June 19, 1934. W. G. URMSON 1,963,254

ELECTRON DISCHARGE DEVICE

Filed Jan. 7, 1931

Fig. 1.

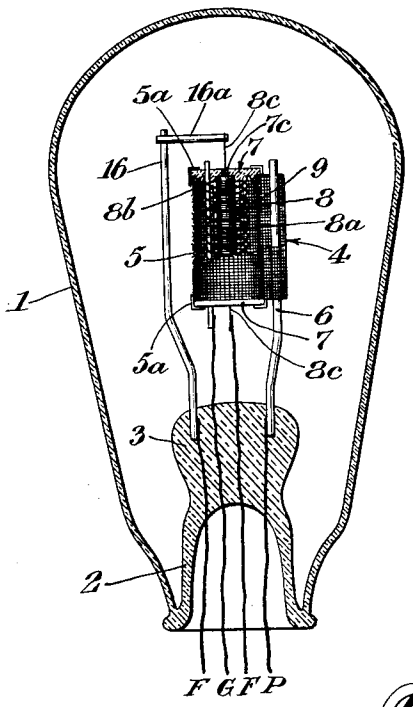


Fig. 2.

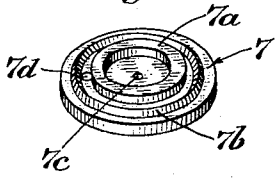


Fig. 3.

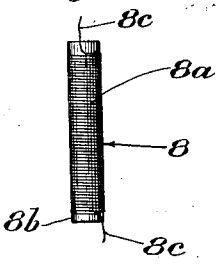


Fig. 4.

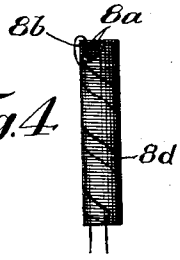


Fig. 5.

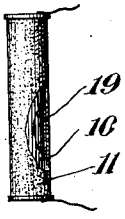


Fig. 6.

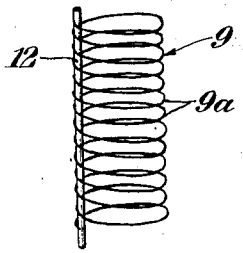


Fig. 7.

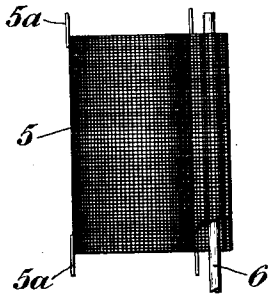
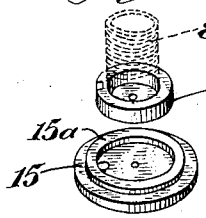


Fig. 8.



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BY his ATTORNEY

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Patented June 19, 1934

1,963,254

UNITED STATES PATENT OFFICE

1,963,254

ELECTRON DISCHARGE DEVICE

William G. Urmson, Hamden, Conn., assignor, by mesne assignments, to Radio Research Laboratories, Inc., a corporation of Delaware

Application January 7, 1931, Serial No. 507,117

11 Claims. (Cl. 250—27.5)

My present invention relates to improvements in electron discharge devices.

One object of the invention is to provide a compact and efficient co-ordination of the electrodes in rectifier and radio tubes and the like, whereby they are maintained in proper space relationship against accidental dislocation and whereby they constitute a unitary structure adapted to be readily supported in the tube, and whereby the respective electrodes may be readily connected to the lead-in wires from the press of the tube.

Another object is to provide a unitary structure wherein provision is made for a heater type of cathode comprising a high resistance heater energizable with high voltage and low amperage current directly from a source having voltage comparable to that of a house lighting circuit; and wherein provision is made for an electron emissive cathode in connection with the heater so as to be heated thereby to emissive temperature. The heater type cathodes referred to include, for example, those disclosed in the copending applications of present patentee Urmson Serial No. 507,116 filed Jan. 7, 1931, and David A. Barnett Serial No. 507,133 filed Jan. 7, 1931.

Other objects and advantages of the invention will become apparent as this specification proceeds.

With the aforesaid objects in view, the invention consists in the novel combinations and arrangements of parts hereinafter described in their preferred embodiments, pointed out in the claims, and illustrated in the drawing wherein like parts are designated by the same reference characters throughout the several views.

In the drawing, Fig. 1 is a combined sectional and elevational view of a three electrode radio tube embodying my invention; Fig. 2 is a perspective view of one of the insulating caps detached from the construction shown in Fig. 1; Fig. 3 shows a heater cathode of the type disclosed in Urmson Serial No. 507,116; Fig. 4 shows another type of heater-cathode as disclosed in Barnett Serial No. 507,133; Fig. 5 is still another form of heater-cathode disclosed in Urmson Serial No. 507,116; Fig. 6 shows the grid element detached from the construction shown in Fig. 1; Fig. 7 shows the plate element detached from the construction shown in Fig. 1; and Fig. 8 shows a two-piece insulating cap construction as a substitute for the one-piece insulating cap of Figs. 1 and 2, the dotted lines in this figure serving to indicate the relation in a fragmentary way of the various electrodes to this cap construction.

