June 2, 1959 D. R. KERSTETTER ET AL 2,889,483

GLASS BASE GRID

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Fig. 1

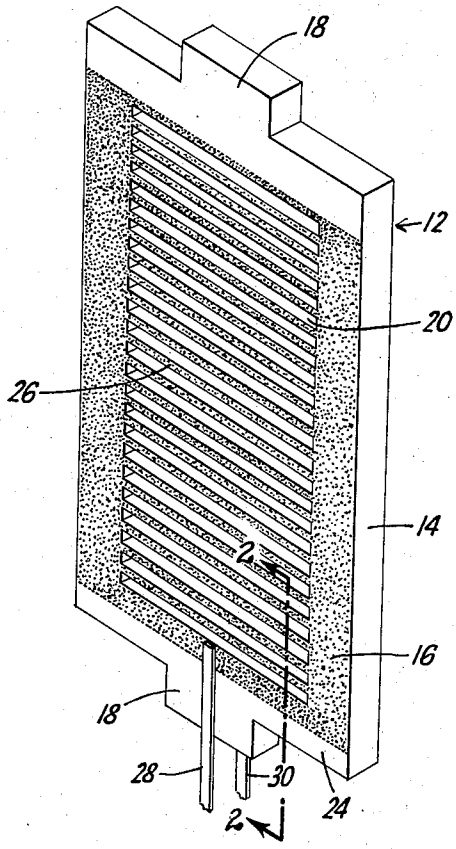


Fig. 2

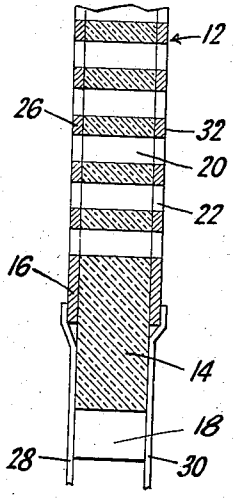


Fig. 3

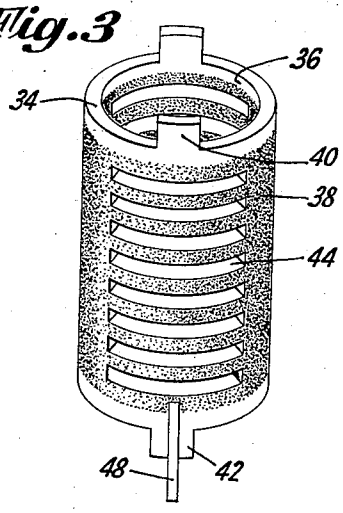
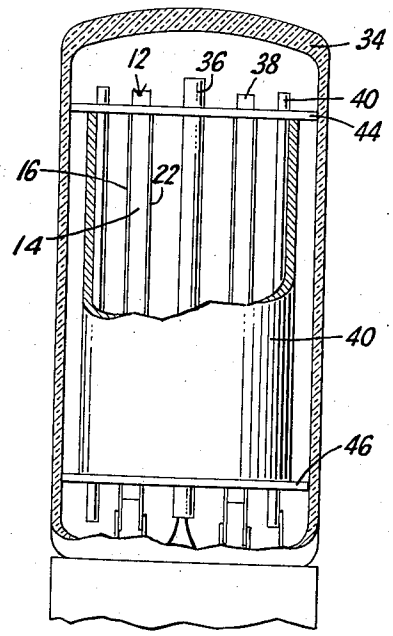


Fig. 4



INVENTORS
DONALD R. KERSTETTER
PAUL H. SASSAMAN
BY
Michael Sterz
ATTORNEY

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GLASS BASE GRID

Donald R. Kerstetter and Paul H. Sassaman, Emporium, Pa., assignors to Sylvania Electric Products Inc., a corporation of Massachusetts

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2 Claims. (Cl. 313—299)

The present invention relates to electron discharge devices, and more particularly to an improved construction for grid electrodes employed in these devices.

