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ELECTRON DISCHARGE DEVICE

2,663,818

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2 Sheets-Sheet 1

FIG. 1

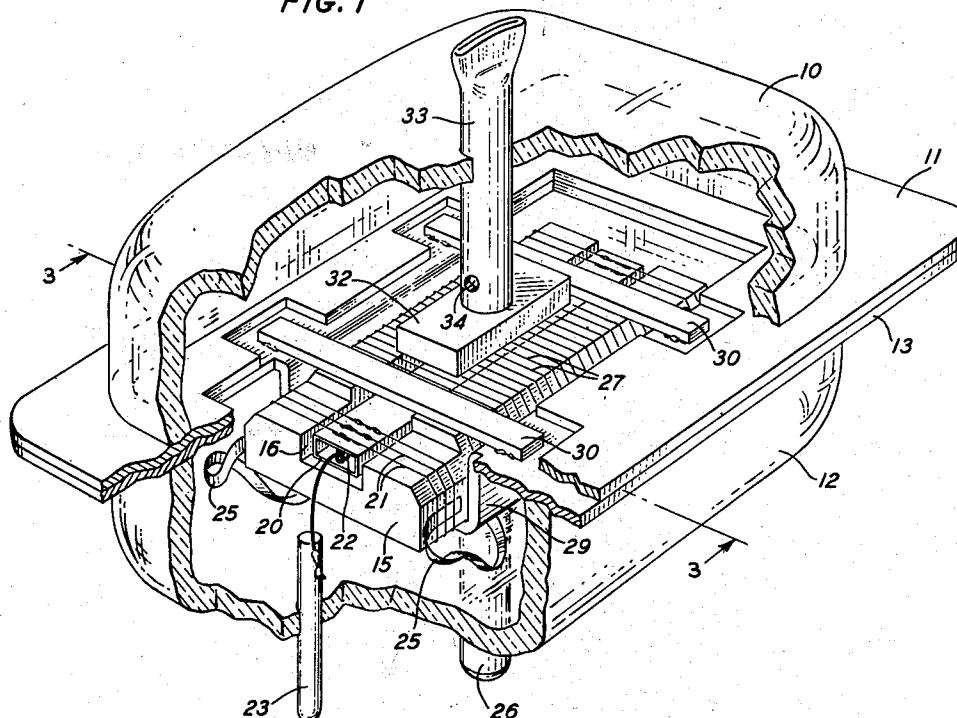
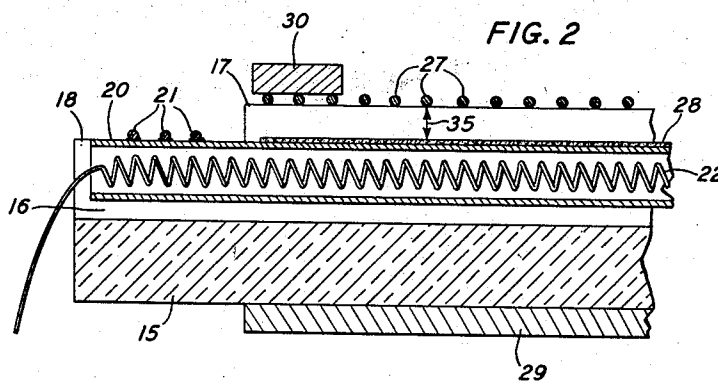


FIG. 2



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ELECTRON DISCHARGE DEVICE

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ELECTRON DISCHARGE DEVICE

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16 Claims. (Cl. 313-250)

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This invention relates to electron discharge devices and, more particularly, to the support and mounting of electrodes therefor.

In close-spaced electron discharge devices employing control electrodes wound with exceedingly fine lateral wires, the accuracy of the positioning of the electrodes, and the ease with which that accuracy can be reproduced from one device to another in manufacture, are of great importance. It is particularly important that the cathode be accurately positioned in close proximity to the next element of the device, which is generally the control electrode. The positioning means employed must be firm, allow for the expansion of the cathode at elevated temperatures without alteration of the cathode-electrode spacing, but not sap away from the cathode any considerable amounts of power.

It is one object of this invention to accurately and facily position and support electrodes in an electron discharge device.

Another object of this invention is to improve the structure of electron discharge devices.

A further object of this invention is to facilitate the manufacture of electron discharge devices.

