June 24, 1930. P. SCHWERIN 1,766,460

ELECTRON DISCHARGE DEVICE

Filed May 29, 1924

Fig. 1

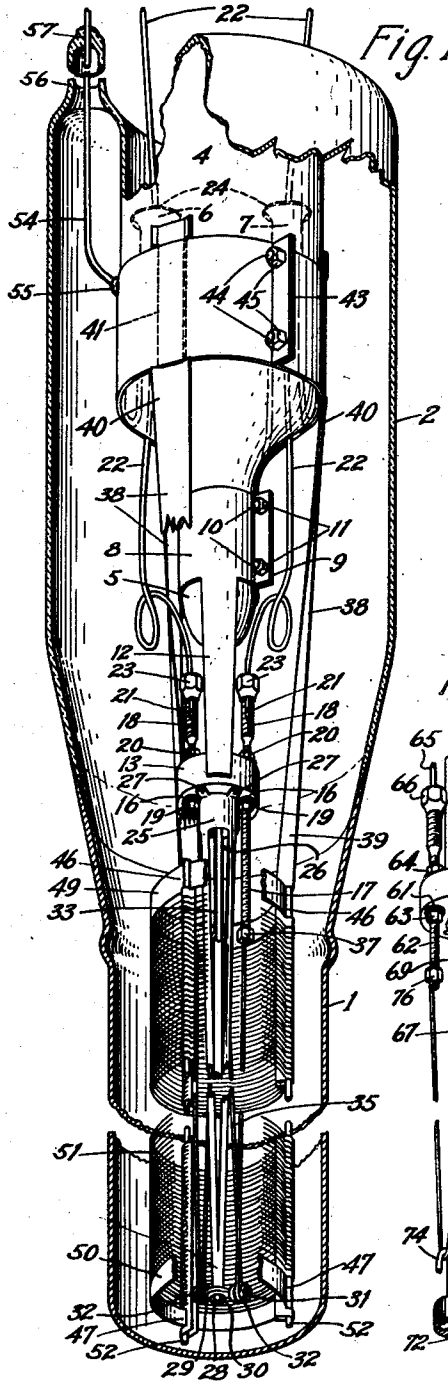


Fig. 2

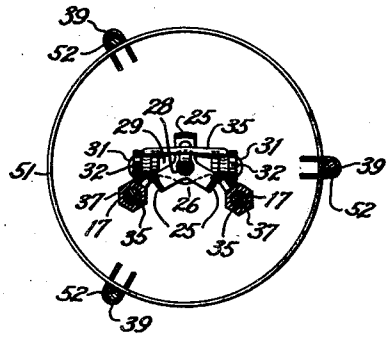


Fig. 3

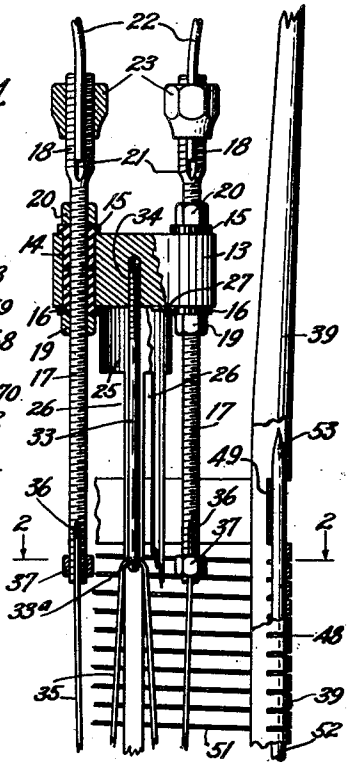
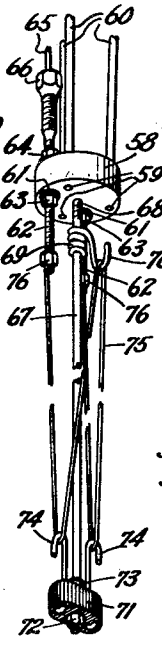


Fig. 4



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Patented June 24, 1930 1,766,460

UNITED STATES PATENT OFFICE

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ELECTRON-DISCHARGE DEVICE

Application filed May 29, 1924. Serial No. 716,606.

This invention relates to electron discharge devices and more especially to devices of this character capable of operating with high voltage currents.

An object of this invention is to provide a unitary grid structure which can be easily assembled, and in which sufficient lateral movement is provided to allow the grid wires to expand without warping out of shape.

Another object is to provide an efficient grid supporting structure.

A further object is to provide a unitary filament supporting structure which may be rigidly supported in operative relation to the other electrodes in the device.

A further object is to provide a support for the filament in which the use of fragile insulating material is reduced to a minimum.

