June 5, 1934. V. L. RONCI ET AL 1,961,393

ELECTRON DISCHARGE DEVICE

Filed Dec. 11, 1929

FIG. 1

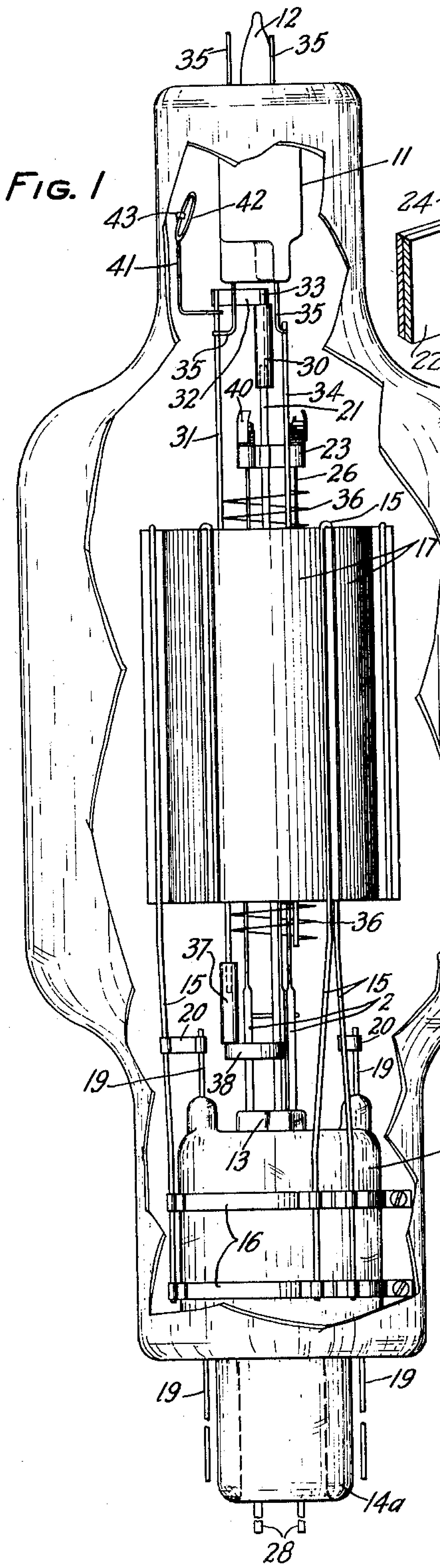


FIG. 3

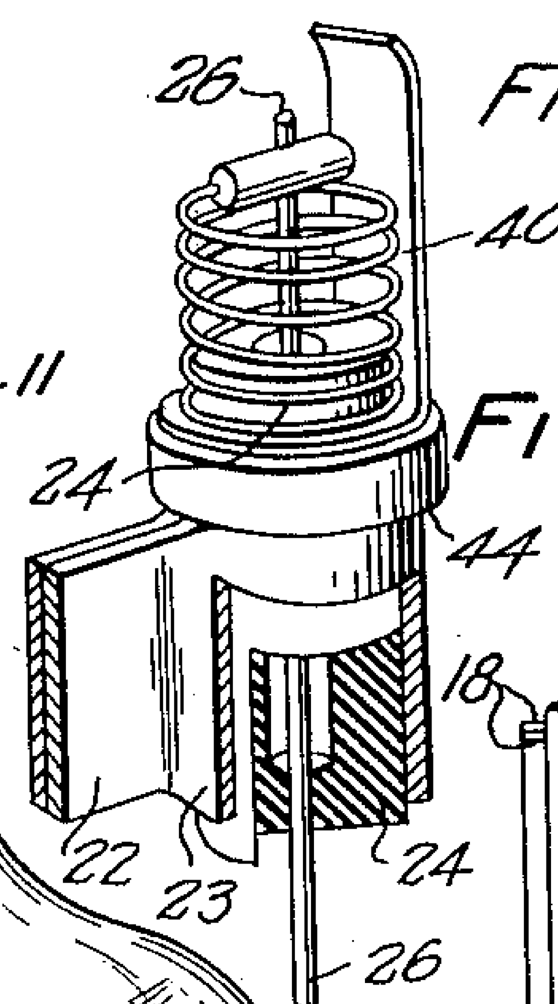
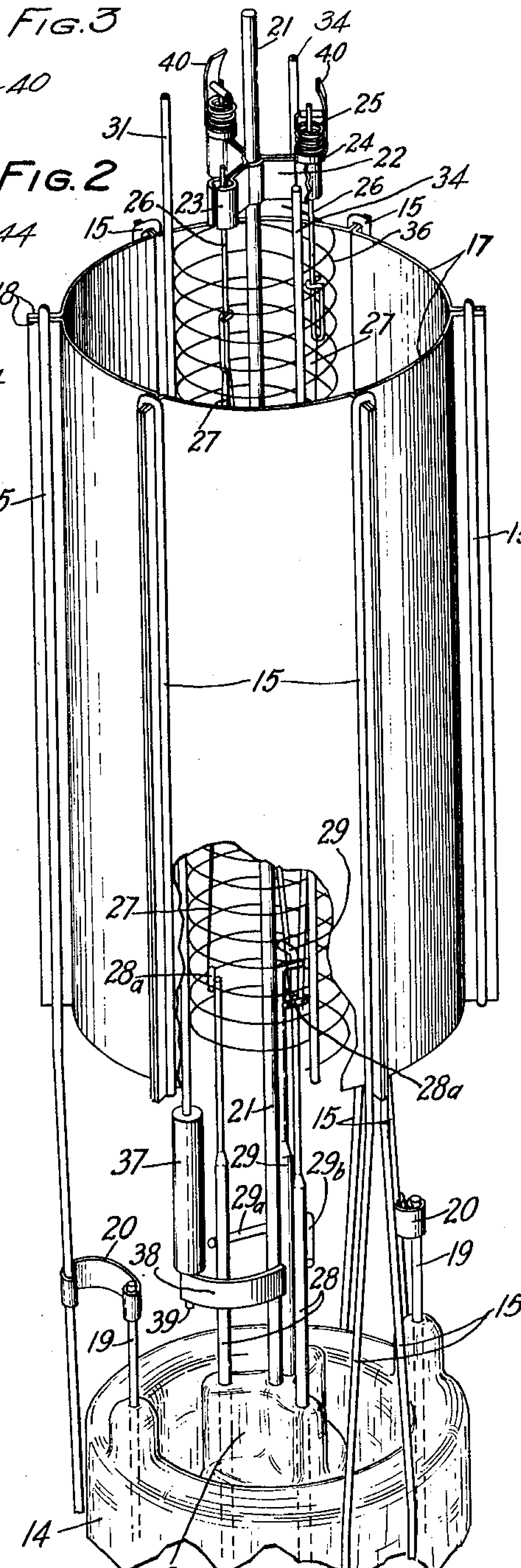


FIG. 2



INVENTORS V. L. RONCI
H. W ERICSSON

BY

Walter C. Kiesel

ATTORNEY

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ELECTRON DISCHARGE DEVICE

Victor L. Ronci, Brooklyn, N. Y., and Harry W. Ericsson, Linden, N. J., assignors to Bell Telephone Laboratories, Incorporated, New York, N. Y., a corporation of New York

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9 Claims. (Cl. 250—27.5)

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

An object of the invention is to attain a high power output of the order of one kilowatt or more from a discharge device while efficiently dissipating the heat in such a device.

In accordance with this invention the discharge device comprises a glass enclosing vessel having a stem at both ends. A large surface cylindrical anode is supported from one end and comprises a metallic cylinder formed of a plurality of flanged sections welded together with the aid of heavy tie wires which extend to the stem to support the anode. This construction facilitates assembly of the anode and the large number of flanges form fins for efficiently radiating the heat from the anode to the glass wall of the vessel which may be cooled with air. A helical wire grid is supported from the stem at the other end of the vessel and extends into the anode, the grid being coaxially spaced from the anode and permitted to move longitudinally without warping by a guiding member extending from the stem supporting the anode. The filament structure comprises a central upright member attached to the anode stem and carries a metallic spider near its free end supporting insulators which hold resiliently mounted hooks to maintain the filament in coaxial relation to the anode and grid. The filament support is also permitted to expand and contract without changing its cooperative relation with respect to the grid and anode by a guiding member projecting from the grid supporting stem.

In the proposed construction the grid electrode is assembled in the device after the filament and plate have been arranged on the opposite stem of the vessel and since the spacing of the grid and filament is relatively small there is danger of distorting the grid helix in the assembly if some precaution is not taken to overcome this difficulty. In one embodiment of this invention the filament supporting spider is provided with protective curved extensions which form skids for the grid helix. This arrangement prevents damage to the grid turns in the assembly so that the grid slides over the filament support without encountering any sharp portions of the filament structure which would tend to alter the parallel relation of the lateral grid wires.

The various features of this invention will be better understood from the following detailed description with reference to the accompanying drawing in which

Fig. 1 is a view in elevation of an electron discharge device with a portion of the container broken away to show the electrodes arranged and mounted in accordance with this invention;

Fig. 2 is an enlarged perspective view of the electrode structures showing various details of construction; and

Fig. 3 is an enlarged detail view partially in cross-section of a portion of the filament support.

