

April 13, 1937.

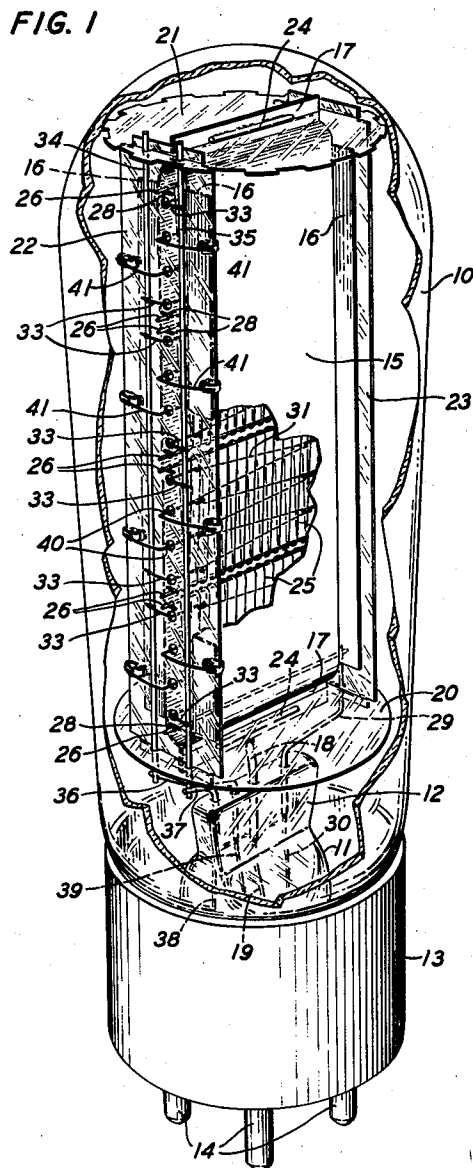
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2,077,177

ELECTRON DISCHARGE DEVICE

Filed April 27, 1935

2 Sheets-Sheet 1



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FIG. 2

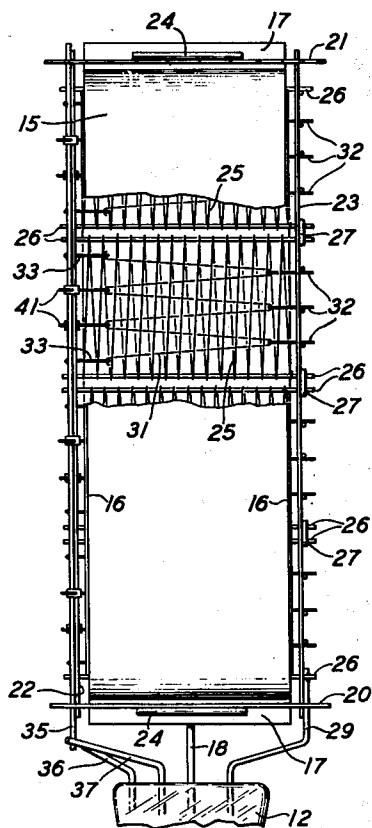


FIG. 3

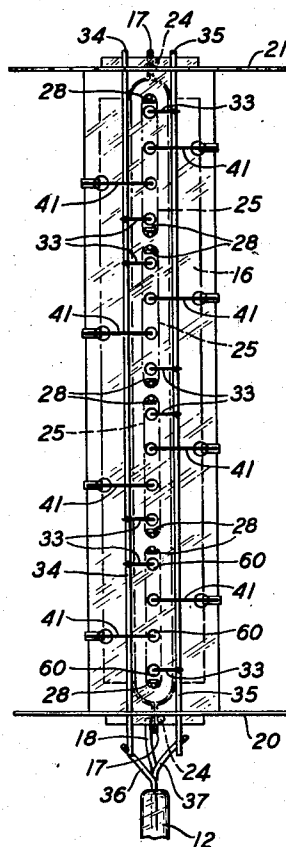


FIG. 4

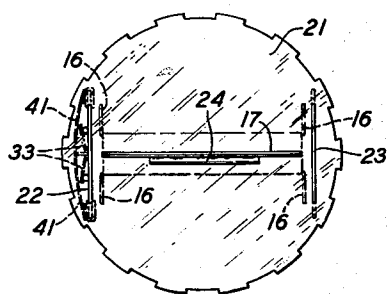
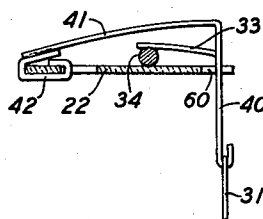


FIG. 5



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ELECTRON DISCHARGE DEVICE

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14 Claims. (Cl. 250—27.5)

This invention relates to electron discharge devices and more particularly to such devices particularly adapted for audio-frequency amplification.

