

July 21, 1942.

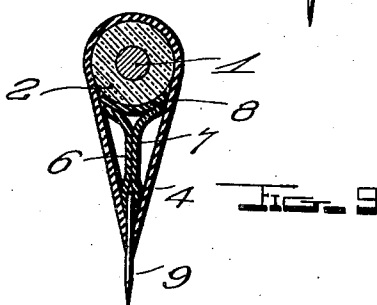
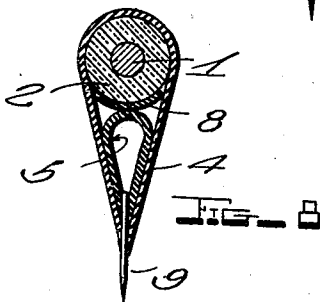
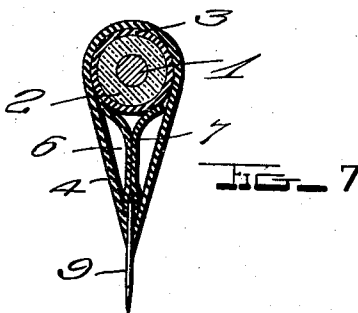
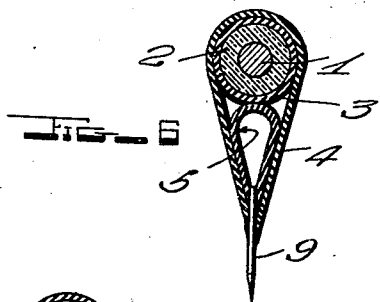
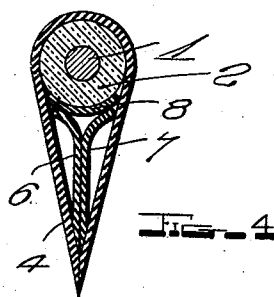
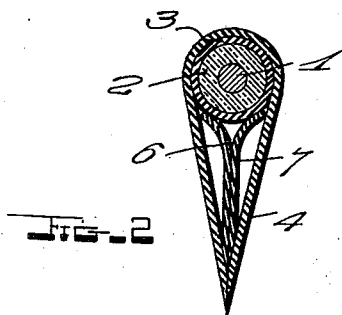
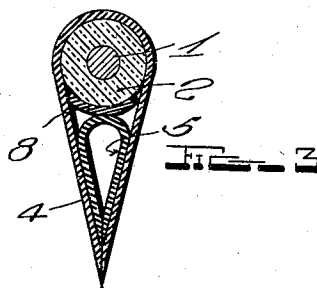
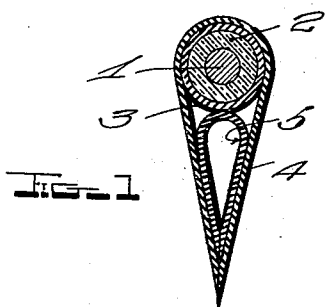
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2,290,655