Referring to the drawing, the electron discharge comprises a large diameter glass containing vessel 10 having end portions of smaller diameter. One of the end portions is provided with a reentrant stem 11 terminating in a press of Y-shaped cross-section and a central glass tubulation 12 which projects from the interior of the stem and is sealed off when the device is completely evacuated. The other end of the vessel is provided with a press 13 similar to the press on stem 11 and three concentric glass walls forming a stem 14 disposed coaxially with respect to the press 13 and vessel 10. The innermost wall extending downwardly from the press 13 is joined to the outer end of the next succeeding concentric wall as shown at *14a*, the second wall extends to the inner end of the stem 14 which in turn is joined to the small diameter portion of the vessel 10. These walls form successive reentrant and outwardly extending glass portions and provide a long insulating path between electrodes having a large difference of potential to be hereinafter described. This arrangement reduces the length of the enclosing vessel and eliminates the breakage of a relatively long glass extension affording similar insulating protection.

A cylindrical plate anode is supported from the stem 14 by a plurality of heavy wires 15 which are welded to parallel clamping rings 16 encircling the stem 14. Since excessive heat is generated in the anode during the operation of the tube it is necessary to make this element of some highly refractory material and in a form that will be sufficiently strong to withstand high temperatures. In accordance with this invention the anode is made up of a plurality of sections 17 of sheet metal, such as molybdenum, each of the sections being curved in a suitable arc and provided with longitudinal flanges 18 to enable the sections to be joined together to form a cylindrical anode as shown. In the manufacture of this type of electrode mechanical joints would introduce difficulties in degassing the electrode and riveting would be costly and cumbersome. If attempts are made to spot weld the flanges together the temperatures required to produce the arc become so great as to cause the material to melt because of the thinness of the material. This difficulty is overcome, however, in accordance with this invention by crimping heavy wires 15 of hairpin formation along the outer surfaces of the flanges to form a preliminary joint and welding the flanges together by placing the welding electrodes against the hairpin wires 15. It is found that this arrangement provides the necessary spacing of the welding electrodes to draw an arc and a potential gradient is obtained whereby a sufficient temperature is produced to make a good weld between the flanges 18 without melting the metal. The hairpin wires 15 also serve an additional function in supporting the anode from the stem 14. The flanges also help to increase the heat radiating surface of the anode. The anode is also provided with a roughened surface which may be obtained by a carborundum blast, to further increase heat radiation from the anode. A leading-in wire 19 is sealed in the stem 14 at opposite ends of one diameter of the stem and is connected to the anode supporting wires 15 by curved metallic strips 20 welded thereto.

Associated with the anode is an electron emitting cathode or filament, preferably of tungsten, which is supported by an upright rod 21 which is embedded in the press 13 and carries near its free end a metallic spider 22 formed of three V-shaped members welded together and to the rod 21 and having split curved portions or yieldable clips 23 at the ends which frictionally hold perforated insulators or spools 24. The insulator 24, as clearly shown in Fig. 3, is provided with a ridge 44 to limit the movement of the insulator in the clip 23 in a direction toward the press 13. These insulators serve to support helical compression springs 25 which are attached to wires 26 which have a shank extending through the insulator 24 on the spider arms and a safety hook for engaging the bight of the filament sections 27. These sections comprise three inverted V-shaped tungsten filaments each suspended from a hook and extending toward the stem 13. A pair of leading-in wires 28 are sealed in two of the legs of the Y-shaped press 13 and are provided with short wires 28*a* to which one end of two of the sections of filament are attached. A pair of metallic rods 29 having bent free ends which are attached to the ends of the third section of filament are also embedded in the remaining leg of the Y-shaped press and together with the leading-wires 28 serve to convey heating current to the sections of filament in multiple. This is accomplished by connecting one of the leading-in wires 28 and one of the rods 29 by a tie member 29*a* and connecting the other leading-in wire 28 and the other rod 29 by a tie member 29*b*. In this arrangement all the sections of the filament 27 are disposed in a cylindrical boundary concentric with the anode in order to supply a uniform emission of electrons from the filament to all portions of the anode.

During the operation of the device the filament supporting rod 21 is subject to intense heat from the filament and in order to allow free expansion thereof without warping or changing the space relation of the filament with respect to the anode the free end of the rod is slidably fitted in a guiding member comprising a tubular quartz sleeve 30 which is axially supported in the device by a metallic band 32 welded to a pin 33 embedded in the quartz sleeve 30 and an upright metallic member or rod 31. The rod 31 together with two similar rods 34 is supported from the stem 11 by leading-in wires 35 bent at their inner ends and attached to the rods to form a rigid structure. The rods 31 and 34 are equally spaced from each other and a helical wire grid or control electrode 36 is welded to the inner surface thereof. In order to allow free expansion of the grid the free end of the rod 31 is slidably held by a guiding member comprising a tubular quartz sleeve 37 eccentrically supported with respect to the axis of the vessel 10 by a metal band 38 welded to a pin 39 fused in the quartz sleeve and attached to the central upright rod 21.

