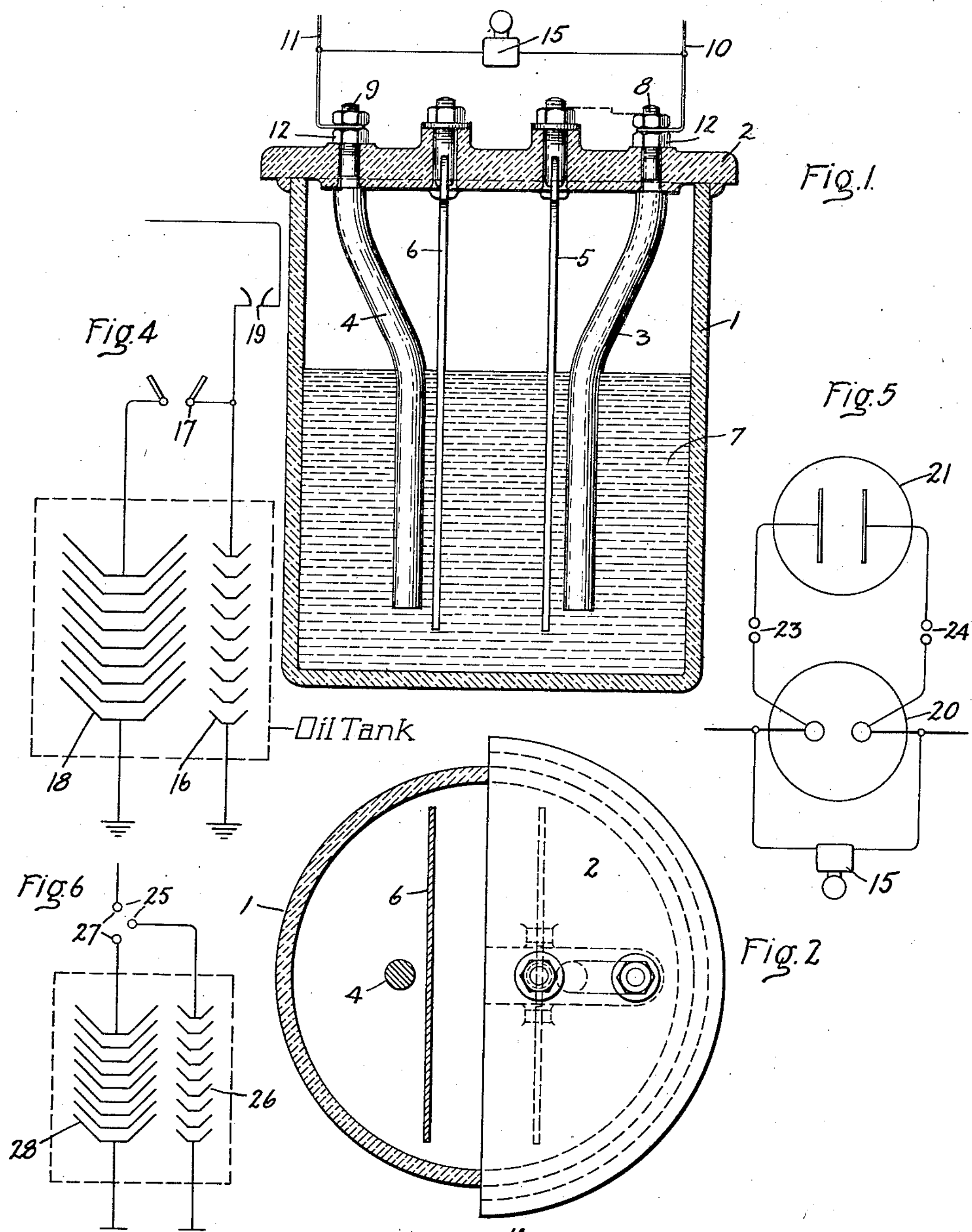
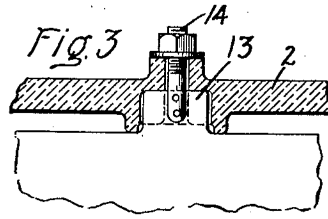
E. E. F. CREIGHTON.

LIGHTNING ARRESTER.

APPLICATION FILED DEC. 22, 1908.

1,004,535. Patented Sept. 26, 1911.





