March 22, 1938. V. L. RONCI 2,111,602

ELECTRON DISCHARGE DEVICE

Filed Aug. 21, 1934 2 Sheets-Sheet 1

FIG. 1

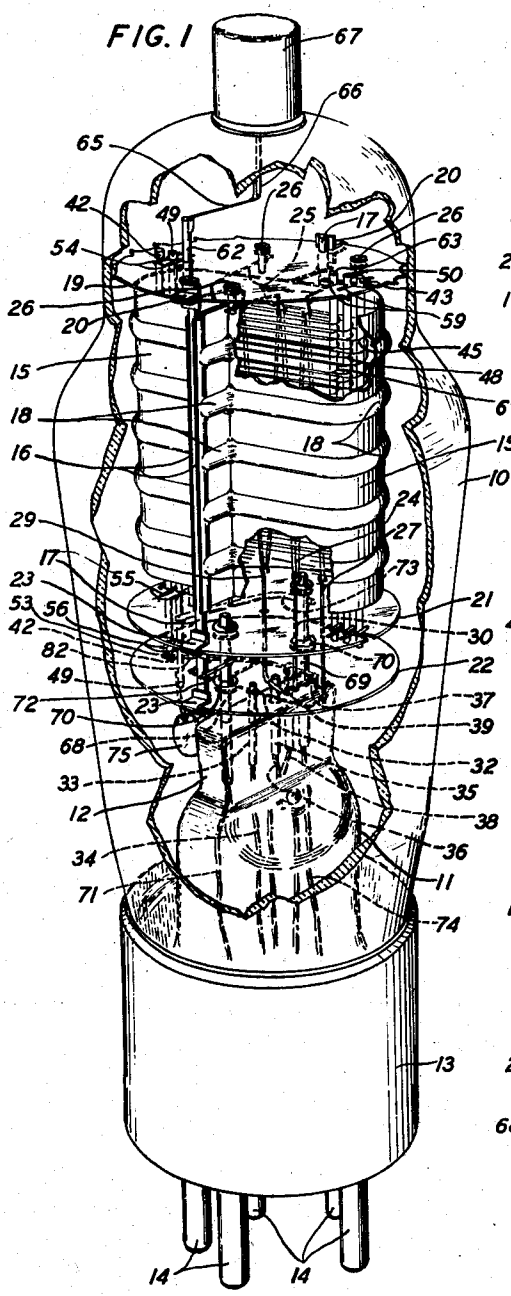

FIG. 2

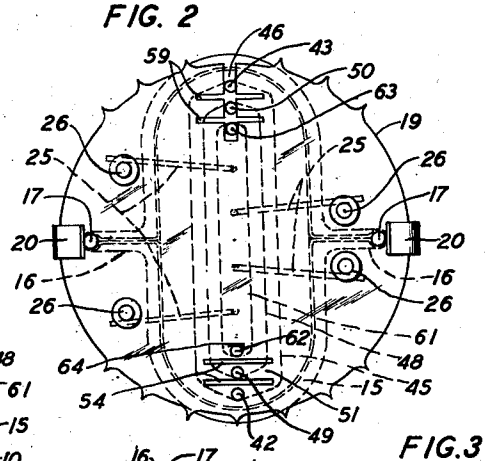

FIG. 3

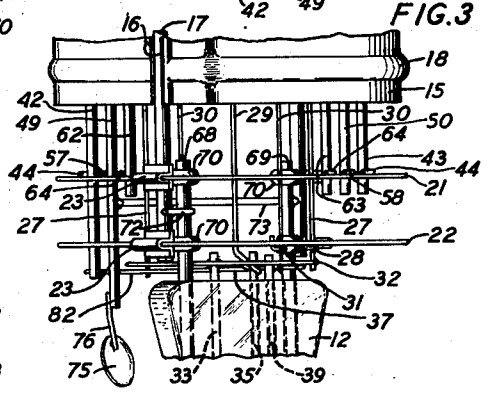

FIG. 4

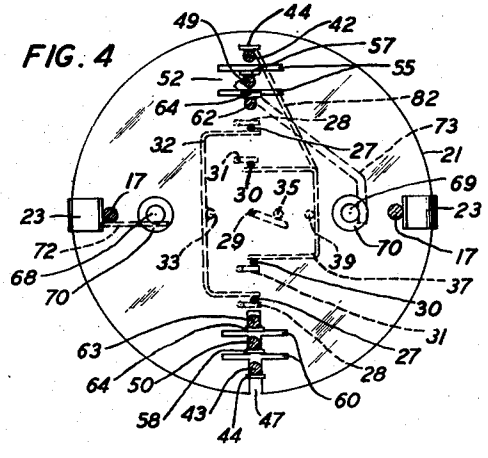

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FIG. 5

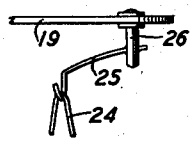


FIG. 6

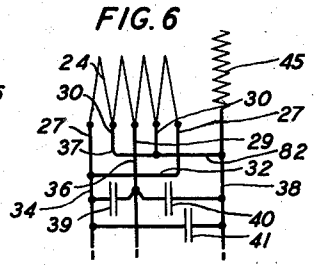


FIG. 7

FIG. 9

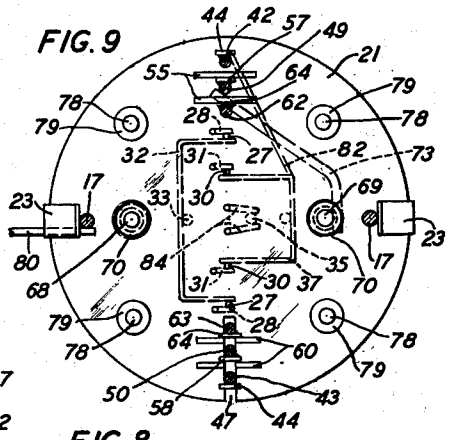
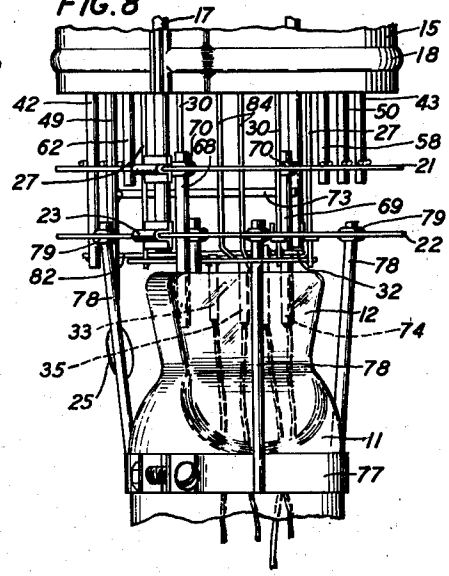


FIG. 8



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UNITED STATES PATENT OFFICE

2,111,602

ELECTRON DISCHARGE DEVICE

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Application August 21, 1934, Serial No. 740,735

4 Claims. (Cl. 250—27.5)

This invention relates to electron discharge devices and more particularly to an electrode assembly for such devices including a plurality of grid electrodes and adapted to operate efficiently at high frequencies.

One object of this invention is to maintain accurate space relation between a plurality of electrodes in electron discharge devices.

Another object of this invention is to maintain a plurality of sections of a filamentary cathode in a common plane whereby short circuits between the sections and another electrode thereadjacent are prevented.

A further object of this invention is to expedite and to simplify the fabrication of electron discharge devices.

