Dec. 1, 1936. J. P. LAICO 2,062,892

ELECTRON DISCHARGE DEVICE

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FIG. 1

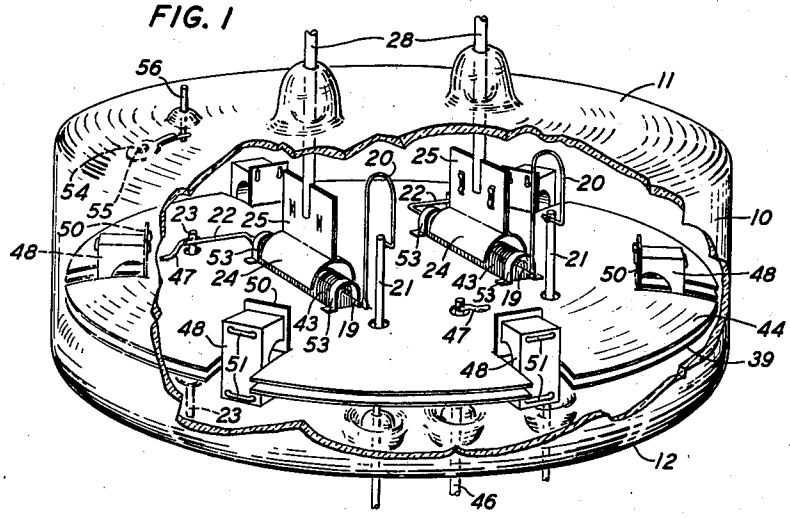

FIG. 2

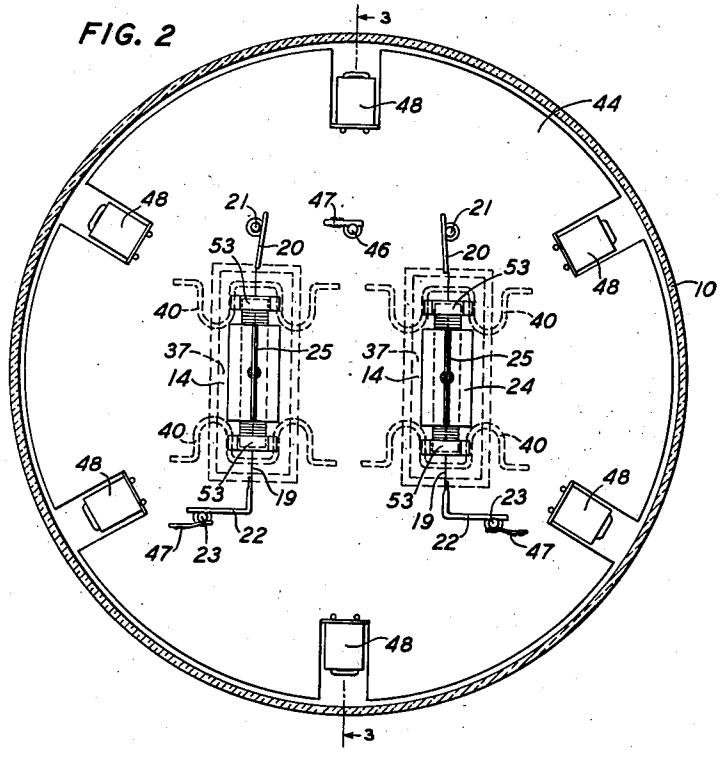

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FIG. 3

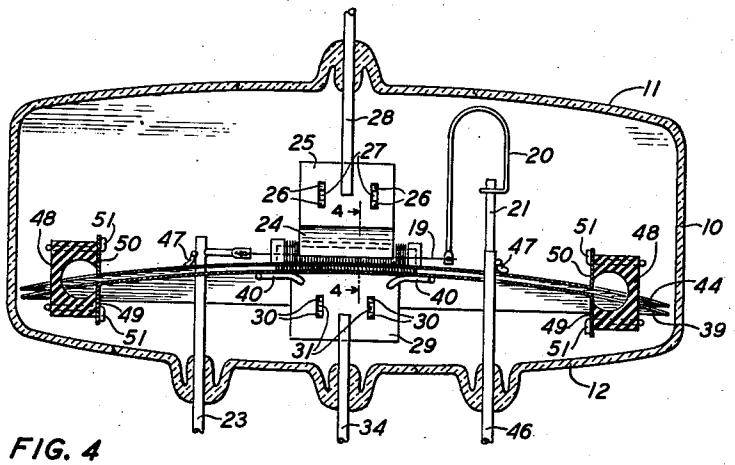


FIG. 4

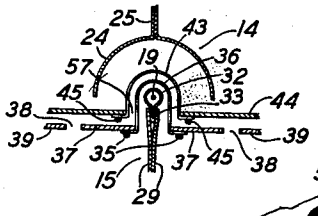
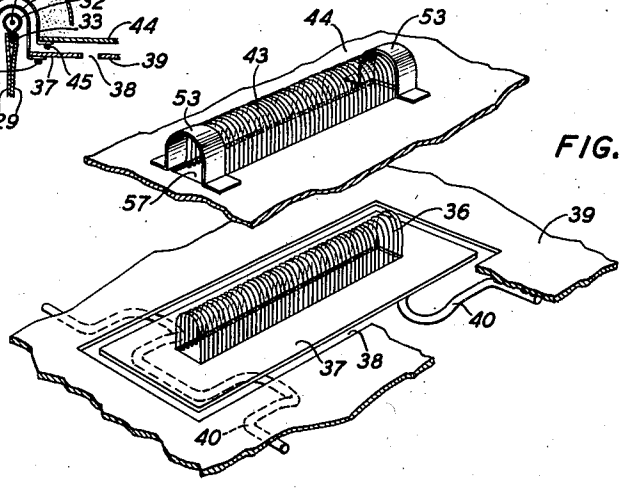


FIG. 5



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UNITED STATES PATENT OFFICE

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ELECTRON DISCHARGE DEVICE

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Application December 29, 1934, Serial No. 759,683

8 Claims. (Cl. 250—27.5)

This invention relates to electron discharge devices and more particularly to such devices including a plurality of grid electrodes and adapted for the amplification of ultra-high frequency impulses.

One object of this invention is to expedite the accurate positioning of an electrode in electron discharge devices, relative to another electrode.

Another object of this invention is to maintain an electrode in electron discharge devices in a desired space relation with another electrode.

In one illustrative embodiment of this invention, an electron discharge device, which may be of the general type disclosed in the pending application, Serial No. 750,287, filed October 27, 1934, of Arthur L. Samuel, comprises an enclosing vessel and a plurality of electrode units within the enclosing vessel. Each of the electrode units may comprise a cathode, a control electrode, an anode, and a shield electrode and a suppressor electrode between the control electrode and anode. The shield electrodes are mounted upon a disc or plate and the suppressor electrodes are mounted upon another disc or plate disposed in proximity to the first plate or disc and forming