One object of this invention is to increase the power capacity and mutual conductance of electron discharge devices.

In one embodiment of this invention an electron discharge device comprises an anode, a plurality of grid electrodes within the anode, and a plurality of electrically connected cathode elements within the grid electrodes, the grid electrodes being electrically connected together and disposed side by side.

In accordance with a feature of this invention, the anode is in the form of a flattened cylinder, for example hollow and substantially rectangular in form, and the grid electrodes are flattened helices having their longer sides disposed parallel to and equally spaced from the longer sides of the anode. The cathode elements may each consist of a plurality of V-shaped filamentary sections disposed in medial planes of the helical grids parallel to the longer sides of the anode. This construction enables relatively small and substantially uniform electrode spacings and also provides an extended effective cathode surface so that a relatively high mutual conductance is obtained. Furthermore, it enables the use of a relatively large anode and cathode so that a high power capacity for the device is obtained.

In accordance with another feature of this invention, the grid electrodes and the cathode elements are supported from an insulating frame disposed about the anode and having arms extending across the open sides thereof. The grids may be mounted on metallic rods extending through the arms, and the cathode elements may be engaged by resilient members extending from one of the arms.

In accordance with a further feature of this invention, the insulating frame is supported by the anode so that all of the electrodes may be fabricated in a unitary assembly which may be supported from the stem of the enclosing vessel by a metallic member secured to the anode.

The invention and the features thereof will be understood more clearly and fully from the following detailed description with reference to the accompanying drawings in which:

Fig. 1 is a perspective view of an electron discharge device illustrative of one embodiment of this invention with portions of the enclosing vessel and of the anode broken away to show details of the electrode structure more clearly;

Fig. 2 is a front view in elevation of the electrode assembly embodied in the device shown in Fig. 1, a portion of the anode being broken away to show details of the grid and cathode elements more clearly;

Fig. 3 is a side view of the electrode assembly shown in Fig. 2 to illustrate the small spacing between the electrodes;

Fig. 4 is a top view of the electrode assembly shown in Fig. 2; and

Fig. 5 is an enlarged detail view of a portion of the supporting system for the cathode.

Referring now to the drawings, the electron discharge device shown therein comprises an enclosing vessel 10 having a stem 11 terminating in a press 12, and having secured to one end thereof an insulating base 13 carrying a plurality of terminal prongs 14 through which the electrodes of the device may be associated with an external circuit.

An electrode assembly is supported from the stem 11 and comprises a flattened cylindrical or substantially rectangular hollow anode 15, which may be formed of two metallic plates having longitudinal flanges 16 and end flanges 17, the corresponding end flanges of the two plates being secured together as by welding. The flanges 16 serve to increase the rigidity of the anode thereby preventing distortion thereof by heat during the outgassing treatment and operation of the device. The anode 15 may be supported by a single rigid metallic rod 18 secured to the lower end flanges 17 and embedded in the press 12. The rod 18 may be connected to one of the terminal prongs 14 by a conductor 19 and serve as a portion of the leading-in system for the anode.

The anode 15 supports and is encompassed by an insulating frame which comprises end members 20 and 21, for example, mica discs, and longitudinal members or arms 22 and 23, for example, mica strips, extending across the open ends of the anode 15. The longitudinal strips 22 and 23 may be provided with reduced end portions which extend through slots in the end discs 20 and 21 and form shoulders against which the discs 20 and 21 abut. The discs 20 and 21 may be provided also with diametrically extending slots for receiving the flanges 17 on the anode 15, and are held securely against the shoulders on the arms or strips 22 and 23 by metallic members or wires 24 suitably secured, as by welding, to the flanges 17. As shown clearly in Figs. 1 and 4 the periphery of the upper insulating disc 21 may be serrated and may engage the inner

wall of the enclosing vessel to prevent lateral displacement of the electrode assembly.

