

Dec. 15, 1936.

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2,064,320

ELECTRON DISCHARGE DEVICE

Filed Feb. 27, 1930

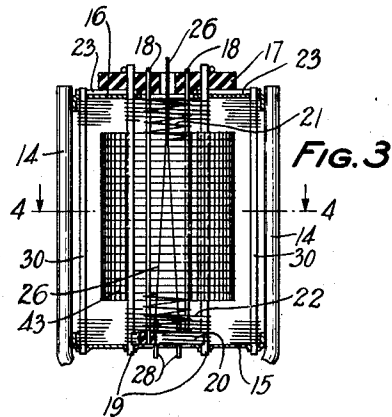
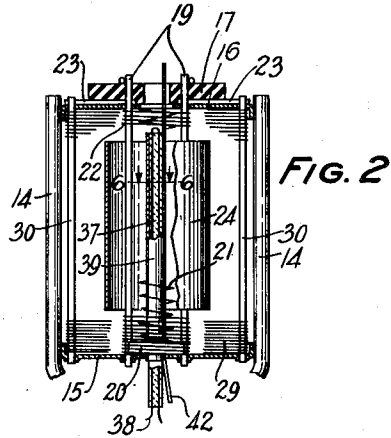
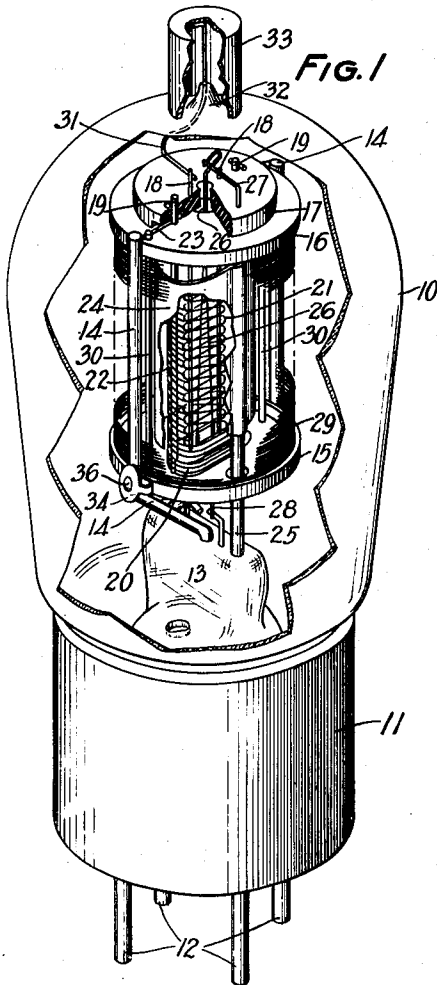


FIG. 4

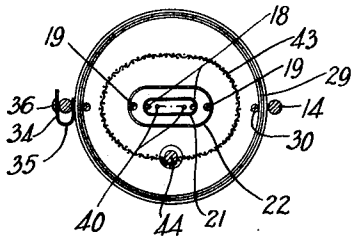
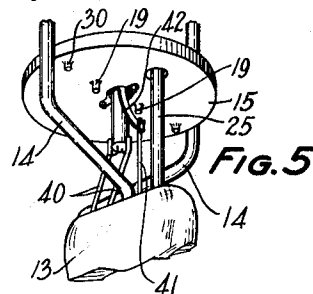
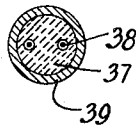


FIG. 6



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2,064,320

ELECTRON DISCHARGE DEVICE

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Application February 27, 1930, Serial No. 431,670

9 Claims. (Cl. 250—27.5)

This invention relates to electron discharge devices and more particularly to such devices of the screen grid type.

An object of the invention is to support a plurality of electrodes of an electron discharge device in a unitary arrangement to obtain a high amplification constant and low inter-electrode capacity.

A further object of the invention is to improve the operating characteristics of electron discharge devices.

A feature of the invention relates to the complete shielding of the electrodes in an electron discharge device against extraneous magnetic and electric fields.

Another feature of the invention relates to the electrode structure in electron discharge devices whereby the electrodes will be free to expand without warping or changing their cooperative space relation.

A further feature of the invention relates to the protection of the vitreous portions of an electron discharge device against damage by high frequency electric fields.

