Jan. 1, 1924 **1,479,693**

C. E. BENNETT

ARC GAP

Filed Aug. 10, 1920

Fig. 1.

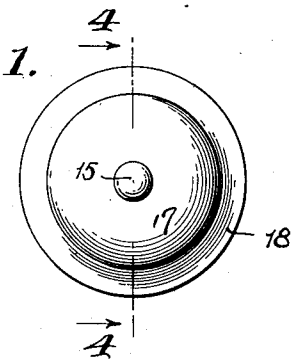



Fig. 2.

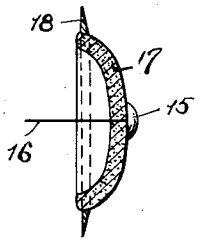



Fig. 3.

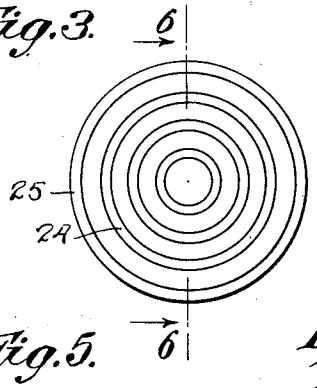



Fig. 4.

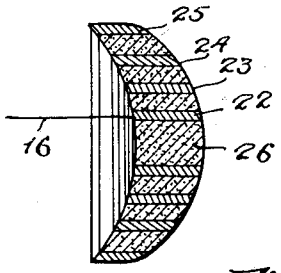



Fig. 5.

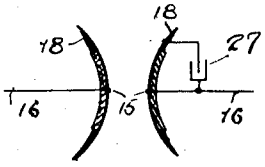



Fig. 7.

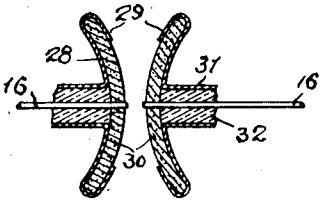



Fig. 8.

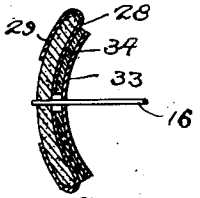
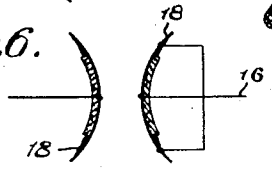



Fig. 6.




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# UNITED STATES PATENT OFFICE.

CHARLES E. BENNETT, OF ATLANTA, GEORGIA, ASSIGNOR, BY MESNE ASSIGNMENTS, TO BALT MANUFACTURING COMPANY, OF ATLANTA, GEORGIA, A CORPORATION OF GEORGIA.

## ARC GAP.

Application filed August 10, 1920. Serial No. 402,569.

*To all whom it may concern:*

Be it known that I, CHARLES E. BENNETT, a citizen of the United States of America, residing at Atlanta, in the county of Fulton and State of Georgia, have invented certain new and useful Improvements in Arc Gaps, of which the following is a specification.

My invention relates to arc gap installations, and particularly to a gap terminal construction designed for effective operation in a protective ground connection for a main, upon which may be impressed excessive current at either high or low frequency. The invention may be combined with a gap terminal of the type shown in my co-pending application Ser. No. 384,221, filed May 25, 1920, in which the metallic electrode terminal has associated therewith a moisture permeable body of insulating material which serves to maintain a substantially uniform gap rating between the terminals, regardless of variation in gap impedance incident to changes in moisture conditions at the gap. The present invention, however, while susceptible of combination with my prior construction, is not concerned so much with moisture conditions as with variation in the operation of the gap under dry conditions when currents of abnormally high frequency are impressed on the line. My object is to provide a construction such that the operation of the gap is substantially uniform, regardless of the frequency of the line current. This may be accomplished in various ways, and I have illustrated only a few in the accompanying drawings, in which—

Figs. 1 and 2 are respectively front elevation and vertical section through one of a pair of gap terminals embodying one form of my invention;

Figs. 3 and 4 are similar views of a modification;

Figs. 5 and 6 are more or less diagrammatic views illustrating the application of the invention to a line installation;

Fig. 7 is a vertical section through a pair of terminals showing a still further modification; while

Fig. 8 is a similar view of a terminal embodying yet another modification.

In the experiments which led to the present invention, I have dealt for the most part with gap terminals of a type generally similar to those of my co-pending application above mentioned. As perhaps typical of that class is the terminal shown in Figs. 1 and 2 of the present case, in which the gap contact 15, connected by the lead 16 to the line, is associated with a disc 17 of insulating, preferably moisture absorbent, material, such as lava. The contract button 15 is relatively small, and under dry weather conditions its action more nearly approaches that of a needle point contact than that of a sphere of large size. In other words, it is so small with relation to the normal line current that corona formation is an incident to discharge across the gap. As well understood, corona formation preceding a discharge retards the action of the gap.

This may suffice under normal 60-cycle line surges, since the flow of current is not so rapid at that frequency as to reach the protected equipment in the line before the gap is broken down and the surge discharged. It is far from adequate, however, when the source of disturbance on the line is a high frequency current. The speed or pressure of the latter is such that when its discharge across the gap is delayed by the phenomenon of corona formation preceding the arc, the current passes to the equipment and causes injury before the arc forms at the gap and the disturbance is relieved by the discharge to ground across the gap. It is therefore necessary, where a small contact of this type is employed, to provide some means for eliminating the phenomenon of corona formation as a preliminary incident to the striking of the arc across the gap. This is of course a difficulty peculiar to dry weather conditions, since when the insulating disc 17 is wet, the conducting area of the contact is so enlarged that its approximation to needle point conditions is no longer present, and there is no corona lag to the arc formation on discharge across the gap.

