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ELECTRON DISCHARGE DEVICE

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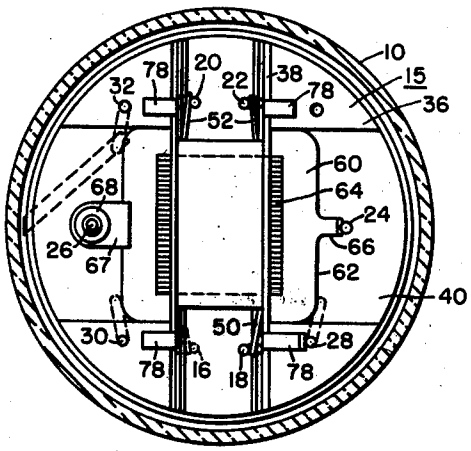


Fig. 1.

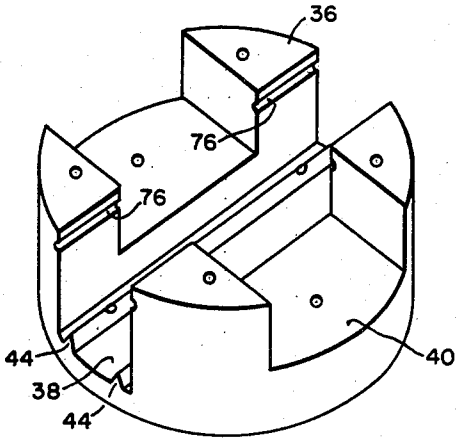


Fig. 3.

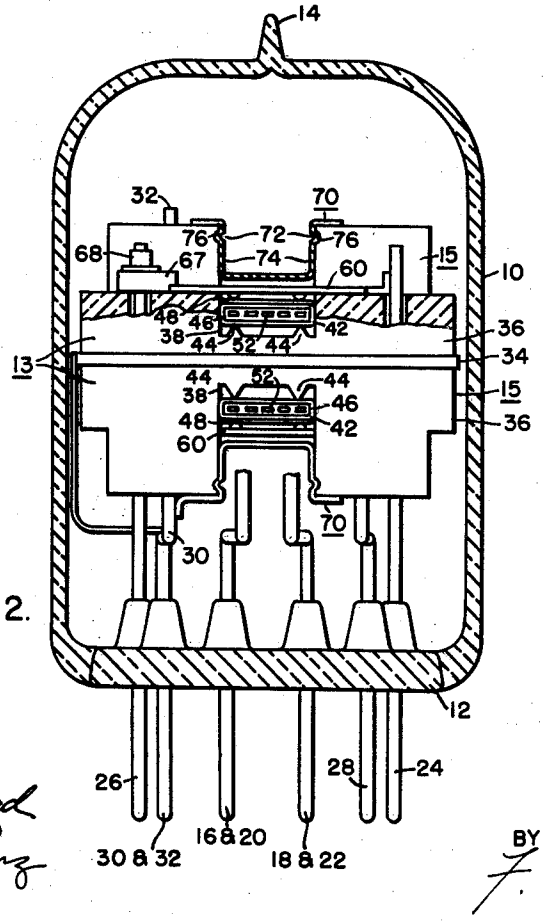


Fig. 2.

WITNESSES

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ELECTRON DISCHARGE DEVICE

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This invention relates to electron discharge devices and, more particularly to improvements in electrode assemblies.

It is an object of our invention to provide an improved electrode assembly structure for an electron discharge device.

It is another object to provide an electron discharge device which is rugged and able to operate under conditions of shock or vibrations.

It is another object to provide an electrode assembly particularly suited to those devices requiring high value of transconductance.

It is another object to provide an electrode structure adaptable to internal shielding of twin-type tube structures.

It is another object to provide an electrode structure that is suitable for mechanical or automatic assembly.

These and other objects are effected by our invention as will be apparent from the following description taken in accordance with the accompanying drawing throughout which like reference characters indicate like parts, and in which:

Figure 1 is a top view of an electrode assembly embodying our invention;

Fig. 2 is a side view partly broken away of the electrode structure shown in Fig. 1; and

Fig. 3 is a perspective view of the mount support structure shown in Fig. 1.

Referring in detail to the drawing, there is shown an electrode discharge device embodying our invention. The device shown for purposes of illustrating our invention is a twin triode but the teachings may be utilized for any number of electrode structures such as for a twin triode, twin pentode, or a triode-pentode.

