April 19, 1949. E. K. KELLEY 2,467,390

FILAMENT SUPPORT FOR ELECTRIC SPACE DISCHARGE TUBES

Filed Oct. 29, 1945

FIG. 1.

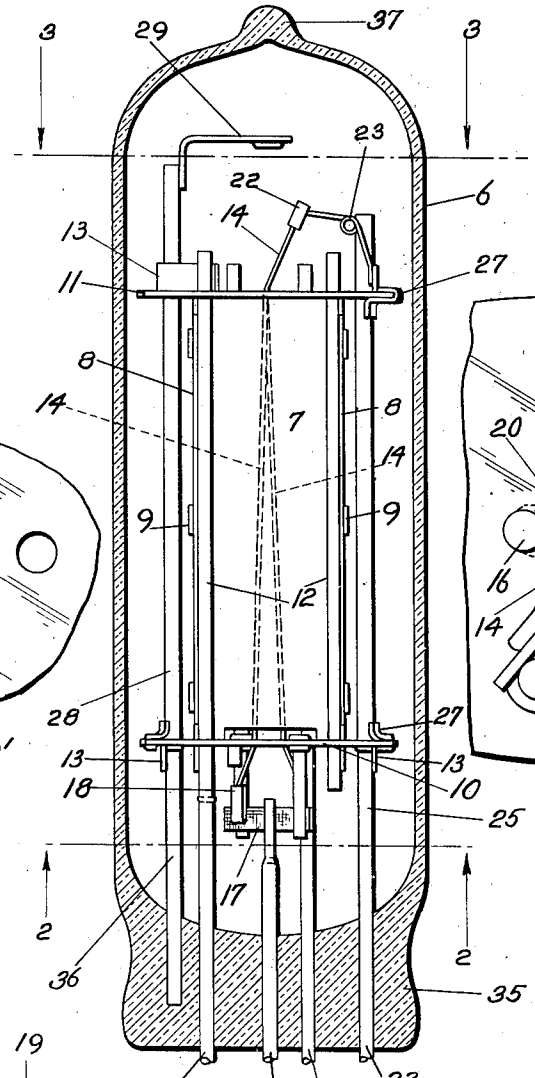



FIG. 4.

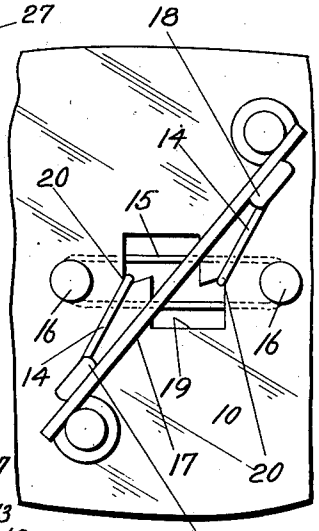



FIG. 5.

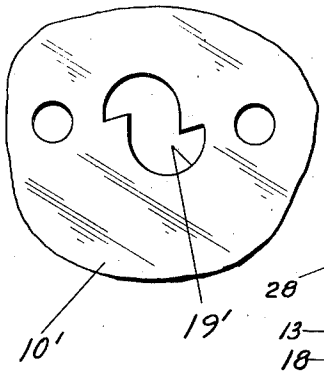



FIG. 2

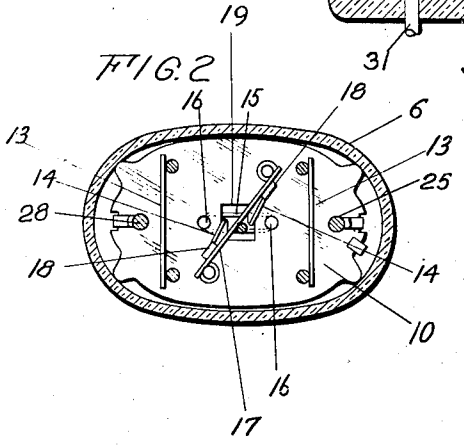
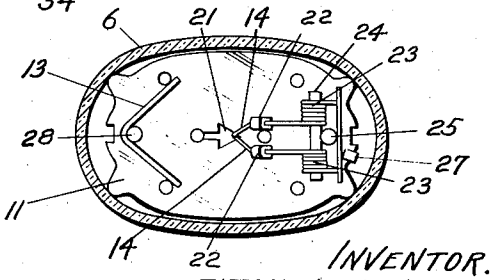



FIG. 3.