a condenser therewith. The two discs or plates may be secured in proper relation to each other prior to the mounting thereof within the enclosing vessel, the suppressor electrodes being mounted upon the disc or plate therefor prior to the securing together of the plates or discs.

In accordance with a feature of this invention, the shield electrodes are individually mounted on supports or plates adapted to be disposed within apertures in the shield electrode plate or disc, the supports or plates being secured to the latter plate or disc by a plurality of flexible brackets. The shield electrodes may be accurately positioned with respect to the corresponding suppressor electrodes by flexing the brackets.

In accordance with another feature of this invention, the cathodes of the electrode units are supported separately from the plates or discs carrying the shield and suppressor electrodes so that expansion and contraction of the plates or discs will not affect the positioning of the cathodes relative to the corresponding control electrodes and anodes.

The invention and the features thereof will be understood more clearly and fully from the following detailed description with reference to the accompanying drawings in which:

Fig. 1 is a perspective view of an electron discharge device illustrative of one embodiment of this invention, portions of the enclosing vessel being broken away to show the electrodes more clearly;

Fig. 2 is a plan view of the electron discharge device shown in Fig. 1;

Fig. 3 is a side view in cross-section along line 3—3 of Fig. 2 of the device shown in Figs. 1 and 2;

Fig. 4 is a view in cross-section along line 4—4 of Fig. 3 showing the configuration and relative disposition of the electrodes; and

Fig. 5 is a partly exploded view in perspective of the shield and suppressor grid assemblies for the electrode units.

