Jan. 18, 1938. J. P. LAICO 2,105,483

ELECTRON DISCHARGE DEVICE

Filed Oct. 7, 1936

FIG. 1

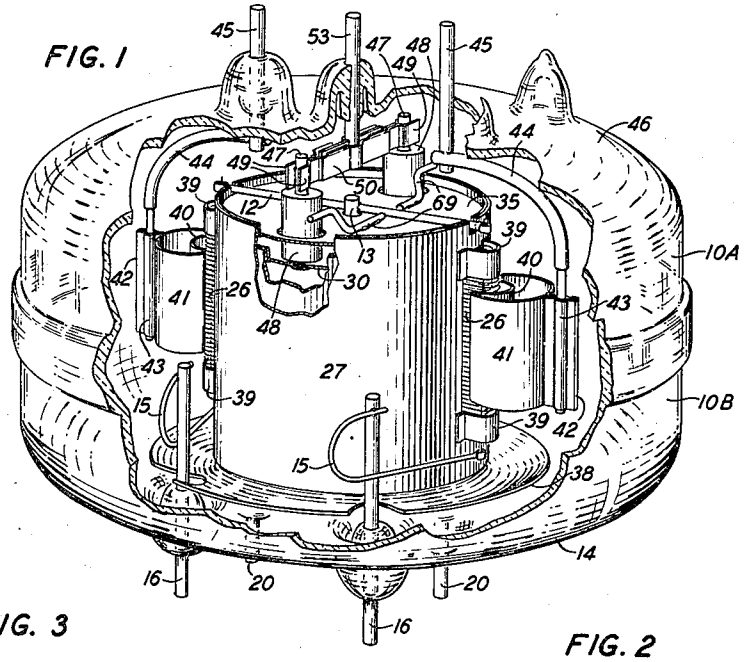


FIG. 3

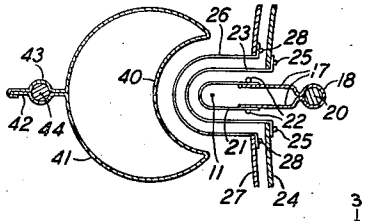


FIG. 2

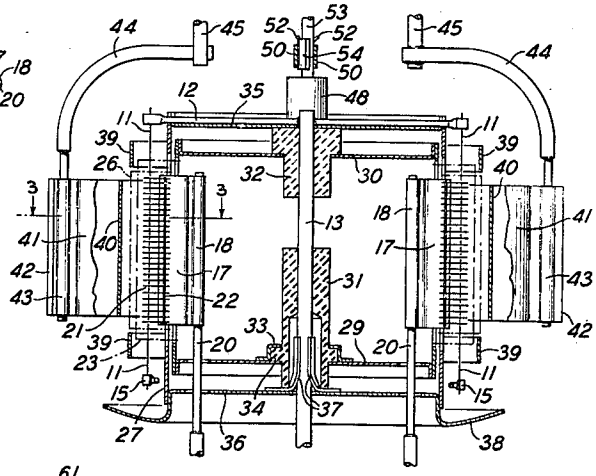


FIG. 4

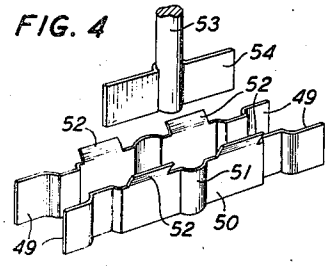
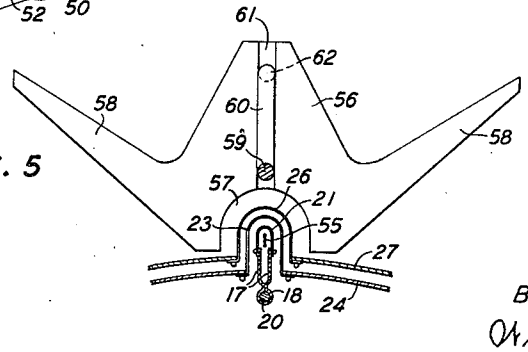


FIG. 5



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ELECTRON DISCHARGE DEVICE

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6 Claims. (Cl. 250—27.5)

This invention relates to electron discharge devices and more particularly to such devices including a plurality of electrode units mounted within a single enclosing vessel and adapted to translate ultra high frequency impulses.

One object of this invention is to expedite the fabrication of electron discharge devices embodying relatively complex electrode structures.

Another object of this invention is to facilitate efficient electrical association of electrodes of an electron discharge device with the leading-in conductors therefor.

