May 12, 1931. R. TANBERG 1,805,195

ELECTRIC SURGE RECORDER

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Fig. 1.

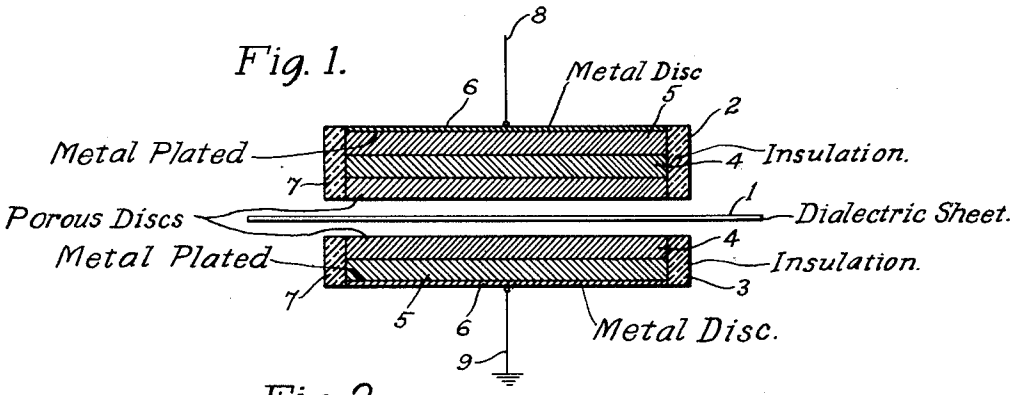
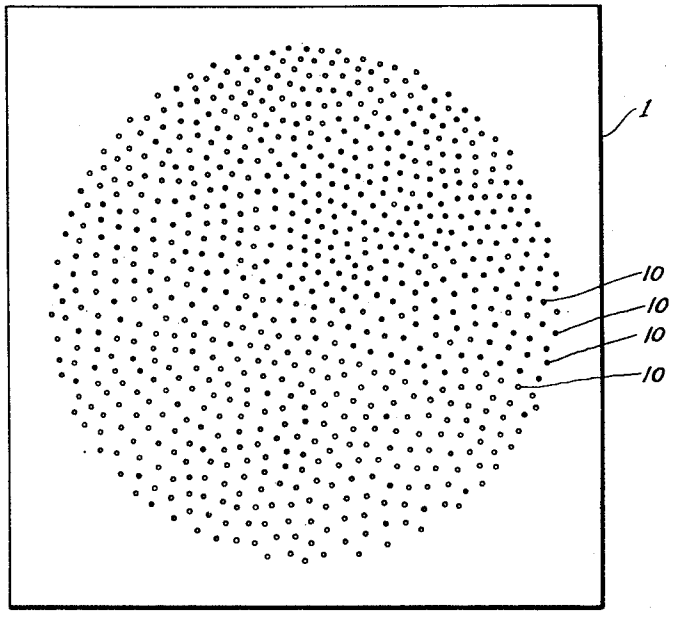


Fig. 2.



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UNITED STATES PATENT OFFICE

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ELECTRIC SURGE RECORDER

Application filed December 14, 1928. Serial No. 325,984.

My invention relates to electric surge recorders and more particularly to means for affecting the appearance of a dielectric material in accordance with an electric impulse discharge.

An object of my invention is to provide means for making a permanent record of the magnitude and duration of a momentary electric phenomena, such as an electric discharge, which traverses a commercial lightning arrester of an electric power-transmission system when a surge occurs thereon.

Broadly speaking, my invention consists of a thin sheet of dielectric material and means, including a plurality of semi-conducting porous members disposed on opposite sides of said dielectric material, for affecting the appearance of said material in accordance with an electric surge.

My invention, however, may be more readily understood by reference to the accompanying drawings in conjunction with the following description.

In the drawings:

Figure 1 is a view in vertical section of an electric surge recorder constructed in accordance with my invention, the several elements of the device being separated to facilitate the illustration thereof.

Fig. 2 is an enlarged plan view of the record of an electric surge made by an electric surge recorder in accordance with my invention.

Referring to Fig. 1, a thin sheet 1 of a smooth dielectric material, such as tissue paper, is disposed between coacting upper and lower devices 2 and 3, respectively. Each of said devices preferably comprises one or more semi-conducting porous discs 4 of approximately 2″ in diameter for contact with opposite sides of the sheet of paper 1, when the current value to be measured is between 50 and 600 amperes.

Such size of the discs 4 may be increased for measuring higher currents than that specified, where very accurate results are desired, and vice-versa for smaller currents.

The composition of each of the discs preferably consists of carborundum, calcined clay, Klingenberg clay, and sufficient carbon to give the desired conductivity required to make the composition semi-conducting. The discs 4 are each backed by a copper plated similar disc 5, having a copper-plated surface in contact with a disc 6 of electrical-conducting material, such as brass. All of the discs of each device are bound together, preferably by a mixture of water glass and carbon powder and insulated with a ring 7 of shellac.

As shown in Fig. 1, the upper and lower conducting devices 2 and 3 are separated from the paper 1 for clearness of illustration, but, actually, the devices 2 and 3 are in close surface engagement with the faces of the paper 1 and are held in such position by any suitable apparatus (not shown).