The electrode discharge devices include an envelope **10** closed at the lower end with a button stem header **12** closed at the upper end by an exhaust tubulation **14**. The electrode structure **13** embodying our invention may be incorporated in any suitable type envelope structure and the one shown here is only for the purposes of illustration. A plurality of lead-in conductors **16**, **18**, **20**, **22**, **24**, **26**, **28**, **30** and **32** are sealed through the header **12** and are welded directly to their respective elements of the electrode assembly **13** within the envelope **10**. The lead-in conductors not only supply the necessary voltage to the elements of the electrode assembly **13** but also support the electrode structure **13** within the envelope **10**.

The electrode assembly **13** is comprised essentially of two identical triode electrode structures **15** positioned back to back and separated from each other by means of a planar shielding member **34**. In the specific embodiment shown, the two separate triode structures **15** are positioned so that their planar elements are substantially parallel to the header **12** of the envelope **10**.

For ease in describing the structure, the description is limited to the upper triode structure **15**. The upper electrode structure **15** is comprised of a support wafer **36** of any suitable material such as ceramic provided with grooves or channels **38** and **40** in the upper surface. The

grooves may be machined or molded in a suitable manner. In the specific embodiment shown, one channel **38** is cut to a depth of approximately ⅙ of the thickness of the wafer **36** and provides a channel or slot for positioning a cathode **42** within the ceramic wafer **36**. The bottom surface of the channel is substantially parallel to the wafer surface while the side walls are substantially perpendicular. It is desirable to provide integral ridge portions **44** on the bottom surface of the channel to aid in thermal isolation of the cathode **42** from the main wafer **36**. The cathode **42** utilized in the specific embodiment comprises a tubular metallic sleeve **46** having a rectangular cross-section. An electron emissive coating **48** is applied in a suitable manner on the outer surface of one of the large dimensioned sides of the rectangular sleeve while the other surface rests on the ridge portions **44** on the bottom of the channel **38**. A tab **50** is provided on the cathode sleeve **46** to which the lead-in **18** is welded in a suitable manner. A heating element of filament **52** is positioned within the tubular sleeve **46** of the cathode **42** and is electrically insulated therefrom to provide heat to the emissive coating **48** of the cathode **42**. The ends of the filament **52** are connected to lead-in wires **20** and **22**.

The second groove or channel **40** is also located in the same surface of the wafer **36** but at a lesser depth than the cathode channel **38**. The channel **40** is positioned at an angle with respect to the cathode channel **38** and in the specific embodiment shown is at right angles with respect thereto. The bottom of channel **40** is also substantially parallel to the face of the wafer **36** while the side walls are substantially perpendicular. The channel **40** provides means for positioning a control grid **60** within the electrode structure **15**. This control grid **60** is in the form of a frame grid member and of a planar type structure. The grid **60** essentially consists of a frame **62** of sheet-like material and in the specific embodiment substantially quadratic which supports and positions the active portion **64** of the grid **60**. The active portion **64** of the grid **60** consists of lateral wires or a mesh structure across an aperture in the rectangular frame member **62**. The lateral wires may be attached to the frame **62** by any suitable means such as notching and peening, welding or brazing. The dimensions of the frame grid **60** are such that one dimension is such as to rest within the grid channel **40** substantially against the sides of the channel **40** while the other dimensions of the planar grid **60** is such that the active portion **64** extends at least across the width of the cathode channel **38**. The depth of the grid channel **40** with respect to the cathode channel **38** is carefully controlled to obtain the proper spacing between the cathode **42** and the grid electrode **60**. The grid electrode **60** is provided with a tab **66** on one side of the rectangular frame and is attached to the stem lead **24**. The other side of the frame grid **60** resting within the grid channel **40** is secured to the ceramic wafer **36** by means of a ceramic or insulating washer **67** located about the stem lead **26** and held in place by an eyelet **68**. It may also be desirable to further insure proper spacing between the cathode **42** and grid **60** to provide ceramic projections which must be carefully controlled as to their height on the underside of the grid frame **62** adjacent to the cathode **42**. These projections touch the cathode **42** and when the grid **60** is secured down by means of the insulating washer **66** the projections will press down on the cathode **42** and retain the cathode **42** in a fixed or locked position within the cathode channel **38**.

A plate member **70** is next provided or positioned within the electrode structure **15** and consists essentially of a metallic elongated member of suitable material having a U-shaped cross-section. Raised portions or ribs **72** are provided on the exterior surface near the top of the legs

74 of the plate 70. Matching depressed portions 76 are provided in the side walls of the cathode channel 38 near the top to retain the plate 70 in the wafer 15. The plate 70 is thus locked into the wafer in a manner shown in Fig. 2. Out-turned portions or tabs 78 are provided on the ends of the legs 74 at each corner to rest on the top surface of the ceramic wafer 15. One of the tabs 78 is made longer to provide a means of welding the stem lead 28 to the plate 70.

