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ELECTRODE STRUCTURE FOR ELECTRICAL SPACE DISCHARGE TUBES

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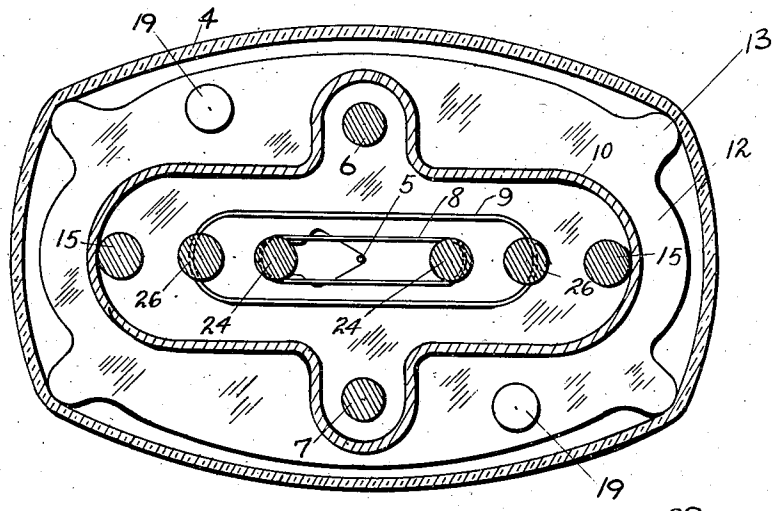


FIG. 3

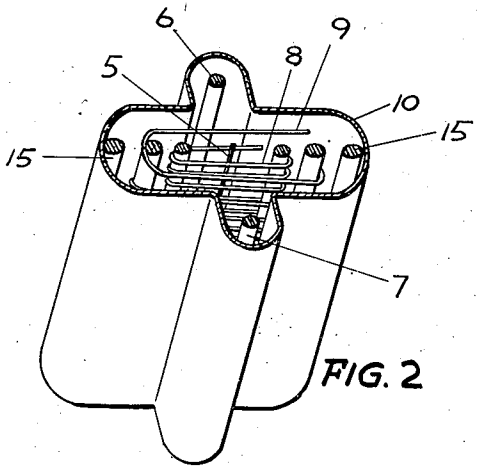


FIG. 2

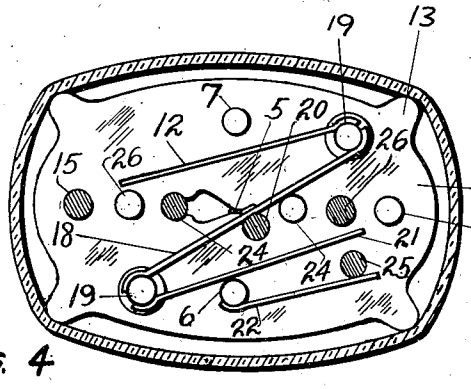


FIG. 4

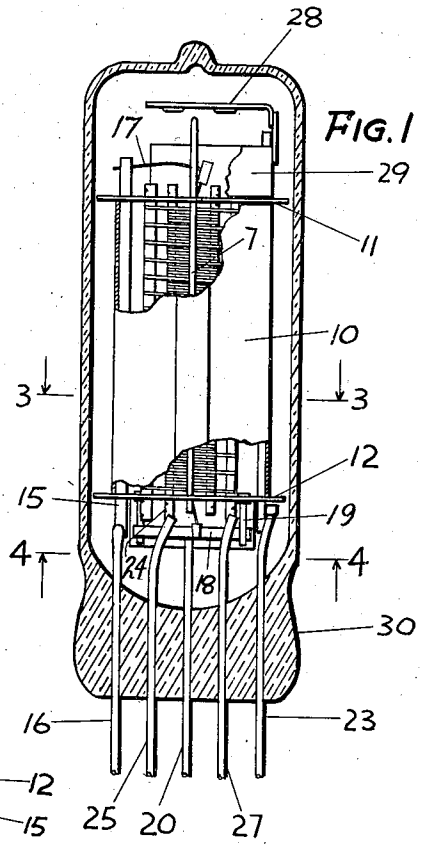


FIG. 1

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ELECTRODE STRUCTURE FOR ELECTRICAL SPACE DISCHARGE TUBES

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3 Claims. (Cl. 250—27.5)

1

This invention relates to space discharge tubes, and particularly to tubes of small dimensions suitable for use in portable devices, such as hearing aids, pocket radios, and similar constructions.