Still another object of this invention is to facilitate complete removal of occluded gases from electrodes in an electron discharge device.

In one illustrative embodiment of this invention, an electron discharge device, which may be of the general construction disclosed in my Patent 2,062,319 granted December 1, 1936, comprises two electrode units each including a cathode, a control electrode, an anode, and shield and suppressor grids disposed between the control electrode and the anode. The anodes may be supported by individual leading-in conductors sealed in one end of the enclosing vessel and the remaining electrodes may be supported from the opposite end of the vessel by leading-in conductors for the cathodes, control electrodes, and suppressor grids. A leading-in conductor for the screen or shield grids preferably is sealed in the first-mentioned end of the vessel.

In the manufacture of the device, the vessel may be composed of two similar halves of vitreous material, one carrying the anodes and the other supporting the remaining electrodes. The two halves are placed together with the anodes in proper relation to the other electrodes, and are sealed to one another, as by fusing, at their contacting edges.

It is desirable in order to facilitate assembly and to insure the proper space relation of the anodes to the other electrodes associated therewith, that all the leading-in conductors be sealed into the vessel before joining of the two halves thereof. The problem then is presented of establishing electrical connection between the screen or shield grids, which are mounted on one-half of the enclosing vessel, and the leading-in conductor for these grids, which is sealed in the other half of the vessel.

In accordance with one feature of this invention, the screen or shield grid structure is provided with a pair of elongated, metallic, resilient strip members disposed parallel to and in contact with each other. An elongated plate member or blade is rigidly affixed to the leading-in conductor for the screen grids and extends parallel to the resilient strip members. When the two portions of the enclosing vessel are joined, the plate member or blade is inserted between the resilient members and is securely grasped thereby. Because of the relatively large contact areas between the blade and the resilient members, a positive, low resistance and efficient electrical connection between the screen grids and the leading-in conductor therefor is attained. Furthermore, this construction provides a slidable linkage between opposite ends of the enclosing vessel so that the anodes may be aligned accurately with the other electrodes of the device and the screen grid assembly may expand and contract longitudinally during operation and outgassing treatment of the device.

In accordance with another feature of this invention the anodes are so constructed as to provide a closed electrically conductive surface whereby eddy currents may be produced efficiently therein and complete removal of occluded gases therefrom is enabled.

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

Fig. 1 is an elevational view in perspective of an electron discharge device illustrative of one embodiment of this invention, a portion of the enclosing vessel and of the suppressor and shield grid assemblies being broken away to show the structure more clearly;

Fig. 2 is an elevational view mainly in cross-section of the electrodes and the supports therefor in the device illustrated in Fig. 1;

Fig. 3 is a view in cross-section along line 3—3 of Fig. 2, showing the configuration and relative disposition of the electrodes in the pentode units;

Fig. 4 is an enlarged exploded view of the leading-in structure for the screen grids in the device illustrated in Fig. 1; and

Fig. 5 is a view in cross-section illustrating the configuration of the electrodes and the space relation thereof in a modification of the embodiment of this invention shown in Fig. 1.

Referring now to the drawing the electron discharge device shown in Fig. 1 comprises an enclosing vessel, which may be composed of two similar dish-shaped halves 10—A and 10—B of vitreous material, such for example as a molded boro-silicate glass commercially known as "Nonex", the two halves being sealed together at their rims. The enclosing vessel houses a pair of

pentode units, each of which includes a cathode, a control electrode or grid encompassing the cathode, an anode and a screen and a suppressor electrode disposed between the control grid and the anode, the anodes and the grid electrodes preferably presenting substantially coaxial surfaces to the cathode.

The cathode of each pentode unit may be a linear filament or small diameter helix 11, for example of thoriated tungsten, which is supported at one end by a rigid cross wire or rod 12 carried by a metallic standard or upright 13 sealed in the lower end wall 14 of the enclosing vessel. Each of the cathodes is secured at its other end to a resilient J-shaped wire 15 mounted upon a rigid wire or stub 16 sealed into and extending through the end wall 14.

Each cathode 11 has associated with it a control electrode which comprises an elongated metallic plate member of relatively large area having spaced parallel arms 17 and a small diameter cylindrical portion 18 into which a support rod 20 extends. The support rods 20 preferably are welded to the cylindrical portions 18, and are sealed in and extend through the lower end wall 14 of the enclosing vessel. Each control electrode includes also a plurality of U-shaped wires of small gauge each of which is affixed, as by welding, at its ends to the arms 17 together with bracing members such as wires 22.