In the assembly of the electrodes in the device the grid 36 is inserted after the filament 27 and the anode 17 have been mounted on the press and stem respectively of the vessel. Furthermore, the device being a voltage amplifier requires the grid to be very close to the filament. In view of this requirement there is danger of distorting or injuring the grid helix during assembly. In accordance with this invention this difficulty is overcome by providing the filament supporting spider arms 22 with protective curved extensions 40 which act as skids for the grid helix. In this arrangement, the grid slides over the filament supporting structure without catching on the compression springs 25 or in any way encountering any portions of the filament structure which would tend to alter the relation of the turns of the grid helix. A bent metallic wire 41 attached to a grid upright rod 31 extends into the space between the stem 11 and the wall of the vessel 10 and terminates in a ring portion 42 to which is applied getter material 43 such as magnesium pellets which when vaporized and the vapor deposited on the glass portion of the vessel after the final evacuation process is completed fixes residual gases and maintains a high vacuum in the device.

The complete assembly of the electrodes in the device affords a high degree of insulation between electrodes of different potential which is of particular importance in the operation of electron discharge devices in high frequency short wave systems. Furthermore the electrodes are constructed to withstand high voltage operating conditions without warping and changing their accurate space relationship since the grid and filament supporting structure is always maintained in coaxial position and allowed to expand and contract in a longitudinal direction. The filament is also allowed to expand individually by sliding in the guiding slot of the safety hooks supporting the bight of the filament.

While the description of this invention relates to specific details of construction it is of course understood that various modifications may be made without departing from the scope of the invention as defined in the appended claims. It is also to be understood each feature of the invention may be employed in a device in exclusion to other features and that the invention is not limited to the combination of all the features as a cooperative structure.

What is claimed is:

1. In an electron discharge device a large surface anode comprising flanged sections coupled together with the flanges in face to face relation, and hairpin-shaped tie members engaging the outer surface of each of the flanges.

2. In an electron discharge device, a stem, a support comprising an upright member extending from said stem, a metallic spider member

having radiating arms attached to said upright member, insulators supported in said arms, resilient members mounted on said insulators, and an electrode supported at one end from said stem and at the other end by said resilient members.

3. In an electron discharge device, a support comprising an upright member, a metallic member having radiating arms attached to said upright member, an insulator held in each of said arms, resiliently mounted hooks extending from said insulators, an electrode carried by said hooks, and guide members on said arms extending over said insulators and hooks.

4. An electron discharge device comprising an enclosing vessel having a stem at each end thereof, said stems being in alignment with each other, an upright member extending from one stem, a plurality of rods supported parallel to said member from the other stem, means mounted on one of said rods for guiding one end of said upright member, a helical wire grid mounted on said rods, a cathode supported by said upright member, and means supported from said upright member for guiding one of said rods and allowing free longitudinal movement thereof.

5. In an electron discharge device, a glass enclosing vessel having a stem at each end thereof in alignment, an upright member extending from one stem, a metallic member having radiating arms attached to said upright member, an insulator held in each of said arms, resiliently mounted hooks extending from said insulators, an electrode suspended from said hooks, and a guiding member supported from said other stem engaging said upright member and allowing longitudinal movement thereof.

6. An electron discharge device comprising a glass enclosing vessel having a reentrant stem at each end, a filament structure supported from one stem, a grid structure supported from the other stem, guiding means for said filament structure supported from said grid structure, and guiding means for a portion of said grid structure supported from said filament structure.

7. In an electron discharge device having a glass stem, a metallic collar encircling said stem and clamped thereto, a plurality of looped wires welded to said collar and extending lengthwise of said stem, and a sectional closed anode supported by said wires.

8. In the fabrication of a hollow anode for electron discharge devices from a plurality of curved sections having longitudinal flanges, the method which comprises positioning the sections with corresponding flanges together to form a closed body, crimping a heavy wire around adjacent flanges, and spot welding said flanges and wires together.

9. An electron discharge device comprising an enclosing vessel having a reentrant stem at each end, a rigid rod embedded in one of said stems and extending lengthwise of said vessel, a filamentary cathode suspended from said rod, a rigid support extending from the other of said stems and parallel to said rod, an electrode mounted on said support, a guide member for said rod mounted on said support, and a guide member for said support carried by said rod.

VICTOR L. RONCI.
HARRY W. ERICSSON.