

June 6, 1933.

V. L. RONCI

1,912,404

ELECTRON DISCHARGE DEVICE

Filed Feb. 27, 1926

2 Sheets-Sheet 1

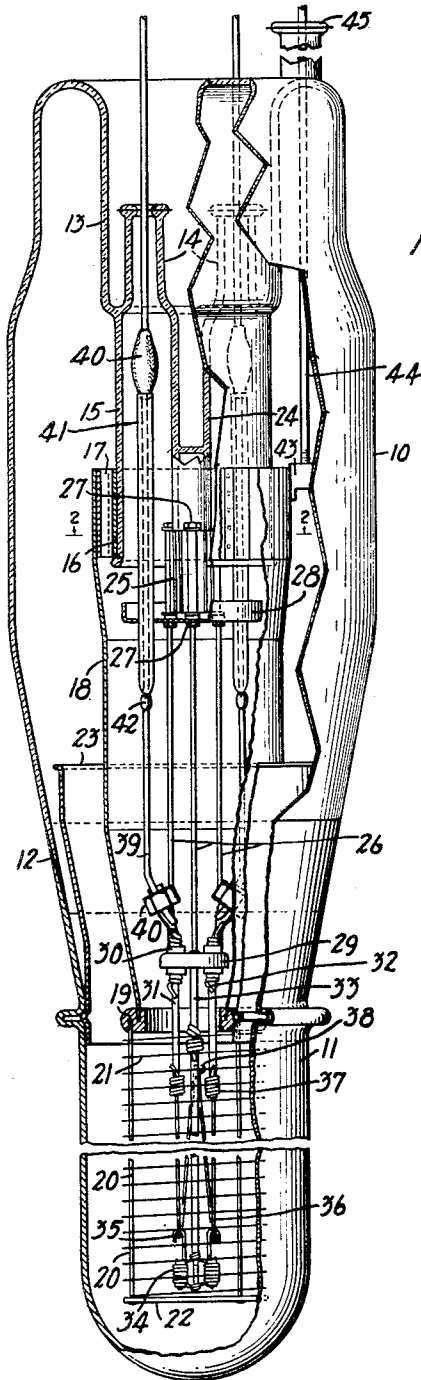
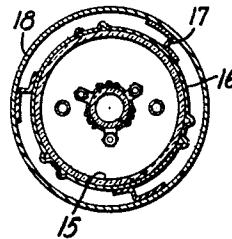


Fig. 1

Fig. 2



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2 Sheets-Sheet 2

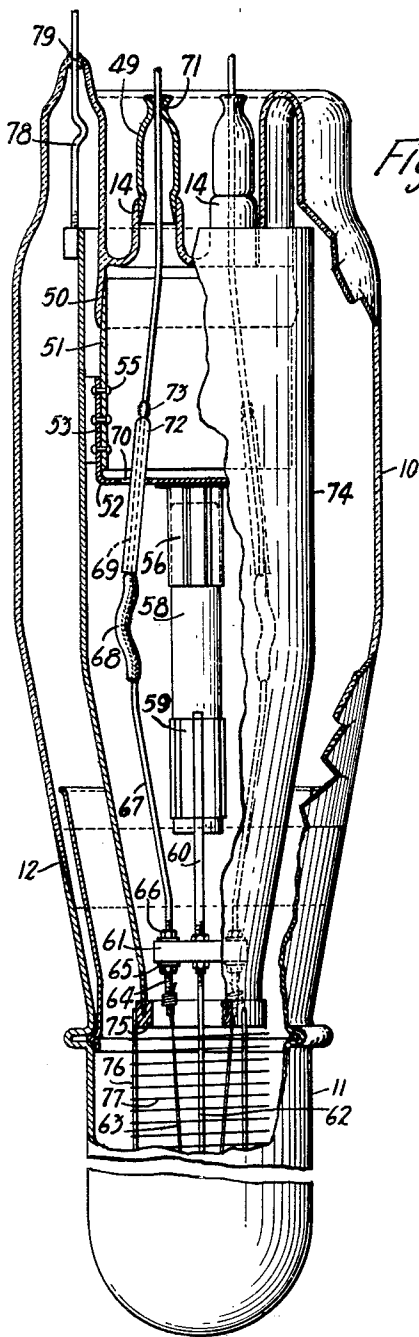


Fig. 5

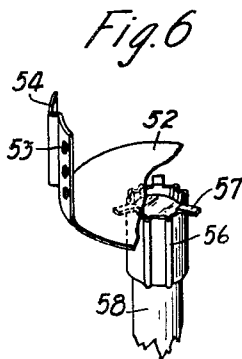


Fig. 6

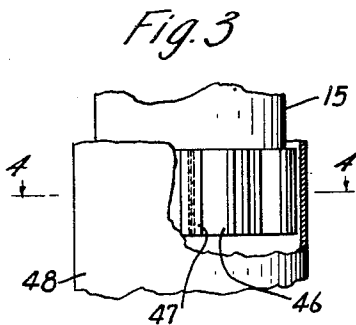


Fig. 3

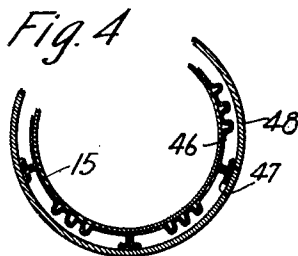


Fig. 4

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UNITED STATES PATENT OFFICE

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ELECTRON DISCHARGE DEVICE

Application filed February 27, 1926. Serial No. 91,203.

