acts more or less as a spring. The upper end of chain 8 is supported from the top wall of the chamber 9, the latter being screw-threaded at its lower end to the bottom wall of the copper tank 6. This chamber 9 has a plurality of slots 10 in its side walls to permit the free circulation of liquid therethrough, and furthermore carries in the upper part of the chamber a rubber baffle 11, which serves to deaden the impact of the chain 8 and basket 7 when these parts are forced upward in the manner hereinafter described.

When an abnormal pressure occurs on the transmission conductor 1 the current jumps the air gap between the disks 2 and 3 and escapes from electrode 4 through the water contained in the lower part of chamber 5 to the electrode 7, and from there through the chain 8 to the copper tank 6 and thus to ground through the conductor 12. If this discharge is small, such for instance as might arise from a slight static effect, no great disturbance would be produced in the tube 5; but if on the other hand the discharge of current is heavy or if the line current follows the discharge across the gap between the disks 2 and 3, the liquid in the lower part of tube or chamber 5 will be almost instantly volatilized and the explosive effect produced thereby will force the plunger or basket 7 and the chain 8 upward into the chamber 9 and will likewise carry upward the column of water and force it out through the longitudinal slots of chamber 9 into the main tank 6, thus almost instantaneously increasing the distance between the electrodes 4 and 7 from a few inches to almost as many feet, and furthermore substituting for the conducting liquid which formerly existed between these electrodes a gas or vapor having an extremely high resistance. At the instant the arc breaks, the steam within tube 5 begins to

condense, thus producing a vacuum which forcibly draws down the plunger or basket 7 together with enough liquid to completely fill the tube so that the device is almost instantly reset for another charge. To increase the intensity of the heating effect at the lower part of tube 5 I interpose a porcelain bushing 13 immediately above the upper surface of electrode 4, thus concentrating the current flow within a relatively small area. To prevent the destructive or deteriorating action of the arc on the hard rubber tube 5 I coat the interior of the tube with a lining of refractory sand 14 or similar material by first introducing a varnish into the tube and then pouring sand through until the inner surface is completely covered, after which the varnish may be set by baking or drying. As the expansion or rapid vaporization in the lower part of tube 5 forces the column upward with great violence into the tank 6, I provide a baffle plate 15 supported on a suitable framework 17, and having the metal guide rod 18 which passes freely through the cover 19 of the copper tank 6. The lower surface of the baffle plate 15 is properly shaped to deflect downward the water which rushes outward from chamber 9. An annular flange 20 is provided in the side wall of the copper tank 6 immediately below the lower edge of cover 19 so that liquid discharged upward along the inner surface of the tank will be deflected toward the center of the tank and thus prevented from escaping between the cover and side wall.

In the modification shown in Fig. 5 the basket or plunger and its supporting chain are dispensed with, and the column of liquid within the rubber tube 21 is relied upon to carry the current from the lower electrode 4 to the copper tank 6, which is in this case the upper electrode. If a heavy current discharge passes from electrode 4 to the liquid in the lower part of the tube 21 the liquid will be vaporized and its expansion will force the column of water upward into the tank and thus rupture the arc. By making the insulating tube smaller at the bottom than at the top I am enabled to greatly concentrate the heating action of the current at the lower part of the tube. In the modification shown in Fig. 6, the liquid consists of oil or other low conducting fluid and the upper electrode consists of an aluminum or other metal rod 22 provided at its upper end with a baffle plate 23 and an insulating guide rod 24 which passes upward through the center of the cover 19, and provided at its lower end with a ball or plunger 25. The baffle plate 23 consists of metal and is normally seated on the conducting bracket or shoulder 26 riveted to the side of the copper tank 6. With this construction the path of the lightning discharge is from electrode 4 through the oil to the lower end of the aluminum rod 22, then through the baffle plate 23 to the bracket 26 and thus to ground through a water resistance 27 of ordinary form. In case of a heavy current discharge from the lower electrode 4, the lower part of the column of oil in the insulating tube 5 will be volatilized and the explosive effect produced thereby will force the column of oil upward against baffle plate 23, thus moving the upper electrode 22 away from the lower electrode and at the same time interposing an auxiliary spark gap between the baffle plate 23 and the bracket 26. As this spark gap is beneath the surface of the oil it exerts a powerful influence to break the arc in the lower part of the tube.

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

1. In a lightning arrester, a plurality of electrodes, means for connecting one of said electrodes to ground, an expansible liquid initially contacting with said electrodes, means for passing current through said liquid to ground, and means for automatically decreasing the quantity of liquid in the path of said current to interrupt said current.

2. In a lightning arrester, a plurality of electrodes, an expansible fluid initially contacting with said electrodes, means for conducting current to ground through said fluid, means for concentrating the heating action of said current near one of said electrodes and means for preventing the expansion of said fluid in a direction transverse to the direction of the current in said fluid.

3. In a lightning arrester, a plurality of electrodes, an expansible liquid initially contacting with said electrodes, means for conducting current to ground through said liquid, and means for causing a violent expansion of said liquid toward one of said electrodes and for limiting the expansion in other directions.

4. Means for protecting an electrical circuit, comprising a chamber, an expansible liquid within said chamber, a plurality of electrodes in said chamber, making contact with said liquid one at least of said electrodes being stationary, and means for causing an expansion of said liquid to increase the distance between said electrodes.

5. Means for protecting an electrical circuit, comprising a chamber, a column of liquid within said chamber, a plurality of electrodes in said chamber in contact with and separated by said liquid, and automatic means for increasing the distance between said electrodes and for violently expelling a portion of said liquid from said chamber.

6. In a lightning arrester, a tubular chamber, an electrode secured to the wall of said chamber, a solid electrode fitting loosely in said chamber, a liquid between said electrodes, means for passing current through said liquid thereby expanding the same and

separating the two electrodes, and means for returning said electrodes and liquid to their original relative position.

7. In a lightning arrester, a tube of insulating material having an open end, a liquid within said tube, means for conducting current to said tube, means for concentrating the heating action of said current to violently expel said liquid and interrupt said current, and automatic means for refilling said tube with liquid.

8. In a lightning arrester, a tube of insulating material having an open end, an electrode secured in the lower part of said tube, a column of liquid supported above said electrode, means for passing current through said column of liquid to ground, and means for concentrating the thermal effect of said current on said liquid near said electrode to interrupt the flow of current through said tube.

9. Means for protecting an electrical circuit from abnormal charges, comprising a tube of insulating material, an electrode secured in the lower part of said tube, a column of liquid supported above said electrode, a second electrode suspended in said liquid, means for passing current through said column of liquid, and means for vaporizing the liquid between said electrodes to increase the distance between said electrodes and to interrupt the current through the column of liquid.

10. A lightning arrester, comprising a tank for liquid, means for connecting said tank to ground, a tube of insulatimg material having one end connected to said tank and having an electrode at the opposite end, a liquid in said tube, means for conducting current to said electrode, means for concentrating the heating effect to said current near said electrode, and means for expelling the liquid from said tube into said tank to interrupt the flow of current from said electrode.

11. A lightning arrester comprising a tank for liquid, a tube of insulating material connected at one end to said tank and provided at the other end with an electrode, a second electrode electrically connected to said tank and suspended in proximity to said first named electrode, and a liquid in said tube expansible by current flowing therethrough to increase the distance between said electrodes and to expel liquid from said tube into said tank.

In witness whereof, I have hereunto set my hand this third day of December, 1904.

EDWARD S. HALSEY.

Witnesses:
THOS. W. CONRAD,
A. M. LAMB.