The grid portion composed of the wires 21 of each of the control electrodes is encompassed in turn by a screen or shield electrode and a suppressor electrode having wire portions 23 and 26 respectively of the same configuration as the grid wires 21 and uniformly spaced therefrom. The U-shaped wires 23 forming the grid portion of the screen or shield electrode extend through diametrically opposite longitudinally extending slots or apertures in a metallic cylinder 24 and are affixed thereto, as by welding, together with bracing members such as wires 25. Similarly, the wires 26 constituting the grid portion of the suppressor electrodes extend through diametrically opposite apertures in a metallic cylinder 27 and are affixed thereto, as by welding, together with bracing members such as wires 28. The two cylinders 24 and 27 are coaxially mounted and form a large surface condenser between the screen and suppressor electrodes. They may be made in one piece or of two substantially semi-cylindrical pieces.

The inner cylindrical member 24 carrying the shield grid wires 23 is provided with end closure discs 29 and 30 upon which insulating members or sleeves 31 and 32, respectively, are seated, these insulating members encompassing the standard or support rod 13. The lower insulating member 31 is held in position upon the closure disc 29 by a metallic band or collar 33 suitably secured to the disc 29 and abutting an annular flange 34 upon the insulating sleeve 31.

Similarly, the outer cylinder 27 is provided with end closure discs 35 and 36, the disc 35 abutting the outer end of the insulating member 32. The lower disc 36 is rigidly held upon the standard or upright 13 by a plurality of metallic strips 37 which are affixed, as by welding, to the disc 36 and the upright 13 and abut the lower end of the lower insulating sleeve 31. Preferably, the closure disc 36 is provided with an outwardly extending annular flange 38 to increase the shielding between the leading-in conductors 20 for the control electrodes, and the anodes.

Mounted upon the outer metallic cylinder 27 are U-shaped metallic bands 39 which are of the same configuration as the wires 26 of the suppressor grids and overlie the ends of the shield grids 23. The standard or upright 13 may be secured at its upper end to the cross wire 12 so that the suppressor grids are connected electrically to the cathodes 11.

Associated with each of the cathode and grid units above described is an anode which comprises a substantially semi-cylindrical portion 40 coaxial with the filament 11, an integral crescent-shaped portion 41 and a flange 42 having a cylindrical channel 43 therein. Each of the channels 43 receives a metallic support or wire 44 each of which in turn is secured to a rigid metallic stub 45 sealed in and extending through the upper wall 46 of the enclosing vessel. The supports or wires 43 may be welded at the lower end thereof to the flanges 42. This construction of the anodes provides a closed metallic loop composed of the portions 40 and 41 whereby intense eddy current may be produced efficiently in the anode structure by high frequency induction, and substantially complete removal of occluded gases from the anodes thereby achieved. Furthermore, the crescent shaped portion 41 provides a large radiating surface to dissipate heat from the anodes.

In the fabrication of the device, the electrode structure including the cathodes 11, the control electrodes 17, 21 and the shield and suppressor electrodes, may be supported on the lower half 10—B of the enclosing vessel through the central standard or support 13 and the leading-in conductors 16 and 20 for the cathodes and the control electrodes respectively. The anodes, as will be apparent, are supported from the other half 10—A of the enclosing vessel through the metallic stubs 45 sealed in the end wall 46. When the two portions 10—A and 10—B of the enclosing vessel are joined, they may be shifted slightly relative to one another to position the anodes 40, 41 properly with respect to the corresponding cathodes and grids. The two halves 10—A and 10—B may then be sealed hermetically to one another, as by fusion of the vitreous material, at their contacting edges.

As illustrated in Fig. 1, a pair of studs 47 are affixed, as by welding, to the upper closure disc 30 for the inner metallic cylinder 24. Each of these studs 47 is encompassed by an insulating sleeve 48 which rests upon the disc 30 and projects through a slightly oversize aperture in the upper closure disc 35 for the outer cylinder 27. The two cylinders 24 and 27 may be rotated slightly and held in proper position relative to one another through the agency of flexible metallic members 69 secured at one end to the disc 35 and at the other end frictionally engaging the insulating sleeves 48. The metallic studs 47 are electrically connected by a pair of resilient or flexible, elongated metallic strips each of which, as shown more clearly in Fig. 4, comprises end portions 49 secured, as by welding, to the studs 47, and an intermediate portion 50 provided with a semi-cylindrical portion 51 and also with outwardly bent lips 52. The intermediate portions 50 extend parallel to each other and preferably originally have the greater portions thereof in contact. Sealed in the upper end wall 46 of the enclosing vessel is a metallic stub 53 slotted at its inner end and carrying an elongated plate member or blade 54. The stub 53 is of such length that when the two halves 10—A and 10—B of the enclosing vessel are joined, the plate member or blade 54 is inserted between the inter-

mediate portions 50 of the resilient metallic members mounted on the studs 47 and is securely grasped thereby, the lips 52 serving to guide the plate member or blade 54 into position between the intermediate portions 50.