In an electron discharge device commonly known as the shielded or screen-grid type there are several internal electrodes, one of which is in the form of a grid arranged to shield the control grid or electrode, for example, from the anode. In such devices the shielding should be thorough and the electrodes should be maintained in their proper spaced relation in order to reduce the inter-electrode capacity.

In accordance with this invention the electron discharge device comprises a glass vessel having a stem from which all the elements are supported by rigid members extending within the vessel, some of the members forming the leading-in wires for the electrodes. A pair of upright metallic rods support two spaced discs which form the end portions of a cage assembly that encases the electrodes in a totally shielded arrangement. A cylindrical anode within the cage assembly is insulatively supported by a rigid rod passing through an aperture in one end disc and embedded in the stem and serving as the leading-in wire for the anode.

A pair of concentric grid electrodes are positioned within the anode and cage assembly and spaced with respect to the plate electrode by insulating discs supported on the metallic end discs. A cathode, either of the filament or indirect heater type, is located within the anode and grid electrodes. This arrangement facilitates the fabrication of the multi-electrode assembly as a unitary structure in which all the elements are supported by the glass stem of the vessel, the electrodes are effectively shielded and the device operates with improved characteristics.

These and other features of the invention will be more apparent from the following detailed description with reference to the accompanying drawing in which

Fig. 1 is a view in perspective of an electron discharge device constructed in accordance with this invention with portions cut away to show the improved assembly and detailed construction of the electrodes;

Fig. 2 is a view of a unitary electrode assembly partly in section and partly broken away showing the spacing and mounting of the electrodes in accordance with this invention and embodying a cathode of the equipotential type;

Fig. 3 illustrates another embodiment of the invention similar to Fig. 2 except that the anode is formed of a wire mesh screen and the cathode is in filamentary form;

Fig. 4 is a cross sectional view of Fig. 3 along line 4—4 showing the space relation and shape of the electrodes;

Fig. 5 is a partial perspective view illustrating the mounting of the electrode supporting structures upon the press; and

Fig. 6 is an enlarged cross-sectional view of the equipotential cathode shown in Fig. 2.

Referring to the drawing, the electron discharge device of this invention relates to the screen grid type and comprises an enclosing glass envelope 10 and a base 11 of insulating material attached thereto and provided with a plurality of prongs 12 to serve as the external terminals of the electrodes. The envelope 10 is formed with a reentrant stem portion terminating in a substantially rectangular press 13 from which all the electrodes are supported. Two rigid metallic members or rods 14 embedded in the press 13 are bent outwardly and upwardly near the press, as clearly shown in Fig. 5, and have parallel portions extending substantially to the opposite end of the envelope 10 to which are attached two annular dish shaped metallic discs 15 and 16, each provided with a central oval opening and having their upturned edges extending toward each other and positioned in spaced relation at opposite ends of the parallel extending portions of the rods 14. An annular block or disc 17, of insulating material, such as porcelain, "Lavite" or similar material, is mounted upon the metallic disc 16 and serves as an insulating spacer for a plurality of relatively light

rigid parallel upright wires 18 and 19 which extend between the discs 15 and 16. The wires 18 pass at one end through the central oval aperture in the disc 16 to be slidably supported in the insulating disc 18 by suitable spaced holes of slightly larger diameter than the wires and are frictionally engaged at the other end in a small rectangular block 20 of Lavite, or other insulating material, having rounded ends which lie on the side of the metallic disc 15 facing its associated metallic disc 16 in axial alignment with the central oval aperture therein. The wires 19 extending parallel to and in the same plane as the wires 18 and the rods 14 and located between them have one end projecting from the insulating disc 17 and the other end piercing the dish shaped metallic disc 15 and frictionally held therein by the rough edged pierced opening surrounding the wires. The wires 19 also frictionally maintain the block 20 in position by engaging slots or grooves in the rounded ends of the block 20. A helical wire grid 21, preferably of oval cross-section as shown in Fig. 4, has its turns affixed to the wires 18 and a second helical grid acting as a shielding grid 22 of the same form as the grid 21 but of larger diameter is mounted on the wires 19 concentrically with the grid 21. The shielding grid 22 is electrically connected to the disc 16 and the supporting rods 14 by tie wires 23, shown clearly in Fig. 1, which extend across the disc 16 through an undercut portion of the insulating disc 17 and are welded to the wires 19 and rods 14.

