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E. B. FEHR ET AL

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ELECTRIC DISCHARGE DEVICE AND METHOD OF MAKING SAME

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Fig. 1.

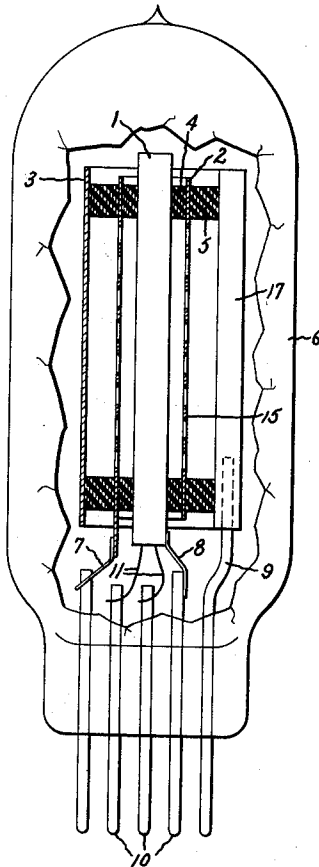


Fig. 2.

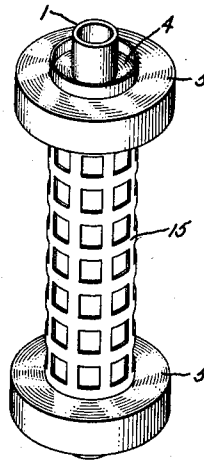
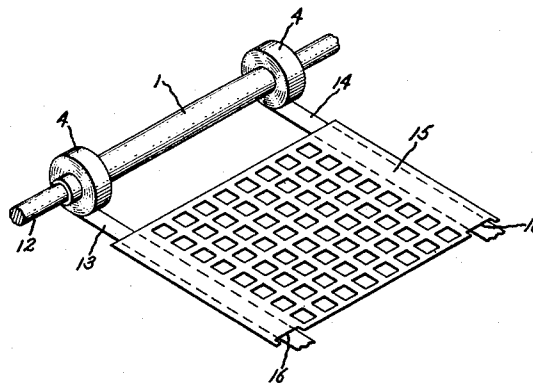


Fig. 3.



Inventors:
Edith B. Fehr,
Allen P. Haase,
by *Charles M. Whitshine*
Their Attorney.

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ELECTRIC DISCHARGE DEVICE AND METHOD OF MAKING SAME

Edith B. Fehr, Schenectady, N. Y., and Allen P. Haase, Owensboro, Ky., assignors to General Electric Company, a corporation of New York

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3 Claims. (Cl. 313—261)

The present invention relates to improved electric discharge devices and a method of making same and more particularly to an improved electrode mounting.

It has been common practice in the mass production of electric discharge devices, particularly of the receiving type, to support the various electrodes in mutually insulated and properly spaced relation by means of insulating disks of mica engaged by the ends of side rods or other projections extending from the electrodes. The present invention involves the concept of supporting the electrodes in spaced and insulated relation by means of a flexible tape which is wound upon the electrodes at the opposite ends thereof, and it is an important object of the present invention to provide an electric discharge device embodying this concept which offers substantial advantages over conventional structures particularly from the standpoint of automatic mounting of the electrodes. The invention also makes possible a more truly concentric design by eliminating the necessity for additional electrode supports such as the grid side rods which tend to distort the field between the electrodes.

Further objects and advantages of our invention will become apparent as the following description proceeds, reference being had to the drawing and its scope will be pointed out in the appended claims. In the drawing, Fig. 1 is an elevational view, partially broken away, of an electric discharge device embodying our invention; Fig. 2 is a perspective view showing a portion of the electrode mount of the device of Fig. 1, and Fig. 3 is a perspective view illustrating a preferred method of mounting electrodes of the device shown in Fig. 1.

Referring now to the drawing as shown in our invention embodied in an electric discharge device, which for purpose of simplification has been illustrated as the triode type and includes a cathode sleeve 1, a grid member of mesh type 2, and a cylindrical anode 3 mounted in concentric relation in the order named. In accordance with the present invention, these electrodes are supported in mutually insulated relation by bodies of insulating material 4 and 5 located between the cathode and grid and grid and anode respectively and at both ends thereof. These layers or bodies of insulating material are in accordance with the present invention built up by wrapping on the electrodes in succession a plurality of layers of flexible tape having suitable properties for use in electric discharge devices. As well understood by those skilled in the art, these properties include good electrical properties and in addition freedom from elements which will be liberated during processing of the tube with detrimental effects on the discharge device, particularly on the cathode, and which does not tend to evolve any appreciable amount of gas after the original processing of the tube during its manufacture. The insulating material may, for example, be flexible sheet asbestos preferably containing a small amount of bentonite or a flexible mica sheet material prepared from mica flakes. The asbestos sheet material may be, for example, of the type

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disclosed in Walters Patent 2,493,604, dated November 6, 1944, and assigned to the assignee of this invention, and the mica sheet material may, for example, be prepared in the manner described in de Senarclens Patent 2,614,055, dated October 14, 1952.

As illustrated in Fig. 1, the mount may be supported within an enclosing envelope 6 by relatively rigid conductors 7, 8 and 9 connected respectively between the grid, cathode and anode and certain of the lead-in conductors 10. The ends of the heater element 11 are also connected to separate lead-in conductors.

