

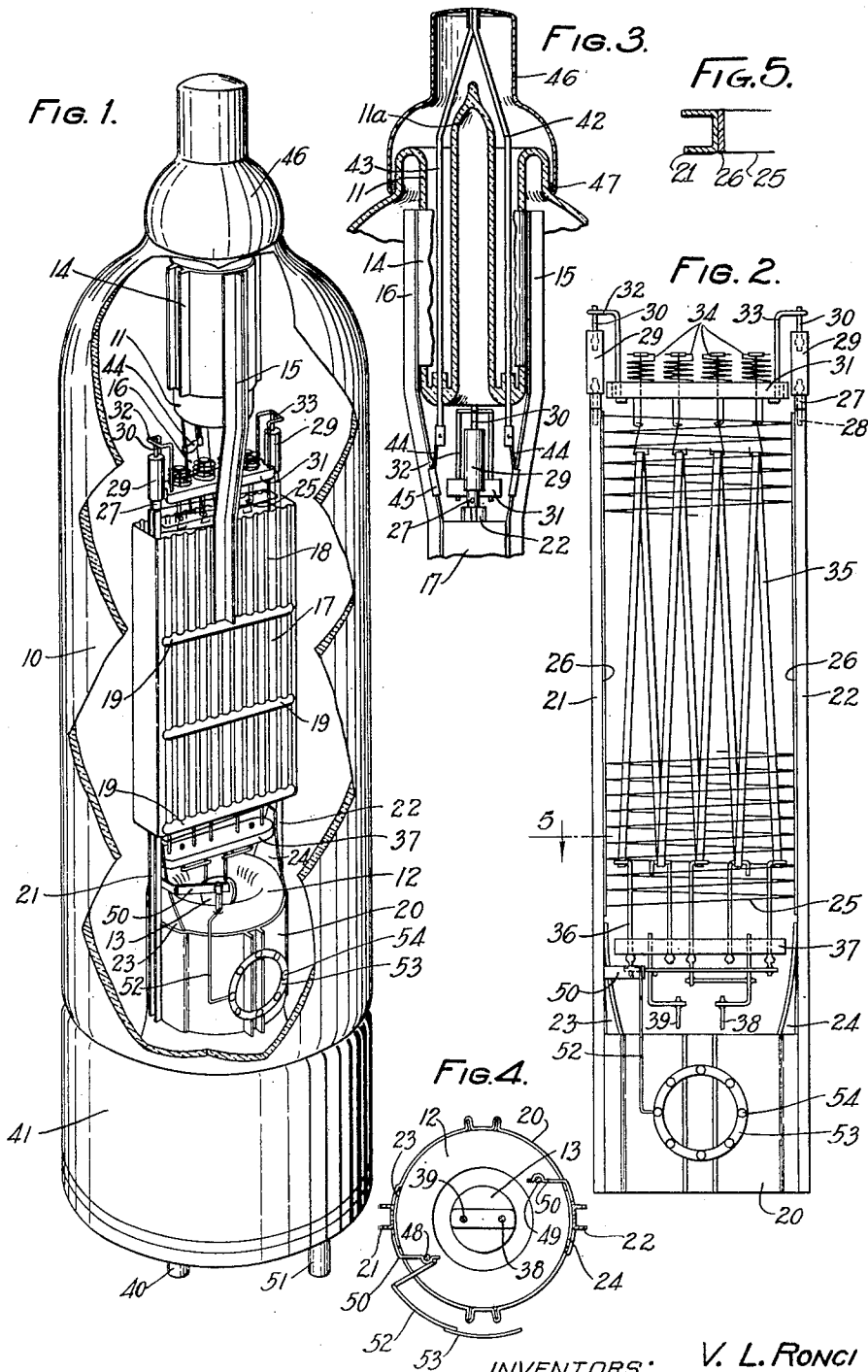
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ELECTRON DISCHARGE DEVICE

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ELECTRON DISCHARGE DEVICE

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This invention relates to electron discharge devices and more particularly to such devices employed in short wave transmission systems.

An object of the invention is to increase the insulation paths between the elements in an electron discharge device.

A feature of the invention relates to the assembly of the electrodes in a discharge device in which the filament structure is efficiently and rigidly supported by the control electrode or grid.