In a specific embodiment illustrative of this invention, the electrodes of a pentode are fabricated as a unitary structure including an insulating member or disc adjacent one end of the anode and a plurality of spaced insulating members or discs adjacent the other end of the anode, the insulating members or discs being fastened to a plurality of supports for the anode. A multisection filamentary cathode and one or more grid electrodes are supported by the insulating members or discs and maintained in position thereby.

In accordance with one feature of this invention the electrode assembly is mounted as a unit from the stem of the enclosing vessel by a plurality of supports mechanically separate from the electrodes, which extend through the spaced insulating members or discs and are secured to one or more thereof.

In accordance with another feature of this invention, the several sections of the filamentary cathode are suspended from a plurality of resilient members disposed adjacent the surface of one of the insulating members or discs toward the cathode. This arrangement enables the use of relatively short resilient members allowing but limited lateral movement of the cathode sections so that the proper position of the sections is maintained and short circuits between the cathode and an electrode thereadjacent are prevented.

In accordance with another feature of this invention, the anode supports are disposed in a plane at substantially right angles to a plane common to the supports for the other electrodes so that relatively long insulating paths are provided between the anode supports and those for the other electrodes.

In accordance with still another feature of this invention, all of the metallic elements extending from the stem of the enclosing vessel may be utilized both as supports and as leading-in conductors for the several electrodes whereby the number of such elements is maintained at a minimum and the fabrication and structure of the device is simplified.

