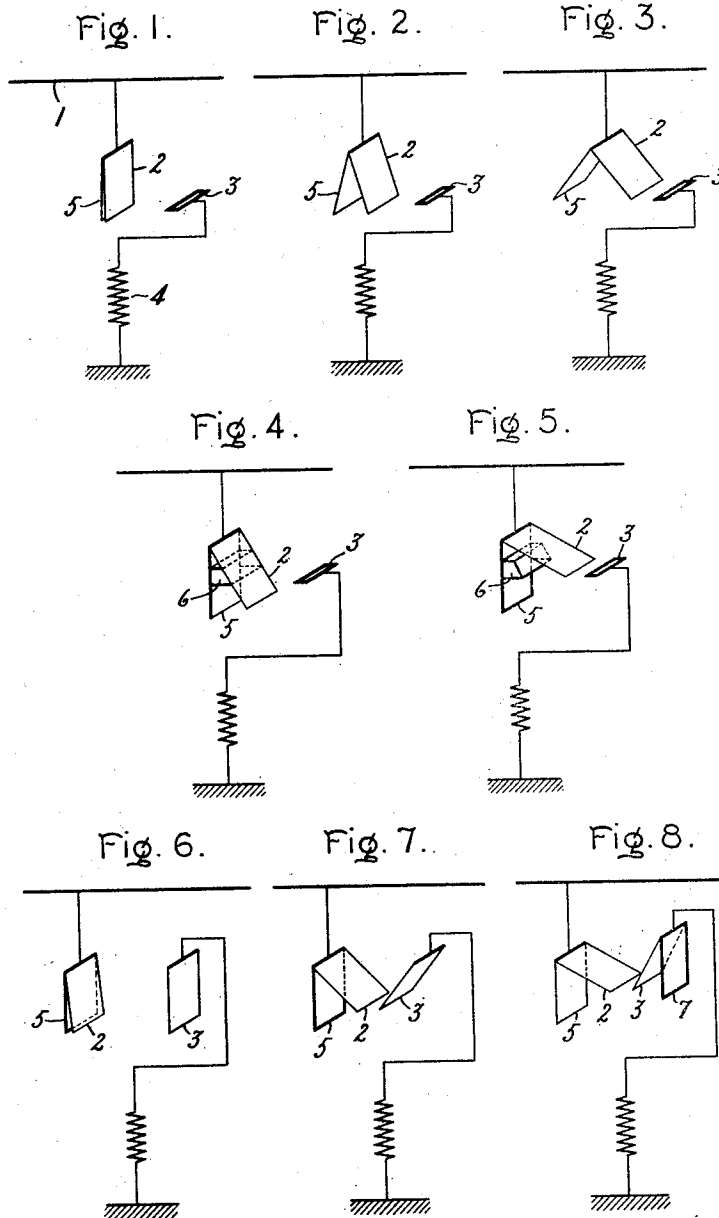


K. KUHLMANN.
PROTECTIVE DEVICE.
APPLICATION FILED NOV. 20, 1906.

3 SHEETS—SHEET 1



Witnesses:

George H. Tilden.
J. Allen Glen

Inventor:

Karl Kuhlmann,

by *Alfred H. Davis*
Att'y

No. 888,241.

PATENTED MAY 19, 1908.

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3 SHEETS—SHEET 2.

Fig. 9.

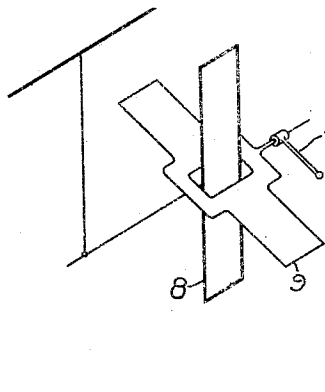


Fig. 10.