In accordance with this invention, an electron discharge device comprises an enclosing vessel having an inwardly projecting stem on each end in which a hollow plate electrode is supported from one of the stems and a grid and filament assembly is supported from the other stem and extends within the plate electrode. The grid-filament assembly comprises a rigid grid frame which insulatingly supports the filament on one end by a suspension carriage which supports resilient springs connected to the looped ends of the filament. The other ends of the filament are attached to hooks extending from an insulator plate supported by the leading-in wires sealed through one of the glass stems of the vessel. This arrangement forms a substantially rigid structure to maintain the electrodes in their desired spaced relation and also insures high insulating paths between the plate and grid and between the grid and filament. The multiple terminal connections leading into the vessel and connected to opposite surfaces of the electrodes provide conductors of large surface area for the high frequency energy supplied to the electrodes. These and other features of the invention will be disclosed in the following detailed description and the accompanying drawing in which

Fig. 1 is a perspective view of the device completely assembled in accordance with this invention with a portion of the enclosing vessel broken away to show the interior construction,

Fig. 2 is an enlarged detailed front view of the unitary grid-filament assembly made in accordance with this invention with the glass stem removed in which the filament is insulatingly supported from the grid structure and the filament leading-in wires are shown broken from the stem.

Fig. 3 is an enlarged detailed view of the upper end of the device with the glass portion of the vessel in cross-section to show the detailed construction,

Fig. 4 is a plan view of the glass stem at the lower end of the vessel to show the arrangement

of the leading-in wires for the grid and filament, and

Fig. 5 is an enlarged view in cross-section of the grid support on the line 5 of Fig. 2.

Referring to the drawing, the electron discharge device, employed particularly as an amplifier in short wave transmission systems, comprises a glass enclosing vessel 10, preferably of borosilicate glass, commercially known as 702 P or "Nonex" glass, having at one end a small diameter reentrant stem 11 which is provided with a concentric tubulation 11a projecting outwardly from the inner end of the stem 11. The tubulation 11a allows the enclosing vessel 10 to be highly evacuated when sealed to a vacuum pump or other evacuating system. After the complete assembly has been supported in the vessel and a high degree of vacuum is obtained, the tubulation 11a is sealed off. The other end of the vessel is provided with a large diameter reentrant stem 12 having a concentric inner stem 13 of smaller diameter terminating in a press portion. A metallic collar 14 surrounds the reentrant stem 11 and is frictionally attached thereto by longitudinal corrugations on the collar in a manner disclosed in Houskeeper Patent 1,536,855 dated May 5, 1925. A pair of metallic arms 15 and 16 of T shaped cross-section extend from the collar 14 and are attached to a rectangular box-shaped plate electrode 17 having open ends and provided with longitudinal corrugations 18 on the wide surfaces thereof. A plurality of transverse strengthening embossments 19 are formed on the plate surfaces and together with the corrugations 18 prevent buckling of the surfaces of the plate electrode 17.

In order to increase the insulating path between the high potential plate electrode and the grid electrode upon which is impressed the high frequency signal energy, the grid electrode is supported from the other end of the vessel and extends into the plate electrode 17 supported from the stem 11. The grid structure is provided with a corrugated collar 20 which frictionally surrounds the stem 12 in a manner similar to the collar 14 attached to the stem 11 at the other end of the vessel. The collar 20 supports a pair of channel upright members 21 and 22 of U shaped cross-section which are attached to the collar 20 by welding. A pair of strengthening members 23 and 24 welded to the inner surface of the collar are provided with wedge-shaped extensions welded to the channel upright members 21 and 22. This arrangement provides a rigid supporting frame for the grid electrode, as

shown in Fig. 2 which can be easily assembled and fabricated by the welding process.

A helical wire grid 25 having a contour corresponding to the plate electrode 17 but of smaller dimensions is supported by the channel members 21 and 22 by welding the adjacent turns to the flat surfaces of the upright members 21 and 22. The grid helix 25 may also be assembled in a different manner as shown in Fig. 2 in which thin flat strips of metal 26 are first welded to the adjacent turns of the grid helix and then the metallic strips 26 can easily be welded at distributed points to the channel members 21 and 22. This structure forms a rigid assembly for the fragile character of the grid electrode and accurately maintains the lateral wires of the grid electrode in spaced relation to the parallel surfaces of the plate electrode 17.