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, portions of the enclosing vessel and of the anode being broken away to show details of the electrode assembly more clearly;

Fig. 2 is a top view of the electrode assembly embodied in the device shown in Fig. 1, showing the configuration and relative disposition of the electrodes;

Fig. 3 is a detail view in elevation of the lower end of the electrode assembly of the device shown in Fig. 1, illustrating the association of the electrodes with leading-in conductors sealed in the stem of the enclosing vessel;

Fig. 4 is a plan view of one of the lower insulating members or discs illustrating the arrangement of the supports for the several electrodes;

Fig. 5 is a fragmentary view illustrating the suspension support for the filamentary cathodes;

Fig. 6 is a diagrammatic view showing the association of the leading-in conductors with the filamentary cathode and the suppressor grid;

Fig. 7 is a perspective view of an electron discharge device illustrative of another embodiment of this invention wherein the electrode assembly is supported as a unit from a band or collar encompassing the stem of the enclosing vessel;

Fig. 8 is a detail view in elevation of the lower end of the electrode assembly and the supporting system for the assembly as shown in Fig. 7; and

Fig. 9 is a plan view of one of the lower insulating members or discs showing the disposition of the supports for the electrodes and the electrical connections for the filament cathode.

Referring now to the drawings, the electron discharge device shown in Fig. 1 is of the pentode type and comprises an enclosing vessel 10 having a stem 11 terminating in a press 12. A base or cap 13, which may be of insulating material, is suitably secured, as by cementing, to one end of the vessel 10 and carries a plurality of terminal prongs 14 for associating the electrodes of the device with an external circuit.

A unitary electrode assembly is supported from the stem 11 and comprises an anode including opposed U-shaped sections 15 having flanges 16 secured together in face to face relation and provided with longitudinal recesses or grooves in which supports or rods 17 are secured as by welding. The anode may be provided with parallel embossments or ribs 18 for increasing the stiffness and preventing warping or distortion thereof during operation of the device.

An insulating member 19, which may be a disc

of mica or the like, is disposed adjacent the upper end of the anode and is provided with apertures through which the supports or rods 17 extend. The insulating member 19 may be fastened to the supports or rods 17 by metallic strips 20 crimped about the peripheral edge of the insulating member and suitably secured, as by welding, to the supports or rods. The disc 19 is also provided with opposed scalloped edges which engage the wall of the dome portion of the vessel and prevent vibrations disturbing the space relation of the electrodes. Two parallel insulating members 21 and 22, which also may be discs of mica or the like, are disposed adjacent the lower end of the anode and are provided with apertures through which the rods or supports 17 extend, the insulating discs being secured to the supports or rods by metallic strips 23 fastened to the discs and suitably secured, as by welding, to the supports or rods. The double spaced discs insure a high degree of insulation resistance between the electrodes.

A cathode 24, which may be a continuous filament of thoriated tungsten, comprises two M-shaped sections disposed within the anode and in a medial plane thereof. The apices or bights of the filamentary cathode are engaged by two pairs of oppositely disposed resilient hook members 25, extending at substantially right angles to the plane of the cathode, which are supported from the under surface of insulating disc 19 by rigid metallic stubs 26 fastened to the disc by eyelets. This suspension assembly for the cathode enables the use of relatively short hook members so that only a limited lateral movement of the apices or bights of the filamentary cathode, caused by expansion and contraction of the cathode, is permitted and the proper position of the cathode with reference to the other cooperating electrodes is maintained. The ends of the filament 24 are secured to hook members 27 which extend through the lower parallel insulating discs 21 and 22 and are held in position by bent wires 28 which are welded to the hook members 27 and extend upwardly in the disc 22 to lock the hook members 27 in position. The midpoint of the filament 24, as a whole, is secured to a hook member 29 extending through the discs 21 and 22, similar to the hook members 27, and is disposed coplanar with the hook members 27. Other hook members 30 disposed coplanar with the hook members 27 and 29 engage the intermediate points of the M-shaped sections of the cathode 24 and also extend through the insulating discs 21 and 22, the hook members 30 being held in position by bent stubs 31 suitably secured thereto and fitted in the disc 22 to prevent displacement of the hooks.