Since the wires 18 and 19 are held in position at one end at least only by friction they are free to expand and contract without warping and therefore the grids 21 and 22 are maintained in their proper cooperative space relation at all times.

An anode 24, in the form of an oval shaped closed cylinder which may be of the solid plate type as shown in Fig. 1, is coaxially aligned with the grid 21 and shield grid 22 and is supported by a single upright rod 25 which extends through a large aperture in the disc 15 and is embedded in the press 13. A cathode 26 which may be of the filamentary type as shown in Figs. 1 and 3 is arranged within the grid 21 and supported between the insulating discs 17 and 20. The cathode may be in the form of an inverted V supported at its apex by a hook attached to a flexible wire 27 extending from the top of the insulating block 17, and engaged at its extremities by wires 28 embedded in the insulating block 20, which pass through the oval central aperture in the metallic disc 15 and are welded to leading-in wires embedded in the press 13.

In order to shield the electrodes completely from all extraneous electric and magnetic fields and improve the operating characteristics of the device an outer helical wire shield 29 surrounds the main electrode structure and is supported between the discs 15 and 16 by rigid wires 30 and electrically connected to the shielding grid 22 and the discs 15 and 16 by the tie wires 23, the ends of the shield 29 resting within the up-turned edges of the metallic discs 15 and 16. The wires 30 are held in position at the lower end by frictional engagement in close fitting apertures in the disc 15 in a similar manner to the positioning of grid wires 19 and are free to expand and contract without warping. A leading-in wire 31 for the control grid 21 is sealed into a portion 32 in the top of the envelope 10 and the end thereof within the vessel is attached to one of

the wires 18 and the outer end is connected to a metallic cap 33 which is cemented to the glass vessel 10 and serves as an external terminal for the grid 21. A metallic disc 34 having a U-shaped bracket portion 35 integral therewith is located near the disc 15 and carries a pellet 36, of getter material, such as magnesium which when vaporized absorbs the residual gases in the device.

This arrangement provides a compact and rigid electrode structure whereby all of the electrodes are supported entirely from the press and which is easily assembled at small cost. The supporting wires for the grid 21 and the shields 22 and 29 are all free to expand when subjected to heat and are arranged along a diameter of the structure thereby maintaining symmetry of the electrodes at all times. Furthermore, the electrodes are completely and effectively shielded from extraneous magnetic and electrostatic fields by the complete cage like shielding structure comprising the closely wound helical shield 29 and the solid end discs 15 and 16. The electronic field is confined to the space between the electrodes and this together with the reduction in inter-electrode capacities effected by the spacing arrangement of the electrodes provides an electron discharge device having improved and uniform characteristics. While the main object of the complete cage-like shield around the electrodes is to protect the electrodes from extraneous interference with the travel of electrons between the electrodes, the end disc portions of the shield serve to rigidly maintain the various parallel supporting wires of the electrons in uniform space relation so that the tube characteristics depending on electrode interrelation do not change during transit or operation of the device. The metallic disc near the stem also provides means for relieving the electrode supporting wires from strain due to expansion since these wires may readily slide through the friction openings in this disc. Furthermore, the lower disc prevents a conductive deposit forming on the glass stem between the leading-in wires of the low and high potential electrodes such as the filament and plate electrodes, thereby prolonging the life of the device.

Another embodiment of this invention is shown in Fig. 2 in which the arrangement and mounting of the electrodes and shielding cage construction is combined with an equipotential type cathode in an electron discharge device. This cathode comprises a drilled quartz rod 37, shown in cross-section in Fig. 6, through which a heater wire 38 is threaded, and a metallic sleeve 39 crimped on the rod 37 and coated with a thermionically active material, such as alkaline earth oxides, capable of emitting electrons when heated. The manner in which external connection to the cathode is made is shown in Fig. 5. Leading-in wires 40 for the heater element are connected to the ends of the wire 38, sealed in the press 13 and connected to the desired pair of the prongs 12, and a leading-in wire 41 is connected to an integral extending portion 42 of the sleeve 39 and also embedded in the press 13 and connected to one of the prongs 12.