These objects are attained by providing a grid structure in which the grid supporting members are of U-shaped cross-section for the length of the grid proper, and the remaining portions of the members are provided with slightly curved surfaces. Spaced slots are cut in the closed edge of the U-shaped portion and a continuous grid wire wound around the supporting members, adjacent turns of the grid helix being equally spaced apart by the slots. Flat metallic bands are positioned above and below the grid wire helix, to increase the rigidity of the structure. A length of wire is inserted in the space between the closed end of the U-shaped portion and the turns of the grid helix, to prevent displacement of the grid wire and the bands in the spaced slots. The upper curved portions of the supporting members are spaced around the periphery of the stem of the vessel and a metallic band or collar clamps the uprights to the stem, thereby rigidly supporting the grid structure from the stem.

The filament unit consists of a metallic platform, which is provided with insulating bushings, to insulate the filament terminals from the metal platform. A sheet metal tripod supporting structure is rigidly attached to this platform, one end of which encircles a tubular extension of the stem in the vessel. A perforated conical frame projects from the under side of the platform and is provided at its lower end with a cross-arm and quartz insulating spools. The filament terminals are inserted in the insulating bushings in the platform and a filament wire connected thereto and supported by the quartz spools at the other end of the conical frame.

This arrangement provides a rigid and compact construction in which the units can be easily dismantled and assembled, whereby the cost of repairs will be materially reduced.

Referring to the drawings, Fig. 1 is an electron discharge device embodying this invention;

Fig. 2 is a plan view on the line 2—2 of Fig. 3;

Fig. 3 is a sectional view of the grid and filament structures with parts in cross-section, to clearly illustrate the invention;

Fig. 4 is a modified form of the filament supporting structure.

The electron discharge device consists of a cup-shaped metallic anode 1 and a glass portion 2, joined together in accordance with W. G. Houskeeper, Patent No. 1,294,466, dated February 18, 1919. A reentrant stem 4 is fused to one end of the glass portion 2 and is provided with an inwardly projecting, centrally disposed tubular extension 5 which is closed at its inner end. Tubular portions 6 and 7 project outwardly from the interior of the stem 4 and are positioned on either side of tubular extension 5.

A metallic collar 8 encircles tubular extension 5, and is provided with angular extensions 9, which are fastened together by means of threaded screws 10 and nuts 11, to clamp the collar 8 on the tubular extension 5. Arms 12 which are integral with metallic collar 8 are attached to a metallic platform 13, preferably by means of spot-welding. The arms 12, provide a rigid supporting structure for the base 13 at three equally spaced points, whereby any vibration or lateral movement is prevented. Metallic disc 13 is provided with apertures 14, through

which "lavite" insulating bushings 15 and 16 extend. Threaded rods 17 extend through the insulating bushings 15 and 16 and are provided at one end with enlarged threaded portions 18. The threaded rods 17 are rigidly attached to the metal disc 13 by means of nuts 19 and 20. The enlarged threaded portions 18 are provided with longitudinal slots 21, which receive filament leads 22. These leads are retained in the slots by means of nuts 23. The leads are brought out of the vessel through tubular members 6 and 7 and are sealed to the glass at 24 as shown in W. G. Houskeeper Patent 1,293,441, issued February 4, 1919. Projecting from the lower side of disc 13 is a sheet metal conical frame 25, provided with openings 26. This frame is attached to the metallic disc through the medium of integral tabs 27, which are preferably spot-welded to the disc to provide a secure connection. This construction facilitates the use of a much longer member as it presents a much more substantial base and lends considerably to the rigidity of the filament structure. A threaded metallic stud 28 projects from the apex of the conical frame, on which a molybdenum cross-arm 29 is seated and rigidly held against movement by means of threaded nut 30. The cross-arm 29 is provided with attenuated extensions 31, which receive spools 32, which are preferably formed of quartz insulating material. The spools are held on the cross arm 29 by offsetting the end of the extensions 31. A metallic rod 33 is threaded into the platform 13 at 34 within conical frame 25. This rod is slightly off center with respect to the platform 13, to facilitate the passage of the filament through the apertures in the conical frame. A hooked portion 33^a on rod 33 is provided to receive one point of the filament. A metallic filament 35 is supported between the base and the apex of the conical frame. One end of the filament is inserted in groove 36 in one of the threaded rods 17 and is rigidly held therein by means of nut 37. The filament is supported at intermediate points by means of quartz spools 32, and hook 33^a within conical frame 25. The other end of the filament terminates in the groove 36 in the second threaded rod 17 and is securely held in the groove 36 by means of threaded nut 37. This metallic structure eliminates to a considerable degree, lavite insulating supports. This material is troublesome of preparation, cracks easily in operation and is not so readily freed of gases as metal.