It has been found, in electron discharge devices having a filamentary cathode of the form described hereinabove, that at high frequencies the self-inductance of the leading-in conductors for the cathode is an important factor in determining the operating characteristics of the device. In order to insure a low self-inductance for the cathode assembly, the hook members 27, 29 and 30 are electrically associated as shown in Fig. 6. The end hook members 27 are electrically connected by a metallic bridge wire or tie member 32 which is secured at an intermediate point, as by welding, to a wire stub 33 embedded in the press 12 and electrically associated with one of the terminal prongs 14 by a conductor 34. The central hook member 29 is secured to a short wire or stub 35 embedded in the press 12 and connected to another terminal prong 14 by a conductor 36. Another bridge wire or tie member 37 electrically connects the intermediate hook members 30 and is electrically associated with a third terminal prong 14 by a conductor 38 connected to a short wire or stub 39 embedded in the press 12 which is secured to the midpoint of the bridge wire or tie member 37. The prongs connected to the conductors 34 and 36 may be associated with a suitable source for providing the heating current for the cathode. The prong connected to the conductor 38 may be connected to a suitable point in the anode-cathode circuit.

It will be apparent from Fig. 6 that the arrangement above described provides three paths of substantially the same length to the cathode so that substantially equal paths are traversed by the radio frequency currents in passing to the several portions of the filamentary cathode.

The conductor 36 may be bridged to the conductors 34 and 38 by radio frequency by-pass condensers 39 and 40, and the conductors 34 and 38 may be bridged by a similar condenser 41.

A pair of parallel metallic uprights or rods 42 and 43 extend between the insulating members or discs 19 and 21 and are held in position by short wires or stops 44 secured to the uprights or rods adjacent the disc 21. The uprights or rods 42 and 43 carry a substantially rectangular helical wire grid 45 disposed within the anode and uniformly spaced about the cathode 24. The grid 45 serves as a suppressor grid and the supporting upright or rod 42, which extends beyond the mica disc 22, is electrically connected to the bridge wire or tie member 37 by a conductor 82, as clearly shown in Fig. 4. The upright or rod 43 is positioned in slots 46 and 47 respectively in the discs 19 and 21 to allow lateral expansion and contraction of the grid 45.

Within the suppressor grid 45 and uniformly spaced about the cathode 24 is a substantially rectangular helical screen grid 48 which is supported by parallel metallic uprights or rods 49 and 50. The upright or rod 49 extends through flexible portions 51, 52 and 53 respectively, in the insulating discs 19, 21 and 22, the flexible portions being formed by slotting the discs as shown at 54, 55 and 56 respectively, and the upright or rod 49 is held in position by a short wire or stop 57 secured thereto adjacent the top of disc 21. Similarly the upright or rod 50 is held in position by a short wire or stop 58 secured thereto adjacent the top of disc 21, the ends of the upright or rod 50 being disposed in the slots 46 and 47, to allow lateral expansion of the screen grid 48. As shown more clearly in Figs. 2 and 4, the discs 19 and 21 are provided with transverse slots 59 and 60 respectively which render portions of the discs flexible and allow longitudinal expansion and contraction of the uprights or rods 43 and 50.

A substantially rectangular helical wire control grid 61 is disposed between the screen grid 48 and the cathode 24 and uniformly spaced therefrom. The control grid 61 is carried by two uprights or rods 62 and 63 which extend through the insulating discs 19 and 21 and are held in position by short wires or stops 64 secured thereto adjacent the top of disc 21. The control grid 61 may be energized through an electrical conductor including a flexible band or strip 65 which is connected to the rod 62 extending beyond the upper disc 19 and a wire 66 which is connected to the strip 65 and to a terminal cap 67 secured upon the top of the enclosing vessel 10.

As will be apparent from Figs. 2 and 4, the supports for the cathode, control, screen and suppressor grids are disposed parallel to each other and in a common plane at right angles to the plane including the anode supports or rods 17, so that a long insulating path is provided between the anode supports, which are at a relatively high potential, and the supports for the other electrodes, which are usually at progressively lower potentials. The anode construction and disposition of the supports therefor enables the use of an anode of maximum dimensions in an enclosing vessel of a given size.

Furthermore, it will be noted that the electrodes, the supports therefor, and the insulating members or discs form a compact assembly which may be fabricated as a unit. This unitary assembly is supported from the stem 11 solely by a pair of rigid metallic guiding supports or rods 68 and 69 embedded in the press 12 and extending through the insulating members or discs 21 and 22. The supports or rods 68 and 69 may be secured to the insulating members or discs 21 and 22 by eyelets 70 fastened to the discs and suitably secured, as by welding, to the supports or rods. This construction insures a rigid assembly due to the multiple contact of the supports with the unitary electrode assembly.