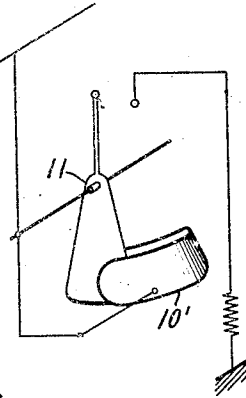
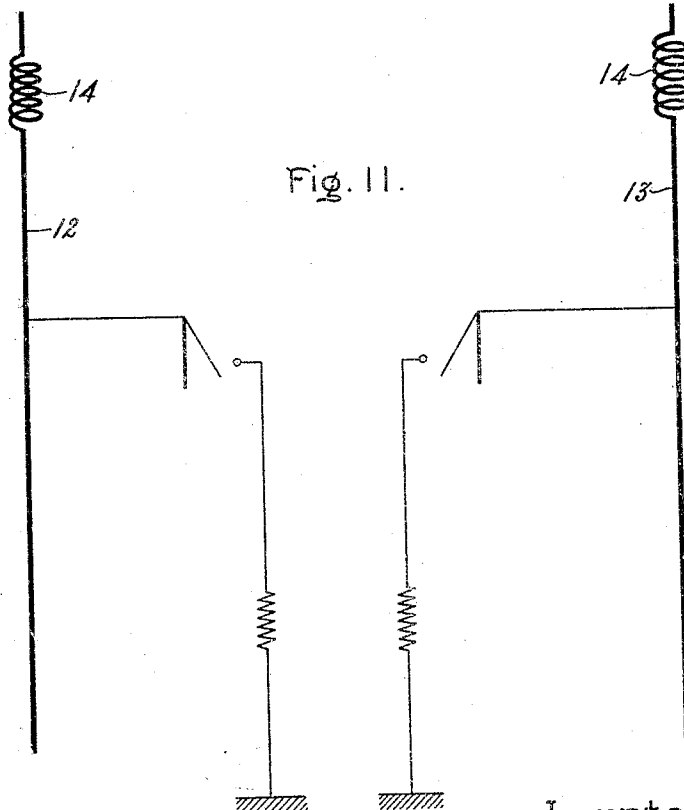


Fig. 11.



Witnesses:

George H. Tilden.
J. Ellis Allen

Inventor:

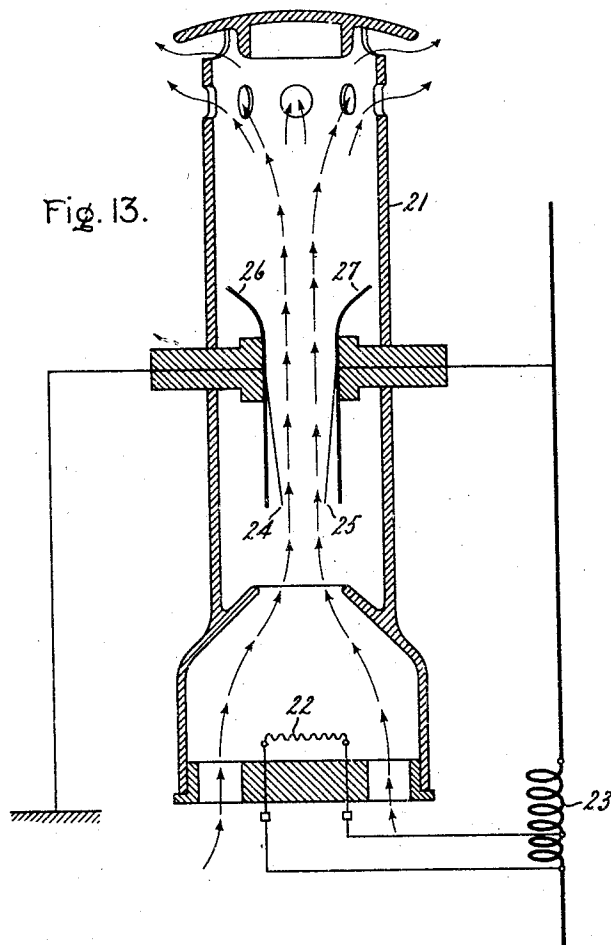
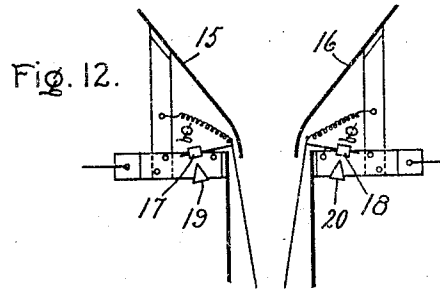
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3 SHEETS—SHEET 3.



Witnesses:

George H. Tilden.
J. Ellis Glen.

