

Nov. 24, 1953

E. J. WALSH

2,660,688

ELECTRON DISCHARGE DEVICE

Filed March 9, 1951

2 Sheets-Sheet 1

FIG. 1

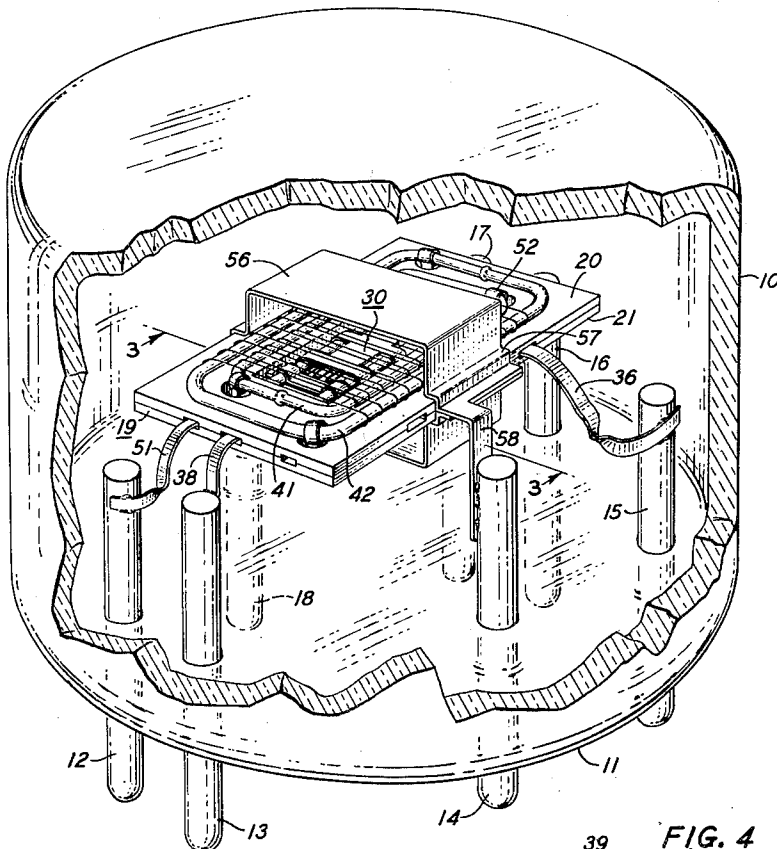


FIG. 3

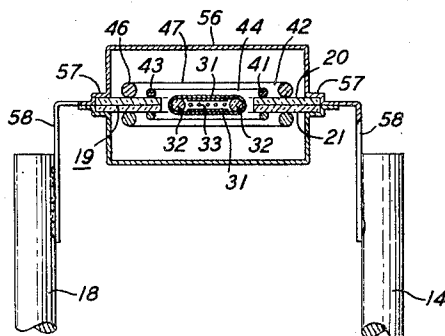
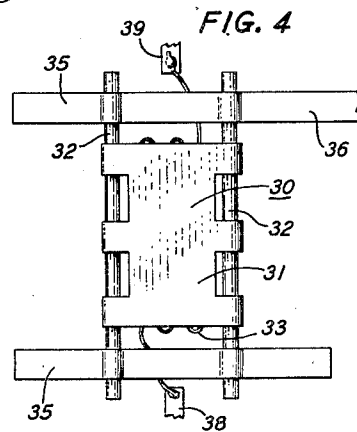


