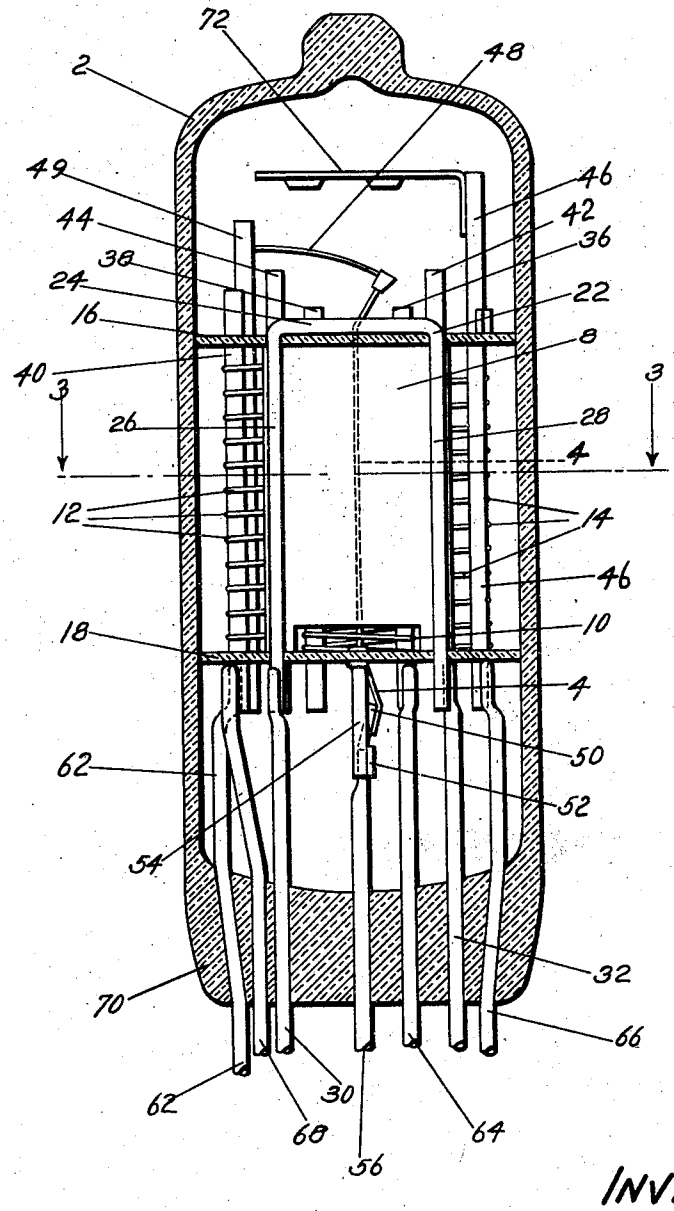
Aug. 27, 1946. R. WOOD 2,406,422

ELECTRICAL SPACE DISCHARGE TUBE

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FIG. 1.



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FIG. 3.

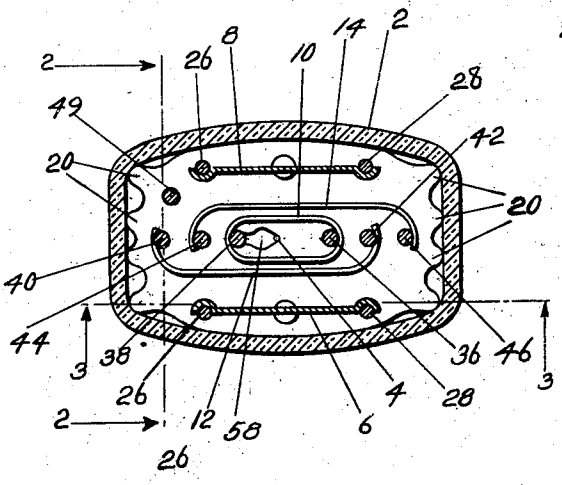


FIG. 2.

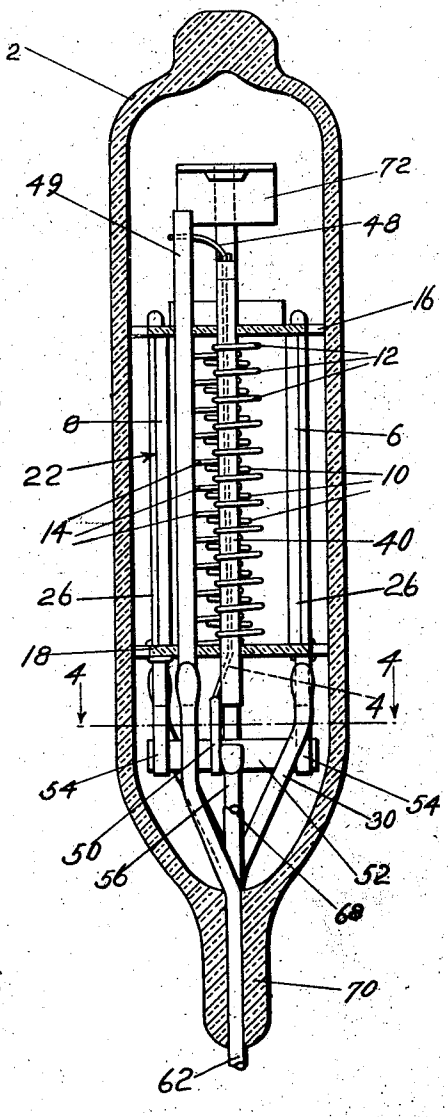
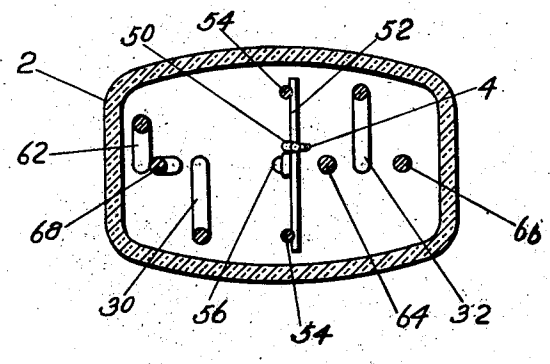