The grid electrodes known in the prior art usually comprise a plurality of small dimensional lateral wires which are supported parallel to one another by larger wire side rod elements. In view of the increased exactness, compactness, and size required for present day tubes, it is becoming more difficult to satisfactorily make and mount tube grid electrodes. These difficulties are due to the inherent weaknesses and size of the tube components.

One type of grid construction devised to obviate this weakness and still retain the exactness required for premium quality, while using small dimensional components, is one which comprises a plurality of parallel lateral wires supported by rigid insulating support members. The extremities of these lateral wires are secured to the insulating support members by fusion. This type of grid structure entails costly and additional production fabrication steps, and does not alleviate the necessity of handling very thin and weak, small dimensional, lateral wires.

An object of this invention is to obviate the aforesaid difficulties.

Another object is to provide for a novel and improved grid structure for use in electron discharge devices whereby the lateral conductors are rigidly and accurately secured in their correct positions.

A further object is to provide for a unitary multiple electrode structure which can be accurately fabricated and easily mounted in a tube electrode assembly.

A still further object of this invention is to provide for an improved beam type electron discharge device which employs a pre-formed, pre-aligned unitary multiple grid assembly.

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A still further object is to provide for an electron discharge device electrode formed by the deposition of a conductive coating on a photo-sensitive etched insulating member.

Briefly, the present invention relates to an improved electrode for tubes wherein the electrode is in the form of a conductive sheath integrally associated and co-extensive with one major surface of an insulating support member. Both major surfaces of this support member may be integrally associated with conductive sheaths, thereby providing for a pre-formed unitary multiple electrode structure.

The novel features that are considered characteristic of my invention are set forth with particularity in the appended claims. The invention itself will be more readily understood from the following description, reference being made to the accompanying drawings wherein:

Fig. 1 is a perspective view of one type of grid electrode assembly embodying the construction of my invention.

Fig. 2 is a sectionalized view along line 2—2 of the structure shown in Fig. 1.

Fig. 3 is a perspective view of another type of grid electrode assembly embodying the construction of my invention.

Fig. 4 is a view, partly in section, of an electron discharge device embodying a grid electrode assembly made in accordance with my invention.

As shown by Fig. 1, the grid assembly **12** comprises two major components, namely a base member **14** and a grid electrode **16**. The base member **14**, which is made of an insulating material such as glass, has support appendages **18** at both of its vertical axial extremities for facilitating mounting and securing the grid assembly within the envelope of a tube. The center section of the base member **14** has a plurality of parallel apertures **20** of pre-determined size to allow passage of electrons transversely through the member. The grid electrode **16** is a conductive sheath integrally associated with a major surface **24** of the base member **14**. This grid electrode **16** is substantially co-extensive with the major surface of the base member **14**, except for the region defined by and close to the support appendages **18**. The lateral conductors **26** of the grid completely cover the area surrounding the apertures **20** in the base member **14**. Connected to the grid **16** at one of its extremities is a conductive lead tab **28**, which will provide for an electrical connection for the grid to its source of potential. This lead tab is fused or welded to the lower portion of the grid.

As shown clearly in Fig. 2, the grid electrode assembly **12** may comprise the base member **14** and two grids, **16** and **22**. This structure embodies a unitary multiple grid assembly. In this instance, the grids **16** and **22** are both integrally associated with the base member **14**, one grid being associated and substantially co-extensive with each major face of the base member. The lead tabs **28** and **30** supply the operating potential for the grids **16** and **22**. Fig. 2 also clearly shows the relationship of the grid lateral conductors **26** and **32** of the two grids **16** and **22** with respect to each other. The apertures **20** not only extend through the base member but also through the grids **16** and **22**, thereby providing for absolute alignment of the lateral conductors of one grid with respect to the other. However, the grid lateral conductors **26** and **32** need not be laterally aligned with respect to each other so that the lateral conductors of one grid are in the same horizontal plane as the lateral conductors of the other grid, since the apertures **20** may be at an angle other than 90° to the major faces of the base member.