FIG. 4



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FIG. 2

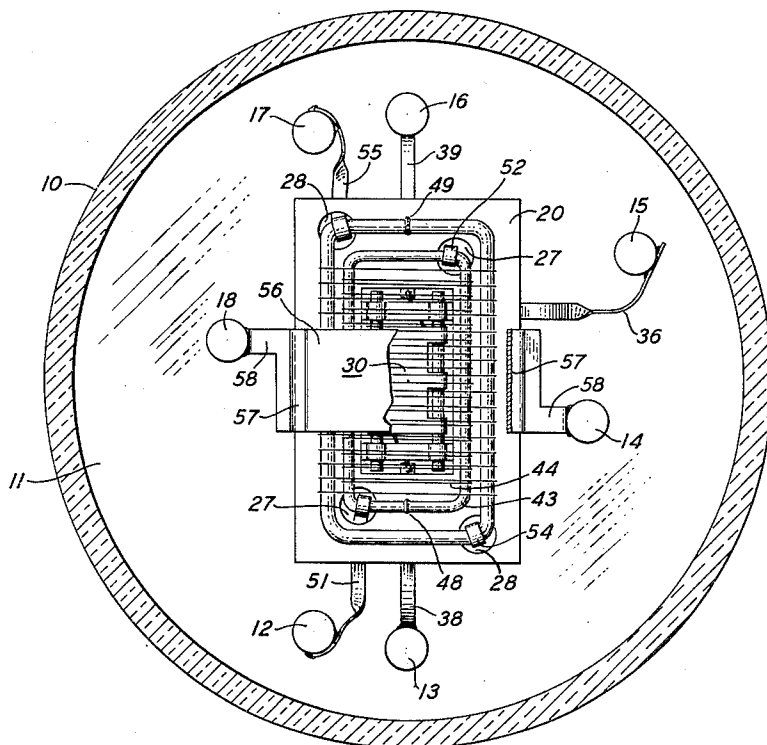


FIG. 6

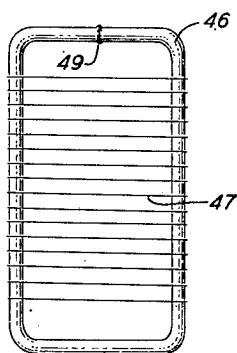
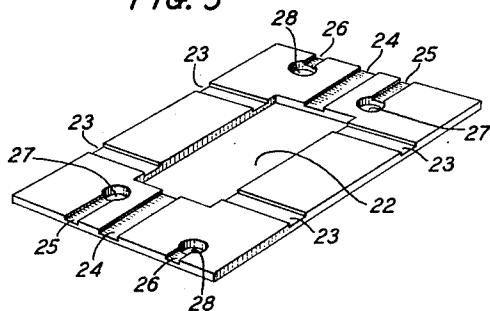


FIG. 5



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ELECTRON DISCHARGE DEVICE

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5 Claims. (Cl. 313-257)

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This invention relates to electron discharge devices and more particularly to the mounting of the electrodes of such devices.

In conventional electron discharge devices employed for a multitude of purposes today, the ends of the various electrode elements extend into or through holes in each of two insulators, usually of mica. These insulators introduce two limitations into the device. First, they introduce serious tolerances in the spacings between the electrodes and, secondly, a usable portion of the electrode, particularly of the working surface of a cathode, is wasted because it extends into or through these insulators.

It is one general object of this invention to improve the structure of electron discharge devices and more specifically to provide a close spacing between the cathode and grid electrodes and enable complete utilization of the cathode surface.

It is also an object of this invention to facilitate construction of electron discharge devices, thereby reducing their over-all cost.

These objects are achieved in accordance with one specific embodiment of this invention wherein all the electrodes are positioned and supported by a single insulator which provides all the reference surfaces for positioning the electrodes. This insulator is apertured centrally and a cathode is supported in the aperture. Preferably, the insulator comprises two insulating blocks having mating grooves on their inner surface in some of which grooves tabs or straps are provided by which the cathode is supported. Control or grid electrodes are positioned on the upper and lower surfaces of the insulator, and are secured together by tabs extending through other apertures in the insulator.

It is therefore one feature of this invention that a pair of flat surface insulator members having central apertures therein support a cathode in the apertures, the surface of the cathode being substantially parallel to the surfaces of the insulator members. Grid electrodes are supported on the outer surface of the insulator members adjacent the cathode so that each of these electrodes is supported by a single insulator. Further, in accordance with a feature of the invention, an anode extends opposite the cathode on each side of the insulator and has portions clamping the insulating members together. Thus, by supporting the anode alone, the entire electrode assembly is supported.