As will be apparent from Fig. 4, large areas of the plate member or blade 54 and of the intermediate portions 50 of the resilient metallic members are in engagement, so that a positive and efficient electrical connection of low resistance obtains between the leading-in conductor 53 and the studs 47. Furthermore, inasmuch as the plate member or blade 54 is frictionally held by the resilient metallic members in the assembly of the device, the two portions 10—A and 10—B of the enclosing vessel may be shifted slightly relative to one another to enable accurate alignment of the anodes 40, 41 with the electrodes associated therewith. Also the frictional engagement between the plate member or blade 54 and the resilient metallic members provides an expansion link so that the screen and suppressor electrode assemblies may expand and contract freely longitudinally during the outgassing treatment and the operation of the device.

In a modification of the pentode units, shown in Fig. 5, the cathode may be an elongated flat ribbon filament 55 having its broader sides parallel to the arms of the U-shaped control grid wires 21. The screen and suppressor electrodes may be of the same construction shown in Figs. 1, 2 and 3. The anodes may be blocks of carbon having a central portion 56 provided with a substantially semi-cylindrical recess 57 coaxial with the grids 21, 23 and 26 and diverging wings or flanges 58. The anodes may be supported by rods 59 sealed in the upper end wall 46 of the enclosing vessel and each having a laterally extending portion 60 fitted in a groove 61 in the central portion 56, and an extending arm 62 fitted in a longitudinally extending bore in the central portion 56.

Although specific embodiments of this invention have ben shown and described, it will be understood, of course, that various 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. In an electron discharge device, an enclosing vessel, an electrode assembly within said vessel, a leading-in conductor extending from one wall of said vessel, a pair of flexible metallic members affixed to said assembly, and a metallic contact member carried by said conductor and grasped by said flexible members.

2. In an electron discharge device, an enclosing vessel, an electrode assembly within said vessel, means supporting said assembly from one wall of said vessel, a leading-in conductor extending from the opposite wall of said vessel, and means electrically connecting said conductor and said assembly comprising a pair of juxtaposed, elongated, flexible metallic strips secured to said assembly and an elongated blade carried by said conductor, and extending parallel to and frictionally engaged by said metallic strips.

3. In an electron discharge device, an enclosing vessel, an electrode assembly within said vessel including a cylindrical member and electrode elements mounted thereon, means supporting said assembly from one wall of said vessel, a leading-in conductor sealed in the opposite wall of said vessel, a pair of studs extending from said cylindrical member toward said opposite wall, a metallic connector secured at its ends to said studs and having juxtaposed flexible intermediate portions, and a metallic blade carried by said conductor and frictionally fitted between said flexible portions.

4. In an electron discharge device, an enclosing vessel, an electrode assembly supported from one end of said vessel, an electrode disposed in cooperative relation to said assembly and supported from the opposite end of said vessel, and a leading-in connection for said assembly comprising a conductor sealed in said opposite end, rigid members affixed to said assembly and extending toward said opposite end, a pair of elongated metallic strips having their ends secured to said rigid member and having juxtaposed, parallel flexible intermediate portions, guiding lips on said intermediate portions, and an elongated large surface metallic blade secured to said conductor, insertable through said guiding lips and grasped by said intermediate portions.

5. In an electron discharge device, an enclosing vessel having two joined parts, an electrode supported from one part of said vessel, a leading-in conductor for said electrode supported by the other part of said vessel, a second electrode supported by said other part, and means defining a laterally and longitudinally adjustable conductive linkage between said first electrode and said conductor.

6. In an electron discharge device, an enclosing vessel including two dished-shaped portions joined at their rims, an electrode assembly supported from one of said portions and including a cylindrical member and a plurality of electrode elements mounted thereon, a leading-in conductor for said assembly extending from the base of the other of said portions, a plurality of electrodes mounted on said other portion and each disposed in cooperative relation with one of said electrode elements, and means electrically coupling said conductor to said assembly including a pair of metallic studs extending from said cylindrical member toward said base, a pair of flexible metallic strips secured to said stubs and having elongated intermediate portions substantially parallel to said base, and an elongated blade member carried by said conductor and disposed substantially parallel to said base, said blade member being grasped by said intermediate portions and laterally and longitudinally slidable therebetween.

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