INVENTOR.
ELTON K. KELLEY,
BY Elmer J. Gorn
ATTY.

Patented Apr. 19, 1949

2,467,390

# UNITED STATES PATENT OFFICE

2,467,390

## FILAMENT SUPPORT FOR ELECTRIC SPACE DISCHARGE TUBES

Elton K. Kelley, Houston, Tex., assignor to Raytheon Manufacturing Company, Newton, Mass., a corporation of Delaware

Application October 29, 1945, Serial No. 625,147

8 Claims. (Cl. 250—27.5)

1

This invention relates to electric space discharge tubes of the vacuum type and more particularly to those of small sizes such as are used in pocket radios, hearing aid devices and the like.

In such tubes the problem of mounting the various tube elements on the usual insulating spacers presents various difficulties because of the small space available. Furthermore, where such tubes are likely to be subjected to great shock and vibration, the electrode elements must be secured in a manner to provide great rigidity.

It is among the objects of the present invention to provide a novel construction of the spacing elements referred to and more particularly to provide for greater ease in the assembly of the cathode filaments and the securing thereof with greater rigidity.

The above and other objects of the invention will be 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 in section, a discharge tube illustrating one embodiment of the invention;

Fig. 2 shows a section taken along line 2—2 of Fig. 1 and looking in the direction of the arrows;

Fig. 3 is a section taken along line 3—3 of Fig. 1 and looking in the direction of the arrows;

Fig. 4 shows a detail of one of the spacing insulators; and

Fig. 5 is a fragmentary section showing a modified form of the spacing insulator.

Referring to the drawing, reference numeral 6 indicates an envelope which in this instance is of glass of ellipsoidal form taken in a transverse section. With the envelope 6 is an electrode essembly comprising a pair of anode plates 7 having outwardly extending flanges 8 providing surfaces for the convenient welding of strips 9 thereto to unite the two anode plates in an integral structure. A lower spacing member 10, preferably of mica, supports the anode structure. An upper spacing member 11 also of insulating material, such as mica, rests upon the upper end of the anode structure. The two mica members 10 and 11 are rigidly secured together by tie rods 12 which project through the spacing members 10 and 11 and are connected at their projecting ends by metal straps 13 providing stops serving to prevent relative motion between the anode structure and the spacing members 10 and 11 to thereby provide a unitary assembly which may be bodily inserted in the tube.

2

A pair of filamentary cathodes 14 extend centrally through the anode structure 7 and are surrounded by a grid 15, which is of elongated form taken in a transverse section, said grid being supported by grid side rods 16. U-bracket 17 is supported from the lower spacing member 10 and has welded thereto a pair of tabs 18, one for each of the filamentary cathodes 14. The tabs 18 are welded to the bracket 17 at points which are out of alignment with an opening 19 in the lower spacing member 10. The opening 19 through the member 10 provides a pair of notches or corners 20 in the apexes of which the filamentary cathodes 14 are held. The apexes of the notches 20 are positioned on a line defined by the centers of the grid rods 16 so that the cathode filaments 14 will be held equally spaced from the grid wires 15. The upper spacing member 11 is provided with a V-shaped slot 21. The apex of the slot 21 is positioned upon the center line of the tube and the two filamentary cathodes 14 are drawn together into the apex of the slot to form a V-shaped cathode. The upper ends of the filamentary cathodes 14 are provided with tabs 22 which are welded to the ends of conducting springs 23. Said ends of the conducting springs 23 are out of alignment with the apex of the V-slot 21 so that the filaments are drawn into the apex of the slot. The conducting springs 23 are wound on a cross bar 24 welded to a conducting side rod 25. The lower ends of the springs 23 are welded to one of the stops 13 which stop is, in turn, welded to the side rod 25 and thus provides a bearing for the springs 23 as well as one of the holding stops for the upper insulating spacer 11.