Inventor:

Karl Kuhlmann,

by *Wm. H. Davis*
Att'y.

UNITED STATES PATENT OFFICE

KARL KUHLMANN, OF BERLIN, PANKOW, GERMANY, ASSIGNOR TO GENERAL ELECTRIC COMPANY, A CORPORATION OF NEW YORK.

PROTECTIVE DEVICES.

No. 888,241.

Specification of Letters Patent.

Patented May 19, 1908.

Application filed November 29, 1906. Serial No. 344,282.

To all whom it may concern:

Be it known that I, KARL KUHLMANN, a subject of the Emperor of Germany, residing at Berlin, Pankow, Germany, have invented certain new and useful Improvements in Protective Devices, of which the following is a specification.

The present invention has for its object the protection of electric distribution systems from injurious excess-potentials. Up to the present time this has usually been done by grounding the conductor to be protected, a sparking section being interposed. Under such conditions the extent of the excess-potential is determined by the length of the spark-path. Since the breaking potential of a sparking section however does not depend alone upon the distance of its electrodes, but also is affected by the temperature, the amount of moisture contained in the air, the radiation and, in great measure, on the cleanliness of the electrode surface, this arrangement was only possible within wide limits. The arc passing when current passes had to be extinguished by devices of a special nature.

According to this invention, the electrodes of the sparking section are movable toward each other under the influence of electrostatic forces, when excess-potential occurs, by such an amount that an equalization of potential takes place, whereupon they return to their original position. The device may be made highly operative when arranged so that at least one of the electrodes is subjected to electrostatic repulsion by means of a fixed or movable plate or the like, arranged adjacent to the electrode and conductively connected thereto. In this case a strong force acts upon the movable electrode and in conformity thereto, its respective positions when without potential, at normal and at excess potential are farther apart than formerly, and the distance of the electrodes for normal potential is greater. This is extremely important. In the first place, with a greater electrode distance the unavoidable inaccuracies of manufacture have proportionately less influence and the adjustment is more exact. In the second place, the arc which is formed is broken more rapidly and surely, when the electrodes move farther apart after equalization is effected. In the third place,

disturbances cannot so easily take place through foreign bodies (insects) which come between the electrodes. Fourth, this prevents the oscillation of the movable electrodes after potential equalization by the striking together.

The drawings forming a part of this specification illustrate the principle of my invention by several examples.

Figure 1 shows the movable electrode suspended by its upper edge and freely movable toward and from a second similarly constituted strip or plate, the device being in the condition of no potential; Fig. 2 shows the same device at normal potential, Fig. 3 shows the same under the condition of excess potential, and at the moment of change of potential; Figs. 4 and 5 show similar devices with one of the plates arranged to be immovable, in these as in the other figures of the drawing, the heavy marginal lines indicate immovable edges; Figs. 6, 7 and 8 illustrate modifications comprising two movable plates which approach each other when the potential becomes excessive; Figs. 9 and 10 show modifications in which the spark gap is formed by an arm rigidly connected, to the movable plate; Fig. 11 illustrates two of the devices arranged for the protection of two conductors of an electrical system; Fig. 12 shows special means for rupturing the arc; and Fig. 13 shows means for creating an upward draft between the arcing electrodes.

In Fig. 1 the conductor 1 to be protected against excess-potentials is provided with a path to ground including the spark gap formed between plates 2 and 3, and also including a resistance 4. The plate or electrode 2 is formed of a thin strip of metal freely movable about the upper edge and suspended opposite a second similarly constituted strip 5. This pair of strips behaves much like the strips of the well known gold leaf electroscope. When line 1 is in the condition of no-potential, the two plates lie close together as in Fig. 1, but when the plates become charged they mutually repel and assume the position shown in Fig. 2. In case of excess-potential on the line the plates spread still farther as shown in Fig. 3 and the abnormal charge jumps the gap to plate 3 and escapes to ground through resistance 4.

In the form of embodiment shown in Figs. 4 and 5 a strip 5 is arranged to be immovable. By this means the deflection of the other strip 2 is greater. The movable strip may consist of a rigid frame covered with thin metal foil in order to make it light and easily movable. Aluminum may be used to advantage. Figs. 4 and 5 show a stop 6 for the movable strip in consequence of which it is excited only by certain potentials. This is, however, not so favorable with respect to the breaking of the arc as if it could fall back as far as the fixed strip 5.