In accordance with another feature of this invention, the cathode comprises two insulating rods on which a sheet of metallic material is supported, the metallic material providing the cathode surface. The rods are then advanta-

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geously held together by straps which can extend through mating grooves in the inner surfaces of the two insulating blocks.

It is a further feature of this invention that the grids on the insulator block surface are wound on frames formed of a larger diameter wire of the same material as the laterals of the grid thus obviating cutting of a frame from sheet metal or the use of side laterals and supports.

A complete understanding of this invention and of the various features thereof may be gained from a 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 plan view of the device of Fig. 1, a portion of the anode having been broken away to show the electrode assembly more clearly;

Fig. 3 is a partial sectional view of the device of Fig. 1 along the line 3-3 thereof;

Fig. 4 is a plan view of the cathode employed in the device of Fig. 1;

Fig. 5 is a perspective view of the insulator block employed in the device of Fig. 1 showing particularly the inner surface thereof and the grooves and apertures therein; and

Fig. 6 is a plan view of a wound electrode employed in the device of Fig. 1.

Referring now to the drawing, the illustrative embodiment shown in Fig. 1 comprises a glass bulb 10 which is sealed to a glass stem 11 to constitute the envelope of the device. A plurality of leads 12-18 extend through the stem 11, these leads being suitably attached to the various elements of the device as described below.

The elements of the device are, in accordance with this invention, all supported by a single insulator 19 which comprises the insulator blocks 20 and 21. Each of these blocks, as clearly seen in Fig. 5, has a central aperture 22 therein and a plurality of grooves in its inner surface adjacent the other block. These grooves include transverse grooves 23 and longitudinal grooves 24 which extend to the central aperture 22, and short grooves 25 and 26 which extend only to apertures 27 and 28, respectively.

A cathode 30 having flat surfaces is positioned in the apertures 22. Each cathode surface, as best seen in Fig. 4, comprises a flat metallic sheet 31, as of nickel, bent around two insulator support rods 32. A heater element 33 fits into the space defined by the two metallic sheets 31. The insulator support rods 32, which may be of ceramic, are held together by straps 35 which extend into the grooves 23 in the insulator blocks

20 and 21, thereby positioning the cathode in the aperture 22. One strap 35 has an integral extension 36 extending away from the blocks 20 and 21 and, as clearly seen in Fig. 1, secured to lead 15.

One end of the heater element 33 is secured to a strap 38 and the other to a strap 39, which straps extend through the grooves 24 in the blocks 20 and 21 and are secured to leads 13 and 16, respectively. The grooves in the blocks prevent the straps from touching any of the electrodes in the device.

A first electrode 41 and a second electrode 42 have members positioned on each side of the insulating means 19 defined by the two blocks 20 and 21. The first electrode, which may advantageously be the control electrode, comprises a wire frame 43 and a plurality of wire laterals 44 extending thereacross, and the second electrode 42, as best seen in Fig. 6, similarly comprises a wire frame 46 and wire laterals 47 extending thereacross. In accordance with a feature of this invention, the frames of the electrodes 41 and 42 are wires of considerably larger diameter than the wire laterals of the electrodes but of the same material, which may advantageously be tungsten. By having all the parts of the electrodes of the same material, there are no differences in thermal expansivities in the electrodes that would tend to cause a lessening of the tensioning in the wire laterals on heating. Further, the use of a wire frame obviates the necessity of cutting a frame out of sheet or other type metal. This is particularly important when tungsten is employed, as it is very hard and will dull a die after only a few pieces have been cut.

Electrodes 41 and 42 are, however, formed with a wire frame which may advantageously, as shown, be a single wire bent into a rectangular shape and having a single joint, the frame for electrode 41 being joined at 48 and that for the electrode 42 at 49. These may advantageously be arc welded butt joints. However, electrodes having wire frames may easily be formed into any of a multitude of forms or shapes merely by bending the wire of the frame into that shape.