The multiple grid electrode assembly may be of a shape other than flat. The assembly may, for example, be circular as shown in Fig. 3. A circular insulating base member **34**, having supporting projections **40** and **42** thereon, and apertures **44** therein may be used in conjunction with an enclosed grid **36** and an exterior grid **38**. These grids are integrally associated with the inner and outer major faces of the base member, respectively. The grids are electrically connected to their source of potential by their lead tabs **48**, only the tab connected to the outer grid being visible in Fig. 3.

Fig. 4 illustrates an electron discharge device **34** having mounted therein between insulating spacers **44** and **46**, a cathode **36**, two unitary multiple-grid assemblies **12** and **38**, and an anode **40**. This tube could be used as a single beam type power amplifier, or if two electrically insulated anodes are mounted to cooperate respectively one with each set of electrodes, a duo-tetrode beam type power amplifier is provided. If only one grid sheath is

integrally associated with one major face of the base member **14**, which base member is shown clearly in Fig. 1, a tube may embody either a single-triode or duo-triode type mount assembly. When the grid lateral conductors **26** and **32** are not laterally aligned so that the lateral conductors nearest the cathode do not shade the lateral conductors of the other grid, the tube may embody either a conventional single or duo-tetrode mount assembly.

Numerous methods may be employed to make the grid structures of this invention. One of the most accurate and efficient processes involves the formation of the base member **14** by photo-etching means. Briefly, this process entails coating an article of glass, which has been pre-cut to the exterior size and shape desired, with a photo-sensitive material, such as silver chloride. The next steps are the formation of a positive design on the photo-sensitive material by the application of light to those areas not covered by a mask of pre-determined configuration, and a subsequent dissolving of the unexposed photo-sensitive material. The glass base is then etched over the unexposed areas to produce apertures therein, thus providing for the formation of a glass grid support of the type embodied in this invention. To complete the grid assembly, a deposit of metal is applied to the major surfaces of the glass member by electroplating or other means for providing the conductive sheath defining the grid electrodes.

In addition to the simplicity of production and accuracy attained in making electrodes of the type described in the present invention, the grid structure itself is rigid, strong, and easily mountable in an electrode assembly. When two metallic sheaths are integrally associated with both major surfaces of the insulating base member, the structure affords a rigid pre-formed multiple grid assembly. This rigidity provides for a reduction in the number of tubes rejected for microphonism, since it obviates vibrational movement of the grids under tube operating conditions.

Another advantage in the unitary multiple grid assembly is the permanent horizontal alignment of the lateral conductors of one grid with respect to the lateral conductors of the other grid. This permanent alignment reduces losses in the manufacture of line-up type tubes due to misalignment of grids, which misalignment causes high screen current. It also avoids the necessity for fabrication of a special anode which would facilitate observance of the grids during the line-up operation. Such specially constructed anode usually includes an observation window cut into the center portion thereof.

The rigidity of a grid electrode made in accordance with my invention markedly diminishes production losses in the manufacture of tube grid components. These losses, amongst others, were due to the inherent weaknesses of conventional lateral wire type grids, misplacement and jamming of lateral wires, and bowing of the grid side rods.

The invention has been described herein particularly with relation to grid electrodes for electron discharge devices, but it is to be understood that other electrodes in these devices may also be applicable to the present type of structure. It is also to be understood that the invention is not limited to the exact construction shown, or to the type of materials used as an example.

The novel features of the present invention are set forth with particularity in the appended claims.

We claim as our invention:

1. An electrode assembly for an electron discharge device comprising in combination, a base member of dielectric material having a plurality of parallely aligned straight slots extending therethrough perpendicular to the major faces of said member, and a pair of slotted conductive electrodes integrally associated with both major faces of said base member, the slots in the electrodes being in register with the slots in the base member.

2. An electrode assembly for an electron discharge device comprising in combination, a base member of dielectric material having a plurality of parallely aligned straight slots extending therethrough perpendicular to the major faces of said member, and a pair of slotted conductive electrodes integrally associated with both major faces of said base member, the slots in the electrodes being in register with the slots in the base member and extending uninterruptedly substantially from one side edge of said member to the opposite side edge.

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