The structural rigidity of the grid electrode is also desirable since the grid electrode assembly supports the cathode or filament. The channel type of upright supports for the grid electrode is particularly adaptable to this arrangement since it is possible to employ the free ends of the channel members 21 and 22 as gripping members for the filament structure. As shown in detail in Fig. 2 the free ends of the channel members are cut to provide ears 27 which embrace short rods 28 extending from quartz pillars 29. The rod 28 is provided at one end with an enlargement which is sealed in the quartz pillar and the ears 27 on the channel members are folded around the rod 28 and preferably welded thereto as shown in Fig. 2. The quartz pillars therefore are rigidly supported by the channel members 21 and 22 and extend from the ends thereof to provide a high insulating path between a filament assembly and the grid electrode. A rod 30 similar to the rod 28 extends from the free end of each quartz pillar 29 and a pair of bent wire hanger members 32 and 33 extend downwardly from the rods 30. These hanger members carry a bridging insulator plate 31 which extends across the space between the channel members 21 and 22. The hangers 32 and 33 have their free ends bent at right angles after passing through the insulator plate 31 to prevent movement of the insulator plate 31. A plurality of compression springs 34 are supported on the upper surface of the insulator plate 31 and are provided with hook members extending through the insulator plate. These springs are of the general form disclosed in J. R. Wilson Patent 1,562,403 granted November 17, 1925 and the downwardly extending hooks support the bights of a filament 35 which is formed into a multiple M shape or zig-zag formation. The lower ends of the filament 35 are attached to hooks 36 rigidly supported in an insulating plate 37. The insulating plate 37 is spaced from the grid supporting structure but rigidly supported in spaced relation with respect to the upper insulating plate 31 and the surrounding grid helix 25 by leading-in wires 38 and 39 sealed in the press portion of the stem 13 and attached to external terminals 40, one of which is shown, carried by the base 41 attached to the vessel 10. The leading-in wires 38 and 39 are provided with extensions fastened into the insulating plate 37 between the hooks 36 and the connection of the filament 35 to the leading-in wires is accomplished by connecting the two end hooks by a bridging wire fastened to the leading-in wire 39 and connecting the center hook 36 to the leading-in wire 38. The assembly of the filament structure from the

grid assembly in accordance with this invention maintains the desired high insulating paths between these elements and at the same time insures the accurate spacing of the cathode with respect to the lateral wires of the helical grid. Furthermore, the suspension carriage arrangement for the support of the filament reduces the overall length of the device.

Since this device is primarily intended for operation in short wave transmission systems, it is highly desirable that the leading-in conductors should provide large surface area for the high frequency energy applied to the electrodes. In accordance with this invention, multiple terminal connections are provided for the input and output electrodes which are respectively the grid and plate electrodes. The multiple connection for the plate electrode 17 consists of leading-in wires 42 and 43 shown in Fig. 3 which are preferably formed of tungsten since this material has approximately the same coefficient of expansion as the 702 P or "Nonex" glass enclosing vessel 10. It is impractical to seal these leading-in wires directly into the glass stem of the enclosing vessel by the ordinary press seal, due to the surface character of tungsten. Therefore, it has been found desirable to seal a short length of glass tubing to the leading-in wire, to form a fluxing bead, and then seal the fluxing bead to the glass stem of the vessel. This is shown clearly in Fig. 3 where the leading-in wires are sealed into the glass stem 11. The inner ends of the leading-in wires 42 and 43 are provided with metallic strip connections 44 which are bent around the flat surfaces of the arms 15 and 16 and welded thereto. The outer ends of the leading-in wires are twisted together and soldered in the end of a cap member 46 attached to the upper end of the vessel 10 by cement 47. This arrangement provides a large surface terminal for the anode or plate electrode 17 and the multiple terminal connection provides the necessary area for the high voltage supplied to the plate electrode 17.