These and other objects of this invention are accomplished in one specific illustrative embodiment of this invention in which a ceramic or other insulating block has a central groove therein. The upper surface of the block on either side of the groove is stepped, there being a precisely dimensioned central portion, and two coplanar accurately dimensioned end portions. A fine wire is wound around the block over both portions and across the central groove. A cathode having a planar face is then positioned in the central groove and supported by the wires across the lower end portions. The wires across the central portion are separated from those across the end portion and serve as the laterals of the control grid of the device. The cathode is thus suspended from the end wires and its plane face is accurately positioned with respect to the control grid.

In this one specific embodiment of the invention, the block is positioned in a cradle, connection being made to the control electrode laterals by the cradle. A tab advantageously extends across the cradle at each end of the upper surface portion of the block to lock the block in position and also to shield the cathode ends and the suspension wires from the field of the anode, which may be positioned adjacent the central portion of the block and slightly removed from the control electrode laterals.

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In another specific embodiment of this invention, the block has only a single top surface but transverse grooves are cut therein adjacent each end. Glass frit or other material which seals to the block is placed in the grooves. A rod is then placed in the grooves and sealed to the block at a height above the base of the transverse grooves accurately determined to obtain the desired accurate spacing of the cathode and the control electrode wires. The cathode is then supported from the transverse rod, the control electrode laterals having been wound around the block and joined thereto.

It is therefore one feature of this invention that the cathode be positioned from the next electrode in the device by being suspended from a support block around which the next electrode is wound.

It is a further feature of this invention in accordance with one embodiment thereof that the support block have two accurately dimensioned surface levels, the cathode being supported by suspension means extending across one surface level and the electrode wires being wound around the next surface level.

It is a further feature of this invention in accordance with the one embodiment thereof that the cathode be suspended by wires wound around the support block, the wires advantageously being initially continuations of the electrode wound around the next surface level.

It is a further feature of this invention in accordance with another embodiment thereof that the cathode be suspended from support rods accurately positioned with respect to the upper surface of the support block in transverse grooves therein.

It is a further feature of this invention that the support block be situated in a cradle forming the control electrode connection for the device, tabs extending across the cradle and across the last laterals of the electrode to lock the support block in the cradle.

A complete understanding of this invention and of the various features thereof may be gained from consideration of the following detailed description and the accompanying drawings, in which:

Fig. 1 is a perspective view of an electron discharge device in accordance with one specific illustrative embodiment of this invention, a portion of the envelope having been broken away;

Fig. 2 is a partial sectional view of the electrode support means of the device of Fig. 1, illustrative of one specific embodiment of this invention;

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Fig. 3 is a sectional view of the device of Fig. 1 along the line 3—3; and

Fig. 4 is a partial sectional view of an electrode support means employable with the device of Fig. 1 and illustrative of another embodiment of this invention.

Referring now to the drawing, the envelope of the electron discharge device illustrated in Fig. 1 comprises an upper or anode, glass or vitreous portion or stem 10 which is joined to an upper electrode disc 11, and a lower or cathode, glass portion or stem 12 which is joined to a lower electrode disc 13. The cathode and control electrode mounting means comprises a support block 15, advantageously of ceramic such as a steatite, having a central groove 16 therein, an upper surface 17 accurately dimensioned and a stepped or lower surface 18 at each end, also accurately dimensioned. The sides of the support block 15 adjacent the surfaces 17 and 18 are advantageously beveled.

A hollow planar cathode 20 is supported in the groove 16 by being suspended from a plurality of wires 21, as for example three, wound around the lower surface 18 and the block 15 at each end thereof. The cathode 20 may be secured to the wires 21 by being brazed or welded thereto. A heater 22 extends through the hollow cathode 20 and is secured at each end to heater leads 23 extending through the cathode glass portion 12. Tabs 25 are advantageously positioned underneath the wound wires 21 at each side of each end of the block 15 and serve to electrically connect the cathode 20 to a cathode lead 26 extending centrally through the cathode glass portion 12.

Electrode wires 27 are wound around the block 15 and the surface 17 intermediate the two end stepped or lower surfaces 18. The cathode 20 advantageously has an electron emissive coating 28, as of barium and strontium oxides, on its surface adjacent and opposite the electrode laterals 27.

The support block 15 together with the suspended cathode 20 and wound grid laterals 27 is advantageously seated in a cradle 29 advantageously formed integral with the lower grid disc 13. The block 15 is locked in position in the cradle by bridges or locking members 30 extending across the upper surface 17 at the ends thereof and brazed or otherwise secured to the lower grid disc 13.