The advantages of the invention as here outlined are best realized when all of its features and instrumentalities are combined in one and the same structure, but useful devices may be provided embodying less than the whole.

It will be obvious to those skilled in the art to which this invention appertains that the same may be incorporated in several different constructions. The accompanying drawing, therefore, is submitted merely as showing preferred illustrative embodiments of the invention but without limiting the invention thereto.

Describing now the devices of the drawing embodying, as stated, preferred illustrative forms of the invention, 1 is the glass envelope of an electron discharge tube, 2 is the stem, 3 the press. The tube in Fig. 1 happens to illustrate a three-electrode radio tube having combined heater-cathode element, a grid and a plate. These three elements are operatively supported insulated from one another to constitute a unitary structure designated in general 4 as follows: The plate 5 (compare Fig. 7) consists of a thin sheet of metal or woven wire bent into cylindrical form with its free ends wrapped around and welded to a wire 6 sufficiently heavy to support the entire unitary structure from the press 3. The open ends of the tubular element thus formed are closed by two discs or caps 7 made of any suitable refractory insulating material. These discs are alike in construction and are held in place against the ends of the tubular electrode by means of lugs 5^a from the plate bent around the edge of the discs to hold them in place. Each disc or cap (compare Fig. 2) has on its inner face two concentric annular ridges 7^a and 7^b, the inner ridge enclosing a center recess and the inner and outer together forming an annular recess. The ends of the cylindrical heater-cathode element 8 are seated in the center recess of the caps; and the ends of the hollow cylindrical grid 9 are seated in the annular recess of the caps.

The combined heater-cathode element may take various forms but in general constitutes a high resistance heater combined with a cathode or itself constitutes the cathode by being made of emissive material or by being coated with emissive material.

Some of the specific forms which this heater-cathode may take are as follows: It may consist, as in the aforesaid Urmson case, of a closely wound coil 8^a of fine wire (Figs. 1 and 3) such as tungsten, supported on a cylinder 8^b of refractory insulating material so as to constitute a high resistance coil which, when energized by volt-

ages comparable with house lighting voltage, carries a few milli-amperes current and is heated to a temperature sufficient to cause electron emission from the emissive material with which the coil is coated. The terminals 8^c of the coil extend respectively through minute center holes 7^c in the insulating caps 7 for connection with the lead-in wires F—F coming through the press of the tube. The upper terminal 8^c connects with a horizontal wire 16^a supported by a wire 16 from the press.

Another form of the heater-cathode element, as in the aforesaid Barnett case, consists of the high resistance wire coil 8^a (Fig. 4) but supported inside of a refractory insulating cylindrical shell 8^b instead of on the outside. In this form, a metallic conductor 8^d constituting the cathode is supported on the outside of the insulating shell so as to be separated thereby from the coil. This outside conductor is made of an electron emissive metal or is made of a metal coated with electron emissive material, and said conductor may take the form of a winding or be a thin cylindrical plate or tube. In any event, as above, the combined heater-cathode is supported axially within the unitary structure by having its ends seated in the discs or caps 7. The aforesaid cathode 8^d may be electrically distinct from the heater coil and may have its own separate terminal connected with its own lead-in wire. In that event, the ends of the heater coil will have their own separate lead-in wires. On the other hand, the heater coil may be connected in series with the cathode as in Fig. 4, in which event there will be only two lead-in wires to the heater-cathode element.

Still another form of heater-cathode element may comprise, as in said Urmson case, a rod 19 (Fig. 5) of an electrically conductive but high resistance composition of materials, such as carborundum, siloxicon, carbon and other ingredients in the proper proportion to give a high resistance comparable to that of the aforesaid heater coil of somewhat similar dimensions. This rod may then be coated with a thin layer of electron emissive material 10.

Indeed, the combined heater-cathode may take other forms but the above are deemed to be sufficiently illustrative.

The grid 9 when present may consist of a cylindrical, open mesh structure supported between the caps 7 by having its ends seated in the annular recess thereof concentric with the heater-cathode. The particular form illustrated (Figs. 1 and 6) consists of a cylindrical wire coil 9^a to one side of which is welded a wire 12 parallel to the axis of the coil. Thus, this wire 12 integrates the coil and supports its various spirals in spaced apart relationship. The ends of this wire project through minute holes 7^d in the caps convenient for connection with the lead-in wire G for the grid.

It will be seen that the correlated and united caps and electrodes form a unitary structure supported from the press on the wire 6 welded to the side of the hollow plate electrode 5. This wire also serves to connect with the lead-in wire P for the plate.

The insulating discs or caps each may be made of two pieces as shown in Fig. 8 but otherwise the essential structure is the same as the one-piece form above described. Thus, referring to this Fig. 8, the inner piece consists of a cylindrical-walled cup 14 and the outer piece consists of a circular base 15 having an annular ridge 15^a located on one face near its outer periphery. The base of the cup-shaped piece 14 fits down into the space within the annular ridge of the outer piece.