Similarly the grid electrode is provided with multiple terminal connections in which the leading-in wires 48 and 49 are sealed in the stem 12, in a manner similar to the sealing of the leading-in wires 42 and 43 described above, these wires being provided with metallic straps 50 which are welded to the flat surfaces of the channel upright members 21 and 22 as shown more clearly in Fig. 4. The leading-in wires 48 and 49 are twisted together exterior to the vessel and soldered to the terminal 51 carried on the base 41. The multiple connection attached to the helical grid within the anode serves the same purpose as the multiple terminal connections for the anode but in this case the high frequency signal current applied to the control electrode or grid travels over the large cylindrical surfaces of the multiple leading-in conductor. Attached to the grid leading-in wire 48 is a downwardly extending wire 52 carrying a metallic ring 53 on which is placed a plurality of magnesium discs 54. The ring 53 is designed to be heated by high frequency current during the final evacuation of the vessel 10, whereupon the magnesium discs are vaporized to absorb the occluded and residual gases within the vessel and the vapor condenses on the inner wall of the glass vessel 10 to fix the absorbed gases.

While the invention has been disclosed in a particular structure, it is of course understood that various modifications may be made with re-

spect to the grid assembly and the support of the filament structure from the grid assembly and the invention is only to be limited within the scope of the appended claims.

6 What is claimed is:

1. An electron discharge device comprising an enclosing vessel having an inwardly projecting stem on each end thereof, a plate electrode supported from one of said stems, a metallic grid frame supported from said other stem, insulating posts rigidly attached to said frame, a carriage suspended from said posts, and a filament resiliently supported by said carriage.

2. An electron discharge device comprising an enclosing vessel having an inwardly projecting stem on each end thereof, a plate electrode supported from one of said stems, a metallic frame having channeled portions supported from said other stem, a filament insulatingly supported from said frame, and a grid helix having its turns supported from the diametrically opposed inner surfaces of said frame and located between said filament and plate electrode.

3. An electron discharge device comprising an enclosing vessel having an inwardly projecting stem on each end thereof, a plate electrode supported from one of said stems, channelled metallic frame members supported from said other stem, a grid helix attached to said frame members, insulating posts carried by said members, downwardly extending hangers attached to said posts, an insulating block between said members and rigidly fastened to said hangers, resilient hooks carried by said block, and a filament supported by said hooks.

4. An electron discharge device comprising an enclosing vessel having an inwardly projecting stem on each end thereof, a plate electrode supported from one of said stems, grid supporting members within said plate and extending from the other stem, an insulating plate supported by the free ends of said members, leading-in wires extending through the other stem, a second insulating plate adjacent the other stem and supported only by said leading-in wires, and a filament extending between and interconnected to the insulating plates.

5. An electron discharge device comprising an enclosing vessel having a stem, a pair of metallic supporting members extending from said stem,

a wire grid helix carried by said members, an insulating plate bridging one end of said members and supported thereby, a second insulating plate adjacent the other end of said members, a filament interconnected to the plates and located within said grid helix, and leading-in wires for said filament extending through said stem and solely supporting said second insulating plate parallel to said bridging plate and out of contact with said metallic supporting members.

6. In an electron discharge device having an enclosing vessel provided with a reentrant stem, a collar surrounding said stem, a pair of metallic supports of U shaped cross-section extending into said vessel from said collar, an electrode supported by said supports, and a strengthening metallic plate attached to each of said frames and said collar.

7. In an electron discharge device having an enclosing vessel provided with a reentrant stem, a collar surrounding said stem, a pair of metallic supports of U shaped cross-section extending into said vessel and attached to the outer surface of said collar, an electrode carried by said supports, and a wedge-shaped member on the inner surface of said collar attached to each of said supports.

8. An electron discharge device comprising an enclosing vessel having a reentrant stem on each end thereof, a plate electrode supported from one of said stems, a grid frame supported from the other stem, insulators extending from the free ends of said frame, a supporting member extending across said frame close to the bases of said insulators and suspended from the opposite end thereof, and a cathode supported by said member.

9. In an electron discharge device having an enclosing vessel provided with an inwardly projecting stem, a collar frictionally surrounding said stem, supporting members of U shaped cross-section attached to said collar, a wire grid helix carried by said members, an insulating bead rigidly attached to the free end of each member, an insulating bridge member extending between said supporting members, and a suspension hanger supporting said bridge member from said insulating beads.

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