PAPER ELECTRODE ELEMENT

Filed Sept. 26, 1939

2 Sheets-Sheet 1



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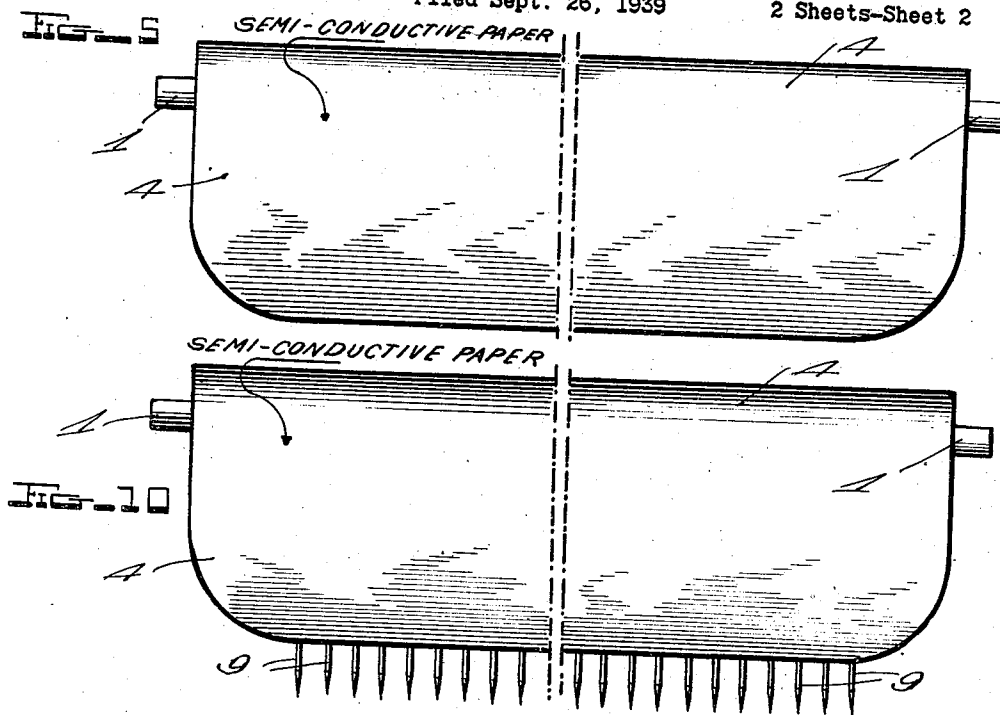
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PAPER ELECTRODE ELEMENT

Filed Sept. 26, 1939

2 Sheets-Sheet 2



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PAPER ELECTRODE ELEMENT

John Thomay, Columbus, Ohio, assignor to
Slayter Electronic Corporation, a corporation
of Ohio.

Application September 26, 1939, Serial No. 296,707

9 Claims. (Cl. 183-7)

My invention relates broadly to electric discharge apparatus and more particularly to the use of semi-conductive paper in various applications for the suppression of gliding streamers, surges and like irregularities in the operation of electric discharge systems.

Certain papers, either in their usual form or impregnated with suitable materials, have long been employed for insulation purposes in electrical apparatus, notably cables and inductive and capacitive elements. In the course of various experiments relating in general to electric discharge phenomena, I have discovered that paper which has been manufactured with the incorporation of a conductive pigment into the pulp under conditions of close control exhibits an electrically semi-conductive characteristic which I have found useful in the operation of electric discharge apparatus. One such paper which possesses semi-conductive properties and has been employed to advantage in accordance with my invention is a readily obtainable black paper having a carbon black pigment. The resistivity of this paper has been found to be substantially uniform because of the close control exercised in its manufacture. Ordinarily nonconductive paper may be rendered semi-conductive by impregnation with a suitable fluid so as to produce the desired resistive characteristic.

One of the objects of my invention is to provide a resistance path for electric currents in electric discharge apparatus through a semi-conductive paper element, which may be embodied in the apparatus in any suitable arrangement.

Another object of my invention is to provide a resistance path for the dissipation of stray electric currents in electric discharge apparatus through a semi-conductive paper element mounted on surfaces exposed to stray discharges, to suppress gliding streamers.

Still another object of my invention is to provide a construction of emitter electrode for electric discharge apparatus with semi-conductive paper embodied in the electrode to provide a resistance path for discharge currents.

A further object of my invention is to provide a construction of streamlined target electrode for electric discharge apparatus with semi-conductive paper embodied in the electrode to provide a resistance path for currents from the field of the discharge.

A still further object of my invention is to provide a combination emitter and target electrode for electric discharge apparatus having

semi-conductive paper embodied therein to provide resistance paths for the electric currents therein.

Another object of my invention is to provide an internal construction of electrode for electric discharge apparatus for supporting an outer semi-conductive paper element providing a resistance path for currents in the electrode.

