May 31, 1927.

W. G. HOUSKEEPER

1,630,431

ELECTRON DISCHARGE DEVICE

Filed July 29, 1922

Fig. 1

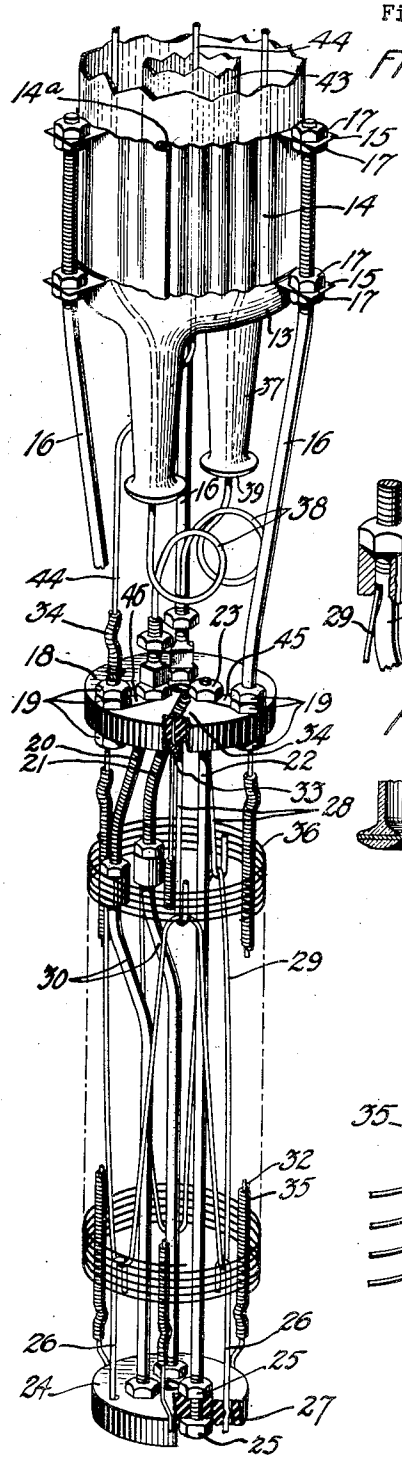


Fig. 3

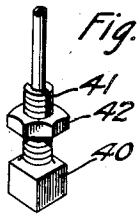


Fig. 4

Fig. 5

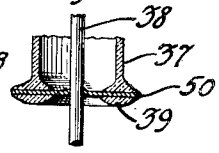


Fig. 6.

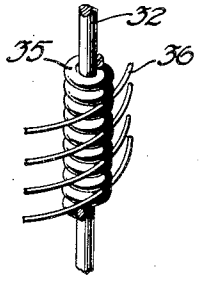
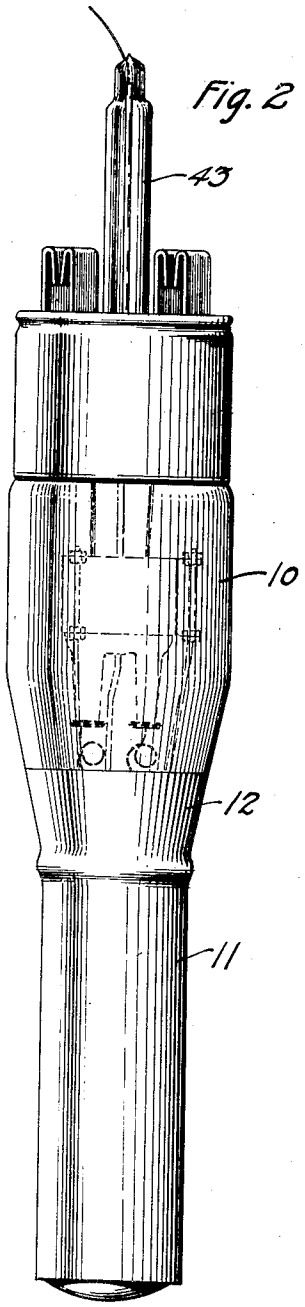


Fig. 2



Inventor:
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Patented May 31, 1927. 1,630,431

UNITED STATES PATENT OFFICE.

WILLIAM G. HOUSKEEPER, OF NEW YORK, N. Y., ASSIGNOR TO WESTERN ELECTRIC COMPANY, INCORPORATED, OF NEW YORK, N. Y., A CORPORATION OF NEW YORK.

ELECTRON-DISCHARGE DEVICE.

Application filed July 29, 1922. Serial No. 578,292.

This invention relates to electron discharge devices, and particularly to devices of this type in which the anode forms a portion of the enclosing vessel.

