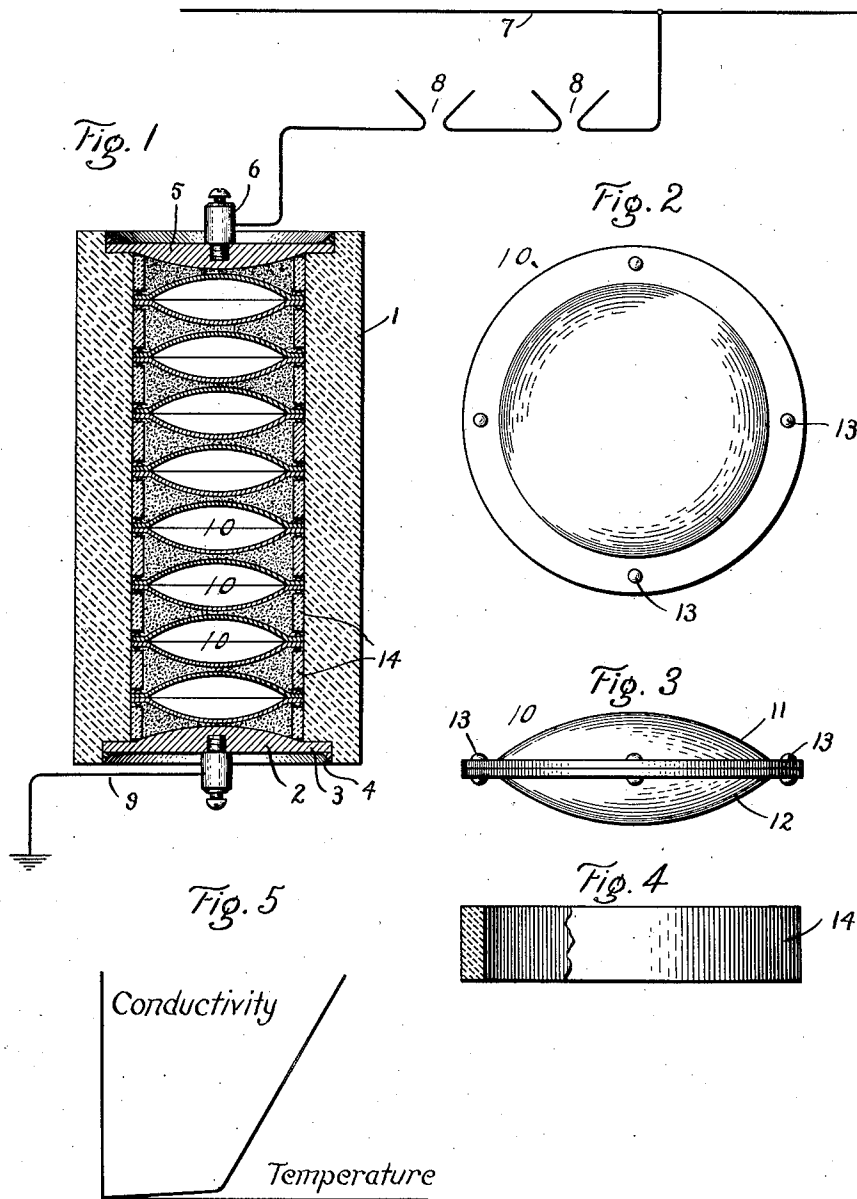


A. B. MARVIN, JR.
 PROTECTIVE DEVICE.
 APPLICATION FILED FEB. 15, 1907.

1,002,069.

Patented Aug. 29, 1911.



WITNESSES:
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UNITED STATES PATENT OFFICE.

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PROTECTIVE DEVICE.

1,002,069.

Specification of Letters Patent. Patented Aug. 29, 1911.

Application filed February 15, 1907. Serial No. 357,547.

To all whom it may concern:

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

This invention relates to the protection of electrical circuits from high potential charges arising from atmospheric disturbances, from resonance, static charges, switching manipulations, etc.

