

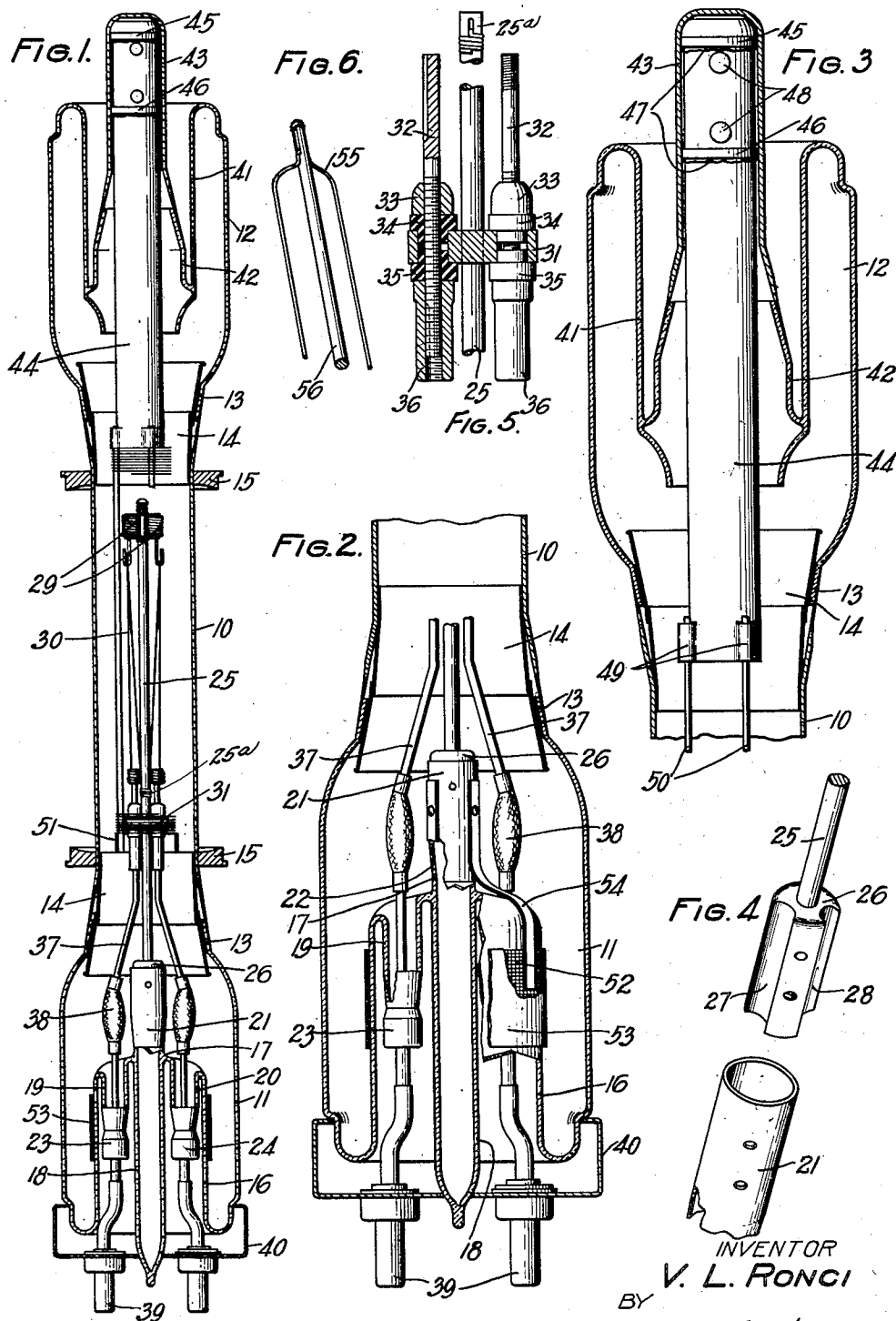
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ELECTRON DISCHARGE DEVICE