FIG. 4.



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ELECTRICAL SPACE DISCHARGE TUBE

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6 Claims. (Cl. 250—27.5)

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This invention relates to electrical space discharge tubes of small dimensions, such as those used in small portable devices, pocket radios and hearing aids, for example, which may be carried on the person. In order that the tubes may be utilized in such devices they must of necessity be made extremely small.

One of the objects of the present invention is to provide a tube of the general type referred to in which certain tube elements and their arrangement are such that said elements can be assembled in a very small space, thus materially reducing the size of the tube.

Another object of the invention is to provide a tube of the type referred to which combines small size with relatively high amplification and low operating voltage.

Another object of the present invention is to provide a tube comprising a single filament cathode supported at two points only, a plurality of anodes cooperating with said cathode and a plurality of additional electrodes between said cathode and each anode.

A further object of the invention is to provide a double space charge tetrode in which the two tetrodes have a common cathode and are adapted to operate in cascade.

These and such other aims and objects of the invention as may hereinafter appear will be best understood from the following description, taken in connection with the accompanying drawings, of a tube incorporating one embodiment of the invention herein presented for illustrative purposes.

In the drawings:

Fig. 1 is a longitudinal section of a tube incorporating one illustrative embodiment of the invention;

Fig. 2 is a longitudinal cross-section on line 2—2 of Fig. 3;

Fig. 3 is a cross-section on line 3—3 of Fig. 1; and

Fig. 4 is a section on line 4—4 of Fig. 2.

The illustrative embodiment of the invention shown in the drawings comprises an evacuated envelope 2 of glass or other suitable material containing the tube assembly which comprises a single filament cathode 4, a pair of anode plates 6 and 8 and a plurality of grids, herein three, 10, 12 and 14, said grid 10 surrounding said cathode and said grids 12 and 14 being interposed between said grid 10 and said anode plates 6 and 8 respectively. Said filamentary cathode, anode plates and grids are suitably spaced by upper and lower insulating spacing members 16 and 18 of mica or other suitable insulating material provided with suitably spaced holes through which said filamentary cathode and the supporting means for said anode plates and said grids extend, as will hereinafter more fully appear. At their edges said spacing

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members are provided with resilient projections 20 (see Fig. 3) for resiliently engaging the wall of said envelope.

The two anode plates 6 and 8 are each mounted in a frame 22 of nickel wire or other suitable material consisting of a straight top portion 24 and depending arms 26 and 28 (see Fig. 1).

To assemble the anode structure, the arms 26 and 28 of the anode frames are inserted through holes in said upper spacing member 16 and said frames are then pressed down until said straight portion 24 of each of said frames rests upon the upper surface of said spacing member 16, whereupon the said anode plates 6 and 8 are welded at their edges to said arms 26 and 28 of their frames, with the upper edge of each anode plate against the under surface of said spacing member 16. Said anode plates may be provided with marginal grooves along their side edges to receive and the better to locate said side arms 26 and 28. Said arms of both anode plates are then inserted through holes in the lower spacing member 18. A lead-in conductor 30 is welded to the anode supporting arm 26 of anode plate 6 and another lead-in conductor 32 is welded to the anode supporting arm 28 of anode plate 8 diagonally across from said anode supporting arm 26, both of said welds being close up against the underside of said spacing member 18 to hold said spacing member in place on said arms. The anode assembly is thus completed and the two anode plates are electrically connected to their lead-in wires and securely fastened in place in the insulating spacing members 16 and 18.

The grid 10 is wound upon and supported by the grid rods 36 and 38, and surrounds the filamentary cathode 4. Grids 12 and 14 are control grids, the former being supported by rods 40 and 42 and the latter by rods 44 and 46.

The grid supporting rods are all in a straight line and the rods to which the ends of the grid members of one of the control grids are secured, alternate with the rods to which the ends of the grid members of the other control grid are secured. Actually the ends of the grid members of each of the control grids are secured at one end to an endmost grid supporting rod, and at the other end to the next to the endmost grid supporting rod, so that the two control grids actually overlap longitudinally of their grid members. This arrangement of the two control grids, therefore, provides a very compact grid structure and correspondingly reduces the size of the tube.