In conventional tubes of the type to which the invention relates, the plates are usually flat members separated from the screen grid by a suppressor grid. The function of the suppressor grid is to prevent the interchange of secondary emission between the plate and the screen grid. In small tubes the accomplishment of this function is limited by the very small spacings involved. In large tubes high plate resistance and increased voltage amplification is obtainable by increasing the distance from cathode to plate, but such increase in the spacing would defeat the objective of small tube size.

A further difficulty arising in construction of tubes of small diameter resides in the fact that conventional constructions are not suitable for use at radio frequencies without additional shielding. There is insufficient room to provide such shielding within the bulb; hence, external shielding is required. Such external shielding is not satisfactory because of the high value of electrostatic capacitance between the grid and plate.

It is among the objects of the present invention to overcome the difficulties mentioned in the foregoing and provide a tube of relatively small diameter, having high plate resistance, and in which the electrostatic capacitance between the control grid and the plate is substantially reduced.

It is a further object of the present invention to provide for the complete shielding of the electrode elements within the tube without increasing the overall dimensions thereof.

The above and other objects and features of the invention will be made fully apparent to those skilled in the art from a consideration of the following detailed description taken in conjunction with the accompanying drawing in which:

Fig. 1 shows in side elevation, with parts broken away to show internal construction, a tube incorporating one illustrative embodiment of the invention;

Fig. 2 is a detail showing in perspective a portion of the electrode assembly of the tube illustrated in Fig. 1;

Fig. 3 shows on a greatly enlarged scale a section taken on the line 3—3 of Fig. 1; and

Fig. 4 shows, on an enlarged scale, a section taken on the line 4—4 of Fig. 1.

Referring to the drawing, the illustrative embodiment of the invention shown comprises an evacuated envelope 4 of glass or other suitable

2

material, containing an electrode assembly which comprises a filamentary cathode 5, a pair of anodes 6 and 7, and a plurality of grids, herein 8, 9 and 10. The anodes 6 and 7 are in the form of rods of relatively small diameter, for example, 0.015 inch. The two anodes are electrically connected together at either end thereof. The control grid 8 and the screen grid 9 surround the filamentary cathode 5 intervening between said cathode and the anodes 6 and 7. The suppressor grid 10 is in the form of an imperforate member of sheet metal surrounding the grids 8 and 9 and having surfaces defining a pair of recesses, one for each of said anodes. The suppressor grid thus provides a shield enclosing the electrode elements, and having recesses extending around the anodes on the sides thereof remote from the cathode.

The filamentary cathode, the anode rods and grids are suitably spaced by upper and lower insulating spacing members 11 and 12 of mica or other suitable insulating material, provided with suitably spaced holes through which the filamentary cathode, the anode rods, and the supporting rods for the grids extend. At their edges, the spacing members 11 and 12 are provided with resilient projections 13 engaging the wall of the envelope 4. The ends of the rods project through the insulating members 12 and 11 and these members are rigidly secured together by tabs welded to said projecting ends of the rods, the insulating members being held apart the proper distance by the suppressor grid 10.