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ELECTRON DISCHARGE DEVICE

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

- 5 An object of the invention is to efficiently apply high frequency current to the control electrode of a device of the high power type which may be used in short wave transmission systems.
- 10 Electron discharge devices capable of increasing the power output have been in general use in long wave transmission systems and usually consist of a cup-shaped anode forming a part of the enclosing vessel and
- 15 a glass portion which supports the cathode and grid in spaced relation with respect to the anode. This construction has proved efficient and satisfactory within the range of frequencies usually employed in long
- 20 wave systems, such as broadcasting and transoceanic radio telephony. However, in short wave transmission systems the intensive and concentrated high tension, high frequency current, applied to the control electrode or grid creates a field which readily
- 25 melts the glass vessel and therefore causes failure or else causes heating of the filament seals and consequent rupture which destroys the vacuum.
- 30 In accordance with this invention, these difficulties are overcome by supporting the grid from the opposite end of the anode with respect to the cathode. In this construction a tubular metallic anode open at
- 35 both ends is provided with glass portions which are sealed to the open ends of the anode. A filament assembly is sealed into one of the glass portions and extends into the anode. The glass portion on the other
- 40 end of the anode is provided with a coaxial tubular metallic termination which is directly in contact with a cylindrical supporting structure which carries the grid electrode at its inner end, the grid being located between the filament and the wall of
- 45 the tubular anode. This construction materially reduces the establishment of injurious high frequency fields. Furthermore, the external metallic termination and the
- 50 continuous cylindrical grid structure serves

as a large surface area to apply the high frequency energy to the grid electrode.

One feature of the invention relates to providing a metallic shield around the glass stem which encloses the filament seals and maintaining this shield at the same potential as the filament. This is accomplished by rigidly supporting the filament structure concentrically from the inner end of the stem and sealing the filament leading-in wires within the stem to metallic cups which are fused to the stem. A metallic shield encircles the stem over a distance determined by the length of the metallic cup seals and the shield is electrically connected to the filament support, to eliminate electrical charges building up on the glass surface.

Another feature relates to the filament supporting structure and the arrangement for evacuating the complete device through a glass tubulation which communicates with the vessel through apertures formed by portions of the filament supporting structure. This structure comprises a glass stem terminating in a tubular opening to which is sealed a metallic reinforcing collar and which connects with an external glass sealing extension projecting toward the outer end of the glass portion. A filament structure having a solid plug at one end is rigidly secured in the reinforcing collar, the plug having ferrules which form communicating paths between the sealing extensions and the interior of the discharge device.

These and other features of the invention will be clearly understood from the following detailed description in connection with the accompanying drawing in which:

Fig. 1 illustrates a high power discharge device made in accordance with this invention having the enclosing vessel in cross-section to show the detail construction.

Fig. 2 is an enlarged view of the filament end of the device of Fig. 1 shown largely in cross-section and with portions broken away to clearly show the construction.

Fig. 3 is an enlarged detail view of the other end of the device of Fig. 1, shown in cross-section to illustrate the assembly of the improved electrode support.

Fig. 4 is a rear perspective view showing sections of the filament supporting structure and the detail construction of the parts entering into the assembly.

Fig. 5 is an enlarged detail view partly in cross-section of the connectors for coupling the filament to the leading-in wires, and

Fig. 6 is a perspective view of a portion of a filament and support therefor, representing a modification of the filament and support shown in Fig. 1.

Referring to the drawing the electron discharge device of this invention comprises a highly evacuated enclosing vessel having a tubular metallic portion or anode 10, preferably of copper, and open at both ends to which are attached glass end portions 11 and 12. The open ends of the tubular anode portion 10 are tapered outwardly and reduced in thickness towards the edge to a knife edge and sealed, fused or welded to the glass portion as shown at 13 in accordance with a method disclosed in W. G. Houskeeper Patent 1,294,466, February 18, 1919. Since excessive heat is generated during the operation of the device, this heat is conveyed away from the glass-to-metal seal as shown at 13 by a funnel-shaped shield 14 which extends over the area of the seal and is secured to the inner surface of the anode portion 10. Similarly, in order to dissipate the heat generated in the device, a cooling medium may be circulated around the exterior of the anode 10 and this is accomplished by surrounding the anode with a container or jacket (not shown) through which the cooling medium may be circulated. As shown in Fig. 1, annular flanges 15 are secured to the wall of the tubular anode to form the ends of the container which may be of a form shown in U. S. Patent 1,628,999, May 17, 1927. The glass portion 11 is provided with an inwardly projecting stem 16 having a central tubular extension 17 which is joined to a glass tubulation reentrant with respect to the stem. The glass stem 16 is also provided with two reentrant tubular extensions 19 and 20 which are arranged on opposite sides of the tubulation 18 and extend parallel therewith. Attached to the central extension 17 is a metallic reinforcing collar or sleeve 21 which is sealed to the extension 17 in the same manner as the seal between the glass portions of the enclosing vessel and the tubular anode and shown more clearly in Fig. 2 at 22. The tubular extensions 19 and 20 are closed by metallic caps 23 and 24 by a similar glass-to-metal seal as disclosed in the Houskeeper patent mentioned above.

