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2,350,003

ELECTRON DISCHARGE DEVICE

Filed July 17, 1940

FIG. 1

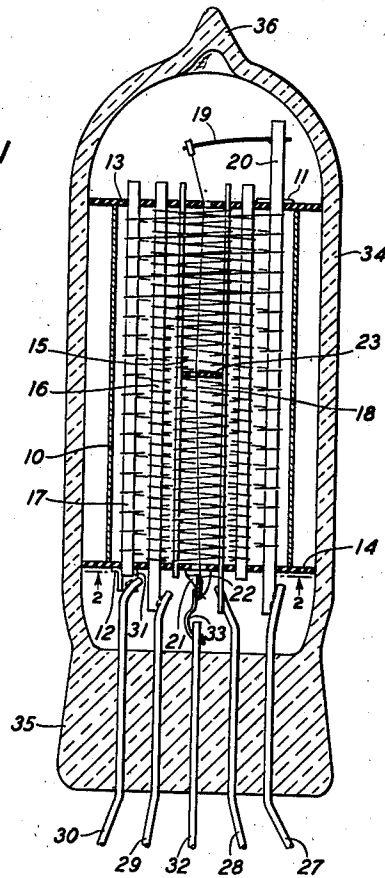


FIG. 2

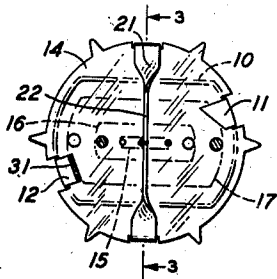


FIG. 3

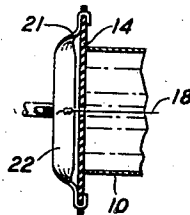


FIG. 4

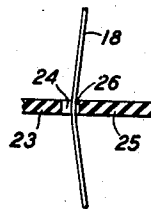
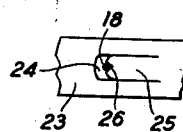


FIG. 5



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## UNITED STATES PATENT OFFICE

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## ELECTRON DISCHARGE DEVICE

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5 Claims. (Cl. 250—27.5)

This invention relates to electron discharge devices and more particularly to such devices of miniature size, applicable in one instance to portable amplifier type audiphone sets adapted to be carried in the vest pocket of a person having subnormal hearing.

In such sets it is desirable to amplify the speech or sound to a definite level which requires at least two stages of amplification of the multi-electrode type of device. Since the associated components of the amplifier are necessarily confined to definite limits in order to form a compact unit which will fit into the pocket of a man's vest or jacket, it is essential that electron discharge devices are reduced to a minimum size so that the definite limits of the unit are not exceeded. Furthermore, microphonic noises due to vibration of the elements in the discharge devices must be eliminated as far as possible in order to attain a high signal-to-noise ratio in the transmission of the set.

An object of this invention is to overcome these difficulties in devices for audiphone amplifiers and allied applications.

Another object of the invention is to facilitate the assembly of multielectrode devices whereby the size is reduced to a minimum.

A further object of the invention is to eliminate vibrational disturbances in the associated elements of the discharge device to reduce microphonic noise.

In accordance with this invention, the discharge device embodies a compact unitary assembly of the electrodes which is self-contained prior to sealing in an enclosing vessel. This construction involves a pentode unit having a central filamentary cathode surrounded by three grids and an anode with end spacer members joining the electrodes into a compact assembly. The cathode is resiliently supported at the top by a tension spring and at the lower end is secured to a metallic bridging strip clamped across the lower spacer and bent at the center at right angles to the plane of the strip to form an anchorage for the filament.

This construction permits the attachment of individual conductors or wires to the various electrodes and facilitates the mounting of the unit in a vessel so that one end of the vessel may be collapsed around the wires and sealed directly to the conductors to form an outwardly extending press. This assembly facilitates mass production and decreases the cost of the device.

A feature of this assembly is the provision of a yieldable conductive coupling between the substantially rigid strip and the conductor of the

filamentary cathode to compensate for expansion coefficients of the different metals and to avoid torsional strains on the filament support. This coupling also reduces heat conduction to the coated filament during the sealing of the leading-in wires in the stem and avoids oxidation of the filament so that activation difficulties are eliminated.