This invention relates to electron discharge devices and more particularly to such devices capable of handling large amounts of power.

5 In certain devices of this character, the magnitude of the voltages impressed upon the anode may be of the order of 10,000 to 100,000 volts, while the voltages applied to the filament and grid are relatively low. 10 Thus, large differences of potential are set up between the metallic electrode supporting members and leading-in wires such that corona effects or disruptive discharges occur which seriously damage the device.

15 The principal object of the invention is to provide an electron discharge device of such structure that the above mentioned harmful discharges do not occur.

A correlated object is to provide an electrode supporting structure in which all 20 sharp metallic points and edges are completely shielded to prevent said harmful discharges.

Another object of the invention is to protect the leading-in wire seals from excessive 25 heat generated in the device.

A further object is to provide a mechanical connection for the grid leading-in wire which facilitates the assembly of the device.

30 This invention was made in connection with the development of high voltage water-cooled discharge devices of the external anode type. In certain devices of this type hitherto used the grid has been supported at the end of a cylindrical metallic shield 35 which has in turn been supported from the glass stem of the tube which is at the opposite end from the metallic anode. In tubes of this type the filament supports the leading-in wires extended into or through the 40 shield, and the upper end of the shield was corrugated to hold it in place on the stem. In this structure it was found that harmful discharges sometimes took place between 45 the anode and the corrugations of the shield.

In accordance with one feature of the invention a metallic collar is mounted on the glass stem within the end of the metallic shield and carries projections to engage the 50 inner surface of the shield to act as a sup-

port therefor. This arrangement is such that the sharp metallic points and edges of the shield support are completely enclosed within the shield which presents a smooth surface toward the anode.

Another feature of the invention is the provision of a heat radiating shield between 55 the leading-in wire seals and the portion of the tube in which an intensive heat is generated. This shield may take the form of a disc mounted on the supports for the filament and cupped or rounded at the edges to prevent setting up of harmful discharges; 60 or it may take the form of a disc which is supported on a tubular member and forms the closure for the stem, the disc also serving to support the filament structure. 65

A further feature is the provision of a metallic socket unitary with the tubular metallic shield and located at the end thereof 70 adjacent the stem. This socket is internally threaded for the purpose of receiving the grid leading-in wire after the assembly of the electrode structures.

Referring to the drawings Fig. 1 illustrates 75 a discharge device with parts broken away to show clearly the structural features of this invention, Fig. 2 is an enlarged cross-sectional view of the collar member on the lines 2—2 of Fig. 1, Fig. 3 is a partial view of a modified 80 arrangement for supporting the cylindrical shield, Fig. 4 is a plan view on the lines 4—4 of Fig. 3, Fig. 5 shows a modified arrangement of the invention as applied to an electron discharge device, and Fig. 6 shows 85 in perspective a partial view of the cap member.

Referring now more particularly to Fig. 1, the electron discharge device of this invention consists of an evacuated vessel having a 90 glass portion 10 and a cup-shaped metal anode portion 11, provided with a tapered edge 12 and sealed to the glass portion in accordance with the disclosure in W. G. Houskeeper Patent 1,294,466, issued February 18, 1919. 95

A reentrant stem 13 is attached to the glass portion and is provided with two tubular extensions 14 which project outwardly from the inner end of the stem 13. A cylin- 100

drical glass extension 15 is joined to the stem 13 and projects within the vessel 10. A corrugated metal collar 16 is frictionally held on the extension 15 and is provided with angular longitudinally bent extensions 17 disposed around the periphery of the collar 16 as shown more clearly in Fig. 2. A metallic shield 18 is preferably built up of alternate cylindrical and tapered sections which are welded together to form a substantially closed shield. One end of this shield has an inside diameter approximately the same as the diameter determined by the arcs formed by the extensions 17. The shield 18 slides over and forms a snug fit with the extensions 17 on the collar. The abutting surfaces of the shield 18 and the extensions 17 may be spot welded to provide a rigid connection. The tapered end of the shield 18 is arranged to fit into a circular groove in the metallic ring 19. The connection at this point being preferably made by pinching the metal edges of the ring against the shield 18. A plurality of rods 20 extend from the opposite surface of the ring 19. These rods form a support for the helical wound wire grid 21. A disc 22 is welded to the ends of the rods 20 and forms a rigid connection for the assembled grid. This disc also acts as a corona shield between the anode 11 and the filament supporting structure to be hereinafter described. A metallic shield 23 similar to the shield 18 but of larger diameter, is concentrically arranged with respect to the shield 18, and adjacent to the seal between the glass portion 10 and the anode 11. The small diameter end of the shield 23 is fastened to the anode by spinning the edge thereof into the ridge formed on the anode. This arrangement forms a good mechanical connection between the shield and the anode and forms an efficient structure for the protection of the glass seal made at the point 12.