Referring now to the drawings, the electron discharge device shown therein comprises an enclosing vessel having a cylindrical portion 10 and substantially plane end walls 11 and 12. Enclosed within the vessel are two electrode units, each of which includes a cathode 19, an anode 14, a control electrode 15 between the cathode and the anode, and a shield electrode or grid and a suppressor electrode or grid disposed between the control electrode and the anode. The electrodes in each unit preferably are coaxially arranged as shown in Fig. 4 and the two units may be disposed parallel to each other. Preferably the electrodes in each unit are disposed as closely adjacent as is mechanically and electrically feasible in order that the electron transit times will be small and the device may be utilized at ultra-high frequencies.

Each cathode comprises a linear filament 19, which may be of thoriated tungsten, supported at one end by a flexible J-shaped member or wire 20 extending from a rigid metallic support or rod 21 sealed in the end wall 12 of the enclosing vessel and at the other end by flexible bent wires 22 individually secured to rigid supports or rods 23 also sealed in the end wall 12.

The anode 14 of each electrode unit includes two sections each having an arcuate portion 24 and a large surface flange 25. The flanges are secured together in face to face relation by integral bent tabs 26 on one flange extending through apertures 27 in the other flange so that the arcuate portions 24 form a semi-cylinder which is coaxially disposed about the corresponding cathode 19. Each anode is supported by a rigid metallic rod or wire 28 secured to the flanges 25 and sealed in the end wall 11 of the enclosing vessel.

Each of the control electrodes 15 comprises two large area plates 29 secured together in face to face relation by integral bent tabs 30 on one plate extending through apertures 31 on the other plate,

the plates carrying a helical control grid 32. The control grid is provided with an integral flat portion 33 held between the plates and welded thereto. As clearly shown in Fig. 4, each grid 32 encompasses a corresponding filament 19 and is coaxial therewith. The control electrodes 15 are individually supported by metallic rods or wires 34 seated in the end wall 12 of the enclosing vessel.

The control electrodes are each encompassed by a shield electrode which, as shown in Fig. 4, comprises a pair of parallel supporting wires 35 carrying a plurality of U-shaped wires 36 which are disposed parallel to one another and are secured to the wires 35 in any suitable manner, for example, by welding. The supporting wires 35 are secured, as by welding, to a support or plate 37, which is disposed in an oversized aperture 38 in another plate or disc 39, and which is secured to the plate or disc 39 by two spaced double U-shaped brackets 40. The disc or plate 39 extends to immediately adjacent the inner wall of the cylindrical portion 10 of the enclosing vessel and together with the wire grids 36 forms an assembly which serves as a shield between the control electrodes 15 and the anodes 14 and hence segregates these electrodes and the leading-in conductors 34 and 28 therefor, respectively, so that the device may be operated efficiently at ultra-high frequencies.

Disposed between each shield electrode and anode is a suppressor electrode which may be of the same general construction in part as the shield electrode. Each suppressor electrode comprises a U-shaped wire portion 43 extending through an aperture 57 in a plate or disc 44 and secured to parallel wires 45 which are secured in turn to the plate or disc 44, corresponding of the apertures 57 and 38 being aligned. The plate or disc 44 is equally spaced from the plate or disc 39 and coextensive therewith and is supported by the wires or rods 23 and a wire or rod 46 sealed in the end wall 12 of the enclosing vessel and each carrying a flexible wire or stub 47 secured to the disc or plate 44. The plates or discs 39 and 44 are maintained in spaced relationship by a plurality of insulators 48 to which tabs 49 and 50 integral with the plates or discs 39 and 44, respectively, are secured by bent wires 51 and form a condenser coupling the shield and suppressor electrodes.

In order to prevent distortion of the plates or discs 39 and 44 by heat during the evacuation treatment of the device and thereby to assure uniform and substantially fixed spacing of the discs or plates and hence a constant capacitance therebetween, the plates or discs are dished. Preferably, the discs or plates are dished to form portions of a spherical surface.

The disc or plate 44 is electrically connected to one end, preferably the negative or grounded end of the filaments 19 by the flexible wires or stubs 47 secured to the rods or supports 23 and 46. This disc or plate serves to increase the shielding between the control electrodes 15 and the anodes 14 and the leading-in conductors 34 and 28, respectively, therefor.