The anode 32 may advantageously be a flat block adjacent the grid laterals 27 between the bridges 30. The anode 32 is supported by an anode lead 33 extending centrally through the upper glass envelope portion 10. The lead 33 is advantageously hollow and serves as the exhaust tubulation for the device, the lead having apertures 34 therethrough communicating with the interior of the device.

As the grid wires 27 are wound completely around the block 15 they are in contact with the cradle 29 and the locking members 30 which provide electrical connection between the electrode and the grid discs 11 and 13 external to the envelope of the device. Tabs, similar to tabs 25, could however be positioned under the grid laterals 27 at each side of the block 15 and connected to the cradle 29 of either grid disc 11 or 13.

In the fabrication of this device, the block or support 15 has wound around it a single very fine wire, such as of the order 0.00030 inch in diameter, the tabs 25 being held in position during the winding operation. The wire is then glazed or otherwise bonded to the block 15. The single

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wire is then separated into three sections, the middle section being the portion of the wire wound around the upper surface 17 and comprising the grid laterals 27 and the two end sections being the portions of the wire wound around the lower surface 18 and comprising the wire supports 21. The cathode 21 is then slipped into the groove 16 in the block 15 and brazed or otherwise secured to the wires 21.

The cathode and electrode mount is thus a separate single unit which may next advantageously be placed on the cradle 29. As is easily seen in Fig. 1, the cradle 29 advantageously is approximately the same length as the central surface portion 17 which coincides with the length of the control electrode. The two locking members or bridges 30 are then welded or otherwise secured to the lower grid discs 13 so as to extend across the ends of the central surface portion 17 and to bear against the grid laterals 27 between it and the surface 17.

The upper and lower glass portions 10 and 12 are advantageously prepared as separate units, each having its associated electrode disc sealed thereto. The upper glass envelope portion 10 is prepared with the anode accurately positioned therein and the lower glass envelope portion 12 with the heater leads 23 and cathode leads 26 extending therethrough. When the electrode and cathode mount assembly is positioned in the cradle 29 the tabs 25 from the cathode 20 are secured to the central cathode lead 26 and the ends of the heater 22 to the heater leads 23.

The upper glass envelope portion is then positioned over the lower glass envelope portion, the two grid discs 11 and 13 being adjacent each other. The two grid discs are welded, brazed, or otherwise sealed together to form the main seal of the device. The device is next exhausted through the anode tubulation lead 33 which is then sealed off.

Electron discharge devices in accordance with this invention in which the cathode is suspended from the stepped mounting block by wires extending across the block assure an accurate spacing 35 between the cathode coating 28 and the electrode laterals 27 because the spacing is dependent on the dimensioning of the surfaces 17 and 18, which can be very accurately and facily controlled in manufacture, as by fine grinding. Expansion of the cathode at the temperature of operation will not affect this spacing 35. Transverse expansion of the cathode 20 can only cause a displacement of the lower side of the cathode, removed from the electrode laterals 27, as the position of the upper side, on which the coating 28 is located, is determined by the suspension wires 21. These wires themselves will not expand materially as the block remains cool and thermally insulates them.

Referring now to Fig. 4, there is shown a partial sectional view illustrative of another embodiment of this invention. The support block 40, for example of ceramic, has a groove 41 centrally therein similar to the groove 16 and in which is located the cathode 20. The block 40 however has only a single upper surface 42 around the central portion of which are wound the electrode laterals 27. The block is also similarly located in the cradle 29 by the locking members 30. In the upper surface 42 adjacent the ends of the block 40 removed from the grid laterals 27 and the cradle 29 there are two transverse grooves 43, one at each end of the block 40. A rod 45 is fastened in place in each groove 43, as by a

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powdered glass glazed to the rod and the block. The cathode 20 is then suspended from the rods 45, as by being clipped thereto.

In the manufacturing of electrode support and mounts in accordance with this illustrative embodiment of this invention, the rods 45 are accurately positioned in the grooves 43 and secured in place, as by the glaze 44, to provide a predetermined accurate spacing 46 between the surface of the electrode coating 28 and the electrode laterals 27. While the rods 45 may be positioned at the base of the grooves 43, in which case the base of the grooves would have to be accurately determined with respect to the upper surface 42, it is a feature of this embodiment of this invention, that the accurate spacing 46 is determined by the positioning of the rods 45 in the grooves 43.