Another feature of the invention relates to the tensioning of the filamentary cathode at an intermediate point of its length to overcome microphonic disturbances due to vibration or shock. This arrangement comprises a resilient insulating spacer member supported by an electrode immediately adjacent the cathode and having a more resilient central tongue provided with a recess which forms a seat for the cathode. The position of the tongue with respect to the axis of the electrode mount causes the filament to be displaced out of its linear position and a consequent tension is impressed on the filament not only at the extremities but also at the center so that mechanical vibration is eliminated and the resultant electrical disturbance is overcome.

A further feature of the invention relates to the mounting of the electrode unit in an enclosing vessel, whereby the manufacturing technique is simplified and the cost materially reduced. In accordance with this feature, the unit and the electrode conductor assembly is fitted into a cylindrical vessel so that the end spacers of the unit engage the wall of the tube and support the unit. The glass adjacent the conductors is then fused and pressed against the wires to form a collapsed seal extending outwardly from one end of the vessel. The other end is closed after the treatment of the electrodes and evacuation processes are completed.

These and other features of this invention will be more clearly understood from the following description taken in connection with the accompanying drawing.

Fig. 1 is an enlarged view in section of the complete device made in accordance with this invention, showing the details of the assembly.

Fig. 2 is a plan view of the lower end of the electrode unit taken on the line 2—2 of Fig. 1 showing the position of the filament bridging member of the unit.

Fig. 3 is a side view of Fig. 2 taken on the line 3—3 of Fig. 2.

Fig. 4 is an exaggerated view in cross-section of portions of the filament and central spacer for tensioning the filament; and

Fig. 5 is a plan view of a portion of the filament spacer showing the relationship of the cen-

tral spacer and filament as employed in the structure of Fig. 1.

Referring to the drawing, the electron discharge device of this invention involves a unitary structure of electrode elements, for example, a pentode structure, comprising an enclosing metallic anode 10 of substantially rectangular cross-section having end projections 11 and 12 at opposite ends which embrace a pair of end insulating discs or spacers 13 and 14 having cooperating notches for the projections and also provided with spaced pointed projections around the periphery of the discs. The end spacer discs are provided with apertures to receive the upright supports of three internal grids 15, 16 and 17, the extremities of the supports extending through the spacers 13 and 14, and the grid helices conforming to the configuration of the anode, but of decreasing dimensions so that the spacial relations of these elements are uniform with respect to the axis of the unit. A very fine filamentary cathode 18 is mounted substantially in the axis of the unit and extends through the end insulating spacers. It is supported at the top by a cantilever spring wire 19 which extends from a long projecting end 20 of the suppressor grid support wire. The upper end of the filament is dampened by contact with the mica disc 13 to overcome vibration at this point. The opposite end of the filament is attached to the center of a metallic bridging strip 21 which extends diametrically across the insulating disc 14 and is clamped thereto in suitable notches exterior to the unit. This strip or ribbon is bent at right angles adjacent the center to form a flat vertical anchor 22 lying in a plane parallel to the axis of the unit. This arrangement permits the complete mounting of all the elements of the unit in a self-contained structure in which the individual elements are accurately spaced in relative positions to facilitate the fabrication of the device.

The compactness and delicacy of the electrode unit may be realized from the size of the elements embodied therein, since the diameter is about one-half inch and the length approximately three quarters of an inch. The filament is a ribbon core of tungsten or alloy metal having the dimensions of .00085 inch in width and a length of .77 inch and is coated cataphoretically with colloidal barium and strontium carbonates which are decomposed to oxides and then activated during the final evacuation process of the device. The coating may be covered with a protective layer of pyroxylin and amyl acetate, which is vaporized during the activation treatment.

The fine and fragile filament is very easily set in vibration due to shock and in order to overcome this difficulty, the filament is tensioned at the mid-point in addition to the tension applied at opposite ends thereof. The tensioning of the filament at the center is accomplished by a mica insert 23 having the longitudinal ends notched to frictionally fit against the support wires of the control grid 15 and the width of the insert being slightly less than the width of the grid. The central portion of the insert is provided with an opening 24 and a resilient tongue 25 integral with the insert 23, the tongue extending toward the opening and provided with a notch 26 to form a seat for the filament. The position of the notched tongue of the insert with respect to the axis of the unit forces the central portion of the filament out of its normal axial position, as

shown in Fig. 4 and thereby eliminates vibration at this point so that mechanical disturbances do not occur to affect the electrical output of the device. The offset of the linear filament does not materially affect the characteristic of the unit during operation.