The electrode members 41 are positioned closely adjacent the cathode 30, the frame 43 being close to the periphery of the aperture 22 and the laterals 45 to the cathode surfaces 31. The two members of electrode 41 are secured together and held in proper position on the outer surfaces of the blocks 20 and 21 by straps 51 and 52 extending around the frames 43 and through the apertures 27 in the blocks 20 and 21. The strap 51 further extends through the groove 25 and is attached to the lead 12.

The spacing between the electrode members 41 and the cathode surfaces 31 is determined by the diameters of the support rods 32 and frame 43 and the thickness of the insulator blocks 20 and 21. Variations in the spacing may be obtained by altering any one of these parameters.

The wire of the frame 46 of the electrodes 42 is of a larger diameter than the wire of the frame 43 of the electrodes 41, the difference in the diameters defining the spacing between these electrodes. The frame 46 is also larger than the frame 43 so that the electrode members 42 are positioned on the outer surfaces of the blocks 20 and 21 further from the aperture 22 than the electrode members 41. Straps 54 and 55 extending through the apertures 28 in the blocks 20 and 21 secure the two members of electrode 42 together and position them on the surfaces

of the insulator means 19 defined by the blocks 20 and 21, strap 55 extending through the groove 26 in the inner surfaces of the blocks 20 and 21 and being attached to the lead 17.

The anode 56 extends on each side of the insulator means defined by the blocks 20 and 21 and has crimped portions 57 adjacent the edge of the blocks which clamp the two blocks together. An integral finger 58 extends from each side of the upper section of the anode 56 and is secured on one side to the lead 14 and on the other to the lead 18, thereby mounting the single insulator means 19 of the electron discharge device and all the electrodes supported thereby within the bulb 10.

As, in accordance with this invention, there is only a single insulator means in the device by which all the electrodes are mounted and positioned, close spacings are attainable. The position of each element is determined by its relation to a single reference plane which is the outer surface of the insulating means 19. In one illustrative embodiment of this invention, as shown in the drawing, the distance from the surface 31 of the cathode 30 to the wire laterals 44 of the electrode 41 is .003 inch, and the distance from the cathode surface 31 to the wire laterals 47 of the electrode 42 is .008 inch. The distance to the anode 56 is, of course, not critical and may be of the order of .030 inch. An appreciation of the size of various component elements of the device can be gained from the fact that the over-all dimensions of the device are a maximum height of the order of one inch and an outside diameter of the order of one inch.

As can be seen clearly from Fig. 2, the full cathode surface is employed, the anode 56 being advantageously of the same width as the length of the cathode surface 31. Further, other cathodes having planar surfaces could be mounted by support tabs by the insulator means 19 in accordance with this invention. Thus, the cathode could be a flat cathode sleeve having support tabs secured, as by welding, to the ends or to the sides.

Because all of the elements are mounted by a single insulator the assembling of electron discharge devices in accordance with this invention is simplified. One advantageous procedure comprises positioning the cathode and the support and connecting straps between the two insulator blocks 20 and 21 which comprise the single support means 19, positioning the preformed electrodes 41 and 42, securing them in place by the straps extending through the apertures 27 and 28, and then clamping the assembly together as by welding the two anode segments together. The electrode assembly thus mounted by the single insulator means can then be attached to the appropriate leads 12 through 18 for support and electrical connection to the electrodes and heater element.

As the two electrodes 41 and 42 are each situated on the single reference surface of an insulator block their spacing is determined by the differences in the diameters of the wires of their respective frames. But further because of this configuration, the inner, or control, electrode 41 is completely encompassed by the outer electrode 42, which may advantageously be a screen grid, so that the control electrode is completely shielded from the anode 56.

It is to be understood that the above-described arrangements are illustrative of the application of the principles 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 pair of flat surface insulator members defining a single insulator means, said insulator members having a central aperture therein and mating grooves on their inner surfaces, a cathode positioned in said apertures, said cathode comprising a pair of ceramic rods, a metallic sheet member across said rods and defining a cathode surface substantially parallel to the surfaces of said insulator members, and strap means secured to said rods and extending into said grooves between said insulator members to support said cathode, a frame electrode positioned adjacent said cathode and mounted on the outer surfaces of said insulator means, and an anode encompassing said cathode and said electrode, said anode having portions securing said two insulator members together.