At its upper end the filamentary cathode 4 is welded to one end of a conducting spring member 48 which is welded at its other end to a rod extending through said spacing members 16 and 18. The lower end of said filamentary cathode is welded to a tab 50 which is welded to a cross-

bar 52 carried by two studs 54 riveted to the spacing member 18 and to which cross-bar 52 is welded in turn a lead-in conductor 56. The filamentary cathode 4 passes through a triangular slot 58 in said spacing member 18 and through a similar slot (not shown) in the spacing member 16 and is maintained in an apex of each of said slots by the resilient tension exerted upon said filamentary cathode by the aforesaid spring member 48.

In addition to the above-mentioned lead-in conductors 30 and 32 for the two anode plates, and the lead-in conductor 56 for the filamentary cathode, additional lead-in conductors 62, 64, 66 and 68 are provided for the filamentary cathode 4, grid 10, control grid 14 and control grid 12, said lead-in conductor 62 being welded to the filament supporting rod 49, said lead-in conductor 64 to the grid 10 supporting rod 36, said lead-in conductor 66 to the control grid 14 supporting rod 46 and lead-in conductor 68 to the control grid 12 supporting rod 40.

All of the above lead-in conductors are sealed through a suitable press 70 formed externally upon the base of the envelope 2.

A getter 72 may be conveniently welded to the upper end of the supporting rod 46 of the half grid 14.

The arrangement of the electrodes and other elements of the tube embodying the present invention is extremely compact with the result that the tube may be very small, and the electrode assembly comprising a single cathode cooperating with two anodes and three grids constitutes in fact a double space charge tetrode in which the two tetrodes are sufficiently isolated for operating in cascade. The present invention therefore provides a tube which produces a degree of amplification substantially equal to that obtainable from two separate complete tetrodes, while dispensing with the additional structure and consequent greater bulk which the addition of the second cathode would involve.

While in the illustrative embodiment of the invention herein described two control grids and two anode plates are used, it will be apparent to those skilled in the art that a tube comprising a greater number of control grids and anodes would fall within the scope of the present invention, and this would be true also of the combination of a single filament cathode with a plurality of cooperating anodes and a plurality of additional electrodes between the common cathode and each anode, the number of additional electrodes between the common cathode and one of said anodes not necessarily being the same as the number of additional electrodes between said common cathode and another of said anodes. Thus a tube having a certain number of electrodes could be combined with another tube having a lesser or a greater number of electrodes, the two tubes having a single filament cathode in common, and still be within the scope of the present invention.

The drain in small batteries that must be used in portable devices, to be carried on the person, such as those to which this invention mainly relates, is a serious matter. The present invention aims to reduce this loss of energy as much as possible. It has been demonstrated that an appreciable part of the energy delivered to the cathode is lost due to the escape of heat from the points of contact of the cathode with the supporting structure. In accordance with the present invention, therefore, a single filament cathode is used which having only two ends or points of contact with the supporting structure reduces to a minimum the loss of energy from the above-mentioned cause.

I am aware that the present invention can be embodied in other specific forms without departing from the spirit or essential attributes thereof, and I therefore desire to present description to be considered in all respects as illustrative and not restrictive, reference being had to the appended claims rather than to the aforesaid description to indicate the scope of the invention.

What is claimed is:

1. In an electrical space discharge tube, the combination of a cathode, a cooperating anode at each side of said cathode, a space charge grid surrounding said cathode, and a control grid between said space charge grid and each anode, said control grids being substantially parallel to and overlapping each other.

2. In an electrical space discharge tube, the combination of a single filament cathode, a cooperating anode at each side of said cathode, a space charge grid surrounding said cathode, and two substantially parallel control grids, one between each of said anodes and said space charge grid, said control grids overlapping each other lengthwise of their grid members.

3. In an electrical space discharge tube, the combination of a cathode, a cooperating anode at each side of said cathode, a space charge grid surrounding said cathode, a control grid between said space charge grid and each anode, said control grids being substantially parallel, and rods disposed in a straight line for supporting said grids, the grid members of each of said control grids being secured at one end to an endmost rod of said line of grid supporting rods and at the other end to an intermediate rod.

4. In an electrical space discharge tube, the combination of a single filament cathode, a cooperating anode at each side of said cathode, a space charge grid surrounding said cathode, a control grid between said space charge grid and each anode, and rods disposed in a straight line for supporting said grids, the grid members of each of said control grids being secured at one end to an endmost rod of said line of grid supporting rods and at the other end to the rod next to the endmost rod.

5. In an electrical space discharge tube, a cathode, two anodes, one on each side of said cathode, a space charge grid surrounding said cathode, and two control grids, one between each of said anodes and said space charge grid, said control grids being parallel and offset with respect to each other.

6. In an electrical space discharge tube, a cathode, two anodes, one on each side of said cathode, a space charge grid surrounding said cathode, and two control grids, one between each of said anodes and said space charge grid, said control grids having offset central portions and curved marginal portions, with the curved marginal portions of one overlapping the curved marginal portions of the other.

ROSS WOOD.