The features and advantages of our invention will be better understood by a consideration of the method of assembly of the device illustrated in Fig. 1. A partially completed mount assembly is shown in perspective in Fig. 2 and the method of effecting that assembly is illustrated in Fig. 3. As shown in Fig. 3, the cathode cylinder 1 is supported from a suitable mandrel 12 for rotation about the axis of the cathode. Strips of flexible insulating tape of the type previously described are applied in a succession of layers near the opposite ends of the cathode sleeve. They are preferably applied by rotating the mandrel 12 to wrap the tape. In starting, the tapes may be retained on the cathode sleeve in any suitable manner, as by sticking with an adhesive or, if desired, by threading into a slot formed in the cathode sleeve. As illustrated in Fig. 3, the grid is in the form of a rectangular sheet of mesh material. While this grid material may be formed in a number of ways, a process known as electroforming is particularly adapted for manufacture of grids suitable for use in accordance with the present invention. In accordance with that process, the grid design is photographically reproduced on a resist coated surface and the resist developed, and the grid produced by electroplating on the developed surface. As illustrated, the rectangular sheet 15 of the grid material is fed onto the strips of tape 13 and 14 at the desired time which, of course, determines the number of layers of tape that have been applied to the cathode and in this way determines the cathode-grid spacing. The dimension of the grid sheet 15 may be just slightly less than the circumference of the bodies of insulating material 4 that have been built up respectively by the successive applications of the strips of tape 13 and 14, so that the edges of the grid fail to meet by an amount sufficient to allow the passage of the tape therebetween. In this manner the winding of the tape may be continued without any interference from the adjacent edges of the grid member. As an alternative, the grid sheet could be notched slightly at the regions of tape as shown at 16. If desired, the grid material may be slightly longer than the circumference of the tape so that there is a slight overlap at the ends of the grid sheet. While this tends to increase the amount that the grid departs from a true cylinder, it insures that there are no areas through which electrons can travel to the anode without being controlled by the grid mesh. The winding of the tape is then continued until a sufficient number of layers have been applied to give desired grid-anode spacing and then the anode, which is likewise formed as a rectangular blank, is applied and the overlapping edges spot-welded to retain the mount in assembled relation. If desired, the anode may be formed with a standing seam with the edges thereof overlapping and extending outwardly as illustrated at 17 in Fig. 1. The bodies of flexible tape added after the grid are illustrated in Figs. 1 and 2 at 5.

As an example of an electric discharge device embodying our invention, the cathode sleeve having an outer diameter of .045 inch was assembled with a grid member approximately 1/4 inch in circumference and a plate mem-

ber essentially $\frac{1}{2}$ inch in circumference. The tape employed was of the clay containing asbestos type and included two strips approximately 4 inches long and .030 inch wide. The tape was wound with five layers between the grid and cathode and ten layers between the grid and anode, the tape being .002 inch thick and giving a grid to cathode space of approximately .010 inch and a grid to anode space of approximately .020 inch. In the device just described the grid material was also .002 inch thick, the same as that of the insulating tape. This relationship between the thickness of the grid material and the insulating tape is not essential. It is apparent that the thinner the insulating tape, the less the grid cross section departs from a true circle.

In the specification, the various electrodes have been described as cylindrical, even though it is apparent that the inner electrode of the assembly may have an oval or even a rectangular cross section. When the inner electrode is non-circular, it may be oriented with respect to the starting point of the tapes to either render the next electrode more or less circular than the inner electrode. In the appended claims the electrodes are therefore referred to as tubular and as being mounted in substantial coaxial relation.

It is clear from the foregoing description that the present invention involves an improved electrode mount assembly for electric discharge devices including a novel method of assembling such mounts which is simple and particularly suited for mass production of electric discharge devices such as those commonly used in radio receivers. While a simple triode device has been selected for purposes of illustration, it will be apparent to those skilled in the art that any number of electrodes may be employed in accordance with the present invention. It will also be apparent that one of the wrappings of the insulating material may be omitted if the insulating material has sufficient width with respect to the length of the electrodes to provide the desired support.

While we have shown and described a particular embodiment of our invention, it will be apparent to those skilled in the art that changes and modifications may be made without departing from our invention in its broader aspects and we intend, therefore, in the appended claims to cover all such changes and modifications as fall within the true spirit and scope of our invention.

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

1. An electrode assembly for an electric discharge device comprising a pair of coaxial rolls of continuous insulating tape each having successive turns superimposed, a first electrode having opposite marginal edge portions interleaved between a pair of successive turns of the respective rolls and having its major portion extending between said rolls, and a second electrode having opposite marginal edge portions wrapped around and supported by the respective rolls with its major portion extending between the rolls in spaced relation to said first electrode, the major portions of said electrodes being separated only by free space forming an unobstructed electron flow path between said electrodes.

2. An electrode assembly for an electric discharge device comprising a support, a roll of continuous insulating tape wound on the support with successive turns of the roll superimposed, a first electrode having only a marginal edge portion interleaved between a first pair of successive turns of the roll and having its major portion extending beyond the side edges of said turns, and a second electrode having only a marginal edge portion wrapped around a later turn of the roll and having a major portion extending beyond the edge of the roll in spaced confronting relation with said first electrode, the confronting portions of said electrodes being separated only by free space forming an unobstructed path for flow of electrons between said electrodes.

3. In an electron discharge device, a tubular first electrode, a plurality of spaced rolls of continuous flexible insulating tape wound on the first electrode with successive turns of each roll superimposed, a concentric second electrode extending between the rolls and interleaved between a first pair of successive turns of each roll, and a concentric third electrode extending between the rolls wrapped around a later turn of each roll and supported thereby.

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