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UNITED STATES PATENT OFFICE.

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LIGHTNING-ARRESTER.

1,004,535. Specification of Letters Patent. **Patented Sept. 26, 1911.**

Application filed December 22, 1908. Serial No. 468,848.

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 and State of New York, have invented certain new and useful Improvements in Lightning-Arresters, of which the following is a specification.

My invention relates to electrolytic condenser cells for protecting transmission lines from abnormal voltages, such as lightning strokes, inductive surges, and the like. Cells of this kind are well-known in the art, consisting essentially of aluminum electrode plates immersed in a suitable electrolyte. These plates have the property of forming an insulating film upon their surfaces when the cell is included in an electric circuit, allowing only a small leakage current to flow through the cell below a certain critical breakdown voltage. When the potential impressed upon the cell exceeds this breakdown voltage a discharge through the same will take place freely; the cell in that case acting much like a water rheostat and its resistance depending among other factors upon the surface area of the electrodes in contact with the electrolyte. Electrode plates of comparatively large area, therefore, will allow a heavy discharge, like a heavy stroke of lightning, to freely pass through the cell, and for this reason plates of large area offer greater protection to the line against the comparatively rare, heavy discharges. However, an arrester with electrode plates of small area possesses a decided advantage under certain conditions; for example, if the arrester is connected to the line in series with a spark gap a decrease in the current-carrying capacity of the arrester will enable a shorter gap to be used with safety. The decrease of the spark gap will give greater protection to the line in the case of ordinary disturbances, such as the discharge of static electricity, or the equalization of surges due to switching operations and the like.

My invention comprises a lightning arrester, which combines the protective feature against heavy discharges possessed by an arrester having plates of large area, with the added protection against ordinary light disturbances due to the shortening of the spark gap made possible with a cell having plates of small area. This is accomplished by combining electrode plates of unequal area either in a single cell or in a plurality of cells connected in a manner as will be explained so that ordinarily the plates of smaller area will take care of the minor disturbances, and the plates of greater area will come into action only for the heavy discharges. When normal conditions have been restored the plates of greater area will automatically drop out of action, and the cell will against functionate with the smaller electrodes. An arrester of this kind possesses the added advantage that it can be used under conditions where a considerable voltage drop is desired in order to operate an alarm device placed in shunt with the arrester. The arrester will ordinarily operate with plates of smaller area and will, therefore, have sufficient resistance to give the required voltage drop; but in the case of heavy discharges the plates of greater area will come into operation and give the added degree of protection without sacrificing the resistance required in the cell to operate the alarm device under ordinary conditions.

In the accompanying drawing, Figure 1 is a longitudinal section of a cell provided with two sets of electrode plates of unequal area; Fig. 2 is a top view, partly in section of this cell; Fig. 3 is a fragmentary view, showing how the auxiliary electrodes are supported; Fig. 4 is a diagrammatic view, showing how two-high-voltage cone-type cells of unequal plate area are combined, so that the cell of larger plate area will come into action only for the heavy discharges; Fig. 5 shows a similar arrangement in connection with a low-voltage arrester cell; and Fig. 6 shows an arrangement of cells with plates of unequal area in which the spark gaps are placed in such relation that a discharge across the gap of the cell with small plate area tends to ionize the gap in series with the cell of greater plate area.

Referring to Fig. 1, the container 1 is provided with an insulating cover 2, from which are supported two pairs of electrodes. One pair 3, 4 may be termed the "active" electrodes, and the other pair 5, 6 may be designated as "emergency" electrodes. The cell is partly filled with a suitable electrolyte 7. The active electrodes 3, 4 are rod-like in form, and are supported by screws from the binding posts 8, 9, which are connected to the line 10, 11. The electrodes

