No. 860,997. PATENTED JULY 23, 1907.

C. P. STEINMETZ.

LIGHTNING ARRESTER.

APPLICATION FILED DEC. 28, 1900.

Fig. 1.

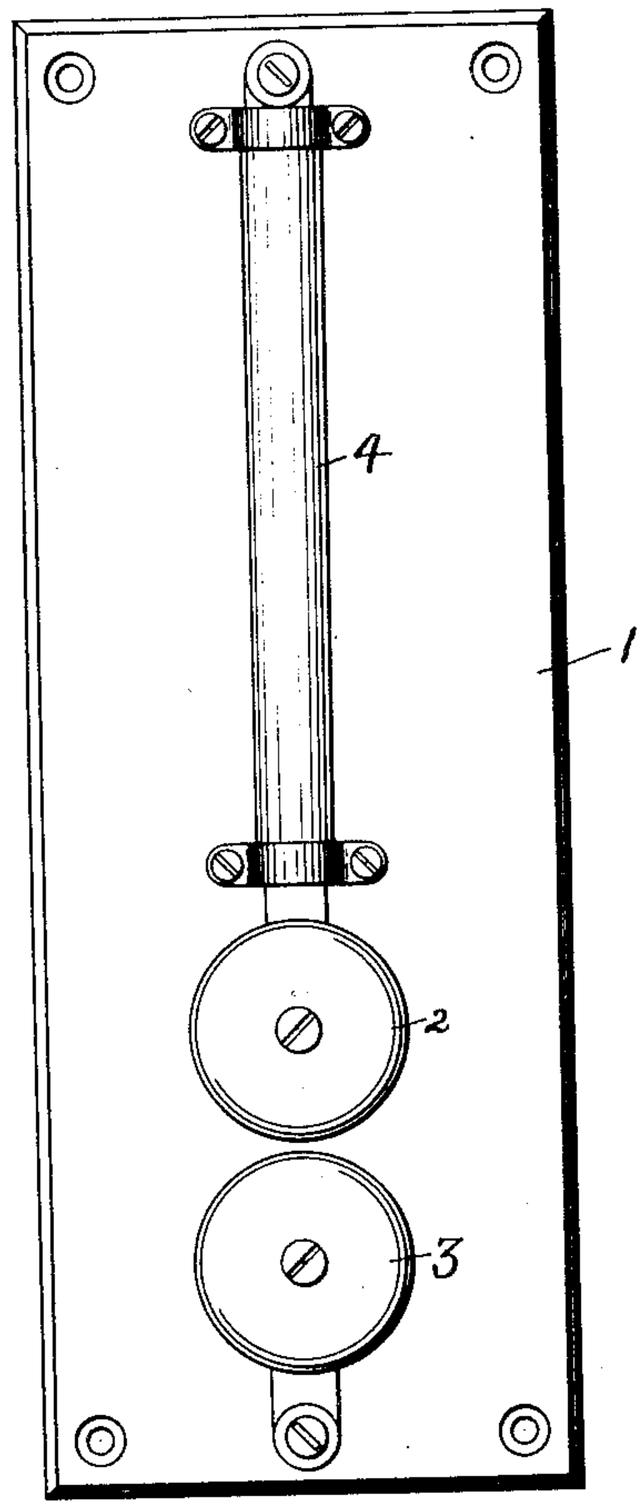
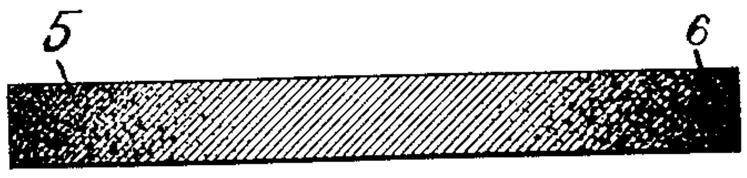



Fig. 2.




Witnesses.
John Ellis Glenn.
Benjamin B. Lucas.

Inventor:
Charles P. Steinmetz,
by Albert G. Davis
Atty.

# UNITED STATES PATENT OFFICE.

CHARLES P. STEINMETZ, OF SCHENECTADY, NEW YORK, ASSIGNOR TO GENERAL ELECTRIC COMPANY, A CORPORATION OF NEW YORK.

## LIGHTNING-ARRESTER.

No. 860,997. Specification of Letters Patent. Patented July 23, 1907.