The assembly of the unit is completed by connecting suitable leading-in conductors or wires 27, 28, 29 and 30 to the projecting ends of the suppressor grid 17, control grid 15, screen grid 16 and the flat extension 31 of the anode, respectively. Another wire 32 is coupled to the bridging strip 21 through a spring wire 33 which compensates for differences in coefficient of expansion between the strip 21 and the wire 32. The filament heating circuit is traced through conductor 32, coupling spring 33, bridging strip 21, filament 18, tension spring 19, grid support 20 and conductor 27. The arrangement forms an efficient coupling of the suppressor grid to the filament so that they are at the same potential.

The complete assembly of the unit and leading-in conductors is fitted into a cylindrical glass vessel or container 34 having a diameter slightly larger than the diameter of the mica spacers 13 and 14 so that the spaced projections thereon engage the inner wall of the vessel and frictionally support the unit therein. The portion of the vessel adjacent the leading-in conductors is then rendered plastic by heating and the glass is collapsed against the leading-in conductors to form a flat press portion 35 which hermetically seals the leading-in conductors therein and forms an outwardly extending stem or press on the vessel. The top of the vessel is dome-shaped and terminates in an exhaust tubulation to evacuate the interior of the vessel after which the tubulation is sealed off at 36.

This manufacturing technique is adaptable to the invention due to the self-contained assembly of the unit whereby each of the elements thereof is accurately positioned and secured to the end insulating spacers to facilitate the connection of individual conductors to the elements, whereby the mounting of the unit in an enclosing vessel may be expeditiously performed. The construction also facilitates the support of the unit in the vessel due to the frictional contact of the end spacer discs against the interior wall of the vessel so that the seal may be fabricated around the leading-in conductors without the cumbersome inclusion of other supporting structures to maintain the unit in position during the sealing operation.

While the invention has been disclosed with respect to a specific assembly of the unit and the elemental parts thereof, it is of course understood that various modifications may be made in the detailed structure without departing from the scope of this invention as defined in the appended claims.

What is claimed is:

1. An electron discharge device comprising an enclosing vessel, an electrode mount therein including a linear filament extending along the axis thereof, spacer discs attached to the ends of one of the electrodes, a tension support connected to one end of said filament, and a metallic bridging element having a central portion with a flat surface parallel to the axis of said mount and end clamping portions parallel to one of said discs embracing the edges thereof, said filament being attached to said central flat surface.
2. An electron discharge device comprising an electrode mount including a linear filament,

means at opposite ends thereof imparting an axial stress on said filament, an apertured mica spring insert frictionally supported by one of the electrodes of said mount intermediate the ends thereof, said filament extending through said insert, and an integral resilient tongue on said insert projecting toward said filament in abutting relation displacing the center portion thereof out of its linear path.

3. An electron discharge device comprising an electrode mount including a linear filament, means at opposite ends thereof imparting an axial stress on said filament, an apertured mica spring insert frictionally supported by one of the electrodes of said mount intermediate the ends thereof, said filament extending through said insert, an integral resilient tongue on said insert projecting toward said filament, said tongue having a seating notch for said filament, the position of said notch being offset from the axis of said mount.

4. An electrical space discharge tube comprising an envelope containing a filamentary cathode, an anode, and a plurality of grids interposed between said cathode and said anode, a press in the wall of said envelope, a plurality of conductors sealed in said press and disposed in a row,

the conductor at one end of said row being connected to one end of said cathode, the conductor at the other end of said row being connected to said anode, one of said grids being connected to one of said end conductors, the central conductor in said row being connected to the other end of said cathode, the conductors located alternately on opposite sides of said central conductor being connected to successive grids.

5. An electrical space discharge tube comprising an envelope containing a filamentary cathode, an anode, and a plurality of grids interposed between said cathode and said anode, a press in the wall of said envelope, a plurality of conductors sealed in said press and disposed in a row, the conductor at one end of said row being connected to one end of said cathode, the conductor at the other end of said row being connected to said anode, the outermost grid being connected to the end conductor connected to said cathode, the central conductor in said row being connected to the other end of said cathode, the conductors located alternately on opposite sides of said central conductor being connected to successive grids.

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