3, 4 are held rigidly in position, as part of each of the binding posts 8, 9, is made square in form, fitting into square holes in the cover so as to avoid lateral movement on the part of the electrodes 3, 4 when held in position by tightening the nuts 12, 12. The emergency electrodes 5, 6 are plate-like in form, so as to give greater area. Their manner of suspension is best seen in Fig. 3. They are supported from the cover 2 by having an ear 13 passed part way up through the cover, being riveted to the supporting rod 14. It will be seen that this method of suspending each pair of electrodes will bring them in close proximity inside of the electrolyte and yet will avoid short circuits on the exterior of the cell. When ordinary light disturbances are discharged by the cell only electrodes 3, 4 will come into play; but when a discharge of unusual severity passes through the cell the current will arc from the electrodes 3, 4 to the electrodes 5, 6, which will temporarily become the active electrodes, and for the time being increase the plate area of the cell. When the discharge has passed the arcs will be extinguished and the electrodes 3, 4 will resume their function. As already mentioned a cell of this kind will provide sufficient drop to operate an alarm 15 placed across the same. If desired, this alarm device, as a bell, may be operated by direct current by causing the cell to exert a rectifying action. This may be done by making the electrodes unsymmetrical as by connecting electrodes 3, 5 metallically, the gap between electrodes 4, 6 being broken down by severe discharges in the same manner as explained.

According to the arrangement shown in Fig. 4, ordinary discharges will pass through the cell having electrode plates of small area 16; but a heavy discharge will arc across the horn gap 17 and pass through the plates of greater area 18. When the discharge has passed, the arc across the gap 17 will rise in the horns and be put out, thus reducing the current flowing from line to ground to a lower value which will cause the arc across horns 19 to break in turn, thus interrupting the current discharging through the cell.

The same arrangement is illustrated in Fig. 5. The plates in cell 20 are in the form of rods; the plates in the cell 21 are in the form of plates but of course may be of any other suitable form of greater area. The alarm device 15 is connected across the cell 20. The cell 21 is connected in shunt with the cell 20 in series with the gaps 23, 24. Ordinary disturbances will be discharged by cell 20. Heavy discharges will arc across the gaps 23, 24, bringing the cell 21 into action. The alarm 15 will operate in every case, as the resistance across cell 20 is high enough so that there will be sufficient voltage drop across the same to ring the bell even in the case of light discharges. When a heavy discharge has passed through the two cells, the arcs across the gaps 23, 24 will first be broken, thus decreasing the dynamic current and enabling the cell 20 to interrupt the current by the building up of its film.

As indicated diagrammatically in Fig. 6, the arc across the gap 25 caused by a discharge through the cell 26 may serve to ionize the gap 27, in series with cell 28, and in this manner make the conjoint operation of the cells of unequal area more reliable. It is obvious that horn gaps may be combined in this manner, although not shown in the figure for the sake of simplicity.

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

1. A lightning arrester, comprising an electrolytic path of low current-carrying capacity, and a second electrolytic path of greater current-carrying capacity arranged to take current from the path of low current-carrying capacity when a heavy discharge of current takes place through the arrester.

2. An electrolytic protective device comprising a pair of electrodes to be connected in series with a spark gap, a second pair of electrodes of greater area in shunt with said first pair of electrodes and in series with a second spark gap, and means for maintaining electrolyte in contact with both pairs of electrodes.

3. In combination with a transmission line, an electrolytic condenser cell therefor, comprising a suitable electrolyte and electrodes partially immersed in said electrolyte, and means for decreasing the resistance of said cell when the potential across the line electrodes tends to rise abnormally.

4. In an electrolytic condenser cell, the combination of electrodes of limited area partially immersed in a suitable electrolyte, and auxiliary electrodes of larger surface area likewise partially immersed in said electrolyte and situated near the former electrodes, but out of contact with the same.

5. In an electrolytic condenser cell, the combination with an electrolyte, of electrodes partially immersed in said electrolyte, and auxiliary electrodes of greater plate area suspended near the main electrodes and in proximity to the same in the electrolyte.

6. In an electrolytic condenser cell, the combination of electrodes normally connected to a line, and independent auxiliary electrodes of larger surface area suspended between the line electrodes in proximity, but out of contact therewith.

7. In combination, an electrolytic condenser cell, an alarm device in shunt with said cell, and means for decreasing the re-

sistance of said cell when the potential across the cell rises abnormally.

8. The combination with an electrolytic condenser cell having two sets of electrodes of unequal area, of an alarm device in shunt with one set of electrodes.

9. The combination with an electrolytic cell having two sets of electrodes, the second set being of greater area than the first, of an alarm device in shunt with the first set of electrodes.

In witness whereof, I have hereunto set my hand this 21st day of December, 1908.

ELMER E. F. CREIGHTON.

Witnesses:
BENJAMIN B. HULL,
HELEN ORFORD.