One of the supporting rods 15 for the suppressor grid 10 is connected at its lower end to a lead-in conductor 16, and its upper end is connected to the filamentary cathode 5 through a resilient metal rod 17, which rod supports the upper end of the filament under suitable tension. The lower end of the filament is connected to the cross bar 18 of a supporting yoke having upwardly extending arms 19. The upper ends of the arms 19 extend through and are rigidly secured in the lower insulating member 12 at points outside of the suppressor grid 10. The cross bar 18 is welded to and supported by a lead-in conductor 20. A pair of shields 21, each having one end welded to one of the arms 19, extend between the projecting ends of the anodes 6 and 7 and the adjacent projecting ends of the grid support rods. In Fig. 1 the foremost of these shields has been removed for the sake of clearness. One of the anode rods, herein 6 is connected by a conductive strip 22 to a lead-in conductor 23, which conductor is bent outwardy at its upper end to provide a point of

attachment on the outside of and spaced from the adjacent shield 21. The other anode 7 is connected at its upper end to the anode rod 6. For convenience the two anode rods 6 and 7 may be the two arms of a single U-shaped member, the bent portion of the U providing the electrical connection between the two rods. One of the supporting rods 24 for the control grid 8 is connected at its lower projecting end to a lead-in conductor 25. Similarly the lower projecting end of one of the supporting rods 26 of the screen grid 9 is connected to a lead-in conductor 27. A getter assembly 28 may be connected to the upper projecting end of one of the supporting rods 15 for the suppressor grid, and a shield 29 may also be welded to said projecting end of said rod, which shield extends for a sufficient distance to intervene between the upper projecting ends of the grid supporting rods and the upper projecting portion of the anodes 6 and 7.

The electrode assembly described in the foregoing is inserted as a unit within a glass tube having walls which are straight taken in a longitudinal direction, and of ellipsoidal form taken in transverse section. The lower end of this tube is heated and softened sufficiently so that it may be pressed to make the flat external press or seal 30 hermetically sealing all of the external connections provided by the lead-in conductors 16, 20, 23, 25 and 27.

The construction described in the foregoing provides a tube in which the anode plates are in the form of rods of relatively small diameter, which construction reduces the electrostatic capacitance between the control grid and plate and at the same time increases the plate resistance.

The suppressor grid provides a shield member having surfaces defining recesses which extend around each of the anode rods, surfaces providing a shield. This shield is connected to the cathode and provides a potential minimum between the screen grid and the plate. This is due not only to the electrostatic effect of the shield, but also due to the fact that the shield confines the electron stream to form a beam, thus further reducing the potential due to space charge. The shield member also reduces the electrostatic capacitance between the control grid and the plate. Furthermore, the suppressor grid effectively shields the entire structure from external coupling effects. A significant part of the grid-plate capacitance in small tubes results from the electrostatic path from the grid-lead in the press along the cross-section of the tube walls and through space to the plate. The shield provided by the present structure isolates the plate from the bulb and thus eliminates this contribution to grid-plate capacitance.

While there has been herein described a preferred embodiment of the invention, other embodiments within the scope of the appended claims will be apparent to those skilled in the art from a consideration of the embodiment shown and the teachings hereof.

What is claimed is:

1. An electrical space discharge tube comprising a cathode, a pair of anodes disposed on opposite sides of said cathode, a pair of grids surrounding said cathode and intervening between said cathode and anodes, and a suppressor grid comprising an imperforate sheet of metal surrounding said grids and having surfaces defining a pair of recesses, one for each of said anodes, said surfaces providing shields extending around the sides of said anodes remote from said cathode.

2. An electrical space discharge tube comprising a filamentary cathode, a pair of anode rods of relatively small diameter disposed on opposite sides of said cathode, a pair of grids surrounding said cathode and intervening between said cathode and anode rods, and a suppressor grid comprising an imperforate sheet of metal surrounding said grids and having surfaces defining a pair of recesses, one for each of said anode rods, said surfaces providing shields extending around the sides of said anode rods remote from said cathode.

3. An electrical space discharge tube comprising a filamentary cathode, a pair of anode rods disposed on opposite sides of and extending parallel with said cathode, a pair of grids surrounding said cathode and intervening between said cathode and anode rods, and a suppressor grid comprising an imperforate sheet of metal surrounding said grids and have surfaces defining a pair of recesses, one for each of said anodes, said surfaces providing shields extending around the sides of said anode rods remote from said cathode.

ROSS WOOD.

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