Disposed within the anode 15 are a plurality of flattened helical grids 25 which are disposed in alignment and with their longer sides parallel to and equally spaced from the inner surfaces of the anode in juxtaposition thereto. The grids 25 are each supported by parallel metallic rods 26 which extend between the insulating strips 22 and 23 and are fitted in apertures in the strips. The several grids are connected together electrically by a plurality of metallic stubs 27, shown clearly in Fig. 2, which are secured to the rods 26 as by welding and bear against the insulating strip 23. The rods 26 may be held in position by the stubs 27 and by other stubs 28 which are affixed to the rods and bear against the insulating strip 22. The lowermost of the rods 26 is affixed to a bent metallic support 29 embedded in the press 12 and connected to one of the terminal prongs 14 by a conductor 30.

Each of the grids 25 encompasses a cathode element, which may be a filament 31, formed of a plurality of V-shaped sections, and which preferably is disposed in a medial plane of the corresponding grid, parallel to the longer sides of the grid. The cathode sections may be supported at one extremity by a plurality of hook members 32 extending from and carried by the insulating strip 23 and at the other extremity by resilient hook members 33 and 41. The ends of each of the cathode elements are engaged by resilient hook members 33 passing through guide apertures 60 in the strip 22, extending from rigid metallic uprights or wires 34 and 35 and suitably affixed thereto. The uprights or wires 34 and 35 extend through the end discs 20 and 21 and are secured to rigid bent wires 36 and 37 respectively embedded in the press 12. The bent wires, in turn, are connected to two of the terminal prongs 14 by conductors 38 and 39 respectively so that the uprights 34 and 35 form a part of the leading-in system for the several cathode sections. As clearly shown in Fig. 3, one end of each of the filaments 31 is connected to the upright or wire 34 and the other end is connected electrically to the upright or wire 35, so that the several filaments are electrically in parallel. Inasmuch as adjacent ends of the several filaments are at opposite potentials, the filaments form and are disposed in a substantially equipotential plane so that substantially uniform flow of electrons results from the cathode sections to the anode.

The bights of the filamentary cathode elements 31 adjacent the strip 22 are engaged by L-shaped members, each of which, as shown clearly in Fig. 5, includes a hook portion 40 passing through an aperture 60 in the insulating strip 22 and engaging one of the bights, and a bowed resilient arm 41 which is suitably affixed, as by welding, to a metallic clip 42 bent around an edge of the strip 22 and crimped to the strip. The members 40, 41 maintain the several filaments 31 taut, so that uniform spacing between the filaments and the grids is maintained during operation of the device.

The construction in accordance with this invention enables the attainment of substantially uniform spacing between all parts of the cathode and the anode and grids, allows the use of very small electrode spacings, and provides an extended effective cathode surface so that a relatively high mutual conductance is obtained. Moreover, it will be apparent that the electrodes may be fabricated as a unitary assembly exter-

nally of the enclosing vessel and may be mounted as a unit upon the stem 11.

Although the invention has been described with reference to devices having filamentary cathodes, it may be embodied in devices having heater type cathodes. Furthermore, although a specific embodiment of this invention has been shown and described, it will be understood, of course, that various modifications may be made therein without departing from the scope and spirit of this invention as defined in the appended claims.

What is claimed is:

1. An electron discharge device comprising a hollow anode, an insulating frame having arms extending across the sides of said anode, a plurality of grid electrodes within said anode and disposed side by side, means supporting said grid electrodes from said arms, a plurality of cathode elements within said grid electrodes, and supporting means on said arms engaging said cathode elements.

2. An electrode unit for electron discharge devices, comprising a hollow anode, a frame carried by said anode and having insulating arms extending across the sides thereof, a plurality of grid electrodes within said anode and disposed side by side, a plurality of supports for said grid electrodes extending between said arms and carried thereby, a plurality of filament elements disposed one within each of said grid electrodes, supporting means mounted on one of said arms and engaging said filament elements, and a plurality of resilient members mounted on the other of said arms and engaging said filament elements.

3. An electron discharge device comprising a hollow substantially rectangular shaped anode, a frame surrounding said anode having insulating arms extending across the sides of said anode, a plurality of flattened helical grids within said anode and equally spaced therefrom, said grids being electrically connected together, means supporting said grids from said arms, a filamentary cathode element within each of said grids, and means supporting said cathode elements from said arms.