The upper conducting device 2 in the modification shown is provided, preferably, with two 55,000 ohm semi-conducting porous discs 4, whereas, the lower conducting device 3 is provided with only a single semi-conducting disc of the same resistance. The discs 5 have a resistance of the order of a few ohms. Such assembly is disclosed merely by way of illustration as the devices 2 and 3 may comprise single discs or any other convenient number of any ohmic resistance. The upper conducting device 2 is electrically connected, by a conductor 8, to an electric system (not shown) the surges of which are to be recorded and the lower conducting device 3 is connected, by a conductor 9, to ground.

When an electric surge occurs on the system, such a transmission line, that is of sufficient magnitude to break through the surge recorder to ground, the tissue paper 1 is punctured by a number of minute openings, indicated at 10 in Fig. 2. It has been found that the number of openings 10 punctured in the paper bears a definite relation to the maximum surge current going through the recorded, and the size of the openings is a measure of the duration of the discharge. That is, if the surge current is relatively large, a relatively large number of openings will be formed, and if the duration of the surge is relatively long, the average diameter of the openings will be large. The openings 10 are shown greatly enlarged in Fig. 2 to facilitate the illustration thereof, since, actually, it is difficult to see the holes 10 without the aid

of a microscope. The holes 10 are fairly evenly distributed over the sheet of tissue paper 1 and, as mentioned above, the number of holes per unit area is a measure of the maximum current of the surge.

The recorder functions as an automatic device passing current only when the magnitude of the electric surge exceeds a certain value.

The discs 5 are copper-plated to make electrical contact with the metal plates 6. The discs 5, of course, may be coated with any conducting material having the conductive characteristics of copper without affecting the result attained by my invention. The brass discs 6 also my comprise any suitable similar conducting material, such as copper, gold or silver, but I prefer to use brass because of its desirable properties of cheapness and adaptability in manufacture.

In experimenting with my novel surge recorder, I have discovered that: (1) the number of holes punctured in the paper record is not influenced by the number of surges sent through the surge recorder. The same number of holes are produced by one surge as by a number of consecutive surges of the same magnitude. The size of the holes, however, is increased by repeated discharges; and (2) the number of holes in a record always corresponds to the largest surge current sent through the surge recorder with the particular record in place. I have found also, by tests, that the steepness of the surge front does not affect the results to any noticeable degree.

In order to make the holes visible for facilitating the work in counting them, the recording paper may be treated with a solution of manganese linoleate in carbon tetrachloride. Such treatment causes the holes to stand out against a dark background, making it possible to count them directly with the naked eye without the aid of a microscope.

My novel surge recorder is particularly applicable for use in combination with lightning arresters, principally because it is well adapted to measuring the surge current through the same. Because of its extreme simplicity and small cost, a recorder of the type described may be installed in great numbers on different transmission systems, whereby valuable data may be obtained. The attendance required in such case consists only in changing the paper records at the end of each lightning season. For such type of service, a preferable arrangement comprises connecting the recorder in series-circuit relation with any type of arrester, either as a separate unit or built as a part of the arrester itself.

My device may, of course, be connected to the transmission line in such manner that a record of the potential of an electric surge may be properly made. The recorder will indicate currents of a magnitude of approximately 1 ampere by proper dimensioning of the electrode plates and, therefore, it will serve as a potential surge recorder when connected to a transmission line by means of a series resistance and a series gap. All surges of a magnitude larger than such series-gap setting would be recorded.

An indication of the total area of the holes in the record is to be found by measuring the time required for a certain volume of air under a certain pressure to pass through a known area of the paper. A measure of the average size of the holes is obtained by dividing the reciprocal value of such time by the number of holes in the same area.

It will be apparent to those skilled in the art that various changes may be made in my invention without departing from the spirit thereof, and I desire to secure protection for my device as set forth in the following claims.

I claim as my invention:

1. An electric surge recorder comprising a sheet of dielectric material, and means for simultaneously puncturing said sheet with a plurality of openings in accordance with the magnitude of the current of a single electric impulse discharge.

2. An electric surge recorder comprising a thin sheet of dielectric material and means for affecting said material to give a visual indication of the characteristic of an electric impulse discharge including a plurality of semi-conducting members of appreciable surface areas cooperating with a corresponding area of said dielectric material.

3. An electric surge recorder comprising a plurality of semi-conducting discs and a sheet of tissue paper disposed between said discs in surface-to-face engagement therewith.

4. In combination, in an electric circuit, a sheet of dielectric material, and means including electrodes connected to said circuit and co-operating with said sheet to instantaneously change the character of a plurality of distinct relatively small areas of the sheet distributed over a relatively large area thereof in accordance with a characteristic of an electric-impulse discharge in the circuit.

5. In combination, in an electric circuit, a sheet of dielectric material, and means including electrodes connected to said circuit and co-operating with said sheet to instantaneously provide a plurality of openings of relatively small areas in the sheet distributed over a relatively large area thereof in accordance with a characteristic of an electric-impulse discharge in the circuit.

In testimony whereof, I have hereunto subscribed my name this 12th day of December, 1928.

RAGNAR TANBERG.