To use this two-piece form of cap, two of the cups 14 are fitted over the ends of the heater-cathode 8 and are secured thereon by means of any suitable refractory insulating cement with the terminals of the heater element coming out of axial holes through the bottom of the cups. The heater-cathode element is then supported with these cups seated within the annular ridge of the other part and with the terminals of the elements passing through axial holes therein. The grid 9 surrounds the heater-cathode element as before with its supporting rod 12 passing through holes adjacent the inner side of the annular ridge. The grid is held from contact with the heater-cathode because its cylindrical ends are seated about the cup parts 14. The cylindrical plate 5 has its open ends closed by the parts 15 and these are held in place as before by the bent over lugs 5^a of the plate.

Of course, in rectifier tubes the grid 9 (Fig. 1) will be omitted.

What I claim is:

1. In an electron discharge tube, a unitary structure supported therein comprising a hollow plate electrode, insulating caps closing the ends of the hollow plate, said caps having a center recess and a surrounding annular recess; a heater-cathode element supported axially within the hollow plate with its ends seated in the center recesses of the caps; and a hollow grid surrounding the heater-cathode with its ends contained in the annular recesses of the caps.

2. In an electron discharge tube, a unitary structure supported therein comprising a hollow plate electrode, insulating caps at the ends of the hollow plate, said caps having annular grooves, a heater-cathode element supported by said caps in axial position within the hollow plate; and a hollow grid supported by the grooves in said caps in surrounding position relatively to the heater-cathode, the caps having orifices for the passage of the terminals of the heater-cathode and grid.

3. In an electron discharge tube, a unitary structure supported therein comprising a hollow plate electrode, insulating caps at the ends of the hollow plate, said caps having annular grooves, a heater-cathode element supported by said caps in axial position within the hollow plate; and a hollow grid supported by the grooves in said caps in surrounding position relatively to the heater-cathode, said grid comprising a wire coil to one side of which is welded a terminal wire parallel with the axis of the coil; the caps having holes receiving through them the ends of said grid terminal wire.

4. In an electron discharge tube, a unitary structure supported therein comprising a cylindrical plate electrode, insulating caps at the ends of said cylindrical plate, said caps having annular grooves, a heater-cathode element supported by said caps in axial position within the cylindrical plate; a hollow grid supported by the grooves in said caps in surrounding position relatively to the heater-cathode; and means for supporting said unitary structure comprising a sufficiently heavy wire projecting from the press of the tube and welded to the side of the cylindrical plate.

5. In an electron discharge tube, a unitary structure supported therein comprising a hollow plate electrode, a hollow grid, insulating caps

closing the ends of the hollow plate, said plate having bent up lugs engaging the caps securing them in place; said caps having a center recess and annular grooves to receive the ends of said grid; and a heater-cathode element supported axially within the hollow plate with its ends seated in the center recesses of the caps.

6. In an electron discharge tube, a unitary structure supported therein comprising a hollow plate electrode, a hollow grid electrode, insulating caps closing the ends of the hollow plate, said plate having bent up lugs engaging the caps securing them in place, said caps having a center recess and annular recesses in said grooves to receive the ends of said grid; a heater-cathode element supported axially within the hollow plate with its ends seated in the center recesses of the caps; and means for supporting said unitary structure comprising a wire projecting from the press of the tube welded to the side of the hollow plate.

7. In an electric discharge device, a cathode, a tubular grid, a tubular anode, and insulator caps on both ends of said anode, said caps having concentric grooves for spacing the cathode grid and anode.

8. In an electric discharge device, a tubular cathode, a tubular grid, a tubular anode, and insulator caps on both ends of said anode, said caps having concentric grooves for spacing the cathode grid and anode.

9. In an electric discharge device, a tubular anode, insulating caps on both ends of said anode, each cap having a plurality of annular grooves therein, a cathode element supported by the inner grooves in said caps in axial position within said tubular anode, and a hollow grid intermediate said anode and cathode, the ends of said grid being seated in the outer grooves in said caps.

10. An electrode assembly comprising a pair of insulating members and a plurality of electrodes, including cathode, anode, and control grid, said insulating members having a number of parallel projections thereon to separate the ends of said electrodes, and means including said projections for maintaining all of said electrodes in concentric spaced relation.

11. An electric discharge device comprising an enclosing receptacle, insulating blocks within said receptacle, said blocks having a plurality of similar projections, and cathode grid and anode electrodes seated in said blocks and maintained in spaced relation by said projections.

WILLIAM G. URMSON.

DISCLAIMER

1,963,254.—*William G. Urmson,* Hamden, Conn. ELECTRON DISCHARGE DEVICE. Patent dated June 19, 1934. Disclaimer filed April 19, 1935, by the assignee, *Radio Research Laboratories, Inc.*

Hereby enters this disclaimer to the following claims of said patent, to wit:

Claims 2, 3, 4, 7, 10 and 11.

[*Official Gazette May 14, 1935.*]