June 21, 1938. O. KARL 2,121,597

ELECTRODE SUPPORT

Filed Nov. 6, 1937

Fig. 1.

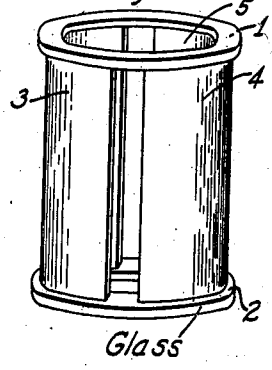



Fig. 2.

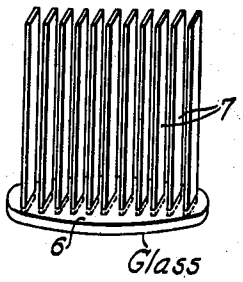



Fig. 3.

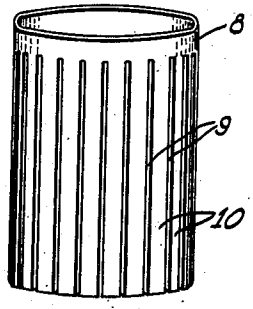



Fig. 4.

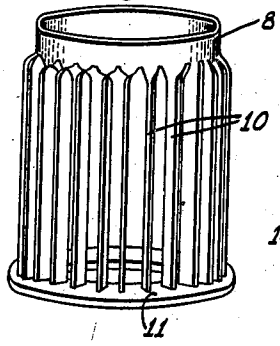



Fig. 5.

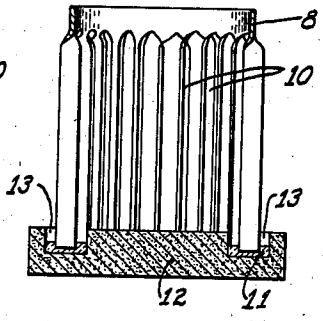



Fig. 6.

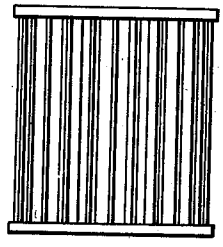


Fig. 7.

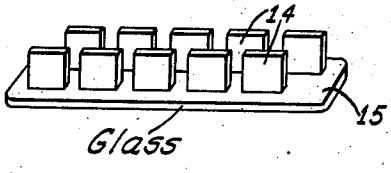
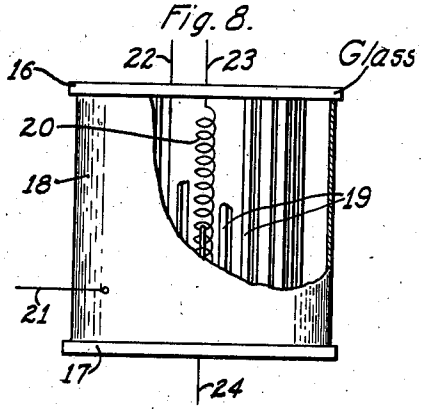



Fig. 8.




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Patented June 21, 1938

2,121,597

# UNITED STATES PATENT OFFICE

2,121,597

## ELECTRODE SUPPORT

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Application November 6, 1937, Serial No. 173,263
In Germany November 30, 1936

8 Claims. (Cl. 250—27.5)

The invention relates to electrodes and their supports and especially to grid and grid supports.

An object of the invention is to provide a sturdy and easily formed electrode and electrode support.

The invention particularly concerns one or a plurality of individual electrodes, preferably of sheet metal, which may be connected in parallel so as to form one composite electrode. The invention contemplates directly fusing such an electrode, for example a grid, into one or more plates or rings of glass or of vitreous material which will thus support the electrode. The supporting plates can be provided at either one or at both ends of the electrode or electrodes and may be attached in any suitable manner to the vessel. The supporting plates can be circular, ring shaped, or cornered, as desired, depending upon the construction of the electrode.

The application of the new method is especially advantageous if the sheet metal to be supported by the plates is thin. The invention is of special importance if a great number of sheet metal electrodes must be supported in such a manner that the distances between the individual electrodes will be exactly equal to definite predetermined values. This latter condition is present in the case of electronic amplifiers and similar tubes. Up to the present time, the mounting of the numerous sheet metal electrodes in tubes of this type has been quite intricate from a technical standpoint. According to the invention, however, the work involved will be greatly simplified. An electrode system assembled by the invention offers the advantage that it will be of more stable construction.

Other advantages will be apparent from the following description and drawing, in which:

Figure 1 is a perspective view of a preferred modification;

Fig. 2 is a perspective view of a still further modification;

Figs. 3 and 4 are perspective views of a still further modification in an initial and intermediate form while;

Fig. 5 is a cross sectional view of article and apparatus for obtaining the article in Fig. 4 from that in Fig. 3;

Fig. 6 is a side elevation of the final form;

Fig. 7 is a perspective view of a still further modification of the invention; and

Fig. 8 is a side elevational view with parts broken away to illustrate a preferred embodiment of complete electrode structure.