The filament structure comprises a central upright metallic rod 25 which is provided with a solid metallic plug 26 at one end having longitudinal cut-out portions 27

and 28, the metallic plug 26 having a diameter to easily fit within the metallic collar 21 and secured therein by screws which pass through the collar and plug. This construction forms a rigid support within the device and the cut-out portions of the plug 26 and the wall of the collar 21 form communicating passage-ways between the interior of the entire vessel and the glass tubulation 18, whereby the device can easily be evacuated and all gases removed to secure a high vacuum. The upright supporting rod 25 carries at its free end a pair of metallic nests 29 which support insulators having hooks to engage the bights of the filament 30. These nests and the associated parts of the structure may be similar to the insulating supports disclosed in Patent 1,616,139, February 1, 1927. The filament 30, preferably of tungsten, is formed into an M with the bights strung over the hooks supported in the nests 29, the bight at the lower end being strung on a hook 25a carried by the upright rod 25 and the free ends attached to metallic connectors supported on a metallic disc carried by the upright rod 25. The construction of the connectors is shown more in detail in Fig. 5 in which the metallic disc 31 is provided with two openings located on opposite sides of the central support 25. Extending through each aperture is a threaded metallic rod 32 having a metallic shoulder 33 threaded on the rod and positioned between the ends thereof. This shoulder engages a flanged insulating collar or eyelet 34 which is seated in the aperture of the metallic disc 31 on one surface and through which the metallic rod 32 extends beyond the lower surface thereof. A similar flanged insulating collar or eyelet 35 engages the other surface of the disc 31 and is seated in the aperture. The complete assembly is rigidly secured in place by a metallic sleeve 36 which is threaded on the metallic rod 32 and rigidly fastens the insulating collars 34 and 35 against the metallic disc 31. The free ends of the filament 30 are attached to the slotted connector rod 32 by a wire helix which is spot welded to prevent loose connection between the filament and connector. The hollow metallic sleeve 36 on the opposite end of the connector forms a cavity for a leading-in wire 37 which is joined to the metallic cups 23 and 24. The leading-in wire 37 is provided with a flexible braid portion 38 to compensate for expansion and contraction during operation. The hermetically sealed cups or seals 23 and 24 are provided with conductor extensions which are attached to terminals 39 carried by a metallic base 40 substantially enclosing the end of the glass portion 11.

In order to increase the insulating path between the low potential terminals of the

filament and the high tension, high frequency terminal of the control electrode or grid when employing the discharge device in short wave transmission work, the grid electrode is supported from the opposite end of the device as shown in the drawing. The electrode extends from and is supported by the glass portion 12 which is sealed to the other end of the metallic anode 10. The glass portion 12 is provided with an inwardly projecting stem 41 having an outwardly extending tapered portion 42 which is sealed to a metallic thimble or cup-shaped termination 43. The cup-shaped termination 43 is provided with a tapered knife-edge which is fused or welded to the glass portion 42 in a manner heretofore described. The cup-shaped termination 43 is coaxially positioned with respect to the glass portion 12 and the anode 10 and projects beyond the end of the glass portion 12 to serve as a large surface terminal for a purpose to be hereinafter described. Extending into the cup-shaped termination 43 is a cylindrical conductor or tubular metallic sleeve member 44 having its end formed to fit accurately in the end of the metallic termination 43 and provided with spaced integral annular rings 45 and 46 having a diameter substantially the same as the inner diameter of the metallic termination 43. These rings serve as positioning means for the tubular conductor 44 and form shoulders for several turns of cold solder as shown at 47 which may be heated externally to fuse the solder and mechanically join the tubular conductor 44 to the inner surface of the metallic termination 43.

The tubular conductor 44 is also provided with a plurality of spaced holes or vents 48 in order to remove air and gases from the space between the walls of the tubular member or conductor 44 of the metallic termination 43. The free end of the tubular conductor 44 is provided with raised extensions or ridges 49 at distributed points to serve as sleeves for the upright wires 50 upon which the grid helix 51 is wound. The extensions 49 are crimped around the wires 50 and securely maintain them in rigid position. The upper ends of the wires 50 are surrounded by a metallic band 51 to maintain the wires in parallel relation and to form a more rigid structure. The tubular structure of the grid support forms a large surface area for supplying the high frequency, high tension energy to the grid or control electrode positioned between the filament and anode of the discharge device and the unitary assembly of the grid, hollow tubular member 44 and the metallic terminal 43 serves as a means for accurately positioning the grid electrode in coaxial relation with respect to the filament and anode.