A tubular glass extension 24 concentrically arranged with respect to the cylindrical glass extension 15 and fused to the stem 13, forms the supporting means for the filament supporting structure. A corrugated metallic collar 25 is frictionally supported on the tubular extension 24 and carries a number of supporting rods 26 attached thereto by means of nuts 27. A heat deflecting shield 28 having the edges turned up is rigidly held to the rods by means of the nuts 27. This shield protects the glass tubes 14 extending from the stem to prevent the excessive heat generated in the device from softening the seals at the ends thereof. The edges of shield 28 are up-turned to present a surface toward shield 18 so that discharges therebetween are less likely to occur. Attached to the free ends of the rods 26 is an apertured metallic disc 29 through which project insulating bushings 30 for insulating the filament connectors 31. These connectors are preferably support-

ed in the disc by means of a few turns of wire 32 wound around the connector on either side of the insulator 30, the ends of the wire being welded to the connector 31. A central supporting rod 33 projects from the disc 29 and carries a pair of wire helices 34 which hold insulators to support filament hooks 35 in accordance with the disclosure in my U. S. Patent 1,616,139, issued February 1, 1927. A tungsten filament 36 is strung between the connectors 31 and the hooks 35 and fastened at the connectors by a wire helix 37 of small diameter threaded over the end of the filament and the connector 31. The mid-point of the filament is held by a hook 38 formed on the rod 33 adjacent the connectors 31. The free ends of the connectors are slotted to receive the leading-in wires 39 which are attached thereto by means of nut 40. These leading-in wires extend through an aperture in the heat radiating shield 28 and are sealed at the terminations of the tubular extensions 14. Due to the large diameter of these leading-in wires and the expansion and contraction of the metal, it is preferable to provide a flexible section 40 preferably of copper braid. This flexible section is located as close to the seal as possible to prevent an electric path being set up between the flexible connection 40 and the edge of the shield 18.

A substantially large radiating surface is retained for the shield 28 by reducing the size of the openings through which the leading-in wires extend. These openings are of such diameter as to accommodate tubular insulating members which surround the leading-in wires, to prevent contact with the shield 28. This is taken care of by sliding a glass tube 41 on the leading-in wire, one end of the tubing having an opening substantially the diameter of the wire, and enlarging the leading-in wire by a flattened portion 42, adjacent the tapered end of the glass tubing 41. The other end of the glass tubing abuts against the flexible connection 40 and in this way is prevented from shifting its position. Attached to the shield 18 is a metallic socket 43 having an internally threaded portion to receive leading-in wire 44. This wire projects through a sealed joint 45 at the juncture between the glass vessel and the stem.

The structural arrangement of the enclosing shield 18 provides an efficient support for the grid electrode 21 and also protects the filament supporting structure within the shield, whereby the large potential difference between the anode 11 and the filament, which creates an electric field of high intensity within the device, is prevented from setting up a discharge, due to the large surface area of the substantially smooth closed shield 18. Furthermore, the concentric arrangement of the anode shield 23 and the shield 18 offers a plurality of parallel sur-

faces upon which the respective charges are spread, whereby the potential gradients at the shields are reduced to a minimum.

A modified form of the shield supporting means is shown in Figs. 3 and 4 and illustrates a means of forming the collar and the longitudinal projecting extensions as an integral structure. In this arrangement the corrugated collar 46 is provided with integral T-shaped extensions 47, distributed around the periphery of the collar, intermediate the corrugated sections. The flat surfaces of the T-shaped extensions 47 lie in a cylindrical surface of substantially the same diameter as the inner diameter of the cylindrical shield 48, which may be attached to the extensions 47 in the same manner as described in connection with Fig. 1.

A further modification of the shield support and electrode structure is shown in Fig. 5. In this arrangement the tubular extensions 14 are provided with metallic thimbles 49 which are sealed to the extensions 14 and provided with apertures to receive the leading-in wires from the filament. A cylindrical continuation 50, on the stem, is welded to a tubular metallic collar 51 which is provided with a tapered edge at the sealing point to form an efficient joint between the glass and metal. Enclosing the inner end of the collar 51 is a metallic disc 52 which is provided with integral legs 53 projecting from the periphery of the disc and at right angles thereto. Each leg is provided with a lateral extension 54 which is bent outwardly, the free end of the extension lying in a parallel plane with the leg 53. The leg 53 is provided with apertures corresponding to similar apertures in the collar 51, whereby the two members may be secured together as shown at 55.