In order to secure greater rigidity of the side rod 25 relative to the remainder of the electrode assembly, tabs 27 are welded at one end to the rod and bent over the upper and lower surfaces of the upper and lower spacers 10 and 11. A second side rod 28 similar to the rod 25 and positioned on the opposite side of the electrode assembly supports, at its upper end, a getter 29.

A lead-in conductor 31 secured to the projecting end of one of the rods 12 provides an external electrical connection to the anode 7. A lead-in conductor 32 secured to the U-bracket 17 provides one of the lead-in conductors for the filamentary cathode 14 and a similar lead-in conductor 33 attached to the lower end of the side rod 25 provides the other external connection for the cathode. A lead-in conductor 34 welded to the lower projecting end of one of the grid side

rods 16 provides an external connection for the grid 15.

The electrode assembly described in the foregoing is inserted as a unit within a straight-sided glass tube forming the envelope 6. The lower end of this tube is heated and softened sufficiently so that it may be pressed to make the press or seal 35, hermetically sealing all of the external connections provided by the lead-in conductors 31, 32, 33, and 34. For purposes of support an additional conductor 36 may be welded to the lower end of side rod 28 and sealed in the press 35. This conductor may terminate in the press. The upper end of the tube is provided with the usual tubulation exhausted and sealed off at 37.

The construction described in the foregoing greatly facilitates the manufacture of the electrode assembly and increases the strength and rigidity thereof so that the tube may be made of very small dimensions and capable of withstanding great shock. For example, in the construction of one embodiment of the invention where the narrow inside dimension of the grid measures but 0.015 inch the filaments must be threaded through the openings in the upper and lower spacers with the end tabs 18 attached although the larger dimension of the tab is 0.020 of an inch. The openings 19 and 21 facilitate the insertion of the filaments and thereafter the vertexes of the corners 20 and the apex of the V-slot 21 function to locate the two filament wires on the major transverse axis of the grid and within the minor interior diameter thereof. Thus it becomes possible to pull the filaments into the locating corners and weld the tabs to the diagonal cross-bar simultaneously. The wires are thereafter prevented from slipping out of position since any movement of the wires along the side walls of the opening would require an increase in the length of the wire from the points of attachment at 18 to the opening. In other words, the distance from the points of attachment of the lower ends of the filaments at the tabs 18 to the vertexes 20 is less than the distance from these tabs to any other point along the adjacent side walls of the opening. Similarly, the distance from the points of attachment of the upper ends of the filaments at the tabs 22 to the apex of the V-slot 21 is less than the distance from these tabs to any other point along the adjacent side walls of the slot.

It will be seen that the construction provides a V-formation for the filaments within the grid, both filaments being connected to the same conductor at the bottom where they are held in accurately spaced relation, and converging together at the top.

Preferably, the opening 19 in the lower spacer 10 is substantially wider than the width of the grid. This permits the tabs 18 to slip through the opening readily in the assembly of the tube. Also, as illustrated in the modified form of Fig. 5, which shows at 10' a fragment of a lower spacer, the walls of the opening 19' may be continuously curved except at the locating corners.

While there have been herein described certain preferred embodiments 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 forms shown and teachings hereof. Accordingly, a broad interpretation of the appended claims commensurate with the scope of the invention within the art is desired.



What is claimed is:

1. An elongated assembly for an electrical space discharge tube comprising a pair of filaments providing a filamentary cathode, an anode structure, insulating spacers comprising an upper spacer and a lower spacer at the upper and lower ends of said anode structure, resilient members above the upper surface of said upper spacer, the upper ends of said filaments each being secured to one of said members, said lower spacer having an opening therein providing a pair of corners on opposite sides of the axis of said tube, said filaments passing through said opening, the ends of said filaments on the lower side of said lower spacer being secured at points out of alignment with said opening and beyond the edges thereof but respectively adjacent said corners, the filaments being drawn into the respective vertices of said corners by the tension of said resilient members.