Electron discharge devices of the exterior anode type usually consist of a cup-shaped metallic member to which is fused a glass portion to form the enclosing vessel. The grid and cathode are supported within the metallic portion by means of spaced insulating members, one of which is supported from the glass portion by a metallic framework and the second of which is supported from the first by metallic supports. Electron discharge devices of this type are used for the generation of power and the voltages applied across the electrodes are extremely high being of the order of 20,000 volts, and the heating current for the cathode being of the order of 100 amperes. The heat generated within the device during its operation is so great that it is necessary to use for the control electrode, a highly refractory metal of low vapor pressure, such as molybdenum and the like. Control electrodes formed by welding together pieces of molybdenum or other similar metals, to form a grid have not been satisfactory because when molybdenum is subjected to the heat necessary to weld two pieces of it together, it assumes a crystalline structure which is very fragile. Welded connections between the various elements of the supporting structure and also between the leading-in wires and the electrodes have been found to be undesirable as they are not altogether reliable and often come apart.

Because of the high value of the heating current for the cathode, it is necessary that the leading-in wires be of relatively large diameter, that is in the neighborhood of $\frac{1}{16}$–$\frac{1}{8}$ inches. It is therefore impracticable to seal the leading-in wires directly into the glass as heretofore.

An object of this invention is an electrode structure and supporting means therefor wherein the connections between the various parts are entirely mechanical.

Another object of the invention is a helical wire grid structure in which the turns of the helix are supported from uprights and spaced from each other solely by mechanical means.

Another object of the invention is a grid structure wherein reinforced helices receive between adjacent turns a grid wire whereby the various reaches thereof are supported and spaced.

Another object of the invention is a grid structure wherein a grid wire is trained between turns of tightly wound helices whereby it is supported and the ends of the reaches of the grid wire are held firmly against movement.

Another object of the invention is the prevention of the accumulation of an electrical charge upon the supporting structure due to the high voltage impressed on the anode.

Another object of the invention is a simple and effective seal between the enclosing vessel and leading-in wires of relatively large current carrying capacity.

Another object of the invention is an efficient and reliable mechanical connection between the leading-in wires and the electrodes with which they are associated.

Another object of the invention is an electrode assembly and supporting means therefor which is simple in structure and efficient in operation.

Referring to the drawings:

Fig. 1 is an elevation, partly broken away, of the cathode and grid assembly and its supporting structure.

Fig. 2 is an elevation of the complete device.

Figs. 3, 4, 5 and 6 are detail views.

The enclosing vessel of the electron discharge device comprises a glass portion 10 and a cup-shaped metallic portion 11 which are joined together at 12 according to the method disclosed in my U. S. Patent No. 1,294,466, issued February 18, 1919. The cup-shaped portion 11 serves as the anode of the device and to the end of the glass portion 10 is fused an inwardly projecting stem 13. Surrounding the stem 13 is a crimped metallic collar 14, the ends of which are joined together mechanically by interlocking lips 14^a. The collar is maintained on the stem solely by friction and serves as a means for supporting the grid and cathode assembly. Projecting outwardly from the top and bottom edges of the collar are tabs 15 through which pass supporting members 16 which are attached to the tabs by means of nuts 17. The outer ends of said supporting members pass through apertures in an insulating disk 18 aranged in alignment with the inner end of the stem and are attached

to the disk by means of nuts 19. A plurality of supports 20, 21 and 22 have one set of ends passing through apertures in the disk 18 and are held in position by nuts 23. The support 22 is a straight rod whereas the supports 20 and 21 are bowed near their upper ends and are threaded approximately to the middle of the bows. The other ends of the supports 20, 21 and 22 pass through a second insulating disk 24 which is held in position thereon by nuts 25. The two disks 18 and 24 are therefore definitely fixed relative to each other and are adapted to support the grid and cathode. A plurality of hooks 26 for engaging filaments 29, are supported from the disk 24 and are held against movement toward the disk 18 by the engagement of crimps 27, in the ends of the shanks with the surfaces of apertures in the disk through which they extend. The shanks of the hooks 26 are passed through the apertures in the disk 24 before being crimped and after being arranged in position, the crimps 27 are formed therein and the hooks pulled until they are tight. A pair of filament supporting hooks 28 extend from the disk 18 toward the disk 24 and are held in position by means of crimps in their shanks which bind against the walls of the apertures through which the shanks pass. The filament 29 is trained between these hooks and the ends of the filament are attached to the bows of the supports 20 and 21. The hooks 28 are positioned after the filament has been formed and suspended from the hooks 26, and their shanks are forced into their apertures until the hooks contact with the filament. Each of the supports 21 and 22 is provided with a tapered slot 30 at its bow portion into which one end of the filament fits. A sleeve 31 is passed over each end of the filament and grips it against the support. This sleeve is held in gripping position by means of the nut 31a. The collar and nut are placed on the support while it is a straight length of wire and then the wire is bent to provide the bow portion. The hooks 26 and 28 are so arranged that the filament lies substantially on the surface of a cylinder and the bows of the uprights 21 and 22 lie on the same surface.