The general principle involved in constructing an electrode according to the invention is illustrated by Fig. 1. The two halves 3 and 4 of an electrode of sheet metal are fused into the supporting plates 1 and 2 of glass which, in this particular case, are ring shaped. The other electrodes can project into the opening 5 into the inner space surrounded by the two sheets 3 and 4, although they may be supported by parts located outside of this space. These other electrodes may, of course, be fused into the supporting plates of glass 1 and 2, just mentioned.

Fig. 2 discloses a flat type of grid. The parallel elements 7 are straps of thin sheet metal and are fused into the glass disc 6. A duplicate disc may be provided at the other end of the electrode.

A cylindrical grid-like electrode according to the invention, is illustrated in Figs. 3, 4, 5 and 6. As indicated in Fig. 3, a cylinder of sheet metal is provided with slits 9 that run parallel to the axis of the cylinder so that there are formed a number of strips 10 which hang downward from the border 8 of the sheet metal cylinders. The sheet metal strips are then preferably bent around axes parallel to the axis of the cylinder until they form with the radius a certain angle or until they have the direction of the radius of the cylinder. This construction is illustrated in Fig. 4. The grid is fastened in a suitable manner above a mold 12 as shown in Fig. 5. This mold is preferably of graphite and has the shape of a ring provided with a groove 13. The groove 13 is then filled with molten glass 11 so that there will be formed a solid glass frame supporting the strips constituting the grid. The same procedure should be followed if it should be desired to provide the other side of the electrode with a supporting glass plate or glass frame. The non-slitted border 8 of the cylinder can be cut off and the electrode turned upside down so that the process of fusion can be repeated for this end of the electrode. In this manner is obtained an electrode having the shape represented in Fig. 6. A portion of the non-slitted part may be left for electrically connecting the parts or this may be accomplished by joining the parts with a wire or strap of conducting material to all or to groups of the straps as desired. It is equally possible to use at the beginning individual straps of sheet metal held at one end in proper position by means of a rig of simple construction so that they can be fused into glass at one end and then turned upside down and provided with a glass ring at the other end.

The electrode, however, might be finished at the free end by other means than that of glass because of the stable position maintained by the fused glass at the other end.

In the case of electrodes subject to high heat under normal operating conditions, it may be desirable to protect the fused regions in their neighborhood by establishing a heat conductive connection between the sheet metal of the electrode and the parts that will readily dissipate the developed heat by radiation because only a small fraction of that heat will then reach these fused regions.

Fig. 7 shows how great a number of sheet metal electrodes 14 can be supported by means of glass plate 15. Electrode systems of this kind are found, for example, in electronic amplifiers. The electrode plates in Fig. 7 could, of course, be arranged concentrically and fused into a ring of glass, if desired.

It is especially advantageous to use the supporting plates of glass at the same time for sealing an opening in the wall of the vessel. An example of this is given in Fig. 8. Two glass plates 16 and 17 support an anode 18, a grid 19, and a cathode 20. The lead of the anode is designated by 21, that of the grid by 22 and those of the cathode by 23 and 24.

In those cases where there is any danger of short circuits between electrodes having different potentials due to a condensation of some of the metal vapor contained into the tube on the supporting parts, it may be advisable to roughen the surface of the glass at these parts or to cover it with an oxide layer such as aluminum oxide.

It is apparent that many modifications may be made in the preferred embodiments illustrated without departing from the spirit of the invention. Accordingly, only such limitations should be put on the following claims as are necessitated by the prior art.

I claim as my invention:

1. An electrode and support therefor for an electrical discharge device comprising a plurality of parallel sheets of metal and insulating material fused thereto at the ends.

2. The method of constructing an electrode structure which comprises slitting one end of sheet material into parallel straps and fusing insulating material to the ends of said straps.

3. The method of constructing an electrode structure which comprises slitting one end of sheet material into parallel straps and fusing insulating material to the ends of said straps, cutting off the part above said straps and fusing insulating material in place thereof.

4. The method of constructing an electrode structure which comprises forming a metal sheet material into a cylinder, slitting one end into parallel straps, bending said straps to the desired angle and fusing insulating material to the ends of said straps.

5. The method of constructing an electrode structure which comprises forming a metal sheet material into a cylinder, slitting one end into parallel straps, bending said straps to the desired angle and fusing insulating material to the ends of said straps, cutting off the part above said straps and fusing insulating material in place thereof.

6. The method of constructing electrode structure which comprises slitting one end of sheet material into parallel straps, bending said straps to the desired angle and fusing insulating material to the ends of said straps.

7. The method of constructing electrode structure which comprises aligning metal straps into parallel relation, bringing the ends of the straps and molten insulating material together in a mold of the desired shape and fusing the straps and material together.

8. An electrode and support therefor for an electrical discharge device comprising a plurality of parallel sheets of metal and insulating material fused thereto at the ends, said insulating material being coated around said metal with aluminum oxide.

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