The support or rod 68 is electrically connected to one of the terminal prongs 14 by a conductor 71 and to one of the anode supports 17 by a tie wire 72. Similarly the support or rod 69 may be connected to the screen grid support or rod 49 by a tie wire 73 and to one of the terminal prongs 14 by a conductor 74.

A metallic disc 75 is suspended from the support or rod 49 by a wire 76 and carries a vaporizable material, such as a magnesium pellet, which may be flashed during the evacuation of the device to fix residual gases within the enclosing vessel 10.

In another embodiment of this invention illustrated in Figs. 7, 8 and 9, the supporting system for the unitary electrode assembly may include a two-piece band or collar 77 clamped about the stem 11 and having secured thereto a plurality of equally spaced rigid supports or rods 78. The supports or rods 78 extend through the insulating member or disc 22 and are securely fastened thereto by eyelets 79. In this embodiment, the supports or rods 68 and 69 extend through oversize apertures in the insulating member or disc 22 and are secured only to the insulating member or disc 21 by eyelets 70.

A wire 80 is sealed in the side wall of the enclosing vessel 10 as shown at 81 and is suitably secured, as by welding, to one of the anode supports 17 and serves as a leading-in conductor for the anode. It will be understood, of course, that in the embodiment of the invention shown in Figs. 7, 8 and 9, the metallic rod or support 68 may be utilized as the anode leading-in conductor and the conductor 80 omitted. Conversely, in the embodiment of the invention shown in Figs. 1 to 4, inclusive, a conductor 80, such as shown in the embodiment illustrated in Figs. 7, 8 and 9, may be provided and may be used as the lead-in to the anode and the rod or support 68 utilized solely as a supporting member.

The filamentary cathode may comprise two separate M-shaped sections, the adjacent ends of which are connected to hook members 84 secured to a rigid stub 35 extending from the stem. The other connections for the cathode are as shown diagrammatically in Fig. 6.

Although specific embodiments of the invention have been shown and described, it will be understood, of course, that 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 electrode assembly for electron discharge devices comprising a pair of relatively thin sheet mica discs, means supporting said discs in spaced relation, each of said discs being provided with a peripheral slot and with other slots diametrically opposite said peripheral slot and rendering portions of said discs relatively flexible, a plurality of pairs of supports extending between said discs, one support in each of said pairs being positioned in the peripheral slot and the other support in each pair extending through said flexible portions, and an electrode carried by each pair of said supports.

2. An electron discharge device comprising an enclosing vessel having a stem, a unitary electrode assembly including a hollow anode, a plurality of supports secured to said anode, an insulating disc extending across one end of said anode and attached to said supports, parallel insulating discs extending across the other end of said anode and attached to said supports, a plurality of pairs of uprights extending through said first disc and at least one of said parallel discs, a plurality of grids carried by said pairs of uprights, rigid hook members extending through said parallel discs, resilient hook members carried by said first disc, a filamentary cathode suspended between said rigid and resilient hook members, and means supporting said unitary assembly from said stem including a plurality of rigid supports embedded in said stem, said rigid supports extending through said parallel discs and rigidly affixed thereto.

3. An electron discharge device comprising an enclosing vessel having a stem, a unitary electrode assembly including a hollow anode, a plurality of supports affixed to said anode, an insulating disc attached to said supports adjacent one end of said anode, a plurality of parallel insulating discs attached to said supports adjacent the other end of said anode, a cathode and a plurality of grids supported between said discs, means supporting said unitary assembly from said stem including a plurality of rigid members embedded in said stem extending through said parallel discs and rigidly affixed to one of said parallel discs, a collar secured about said stem, and a plurality of rigid supports carried by said collar and rigidly affixed to the other of said parallel discs.

4. An electron discharge device comprising an anode, an insulating member adjacent one end of said anode and affixed thereto, a pair of superposed insulating members adjacent the other end of said anode and positioned thereby, a cathode supported by said insulating members, a plurality of uprights extending through all of said insulating members and spaced thereby, an equal number of uprights spaced from said first uprights and extending through said first insulating member and one of said superposed insulating members, a plurality of grids each carried by one of said first uprights and a corresponding one of said second uprights, and supporting means for said assembly engaging said superposed insulating members.

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