4. An electrode assembly for electron discharge devices, comprising a substantially rectangular shaped anode open at opposite sides, an insulating frame encompassing said anode and carried thereby, said frame having arms extending across the open sides of said anode, a plurality of flattened helical grids within said anode and disposed side by side, supporting members for said grids extending between said arms and carried thereby, a plurality of multi-section filamentary cathodes disposed one within each of said grids, supporting means mounted on one of said arms and engaging the sections of said cathodes, and resilient means on another of said arms and engaging said sections.

5. An electron discharge device comprising a hollow substantially rectangular shaped anode, a plurality of flattened cylindrical grids within said anode and disposed side by side, a plurality of cathode elements disposed one within each of said grids, insulating means adjacent opposite extremities of said anode and carried thereby, and means supporting said grids from said insulating means.

6. An electron discharge device comprising a flattened cylindrical anode of substantially rectangular shape, a plurality of substantially rectangular grids disposed within said anode and side by side, the longer sides of said grids being parallel to the longer sides of said anode, a plu-

5 rality of cathode elements disposed one within each of said grids and in a medial plane thereof, insulating members extending across opposite sides of said anode and carried thereby, and sup-
 10 porting means for said cathode elements affixed to said insulating members.

15 7. An electron discharge device comprising a substantially rectangular anode, a plurality of rectangular grids within said anode and disposed side by side, said grids having their longer sides parallel to and equally spaced from the longer sides of said anode in juxtaposition thereto, a plurality of cathode elements disposed one within each of said grids, each of said cathode elements
 20 including a plurality of filamentary sections disposed in a medial plane of the corresponding grid and parallel to the longer sides of said anode, an insulating frame encompassing said anode and carried thereby, and means supporting said
 25 grids and said cathode elements from said frame.

8. An electron discharge device in accordance with claim 7 comprising means electrically connecting said grids together, and means connect-
 30 ing said cathode elements electrically in parallel.

35 9. An electron discharge device comprising a hollow anode, insulating members adjacent opposite extremities of said anode, a plurality of cathode elements disposed within said anode and extending substantially parallel to said insulat-
 40 ing members, a pair of conducting members extending between said insulating members and at substantially right angles to said cathode elements, and means electrically connecting said
 45 cathode elements to said conducting members.

10. An electron discharge device comprising a hollow anode, insulating members adjacent opposite extremities of said anode and carried by said anode, a plurality of filamentary cathode elements within said anode, a pair of conducting
 40 members extending between said insulating members, means connecting one end of each of said cathode elements to one of said conducting members, and means connecting the other end of each of said cathode elements to the other of
 45 said conducting members.

11. An electron discharge device comprising a flattened cylindrical anode having opposite open sides, an insulating frame carried by said anode, said frame including arms extending across the
 50 open sides of said anode and members extending adjacent opposite ends of said anode, a pair of conducting members extending between said

members and disposed adjacent one of said arms, a plurality of filamentary cathode elements within said anode, means electrically connecting each of said cathode elements to said conducting members, resilient means carried by said one arm and engaging said cathode elements, and supporting means carried by the other of said arms and engaging said cathode elements.

12. An electron discharge device comprising a hollow anode having opposite open sides, an insulating frame carried by said anode and including arms extending across the open sides of said anode and disc members extending across opposite ends of said anode, a pair of conducting members extending between said disc members and disposed adjacent one of said arms, a plurality of helical grids within said anode and disposed side by side, means supporting said grids from said arms, a plurality of cathode elements disposed one within each of said grids, means electrically connecting one end of each of said cathode elements to one of said conducting members, means electrically connecting the other end of each of said cathode elements to the other of said conducting members, resilient members carried by said one arm and engaging said cathode elements, and means carried by and extending from the other of said arms and engaging said cathode elements.

13. An electron discharge device comprising a vessel having a stem, a flattened cylindrical anode extending beyond said stem with its lateral axis at right angles to said stem, upper and lower insulating discs supported by said anode and mounted axially with respect to said vessel, insulating strips extending across the open sides of said anode and supported by said discs, a helical grid positioned within said anode, a pair of supports for said grid extending between said insulating strips, and a cathode within said grid and supported by the insulating strips.

14. An electron discharge device comprising a hollow anode having open sides and end flange portions, an insulating disc having a slot fitted over each flange portion and secured thereto, an insulating strip spaced from one open side of said anode and having portions engaging the insulating discs, a grid and a cathode positioned within said anode, and means engaging said cathode and grid supported by said strip.

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