Centrally supported on the disc 52 by means of tabs 57, is a corrugated expandable metal collar 56. These tabs are bent at right angles to the plane of the collar and are preferably welded to the opposite face of the disc from which the legs project.

The collar 56 is arranged to receive a rod of insulating material 58, preferably quartz, and the corrugations in the collar are crimped to hold the rod 58 securely in position. A collar 59 surrounds the other end of the rod 58 and carries metallic supporting rods 60 which are attached to a filament supporting block 61. This block is preferably circular in shape and carries a central rod 62 which projects within the anode 11. The rod 62 is provided to support the bight of the filament 63 which has its free ends electrically and mechanically attached to threaded connectors 64. These connectors pass through insulating bushings 65 in the supporting disc 61 and are held therein by means of nuts 66 on either side of the bushings. Each connector is provided with a relatively long extension 67 which is joined to a flexible

copper braid 68. This braid is soldered to a leading-in wire 69 which passes through an aperture 70 in the disc 52, tubular extensions 14, thimble 49, and is soldered to the end thereof at 71. The portion of the leading-in wire passing through the aperture 70 in disc 52, is provided with a length of glass tubing 72, which is held in position at one end by the flexible connections 68, and at the other end by a flattened portion 73 on the leading-in wire 69. A tubular metallic shield 74 which may be tapered at one end, surrounds the filament structure, described above, and slides over the extensions 54 which project from the tubular extension 51. This shield may be of any desired length to afford the protection to be obtained, and as shown in the drawings, is of such length as to surround the seal between the collar and a portion of the stem to prevent corona discharges cracking the seal of the glass. The shield 74 is preferably spot welded to the extensions 54 to prevent movement due to expansion or contraction of the metal. A metallic ring 75 having a groove in one surface thereof, is fitted over the end of the shield adjacent the anode and rigidly held thereon by crimping the outer edge of the ring. A plurality of rods 76 are supported from the ring 75 and provide means for supporting the helical wire grid 77, which surrounds the filament 63 and is coaxial with the anode 11. A wire lead 78 is attached to the end of the shield adjacent the stem, and is sealed to the glass vessel at 79, at the juncture of the stem and the flare of the vessel. This arrangement provides a rigid structure for the electrodes within the device, and the substantially closed chamber formed by the tubular collar 51 and the disc 52, prevents the heat generated in the device from injuring the seals for the leading-in wires.

Furthermore, the comparatively closed smooth shield supports the grid and forms a barrier between the filament supporting structure and the anode, and the electric field between the anode and the shield is of relatively low intensity by virtue of the large surface of the shield so that no destructive discharges occur. The potential difference between the grid and the filament being relatively small, there is no cause to provide shielding between these elements.

What is claimed is:

1. An electron discharge device comprising a vessel having a reentrant stem of insulating material and a metallic anode portion, an electrode support comprising a metallic band attached to said stem, radial extensions on said band projecting outwardly therefrom, a tubular member, a portion of which is in contact with and surrounds said extensions, and an electrode supported from said member.

2. An electron discharge device compris-

ing a vessel provided with a reentrant stem of insulating material and a metallic anode portion, an electrode support comprising a metallic band attached to said stem, angular
5 extensions projecting from said band, a tubular metallic member fitted over said extensions and surrounding said stem, and an electrode supported from said member.

3. An electron discharge device comprising
10 a vessel provided with a reentrant stem of insulating material and a metallic anode portion, a shield structure comprising a collar surrounding said stem, a tubular metallic shield surrounding said collar and stem,
15 and ribs extending longitudinally of the axis of said stem and projecting from said collar for supporting said shield.

4. An electron discharge device comprising a vessel provided with a reentrant stem of insulating material and a metallic anode
20 portion, a shield structure comprising a collar attached to said stem, a tubular metallic shield surrounding said collar and stem, and outwardly extending folded ribs distributed
25 around said collar and integral therewith, for spacing and supporting said shield from said collar.

5. An electron discharge device comprising a vessel provided with a stem and a metallic
30 anode portion, a tubular insulating extension sealed to said stem, an electrode structure comprising a filament support carried by said stem, a filament mounted thereon, an apertured heat radiating shield attached to
35 said filament support and substantially closing said extension, leading-in wires passing through said apertured shield and connected to said filament, insulating tubes surrounding said wires, and projections on said wires to
40 prevent displacement of said tubes.

In witness whereof, I hereunto subscribe my name this 25th day of February, A. D. 1926.

VICTOR L. RONCI.

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