Figs. 3 and 4 show another embodiment of this invention in which a mesh type anode 43 is supported on a rod 44, the anode being concentric with the control grid 21 and shielding grid 22. The mesh type of anode reduces considerably excessive heating of the anode due to bombardment by electrons. It is, of course, understood that the cylindrical portion of the shield 29, as shown in Fig. 1, may also be formed of a wire mesh simi-

lar to the anode 43 to increase the rigidity of the assembly.

While various embodiments of the invention have been disclosed and described it is understood that various modifications may be made in the different assemblies shown without departing from the scope of the invention as defined in the appended claims.

What is claimed is:

10 1. An electron discharge device comprising a container, a plurality of electrodes supported therein, a pair of supporting members extending lengthwise of said container, and a metallic cage structure completely enclosing said electrodes, 5
15 and comprising two spaced annular dish shaped members mounted on said supporting members, a single pair of rods extending between said dish-shaped members and attached thereto, and a wire screen mounted on said rods and seated within 20 said dish-shaped members.

2. An electron discharge device comprising a container, a plurality of electrodes mounted concentrically therein, a metallic shield completely enclosing said electrodes and comprising a pair 25 of spaced disc members each having an inwardly directed peripheral flange mounted at right angles to the axis of said electrodes and a metallic screen seated at each end within said flanges surrounding said electrodes and concentrically dis- 30 posed therewith, said screen and discs being electrically connected to one of said electrodes, an insulating plate mounted within said shield and seated on one of said disc members, another insulating plate mounted exterior to said shield and 35 seated on the other disc member, and means on a plurality of said electrodes in contact with the insulating plates.

3. An electron discharge device comprising a cathode, grid, and plate electrode, a cage electrode substantially surrounding said electrodes 40 comprising two end discs and a metallic screen supported therebetween, a disc insulating member seated on and carried by one of said discs and supporting said cathode and said grid at one 45 end, and another electrode positioning said insulating member on said one disc.

4. An electron discharge device, a mount comprising a press, a pair of upright members embedded in and extending from said press, a metallic disc mounted between said members, an insulating plate adjacent said disc, a resilient member carried by said plate, a second metallic disc 50 mounted between said upright members, an insulating block adjacent said second disc, and an electrode supported between said discs by said resilient member and said insulating block. 55

5. In an electron discharge device, a mount comprising a press, a pair of metallic disc mem-

bers supported in spaced relation therefrom, an insulating member adjacent each of said disc members, a resilient member mounted on one of said insulating members, a plurality of metallic rods extending through the other of said insulating members and frictionally engaged therein, 5 and an electrode supported between said disc and insulating members by said resilient member and said rods.

6. In an electron discharge device, an electrode 10 assembly comprising a press, a plurality of electrodes supported from said press, two bent rod members embedded in said press, each of said members having a straight portion parallel to the longitudinal axis of the device, two metallic disc 15 members attached in spaced relation between the straight portions of said rod members, a straight metallic member adjacent the straight portion of each of said rod members, and a shield between said rod members, supported on said 20 straight metallic members and seated in said discs and surrounding said electrodes.

7. An assembly for electron discharge device, including a press, an electrode supported therefrom, and a cage type shield for said electrode 25 comprising a pair of metallic disc members supported from said press, a spacing member of insulating material parallel to and adjacent each of said disc members, a pair of metallic rods supported between said spacing members at right 30 angles thereto, and a cylindrical metallic screen mounted on said rods and joined to said metallic disc members.

8. An electron discharge device comprising an enclosing vessel having a stem, a plurality of 35 supporting members extending from said stem, a pair of spaced metallic discs transverse to the axis of said vessel rigidly attached to said members, a plurality of supporting wires mounted in a single plane between said discs and supported directly 40 by said discs, and individual coaxial electrodes carried by said supporting wires.

9. An electron discharge device comprising an enclosing vessel having a stem, a plurality of up- 45 right rods extending from said stem, a pair of parallel dish-shaped members mounted in spaced relation on said rods, an insulator carried by each of said dish-shaped members, a cathode supported between said insulators, a pair of rigid wires extending between said insulators and positioned thereby, an electrode mounted on said 50 wires and disposed about said cathode, a pair of supports carried directly by said dish-shaped members, and a screen electrode carried by said supports, seated at each end in said dish-shaped 55 members and surrounding said cathode and said first mentioned electrode.

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