In the fabrication of the device, the shield and suppressor grid structures may be assembled as a unit exteriorly of the enclosing vessel. The suppressor grid units 43, 45 may be secured to the plate 44 and this plate and plate 39 then secured in the desired spaced relation by the insulating members 48. Each of the screen grid units may then be positioned approximately in uniform spaced relation to the corresponding suppressor grid, and the brackets 40 welded to the disc 39. The screen grids may then be positioned accurately with respect to the corresponding suppressor grid by flexing the brackets 40 whereby the supports or plates 37 and the screen grids carried thereby are shifted to the desired position.

In order to assure a more complete shielding between the anodes and the control grids and filaments, U-shaped imperforate strips 53 may be provided at the ends of the suppressor grids, the strips 53 conforming in outline to the suppressor grid and being secured as by welding to the disc 44.

As will be apparent, the cathodes 19 are supported separately from the discs or plates 39 and 44 so that movement of the latter will not affect the position of the cathodes with respect to the control grids and the anodes. Although the disc 44 is connected electrically to the cathodes by the wires 47, these wires preferably are so flexible in comparison to the supports or rods 23 that movement of the disc 44 will not be communicated to the cathodes.

A metallic disc 54 carrying a getter material 55 such as magnesium is supported by a short wire or stub 56 sealed in the end wall 11 of the enclosing vessel at a point remote from the electrodes. After the electrodes have been outgassed and the enclosing vessel sealed, the getter may be flashed, as by high frequency induction heating, to fix residual gases within the enclosing vessel.

Although a specific embodiment of the invention has been shown and described, it will be understood, of course, that modifications may be made therein without departing from the scope and spirit of this invention as defined in the appended claims.

What is claimed is:

1. An electrode assembly for electron discharge devices, comprising a plurality of spaced discs, an electrode carried by one of said discs, another electrode in juxtaposition to said first electrode, and means supporting said second electrode from another of said discs and separate from said one disc, said means being laterally adjustable to align said another electrode with said first electrode.

2. An electrode assembly for electron discharge devices comprising a pair of discs, an electrode mounted upon one of said discs, another electrode within said first electrode, and means mounting said another electrode separate from said one disc including a member supporting said second electrode from the other of said discs, said member being flexible at right angles to the longitudinal axis of said electrodes whereby said another electrode may be positioned accurately within said first electrode.

3. An electrode assembly for electron discharge devices, comprising a plurality of discs, an electrode mounted on one of said discs, a support, another electrode mounted solely on said support, and means securing said support to another of said discs, said means providing the sole mount for said support and being adjustable to center said second electrode laterally with respect to said first electrode.

4. An electrode assembly for electron discharge devices, comprising a plurality of discs, an electrode mounted upon one of said discs, a plate member, another electrode mounted upon said plate member and disposed in cooperative relation to said first electrode, and members supporting said plate member from another of said discs and out of contact therewith, said supporting members being flexible laterally to align said another electrode with said first electrode.

5. An electrode assembly for electron discharge

devices, comprising a plurality of discs having axially aligned apertures, an electrode mounted on one of said discs and overlying an aperture therein, another electrode within said first electrode, a plate supporting said second electrode and disposed in the corresponding aperture in another of said discs, and flexible bracket members securing said plate to said second disc.

6. An electrode assembly for electron discharge devices, comprising a pair of spaced discs having axially aligned apertures, an electrode mounted upon one of said discs and overlying an aperture therein, a support disposed adjacent the corresponding aperture in the other of said discs, an electrode carried by said support and cooperatively disposed with respect to said first electrode, and a flexible double U-shaped member securing said support to said other disc.

7. An electrode assembly for electron discharge devices, comprising a pair of spaced discs having axially aligned apertures, a U-shaped grid electrode mounted upon one of said discs and overlying an aperture therein, another U-shaped grid electrode disposed within said first grid electrode, and adjustable means supporting said second grid electrode from the other of said discs.

8. An electrode assembly for electron discharge devices, comprising a pair of spaced discs having axially aligned apertures, a U-shaped grid mounted upon one of said discs and overlying an aperture therein, a plate member adjacent the corresponding aperture in the other of said discs, another U-shaped grid mounted upon said plate member and disposed within said first grid, and a plurality of flexible double U-shaped members supporting said plate from said other disc.

JOSEPH P. LAICO.