The invention comprises means for relieving an electrical conductor of its abnormal potential charge and for preventing the line current from following through on a high potential discharge.

The apparatus hereinafter described, is, in a sense, a selective device, readily transmitting electrical energy of high potential and high frequency, but opposing a prohibitive resistance to the transmission of electrical energy of lower potential and lower frequency.

In the accompanying drawing I have illustrated a single unit embodying my invention, and I have indicated diagrammatically how this unit may be connected in circuit. It should be understood, however, that such units may be grouped in any of the ways now common in the lightning arrester art. They may be arranged between line conductors and ground; between line and line; or according to other known arrangements which permit discharge from any line conductor to any other line conductor or to ground. Such groupings are well understood and are therefore not illustrated in this specification.

In the drawings, Figure 1 is a sectional elevation of the lightning arrester unit; Fig. 2 is a plan of one of the aluminum partitions; Fig. 3 is an elevation of the same; Fig. 4 is a partial section of one of the porcelain spacing rings; and Fig. 5 is a diagram.

The arrester unit comprises a box or envelop 1 of insulating material such as porcelain, preferably of tubular form as shown. The chamber of this porcelain tube is closed at the bottom by an aluminum disk 2 having a flange 3 fitting in an annular recess in the end wall of the porcelain. The aluminum disk may be held rigidly in place by cement

4 in the angle between the flange and the porcelain tube. The upper end of the tubular chamber is closed by a similar aluminum disk 5. The upper disk is provided with a terminal 6 by which electrical connection may be made with line conductor 7. Spark gaps 8 may be included in this connection if desired. The lower aluminum disk 2 may be connected to ground through a conductor 9. Between the aluminum disks 5 and 2, a plurality of aluminum partitions or electrodes are arranged to form a path sub-divided into a plurality of gaps or spaces. Each aluminum partition or electrode may be of the shape shown in Figs. 2 and 3 and may consist of sheet metal punchings 11 and 12 each having a convex central portion and an annular flange. The concave sides of these two disks or stampings are placed together and the two disks are riveted together with aluminum rivets 13. These aluminum partitions 10 are assembled one above another and are spaced apart by annular porcelain rings 14. In assembling the partitions I fill the spaces therebetween with a fused electrolyte, preferably free from water. In general I prefer to use those fusible salts which give to aluminum its well known asymmetric or rectifying properties when used as anode. Sodium nitrate is such a salt and is suitable for use in this apparatus, though I may use other nitrates or mixtures thereof. I may also use a mixture of sodium nitrate and sodium nitrite. When the arrester is put in use, the salt or electrolyte which separates the aluminum partitions is solid and completely fills the space between adjacent partitions. It happens that sodium nitrate or the other salts above mentioned, are of low conductivity when cold but of good conductivity when hot, and furthermore, it happens that this change from the non-conductive to the conductive condition takes place principally at temperatures between 200 and 400 degrees. This relation is shown diagrammatically in Fig. 3. It will therefore be seen that when the sodium nitrate is solid, a high resistance is interposed between the line conductor 7 and ground. The path of lowest resistance through the arrester unit is along the axis of the unit where the convex surfaces of the partitions approach each other. The number of partitions and their distance apart is adjusted so that the not-