2. An electron discharge device comprising an envelope, a plurality of leads extending through said envelope, a single insulator means within said envelope, said insulator means comprising a pair of adjacent insulator blocks, said blocks having each mating apertures therein and mating grooves in the inner surfaces thereof, a cathode positioned in one of said mating apertures and having surfaces substantially parallel to the surfaces of said insulator blocks, strap means positioned in some of said grooves between said insulator blocks and supporting said cathode, said strap means also connecting said cathode to one of said leads, a control electrode positioned adjacent said cathode, said electrode comprising a wire frame positioned on both surfaces of said insulator means and wire laterals across said frames and secured thereto, said wire frames and said wire laterals being of the same material, strap means extending through other of said apertures securing said two frames together and connecting said electrode to another of said leads, and an anode encompassing said cathode and electrode, said anode having portions securing said two insulator blocks together and integral fingers secured to other of said leads and supporting said insulator means.

3. An electron discharge device comprising an envelope, a plurality of leads extending through said envelope, a single insulator means within said envelope, said insulator means comprising a pair of adjacent flat surface insulator blocks having each mating apertures therein and mating grooves in the inner surface thereof, a cathode positioned in one of said mating apertures and having surfaces substantially parallel to the surfaces of said insulator blocks, means supporting said cathode comprising ceramic rods attached to said cathode and straps joining said rods at the ends thereof and extending through certain of said grooves between said insulator blocks, one of said straps being attached to one of said leads, heater means within said cathode, straps electrically connected to the ends of said heating means, extending through other of said grooves and attached to other of said leads, a control electrode member positioned on the outer surface of each of said insulator blocks adjacent said cathode, a second electrode member positioned on the outer surface of each of said insulator blocks adjacent said first electrode member, said control and second electrode members each comprising a large diameter wire frame and a plurality of fine diameter wire laterals across said frame and secured thereto, said wires

being both of the same material, strap means extending through other of said apertures securing said control electrode frame members together and said second electrode frame members together and extending through other of said grooves to electrically connect said control and second electrodes to other of said leads, said second electrode frame member and wire thereof being larger than the frame and wire thereof of said control electrode member, and an anode encompassing said cathode and electrodes, said anode having portions securing said two insulator blocks together and integral fingers secured to other of said leads to provide electrical connection for said anode and to support said insulator means within said envelope.

4. An electron discharge device comprising an envelope, a plurality of leads extending through said envelope, a single insulator means within said envelope, said insulator means comprising a pair of adjacent insulator blocks, said blocks having each mating apertures therethrough and mating grooves in the inner surfaces thereof, a cathode positioned in one of said mating apertures and having surfaces substantially parallel to the surfaces of said insulator blocks, first strap means positioned in said grooves between said insulator blocks and supporting said cathode, said first strap means also connecting said cathode to one of said leads, an electrode positioned adjacent said cathode, said electrode comprising a frame positioned on both surfaces of said insulator means and wire laterals extending across said frame and secured thereto, second strap means extending through other of said apertures securing said two frames together and connecting said electrode to another of said leads, and an anode encompassing said cathode and electrode.

5. An electron discharge device comprising a pair of flat insulator blocks defining a single insulator means, said insulator blocks having each a plurality of mating apertures therethrough, said apertures including a central aperture, and a plurality of mating grooves in inner surfaces thereof, a cathode positioned in said central apertures and having a surface substantially parallel to the surfaces of said insulator blocks, first strap means extending in said grooves between said insulator blocks and supporting said cathodes, a frame electrode member positioned adjacent said cathode and mounted on the outer surface of said insulator means, second strap means extending through some of said mating apertures to secure said frame electrode to said outer surface, and an anode encompassing said cathode and said electrode member, said anode having portions securing said two insulator blocks together.

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