The large current supplied to the filament by the leading-in wires has a tendency to build up destructive electrical charges on the glass stem through which the leading-in wires are sealed and these charges often fracture the glass due to the intensive heating. In accordance with this invention these charges are deflected by surrounding the glass stem through which the leading-in seals with a metallic shield or collar 53 which is prevented from slipping on the smooth glass by a wire screen 52 which presents a rough surface to the glass. The shield 53 extends over an area of the glass stem substantially the length of the metallic cup seals 23 and 24 enclosed within the stem and this shield is electrically connected to the metallic sleeve 21 by a plurality of straps 54 so that the shield 53 is maintained at the same potential as the filament and any charges tending to creep over the glass surface of the stem will encounter the shield 53 and be conducted to the filament support where they are dissipated.

The length of filament employed in the device shown in Fig. 1 requires a sufficiently rigid supporting arrangement to maintain the length of filament in accurate relation with respect to the other electrodes. However, when a shorter length of filament is desired, for instance, in a device of less power, the filament may be formed as shown in Fig. 6, in which the filament 55 is formed into an inverted U and positioned in a slit in the upper end of upright member 56. After the filament is secured in the end of the upright member 56 the slit may be closed by fusing the end of the rod by welding.

While the invention has been disclosed in the particular embodiment, it is of course understood that various modifications may be made in the detailed parts of the device without departing from the scope of the invention as defined in the appended claims.

What is claimed is:

1. An electron discharge device comprising an enclosing vessel having a glass portion and a metallic portion, said metallic portion forming an anode of said device, said glass portion having an inwardly projecting stem and a central protruding tubulation, a metallic collar attached to said stem at the inner end of said tubulation, an electrode supported from said collar and extending into said anode, and means supported within said collar having a passage-way between said tubulation and the interior of said vessel.

2. An electron discharge device comprising an enclosing vessel having a glass portion and a metallic portion, said metallic portion forming an anode of said device, said glass portion having an inwardly projecting stem and a central protruding tubu-

lation, a metallic collar attached to said stem at the inner end of said tubulation, a metallic plug having cut-out portions surrounded by said collar, an upright support
5 extending from said plug, and an electrode carried by said support.

3. An electron discharge device comprising an enclosing vessel having a glass portion and a metallic anode portion, said glass
10 portion having an inwardly projecting stem, an electrode supported from said stem and extending into said metallic portion, a pair of metallic cup members sealed to said stem and located therein, connections from said
15 electrode to said metallic members, and a metallic shield surrounding said stem over a distance determined by the length of said metallic members and electrically connected to said electrode.

20 4. An electron discharge device comprising an enclosing vessel having a glass portion and a metallic anode portion, said glass portion having an inwardly projecting stem, an electrode supported from said stem and
25 extending into said metallic portion, a pair of cup-shaped terminals sealed to said stem and substantially enclosed thereby, leading-in wires for said electrode attached to said terminals, a metallic shield engaging said
30 stem over an area enclosing said terminals, and a plurality of metallic strips connecting said shield to said electrode.

5. An electron discharge device comprising a vessel having a glass portion and a
35 metallic anode portion, a metallic upright member extending into said anode portion, an apertured metallic disc secured thereto between the ends, a metallic connector extending through said disc having
40 a shoulder on one side, a metallic sleeve member on the other side of said disc engaging said connector, an insulator on each side of said disc rigidly fastened thereto by said connector and sleeve member, a filament carried
45 by said connector and upright member, and a conductor attached to said connector by said sleeve member.

6. A double ended high power discharge device comprising a metallic portion forming
50 the anode of the device and a glass portion at each end thereof, a filament within said anode portion, an inwardly projecting stem on one glass portion supporting said filament, an inwardly projecting stem on the
55 other glass portion, a projecting metallic hollow terminal coaxially positioned with respect to said anode portion and attached to said second stem, a grid spaced between said anode and filament, and a tubular conductor
60 supporting said grid and seated in said hollow terminal.

In witness whereof, I hereunto subscribe my name this 28th day of September 1929.

VICTOR L. RONCI.