mal line potential of the conductor will not send appreciable current through the sodium nitrate, consequently the latter remains solid and of high resistance. In case, however, of an abnormal potential on the line conductor, as for instance, from lightning, the high potential will send current across the spark gaps 8 and through the sodium nitrate and will thereby heat a small portion of it, and by so doing, change it from the substantially non-conductive, to the conductive condition. The greater the heating, the greater the increase in conductivity and the greater the ease with which energy may be discharged from the line conductor. This self reduction in the resistance of the unit does not, however, go on indefinitely, for as soon as current begins to flow through the electrolyte, the aluminum plates take on a coating of non-conducting oxid or possibly of hydroxid, as in the case of the well known electrolytic condenser. The rapid increase in resistance at each aluminum anode increases the total resistance in circuit and cuts down the current flowing. As soon as the films develop, the apparatus begins to act as a condenser, or more correctly speaking, as a plurality of condensers connected in series. This aluminum condenser differs from others of the more usual type by having a variable capacity depending on the length of time during which current has flowed,—in other words, dependent on the condition of the insulating oxid on the plates. In fact, the protective device as a whole may be regarded as a leaky condenser which first permits electrical energy to pass through, but subsequently increases in capacity and chokes back the current. The change in electrical resistance combines with this condenser action to give a resistance which is initially high, then decreases to a low value, and finally increases to a very high value.

The condenser action of the device insures a more ready transmittal of high frequency current than of low frequency current, and the protective device is therefore selective in its action and tends to carry off static or other rapidly oscillating charges without transmitting energy of normal line frequency. There is, of course, a break down potential for the films on the aluminum plates, but by arranging enough plates in the series it is possible to secure a total resistance such that the break down voltage is higher than the normal line voltage by any desired value, say ten per cent. If then, the high potential charge is not completely removed from the line before the aluminum films build up to their maximum value, the high potential will be sufficient to puncture the films and continue the discharge to ground. This discharge, however, will continue only so long as the potential remains

above the break down voltage of the films; or in other words, more than ten per cent. above line voltage. As soon as the potential drops to its normal value, the punctured films take on their high resistance and prevent the line current from flowing through to ground.

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

1. The combination with a conductor subject to abnormal potential, of a discharge path comprising a high resistance electrolyte of good conductivity when heated beyond a predetermined temperature and electrodes spaced apart in said electrolyte to maintain said electrolyte below said temperature during normal potential on said conductor and to permit predetermined abnormal potential on said conductor to cause sufficient current between said electrodes to raise said electrolyte beyond said temperature.

2. A protective device comprising an electrolyte of high resistance when solid and of low resistance when fused, and electrodes spaced apart in said electrolyte to permit said electrolyte to remain solid when said protective device is subjected to normal potential and to allow sufficient current to flow between said electrodes to fuse said electrolyte when said device is subjected to a predetermined abnormal potential.

3. In a self reducing resistance, the combination of a plurality of aluminum electrodes each presenting a convex surface to an adjacent electrode, said electrodes being separated by thin layers of salt subject to great increase in conductivity when heated by current passing between said electrodes.

4. In a self reducing resistance, the combination of a plurality of aluminum electrodes having convex surfaces approaching each other and sodium nitrate separating said electrodes.

5. The combination with a conductor subject to abnormal potential, of a protective device comprising a plurality of electrodes and a normally solid fusible electrolyte which greatly increases in conductivity and forms an insulating film on said electrodes when fused, said electrodes being so related that abnormal potential on said conductor produces sufficient current to fuse said electrolyte.

6. The combination with a conductor subject to abnormal potential, of a protective device comprising a plurality of electrodes separated by a normally solid electrolyte which presents a high resistance to current flow at normal potential on said conductor and through which predetermined abnormal potential on said conductor forces sufficient current to fuse said electrolyte and thereby reduce its resistance.

7. In a lightning arrester, the combina-

tion of a plurality of aluminum plates, a
ground connection for one of said plates, a
line connection for another plate, and an
electrolyte between said plates, said electro-
5 lyte being initially solid but fusible by a
predetermined abnormal difference in po-
tential between said connections to develop
an insulating coating on said plates.

10 8. In a lightning arrester, the combina-
tion of a plurality of aluminum electrodes

each presenting a convex surface to an ad-
jacent electrode, and an electrolyte between
said electrodes normally solid but fusible.

In witness whereof, I have hereunto set
my hand this 14th day of February, 1907.

ARBA B. MARVIN, JR.

Witnesses:

BENJAMIN B. HULL,
HELEN ORFORD.