The grid structure comprises flat metallic upright members 38, preferably sheet molybdenum extending approximately the full length of the tube, which are provided with folded portions 39 of U-shaped cross-section, at one end, the other end being slightly curved outwardly at 40, thereby increasing the rigidity of the upright members. Elongated slots 41 are cut in the parallel edges of the upright members in the end adjacent the stem 4. The upright members 38 are triangularly disposed around the periphery of the stem 4 and a metallic band or collar encircles the upright members and the stem. The width of the collar is approximately the same as the reduced portion of the upright members, whereby the cooperative action of the collar and the curved portions above and below the collar, tend to provide a tight connection. The collar is provided with angular extensions 43 which are clamped together by means of threaded bolts 44 and nuts 45. This arrangement greatly facilitates assembly since considerable variation in the diameter of the glass stem can be encountered without any resultant difficulties in clamping the collar. Intermediate the ends of the upright members 38, a relatively wide slot 46 is provided, and a similar slot 47, is cut in the free end of the upright members. Between the slots 46 and 47, the folded portion 39 is provided with equally spaced slots 48. Reinforcing bands 49 and 50 are inserted in the slots 46 and 47, to strengthen the grid structure and provide uniform spacing of the upright members 38. A continuous wire 51 encircles the upright members 38, adjacent turns of said wire being seated in successive slots 48 in the folded portion 39. Retaining wires 52 are inserted in the closed edge of the U-shaped portions 39 for approximately the length of the grid proper. The tapered ends 53, of retaining wires 52, greatly facilitates the insertion of the wires in the U-shaped portions. The retaining wires prevent the grid wire 51 from slipping out of slots 48. However, sufficient play is allowed the grid wire 51 by this construction, to compensate for any movement due to expansion or contraction. Grid lead 54 is welded to the grid supporting collar at 55 and extends through tubular portion 56, which is attached to the glass portion 2, at one point of the junction of the flare of the stem and glass portion. The grid lead 54 is then sealed to the tubular portion 56 in the usual manner as shown at 57.

Fig. 4 illustrated a modified form of the filament supporting structure shown in Fig. 1, and comprises a metallic disc 58, provided with threaded apertures 59 which accommodate threaded rods 60. These apertures are located at three corners of a triangle in the disc so that when the threaded rods 60 are inserted in the apertures 59, they provide a tripod supporting structure which is rigid and easy to assemble. Furthermore, this construction, eliminates the use of nuts to hold the disc on the rods and thereby reduces expensive assembly costs. Additional aper-

tures 61 extend through the disc 58 and receive "lavite" insulating bushings, through which threaded rods 62 extend. These rods are rigidly held to the disc 58 by means of nuts 63 on either side of insulating bushings. Filament leads 65 are inserted in slots in the enlarged portions of the threaded rods 62 and are held therein by means of nuts 66. A cylindrical rod 67 is threaded in the centre of disc 58 at 68. Rigidly attached to the cylindrical rod, adjacent the disc 58, are a plurality of turns of wire 69, terminating in a hook portion 70. The free end of the cylindrical rod 67 is provided with an insulating block 71, which is rigidly attached thereto by means of nuts 72 and 73 on either side of the insulating block 71. Filament hooks 74 project from the insulating block 71, in a direction toward the metallic disc. A metallic filament is supported between the disc 58 and the insulating block 71 by means of rods 62, hook 70 and filament hooks 74.

Although this description pertains to specific structures, it is to be understood that the invention is not limited to this construction, but is only to be limited by the scope of the appended claims.

What is claimed is:

1. In an electron discharge device, a grid comprising a plurality of serrated members, a continuous wire helix encircling said members, reinforcing bands positioned above and below said helix, and retaining means for said helix and said reinforcing bands passing through said members.

2. In an electron discharge device, a grid comprising a plurality of turns of wire, a support for said grid comprising a folded metallic member having indentations in the closed edge thereof, said grid being positioned in said indentations.

3. A filament support comprising a metal disc, insulating bushings in said disc, a conical metallic member on said disc, and a filament supported between said disc and the apex of said member.

4. A filament support comprising a metal disc, insulating bushing in said disc, a perforated cone on said disc, and a filament supported between said disc and the apex of said cone.

5. A filament support comprising a metal disc, insulating bushings in said disc, a perforated cone on said disc, and a filament supported between said disc and the apex of said cone, the mid-point of said filament being within said cone.

6. A filament support comprising a metal disc, insulating bushings in said disc, a perforated cone on said disc, a grooved insulator attached to the apex of said cone, and a filament supported between said disc and said insulator.

7. The filament support comprising an apertured metal disc, insulating bushings in said disc, a conical frame on said disc, a cross-piece attached to the apex of said frame insulating spools attached to said cross-piece, and a filament supported between said bushings and said spools.

In witness whereof, I hereunto subscribe my name this 27th day of May A. D., 1924.

PAUL SCHWERIN.