The grid structure comprises a plurality of molybdenum longitudinal wires 32, one set of ends of which pass through apertures in the disk 18 and which are fixed relative thereto by means of a crimp 33 in each wire exterior to the disk and a coil of wire 34 surounding and crimped to the projecting end of the each wire and having a portion bearing against the opposite surface of the disk. Around each of the wires 32 is a tightly wound helix 35 of molybnenum wire which fits the wire snugly and which is prevented from movement relative thereto by being crimped to it at each end. A molybdenum wire 36 of smaller diameter is wound around the wires 32 and is laid between turns of each helix 35 whereby it is supported and its adjacent turns are spaced apart. The winding of each helix 35 is sufficiently tight so that the lateral wire 36 is held firmly in place and the ends of the reaches thereof are prevented from sliding due to expansion and contraction of the lateral wire during the operation of the device. The other ends of the wires 32 lie against the periphery of the disk 24 whereby the grid is maintained coaxial with the supporting structure but is allowed to expand and contract longitudinally.

Projecting inwardly from the inner end of the stem are two tubular glass portions 37 through which pass the leading-in wires 38 for the cathode. These leading-in wires are of copper and because of the high current supplied to the filament are of too large a diameter to be sealed directly with the glass. To each of these leading-in wires is welded, or soldered, a thin copper disk 50 which is fused to the flare at the end of each tubular portion 37 and to one surface of which is preferably fused an annulus 39 of glass, the periphery of the copper disk being exposed. The fusing of the disk to the glass is carried out according to the disclosure in my Patent 1,293,441, issued February 4, 1919.

The ends of the leading-in wires 38 are attached to the ends of the supports 20 and 21 which project beyond the disk 18 and have threaded on them the connectors 40. A threaded sleeve 41 projects from each connector and is provided with a saw cut. The ends of the leading-in wires 38 project into the sleeves 41 which are clamped on to the ends of said wires by means of the nuts 42.

A tubular glass member 43 projects outwardly from the end of the stem 13 and in it is arranged the leading-in wire 44 for the grid. The inner end of this leading-in wire is attached to the grid by being received in one of the coils 34 to which it is mechanically attached by crimping. The other end of the leading-in wire is sealed in the extremity of the glass tube 43 thereby establishing a sufficiently long stretch of glass between the grid and filament leading-in wires to prevent leakage. This arrangement also prevents corona loss from the leading-in wire 44 to the collar 14, as the latter is fully insulated by the vacuous space between it and the leading-in wire.

The member 22 is connected by means of the link 45 to one of the supports 16 and another of the supports 16 is connected by means of a link 46 to the member 20 which is connected to one of the filament leading-in wires. As the cathode is usually grounded when the device is operated this arrangement prevents the accumulation of a charge

from the anode upon any portion of the supporting structure.

The invention claimed is:

1. In an electron discharge device, a pair of insulating members, a pair of metallic supporting members extending between said insulating members, each of said supporting members having one end threaded and a notch adjacent one end of said thread, a filament supported between said insulating members, said filament having its ends arranged in said notches, a sleeve on each of said supporting members for gripping an end of said filament against said member, and a nut on each of said supporting members for holding said sleeve in gripping position.

2. An electron discharge device comprising a vessel having a reentrant stem, a collar on said stem, tabs projecting from said collar, uprights passing through said tabs and mechanically joined thereto, and an electrode assembly supported by said uprights.

3. An electron discharge device comprising a vessel having an inwardly projecting stem, a collar on said stem, apertured tabs projecting from the edges of said collar, threaded uprights passing through said apertures, means on said threaded portions of said uprights arranged on each side of said tabs for connecting said tabs and uprights, and an electrode structure supported by said uprights.

4. An electron discharge device comprising a pair of insulating members, a plurality of metallic rods connecting said insulating members, two of said rods being notched and having threaded portions, a filament supported between said insulating members and having each end arranged in one of said notches, a sleeve for gripping said filament against said rod, and a nut on each threaded portion of said rod for holding said sleeve in gripping position.

5. An electron discharge device comprising a pair of insulating members, means for supporting one of said insulating members from the other, a plurality of uprights passing through apertures in one of said insulating members, each of said uprights being crimped adjacent the surface of said insulating member, a helix on the protruding end of each of said uprights and mechanically connected thereto, said crimp and said helix providing means for fixing said upright against motion relative to said disk, and a wire helically wound around said uprights to form a grid electrode, the opposite ends of said uprights having sliding contact with said second insulating member.

6. An electron discharge device comprising a vessel having an inwardly projecting stem, tubular members extending from said stem, leading-in wires in each of said tubular members, and disks attached to said leading-in wires and hermetically sealing the ends of said tubular portions.

7. An electron discharge device comprising an insulating disk, metallic supporting members projecting through said disk, connectors carried by said supporting members, said connectors comprising a split tubular portion, leading-in wires having their ends arranged in said tubular portions, and nuts for clamping said tubular portions against said leading-in wires.

8. An electron discharge device comprising a grid having a longitudinal supporting wire, a wire helix surrounding one end of said wire and crimped thereto, and a leading-in wire for said grid, one end of said leading-in wire being sealed within said helix and crimped thereto.

9. An electron discharge device comprising a vessel, a tubular member projecting into said vessel, a leading-in wire in said member, and a disk attached to said leading-in wire and hermetically sealing the end of said tubular portion.

In witness whereof, I hereunto subscribe my name this 19th day of July, A. D. 1922.

WILLIAM G. HOUSKEEPER.