Because the cathode 20 is suspended at each end from the ceramic or other insulating block 40, heating of the cathode can cause relatively no displacement of the cathode coating 28 or variation in the spacing 46, for the reasons mentioned above with reference to the embodiment of Fig. 2.

Reference is made of the application of C. T. Goddard, Serial No. 231,816, filed June 15, 1951, wherein related inventions are described.

It is to be understood that the above-described arrangements are illustrative of the application of the principle of the invention. Numerous other arrangements may be devised by those skilled in the art without departing from the spirit and scope of the invention.

What is claimed is:

1. An electron discharge device comprising a support block having a central groove therein, a plurality of wire laterals on said block and extending across said groove, a flat cathode in said groove, and support means including a planar portion extending across said groove at the ends thereof, said cathode being suspended directly from said planar portion of said support means.

2. An electron discharge device comprising an insulator block having a central groove therein and a planar upper surface, a plurality of wire laterals wound around said block and secured thereto, said wire laterals extending across said groove in the plane of said surface, a flat cathode in said groove, and support means extending across said groove at the ends of said block and defining a plane parallel to said planar surface, said cathode being suspended from said support means in said plane adjacent said wire laterals.

3. An electron discharge device comprising an envelope, a cradle supported in said envelope, an insulator block positioned in said cradle, said block having a central groove therein and a planar upper surface, a plurality of wire laterals extending across said groove in the plane of said surface and defining an electrode, a flat cathode in said groove, support means extending across said groove at the ends of said block and defining a plane adjacent said wire laterals, said cathode being suspended from said support means in said plane, and locking members extending across said block and secured to said cradle on each side of said block locking said block in position in said cradle.

4. An electron discharge device comprising an envelope, a disc extending through said envelope and defining a cradle portion therein, a plurality of leads extending through the base of said envelope, an insulator block positioned in said cradle, said block having a central groove therein and a planar upper surface, a plurality of wire

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laterals extending across said groove in the plane of said surface and secured to said block, said laterals being in electrical contact with said cradle and defining an electrode, a flat hollow cathode in said groove, support means extending across said groove at each end of said block and defining a plane adjacent said wire laterals, said cathode being suspended from said support means in said plane, a heater element extending within said cathode, means electrically connecting said heater element to certain of said leads in said base, means electrically connecting said cathode to another of said leads in said base, locking members extending across said block between said electrode and said support means, said locking members being secured to said disc on either side of said cradle portion and locking said block therein, an anode positioned adjacent said wire laterals to the other side thereof than said cathode, and lead means extending through said envelope and supporting said anode.

5. An electron discharge device comprising a support block having a first and a second surface thereon, a first plurality of lateral wires secured to said block across said first surface and defining an electrode, a second plurality of lateral wires secured to said block across said second surface, and a cathode suspended from said second plurality of lateral wires in the plane of said second surface adjacent said first plurality of lateral wires.

6. An electron discharge device comprising a support block having a central groove therein, a planar surface thereon and stepped portions of the ends thereof, a first plurality of wire laterals secured to said block, said laterals extending across said groove in the plane of said surface and defining an electrode, a second plurality of wire laterals secured to said block and extending across said groove in the plane of said stepped portions and a planar cathode in said groove and suspended directly from said second plurality of wires.

7. An electron discharge device comprising an insulator support block having two parallel surfaces thereon, a plurality of wire laterals supported by said block, a first portion of said wire laterals being in the plane of one of said surfaces and defining an electrode, a second portion of said wires being in the plane of the other of said surfaces, a cathode positioned adjacent said electrode wire laterals and suspended directly from said second portion of said wires, and means electrically connecting said electrode laterals together.

8. An electron discharge device comprising an envelope, a cradle member supported in said envelope, an insulator block in said cradle member, said block having a central groove therein and two parallel planar surfaces thereon, a plurality of wire laterals secured to said block and extending across said groove, a first portion of said laterals being in the plane of the upper of said surfaces and defining an electrode, a second portion of said laterals being in the plane of the lower of said surfaces, a flat cathode in said groove, said cathode being suspended adjacent said electrode laterals from said second portion of said laterals, and locking means extending across said block and secured to said cradle member on each side of said block locking said block in position in said cradle member.