Though in the previously described protective devices the repulsive action of the electric strips of the same size is almost exclusively considered, the protective devices shown in Figs. 6 and 7, refer to the attractive effect of two strips of different potential, the electrode 3 being formed as a larger movable strip. By this means the power effect is specially strengthened and the change of the electrode distance is increased.

In the form shown in Fig. 8, the electrode 3 is subjected to an attractive as well as a repulsive action. In this arrangement the result might readily be attained that the electrode distance which is necessary in order to protect the system of 6000 volts against an excess-potential of 7500 volts is three times as great as in the former excess potential safety devices with horn-shaped electrodes, or in other words in about 18 m.m. instead of 6 m.m. The distances between the fixed plates 5 and 7 was 30 m.m.

Fig. 9 shows a protective device in which a fixed strip 8 and movable strip 9 are extended beyond the axis of rotation. The power is thereby increased, while the weight of the movable strip 9 is more or less equalized. It is obvious that this can only go to the extent of causing the latter to lose its stability. Here also, for example, the one electrode of the sparking section is not formed by the plate 9 itself but by an arm 10 rigidly connected thereto.

The protective device shown in Fig. 10 resembles somewhat the ordinary arrangement of electrometers and comprises a fixed plate 10' so disposed as to repel one end of a pivotally supported electrode 11, and thereby bring a sparking terminal toward a corresponding grounded terminal.

Fig. 11 shows connections suitable for two conductors 12 and 13 of an electrical system provided with the usual protecting coils 14 to prevent the continuance of an oscillating discharge.

The breaking of the arc, which is driven upward by its heat effect, can be further accelerated by fixed plates 15 and 16 placed above the electrodes and so disposed that they separate outwardly at their upper portions as shown in Fig. 12. The movable strips are here partially compensated for by

small adjustable counter weights 17 and 18. By means of fixed stops 19 and 20 on which the weights impinge when the movable stops rotate, the approach of the latter until they touch, may be prevented. The contact of the electrodes on their respective stops may also be utilized for closing a circuit to actuate an indicating device or a signal to indicate to the operator at the power station that the protective device has responded to an excess-potential.

It is possible to strengthen the upward tendency of the arc by constructing the entire protective device as in Fig. 13, in a chimney casing 21 with suitable openings through which the air current from below is aided. To strengthen this current, a heating device can be arranged in the casing in the form of an electric heating body 22 or a small incandescent lamp. In this instance the air current is provided beforehand. The heated current may, for example, be taken from a portion of the series reactance 23. In this modification the movable plates 24 and 25 and their fixed arc-rupturing extensions 26 and 27 are similar to those heretofore described.

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

1. A protective device for an electrical conductor, comprising a spark gap formed between electrodes, and means for subjecting both of said electrodes to repulsive electrostatic forces to decrease the length of said spark gap and relieve said conductor of excess-potential.

2. A protective device for electrical systems comprising a spark gap formed between two movable electrodes, one at least of which is subjected to repulsive electrostatic forces by means of a plate arranged adjacent thereto and conductively connected therewith and the other of which also moves to vary the length of said spark gap in case of excess potential.

3. The combination with an electrical system subject to excess-potential, of a plurality of plates subjected to the electrostatic potential of said system, and relatively movable to decrease the resistance between said system and ground and a similar set of plates maintained at ground potential, and also relatively movable to decrease the resistance between said system and the ground.

4. The combination with an electrical conductor subject to excess potential, of a resistance path to ground therefor, an electrode subjected to the potential of said conductor, means for electrostatically repelling said electrode to decrease the resistance of said path to ground a similar electrode maintained at ground potential, and means for electrostatically repelling said last named electrode to further decrease the resistance of said path to ground.

5. A protective device comprising electrodes which approach each other to form a low impedance path in case of an excessive potential there-between, and conductors disposed above said electrodes to assist in rupturing the arcs formed between said electrodes.

In witness whereof, I have hereunto set my hand this 2nd day of November, 1906.

KARL KUHLMANN.

Witnesses:

JULIUS RÜMLAND,
OSKAR SINGER.