Application filed December 28, 1900. Serial No. 41,349.

*To all whom it may concern:*

Be it known that I, CHARLES P. STEINMETZ, a citizen of the United States, residing at Schenectady, county of Schenectady, 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 lightning arresters wherein an air-gap device is combined with an ohmic resistance to limit the quantity of line current which can follow a lightning discharge across the air-gap. As ordinarily made, the resistance consists of a rod of composition, usually a mixture of graphite and clay. In practice it is found that the conductivity of such a composition is not constant, but varies with each discharge of current through it. The graphite burns out, especially at the terminals of the rod increasing the resistance of the rod and finally open-circuiting the device.

My invention aims to overcome this difficulty by substituting for the combustible graphite a non-combustible metallic oxid, or mixture of oxids, which, while to a certain extent conductive, yet has a very high resistance. Potassium silicate or sodium silicate may be used in small quantities as a binder, if desired. The rod can thus be made fairly homogeneous, and is of constant resistance at reasonably low temperatures. Among the oxids which can be used for this purpose are the oxids of iron, chromium, etc. All of these are very refractory and stand bright-red heat or even white heat, especially the black oxid of iron, which is of low resistance, and chromite, which is of high resistance, and their mixtures. Instead of using one of these oxids alone, I may combine them in various proportions, to obtain rods having different degrees of resistance.

It has been found in practice that there is a tendency for an arc to form between the end of the resistance rod and the clamp or clip which holds it. To overcome this, I reduce the resistance of the ends of the rod. This may be done in a variety of ways, such for example, as copper-plating the ends of the rod. Or, I may use in the ends a larger proportion of an oxid of lower resistance. Or, I may reduce the ends of the rod of the black oxid, to metallic iron, which is a much better conductor than the oxid. To accomplish this reduction, the rod is baked again at a bright red heat, with its middle portion embedded in oxid and its end portions embedded in powdered charcoal. At bright-red heat carbonic oxid is produced which reduces the oxid to iron, the reduction penetrating the rod from the outside and thus giving a gradual increase of resistance from the outside of the rod terminals towards the center. Hydrogen or hydro-carbon vapors may be used for the same purpose. Or the ends of the rod may be dipped in a carbon compound, such as melted tar or molasses, and baked at a high temperature to carbonize the tar, etc., and reduce the oxid.

In the drawings Figure 1 shows a lightning-arrester embodying a resistance rod made in accordance with my invention, while Fig. 2 shows such a rod in longitudinal section.

In Fig. 1 the base of the lightning-arrester is indicated at 1. Sparking gap terminals 2 and 3 are mounted thereon in the usual way. A resistance rod 4 such as I have described above is connected in circuit with the sparking gap as indicated.

In Fig. 2 a cross-section of a rod is shown in which the conductivity of the ends at 5 and 6 is intended, by heavier shading, to represent a better conductivity of the end than of the middle portion. This result may be secured as above described by impregnating the ends with carbon whereby the oxid of the rod or stick is more or less reduced to metal which coexists with carbon.

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

1. A resistance stick or mass composed of a mixture of oxids of iron having different electrical conductivities.

2. A resistance rod composed mainly of an oxid of iron but having its ends formed of an oxid having greater electrical conductivity than that of the intermediate portions.

3. A resistance rod having its ends impregnated with carbon.

4. A resistance rod formed of a conducting oxid and having its ends impregnated with carbon.

5. A resistance rod composed of oxids electrically conducting at ordinary temperatures, and having its ends of better conductivity than the other portions thereof.

6. A resistance stick having portions thereof, where connections are made, impregnated with metal.

7. A resistance stick having portions thereof, where connections are made, containing metal in the presence of carbon.

8. The method of making a resistance rod, which consists in mixing an iron oxid with a small percentage of binding material, molding and baking the rod, and rebaking it with its ends in contact with an oxidizable carbon compound.

9. The method of making a resistance rod, which consists in mixing an iron oxid with a small percentage of binding material, molding and baking the rod, dipping an end or ends of said rod in melted tar, and then rebaking it.

In witness whereof, I have hereunto set my hand this 27th day of December, 1900.

CHARLES P. STEINMETZ.

Witnesses:
BENJAMIN B. HULL,
MARGARET E. WOOLLEY.