9. An electron discharge device comprising an envelope, a disc extending through said envelope, a cradle member within said envelope supported

by said disc and electrically connected thereto, a lead extending through the base of said envelope, an insulator block positioned in said cradle, said block having a central groove therein and stepped surfaces at each end, a first plurality of wire laterals extending across said groove and defining an electrode, said wire laterals being electrically connected to said disc, a second plurality of wire laterals extending across said stepped portions, a flat cathode within said groove and suspended directly from said second plurality of wire laterals adjacent said electrode laterals, means electrically connecting said second plurality of wires to said leads extending through said base, and means locking said block in position in said cradle member.

10. An electron discharge device comprising an envelope, said envelope comprising an anode portion, a cathode portion, and a disc therebetween, a plurality of leads extending through said cathode portion, a cradle within said envelope integral with said disc, an insulator support block in said cradle, said block having a planar upper surface with stepped portions at each end and a groove centrally therein, a first plurality of wire laterals secured to said block and extending across said groove in the plane of said surface, said laterals defining an electrode and being electrically connected to said disc, a second plurality of wire laterals secured to said block and extending across said groove in the plane of said stepped portions, a flat hollow cathode in said groove and suspended from said second plurality of wires in the plane of said stepped portions adjacent said electrode laterals, tabs electrically connecting said cathode to one of said leads extending through said cathode envelope portion, a heater element extending within said cathode, tabs electrically connecting said heater element to other of said leads extending through said cathode envelope portion, an anode opposite said electrode laterals to the other side thereof than said cathode, lead means extending through said anode envelope portion supporting said anode, and locking members extending across said block at the ends of said planar surface and secured to said disc on each side of said block, locking said block in position in said cradle.

11. An electron discharge device comprising an insulator block having a planar surface and a groove centrally therein along the length of said block, said block also having a transverse groove adjacent each end, a plurality of wire laterals extending across said surface and secured to said block, a rod extending through each of said transverse grooves and across said lengthwise groove, means accurately positioning said rods in said transverse grooves and securing them to said block, and a flat cathode in said lengthwise groove and suspended directly from said rods adjacent said wire laterals.

12. An electron discharge device comprising an envelope, a disc extending through said envelope, a cradle member within said envelope supported by said disc and electrically connected thereto, a ceramic block positioned in said cradle member, said block having a planar surface and a groove centrally therein along the length of said block, said block also having a transverse groove adjacent each end, a plurality of wire laterals extending across said surface and secured to said block, said wire laterals being electrically connected to

said cradle member and defining an electrode, a rod extending through each of said transverse grooves and across said lengthwise groove, means accurately positioning said rods in said transverse grooves and securing them to said block, a flat cathode within said lengthwise groove suspended directly from said rods adjacent said wire laterals, an anode adjacent said electrode to the other side thereof than said cathode, means supporting said anode in said envelope and providing electrical connection through said envelope therefor, means electrically connected to said cathode providing electrical connection through said envelope, and locking members extending across said block and secured to said cradle member on each side of said block locking said block in position in said cradle member.

13. The method of fabricating electron discharge devices which comprises winding a fine wire around a block having a planar surface with stepped portions at each end and a groove centrally therein, bonding said wire to said block, positioning a flat cathode in said groove, securing said cathode to the portions of said wire across said stepped portions so that said cathode is suspended therefrom, and separating said wire portions extending across said stepped portions from the portion extending across said surface.

14. The method of fabricating an electron discharge device which comprises winding a single wire across a support block having two planar surfaces, securing said wire to said block, securing a flat cathode to the portions of said wire across one of said planar surfaces so as to be suspended therefrom, and rupturing the connection between the portions of said wire across said two surfaces.

15. The method of fabricating an electron discharge device which comprises winding a single fine wire around a support block having a groove centrally therein securing said wire to said block, positioning a flat cathode in said groove, securing said cathode to secured portions of said wire so as to be suspended directly therefrom, and rupturing the connection between said portions and the remainder of said wire.

16. The method of fabricating an electron discharge device which comprises winding a single fine wire around an insulator block having a groove centrally therein, a planar upper surface and step portions at the ends thereof bonding said wire to said block, positioning a flat cathode in said groove, securing said cathode to the portions of said wire extending across said stepped portions so that said cathode is directly suspended from said wire portions, rupturing the connection between said wire portions and the remainder of said wire across said planar surface, positioning said block in a cradle member, and locking said block in said cradle member.

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