My experiments have now shown that by arranging a metal ring 18 at the outer area of the insulating disc 17, the corona lag is minimized, if not eliminated, at high frequency on the line, while the presence of the ring does not affect the action of the terminals at normal line frequency.

While the action has been observed as a

fact, regardless of theory, it is thought that the explanation is probably that the ring 18 acts as a condenser under the influence of a high frequency current. The field between small contacts is nonuniform—a condition associated with corona formation. The field between large contacts or spheres is uniform, the arc formation is speedy and without corona. The equivalent of the latter condition appears to be occasioned at high frequency by the presence of a metallic ring 18 at the outer portion of the insulating disc, and the effect of a large sphere terminal is obtained with high frequency current by this construction. In other words, a construction of this type affords a slow gap at normal line frequency but transforms the operation into that of a high speed gap when high frequency is impressed on the line. The functioning of the gap is thus automatically accelerated in accordance with the frequency of the current on the line.

Another construction is illustrated in Figs. 3 and 4, in which I have shown concentric metallic rings 22, 23, 24 and 25 embedded in the lava di-electric 26.

In Fig. 5 the outer ring 18 (Figs. 1 and 2) of one of the terminals is connected to the lead 16 through a condenser 27, while in Fig. 6 the ring 18 is shorted on the lead 16 to the contact of one of the gap terminals.

In Fig. 7 the condenser action is secured by a metal sheath 28, the margin 29 of which overlaps the face of the gap terminal di-electric disc 30, while the collar 31 surrounds the lead 16, from which it is insulated by the bushing 32.

In Fig. 8 the collar and bushing are replaced by a metallic backing plate 33 spaced by mica 34, or the like, from the rear face of the metal sheath 28.

As will be readily recognized, these are but some of the many ways of accomplishing the desired end, viz., the construction of a gap terminal in such manner as to insure its proper functioning under normal line frequency, while accelerating its action when abnormally high frequency is impressed on the line. When possible I desire of course to combine this feature of improvement with the construction disclosed in my prior application above mentioned, by which the diminished impedance of the gap, owing to the presence of moisture, is compensated by redistribution of the lines of force by the enlarged conductive area afforded by the wet body of insulation at the terminal. It will of course be understood that while the gap construction may be applied to various installations, it is of particular value in a protective ground for a power line, one terminal of the gap being connected by the lead 16 to the line, while the other is grounded through an arrester of any well known type.

With the understanding that the constructions shown in the present application, as well as in the prior applications mentioned, are merely illustrative of my invention, which may be variously modified, I claim the following:

1. In an arc gap installation, a pair of gap terminals, and condenser elements associated with said terminals and affecting the flux field across the gap.

2. In an arc gap installation, a metallic terminal connector in the gap circuit, and an associated condenser arranged in multiple with said terminal, in combination with insulation interposed between said terminal and condenser, and serving to electrically connect the same when wet.

3. In an arc gap installation, a metallic terminal connector in the gap circuit, and an associated condenser arranged in multiple with said terminal, in combination with moisture permeable insulation interposed between said terminal and condenser, and serving to electrically connect the same when wet.

4. In an arc gap installation, an exposed metallic terminal connected in the gap circuit, and an associated condenser substantially coaxial with said terminal but spaced therefrom.

5. In an arc gap installation, an exposed metallic terminal connected in the gap circuit, and an associated condenser substantially coaxial with said terminal but spaced therefrom by moisture-permeable insulation serving, when wet, to electrically connect said terminal and condenser ring.

6. In an arc gap installation, a metallic terminal, an associated condenser element, and means serving, when wet, to eliminate the condenser action of said condenser element.

7. In an arc gap installation, a metallic terminal, an associated condenser element, and means, when wet, automatically enlarging the effective terminal area to include said condenser element.

8. In an arc gap installation, a pair of exposed gap terminals between which direct arcing occurs on over potentials at normal frequency, and means varying the flux field between the terminals on over potentials at high frequency to diminish time lag on arc over.

9. In an arc gap installation, a pair of electrodes having means automatically compensating the lowered impedance of the gap in the presence of moisture, and associated means operative when dry to vary the electrostatic flux field between the terminals when subjected to current of abnormally high frequency, and serving to diminsh the time lag of arc over.

10. In an arc gap installation, a gap terminal comprising a conductor constantly connected in the gap circuit, and a con-

denser surrounding and normally insulated from said conductor, the insulating means serving when wet to afford an electric connection between the condenser and the conductor.

11. In an arc gap installation, a gap terminal comprising a conductor constantly connected in the gap circuit, an associated condenser, and means for electrically connecting the condenser and conductor in the presence of moisture at the gap.

12. In an arc gap installation, a gap terminal comprising a plurality of spaced condenser elements associated with said conductor, and means insulating said condenser elements from their conductor, but serving to electrically connect the same under moisture conditions at the gap.

In testimony whereof I have signed my name to this specification.

CHARLES E. BENNETT.