Referring to the entire electrode assembly 13, the specific embodiment utilizes integral stems and lead-ins 16, 18, 20, 22, 24, 26, 28, 30 and 32 so that it is necessary that the lower electrode structure 15 be assembled first and positioned with the channel surface downward over the lead-ins. The shielding member 34 is positioned on top of the lower electrode 15 and then the upper electrode structure 15 is positioned and attached to the lead-ins to complete the electrode assembly 13. It is also possible that the same lead-in might be made in two separate parts which would permit fully assembling the upper and lower electrode structures 15 into the electrode assembly 13 prior to insertion into the envelope 10 and then welding the lead-ins to the corresponding lead-ins or supports in the stem.

The metal shield 34 provided between the two electrode structures 15 is provided with various holes punched therein to provide clearance with respect to the stem leads passing through the structure. A stem lead-in 32 is also provided for the shield 34 and is welded to the metal shield 34 and may be grounded on the exterior of the envelope 10. The shield serves as an electrostatic shield between the upper and lower electrode structures 15. The shielding effect of the metal shield 34 may be enhanced by extending the shield 34 beyond the two electrode structures 15 to substantially the tube wall of the envelope 10.

In the manufacture of the device where two separate stem leads are used, the lower electrode structure 15 could be assembled by positioning or dropping the cathode sleeve 46 with coating 48 and heater into the cathode groove 38. The upper block 36 is held in a position with the channels upward. The next operation would be the positioning or dropping of the control grid 60 within the grid channel 40. The next step would be the press in or snap in positioning of the anode member 70 within the cathode channel 38. The upper portions of the stem leads could then be inserted or prior to the above assembly, and welded and secured in a manner previously described to electrodes. It should be noted that the stem lead 26 provides electrical connection to the grid of the lower electrode structure 15 and this grid is mechanically secured by stem lead 24 on the other side. The metal shielding member 34 is then inserted over the lead-in members after the lower electrode structure 15 is inverted so as to rest on the back of the wafer of the lower electrode structure and is welded to the lead-in member 32. The upper electrode support or wafer 36 is then mounted over the lead-in members so that its back portion rests against the metallic insulating member 34 and the remaining elements of the upper electrode structure are positioned within the wafer 36 in a similar manner as that described with respect to the lower electrode structure 15. The upper lead-in portion could then be welded to the lower support stem lead-in portion. Clamping members (not shown) may be used around portions of the periphery of the wafers 36 to retain them together. This structure lends itself to automatic assembly of elements into the ceramic wafers.

While we have shown our invention in only one form,

it will be obvious to those skilled in the art that it is not so limited but is susceptible to various other changes and modifications without departing from the spirit and scope thereof.

We claim as our invention:

1. An electron discharge device comprising an envelope having an electrode assembly within said envelope, said electrode assembly comprising a plurality of planar type electrodes, means for positioning said electrodes within said assembly comprising a wafer having at least two grooves of different depths intersecting at an angle in one surface thereof, an electrode positioned within the lower portion of the deepest of said grooves, and another electrode within the other of said grooves to support and space said electrodes in a fixed relationship with respect to each other.

2. An electron discharge device comprising an envelope having an electrode assembly within said envelope, said electrode assembly comprised of a plurality of planar type electrodes consisting of at least a cathode, grid and anode, means for positioning said electrodes within said assembly comprising a wafer of insulating material, said wafer having at least two grooves of different depths intersecting at an angle in one surface thereof, said cathode positioned within the lower portion of the deepest of said grooves, said anode positioned in the upper portion of said deepest groove and said grid electrode positioned in the lower portion of another of said grooves intermediate said cathode and anode to support and space the electrodes in a fixed relationship with respect to each other.

3. An electron discharge device comprising an envelope having an electrode assembly within said envelope, said electrode assembly comprised of a plurality of planar type electrodes consisting of at least a cathode, grid and anode, means for positioning said electrodes within said assembly comprising at least one wafer of insulating material, said wafer having at least two intersecting grooves of different depths in one surface thereof, said cathode positioned within the lower portion of the deepest of said grooves, said anode positioned in the upper portion of said deepest groove and said grid electrode positioned intermediate said cathode and said anode within another of said grooves.

4. An electron discharge device comprising an envelope and having therein a unitary electrode assembly comprised of a first and a second tube structure, said first tube structure comprised of a plurality of electrodes and an insulating support having a surface provided with a plurality of intersecting channels, said electrodes received within said channels to support and space said electrodes in a fixed relationship with respect to each other, said second tube structure comprised of a plurality of electrodes and an insulating support having a surface provided with a plurality of intersecting channels, said electrodes received within said channels to support and space said electrodes in a fixed relationship with respect to each other, means for maintaining said first and second tube structure so that said insulating support members are positioned back to back, and metal shielding means positioned intermediate said first and second tube structures.

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