The foregoing, as well as other objects, will be made more apparent as this description proceeds, especially when considered in connection with the accompanying drawings, wherein:

Figures 1 to 4, inclusive, are cross sectional views of streamlined target electrodes constructed according to my invention;

Figure 5 is a partial elevational view of a representative form of streamlined target electrode of the type shown in Figure 1;

Figures 6, 7, 8 and 9 are cross sectional views of emitter electrodes constructed in accordance with my invention and which may also serve as combination target and emitter electrodes;

Figure 10 is a partial side elevational view of a representative form of emitter electrode, such for example, as shown in Figure 6.

The incorporation of semi-conductive paper in composite electrode structures may take a variety of forms. In the drawings I have illustrated a capacitive-resistive type of electrode with the semi-conductive paper providing the resistance component. Figs. 1 and 2 show an electrode comprising a conductive bus 1 surrounded by a dielectric such as a glass tubing 2, with a sheath of the conductive paper 3 on the dielectric tubing 2. The electrode thus far described is suitable for use as a target for an electric discharge, to receive the discharge currents at the semi-conductive sheath 3 and transmit the currents to the bus 1 by capacitive action. The semi-conductivity of the paper sheath 3 is effective to maintain the charge more evenly distributed on the sheath and thus prevent localized high potential areas which might rupture the dielectric 2, and also to prevent surges and streamer formation such as might otherwise arise at the target surface.

I prefer, however, to streamline the electrode by the addition of an outer covering 4 of semi-conductive paper contacting the sheath 3 around the leading edge of the target and tapering to a narrow portion at the trailing edge. In Figs. 1 and 2 alternate means is shown for maintaining the outer covering 4 in position. In Fig. 1, an inner filler piece 5, which may also be of semi-conductive paper, is curved into substantially the

shape shown and mounted within the fold of the covering 4 so as to bear at the middle against the sheath 3 and to join the outer covering 2 at the narrow trailing edge. In Fig. 4, two strips 6 and 7, of semi-conductive paper, are disposed in adjacent positions with the edge portions thereof nearer the sheath 3 separated to form a Y brace, engaging the sheath at the forked end and the narrow portion of the outer covering 4 at the foot end. A single strip of paper may be used to form the Y brace by bending it back on itself at the middle. Suitable adhesives may be used in the assembly of the composite electrodes, in portions of the structure where adhesive connection is required; a semi-conducting Bakelite resinoid is preferred as the adhesive to be used.

In the streamlined electrodes shown in Figs. 1 and 2, the addition of the outer covering 4 places a double thickness of the semi-conductive paper at the leading edge of the target electrode which in some instances may affect the operation of the electrode as a target for electric discharge. In Figs. 3 and 4, a modification is shown wherein the sheath 3 of Figs. 1 and 2 is limited to a sectional element 8, secured to the dielectric 2 in complementary relation to the covering 4 which is mounted directly on the dielectric 2 around the leading edge of the electrode. The modification is shown in Fig. 3 with the filler 5 of Fig. 1, and in Fig. 4 with the Y brace of Fig. 2. Only one thickness of the semi-conductive paper forms the active surface at the leading edge of the electrode in Figs. 3 and 4, therefore, so that its operation as a target for electric discharge is unaffected by the streamlined construction.

The composite target electrodes of Figs. 1-4 are readily converted for discharge functions, thus becoming combination target-emitter electrodes which may serve as emitters only, by the incorporation into the structure of emitter points. Figs. 6-9 illustrate the general disposition of emitter members 9 in the electrodes of Figs. 1-4, respectively; Figs. 6 and 8 indicate the supporting relation of the dual paper sheets 4 and 5 with respect to the members 9, and Figs. 7 and 9 indicate the manner in which the strips 6 and 7 receive the members 9 and the cooperative supporting relation of the outer covering 4. Adhesives such as the semi-conducting Bakelite resinoid above noted may be employed to maintain the emitter members 9 in position.

Figs. 5 and 10, which are partial side elevational views of the target and the target-emitter forms of composite electrodes, respectively, differ substantially only in the showing of the emitter members 9 in Fig. 10.

The electrode structures of Figs. 1-9 are intended to be illustrative only of the manner in which semi-conductive paper may be incorporated into a composite electrode in accordance with my invention. The resistive-capacitive type of electrode shown may be modified to one of purely resistive character, wherein the resistance is provided by paper elements, and various materials may be used to fill the voids in the electrode where greater rigidity or solidarity is desired. Materials such as insulating plastics or dry wood are suitable as fillers. The principal feature of my invention is the arrangement of semi-conductive paper in positions wherein it will provide a resistive path for electric discharge currents, whether such positions be internal or external of composite electrode structures, or in the direct or indirect path of the discharge. In Figs. 1-10, the outer covering 4 is common to all

the different modifications and represents one of the most practical adaptations of my invention, that to composite electrode structures.

While I have disclosed my invention in certain embodiments suggestive of the range of application thereof, I desire it understood that further modifications may be made in the adaptation of the principle of my invention, and that no limitations upon my invention are intended except as are imposed by the scope of the appended claims.

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

1. An electrode including a bus connector and a streamlined body portion having an outer covering of semi-conductive paper for imparting a resistive characteristic to the surface of said electrode.

2. An electrode including a bus connector, an inner sheath of semi-conductive paper, and an outer covering of semi-conductive paper tapering to a narrow edge portion with means disposed between said sheath and the narrow edge portion of said covering for maintaining a streamlined form in said covering and said electrode.

3. An electrode as described in claim 2 wherein said means comprises a curved strip of semi-conductive paper having its middle portion in abutment with said sheath and the opposite edges thereof engaged at the narrow edge portion of said covering.

4. An electrode including a bus connector, an inner section of semi-conductive paper and an outer covering of semi-conductive paper cooperatively arranged to form a sheath concentric with said connector, said outer covering tapering to a narrow edge portion opposite said inner section of semi-conductive paper, and means disposed between said inner section and the narrow edge portion of said covering for maintaining a streamlined form in said covering and said electrode.

5. An electrode as described in claim 4 wherein said means comprises a curved strip of semi-conductive paper having its middle portion in abutment with said inner section of semi-conductive paper and the opposite edges thereof engaged at the narrow edge portion of said covering.

6. An electrode as described in claim 4 wherein said means comprises a Y brace formed of semi-conductive paper and having the forked portion thereof bridged by said inner section of semi-conductive paper and the foot portion thereof engaged with the narrow edge portion of said covering.

7. An electric discharge electrode including a bus connector, an inner element of semi-conductive paper forming at least a partial sheath around said connector, an outer covering of semi-conductive paper tapering to a narrow edge portion, a curved strip of semi-conductive paper having its middle portion in abutment with said inner element and the opposite edges thereof engaged at the narrow edge portion of said covering, and a plurality of emitter members cooperatively supported at the narrow edge portion of said covering by said covering and the opposite edges of said strip member.

8. An electric discharge electrode including a bus connector, an inner element of semi-conductive paper forming at least a partial sheath around said connector, an outer covering of semi-conductive paper tapering to a narrow edge

portion, a Y brace formed of semi-conductive paper and having the forked portion thereof bearing on said inner element and the foot portion thereof engaged with the narrow edge portion of said covering, and a plurality of emitter members cooperatively supported at the narrow edge portion of said covering by said covering and the foot portion of said Y brace, said foot portion comprising a double thickness of said paper and said emitter members being 10 mounted between the separate sheets thereof.

9. An electrode including a bus connector, an inner element of semi-conductive paper forming at least a partial sheath around said connector, an outer covering of semi-conductive paper tapering to a narrow edge portion, and means disposed between said inner element and the narrow edge portion of said covering for maintaining a streamlined form in said covering and said electrode.

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