2. An electrode assembly for an electrical space discharge tube comprising a pair of filaments providing a filamentary cathode, an anode structure, insulating spacers comprising an upper spacer and a lower spacer at the upper and lower ends of said anode structure, resilient members above the upper surface of said upper spacer, the upper ends of said filaments each being secured to one of said members, a V-slot in said upper spacer through which said filaments pass and into the apex of which they are drawn by said members, said lower spacer having an opening therein providing a pair of corners on opposite sides of the axis of said tube, said filaments passing through said opening, the ends of said filaments on the lower side of said lower spacer being secured at points out of alignment with said opening and beyond the edges thereof but respectively adjacent said corners, the filaments being drawn into the respective vertices of said corners by the tension of said resilient members.

3. An electrode assembly for an electrical space discharge tube comprising a pair of filaments providing a filamentary cathode, an anode structure, insulating spacers comprising an upper spacer and a lower spacer at the upper and lower ends of said anode structure, resilient members above the upper surface of said upper spacer, the upper ends of said filaments each being secured to one of said members, a V-slot in said upper spacer through which said filaments pass, said slot having its apex positioned on the axis of said tube, said filaments being drawn into said apex by said members, said lower spacer having an opening therein providing a pair of corners on opposite sides of the axis of said tube, said filaments passing through said opening, the ends of said filaments on the lower side of said lower spacer being secured at points out of alignment with said opening and beyond the edges thereof but respectively adjacent said corners, the filaments being drawn into the respective vertices of said corners by the tension of said resilient members.

4. An electrode assembly for an electrical space discharge tube comprising a pair of filaments providing a filamentary cathode, an anode structure, a grid of elongated transverse cross-section between said anode structure and said filaments, insulating spacers comprising an upper spacer and a lower spacer at the upper and lower ends of said anode structure, resilient members above the upper surface of said upper spacer, the upper ends of said filaments each being secured to one of said members, said lower spacer having an

opening therein providing a pair of corners on opposite sides of the axis of said grid, each of said corners having its vertex on a line centered within the smaller transverse dimension of said grid, said filaments passing through said opening, the ends of said filaments on the lower side of said lower spacer being secured at points out of alignment with said opening and beyond the edges thereof but respectively adjacent said corners, the filaments being drawn into the respective vertices of said corners by the tension of said resilient members.

5. An electrode assembly for an electrical space discharge tube comprising a pair of filaments providing a filamentary cathode, an additional electrode, spacing members comprising upper and lower insulating spacers, a bracket secured to the lower side of said lower spacer, said lower spacer having an opening therein, said opening having a pair of notches one for each of said filaments, said filaments being welded to said bracket at spaced points thereon which are out of alignment with said opening, beyond the edges thereof, and on opposite sides thereof, each of said filaments being drawn into the apex of one of said notches, a V-slot in said upper spacer, and tension means positioned above said upper spacer, said filaments being secured to said tension means at points out of alignment with said V-slot, beyond the edges thereof, and on the side adjacent the apex thereof, whereby said filaments are drawn together into said last-named apex.

6. An electrode assembly for an electrical space discharge tube comprising a pair of filaments providing a filamentary cathode, an additional electrode, spacing members comprising upper and lower insulating spacers, a bracket secured to the lower side of said lower spacer, said lower spacer having a central opening therein, said opening have a pair of notches on opposite sides of and in alignment with the center of said opening, said filaments being welded to said bracket at spaced points thereon which are out of alignment with said opening, beyond the edges thereof, and on opposite sides thereof, each of said filaments being drawn into the apex of one of said notches, V-slot in said upper spacer, and tension means positioned above said upper spacer, said filaments being secured to said tension means at points out of alignment with said V-slot, beyond the edges thereof, and on the side adjacent the apex thereof, whereby said filaments are drawn together into said last-named apex.

7. An electrode assembly for an electrical space discharge tube comprising a pair of filaments



providing a filamentary cathode, an additional electrode, spacing members comprising upper and lower insulating spacers, a bracket secured to the lower side of said lower spacer, said lower spacer having a central opening therein, said opening having a pair of notches on opposite sides of and in alignment with the center of said opening, said filaments being welded to said bracket at spaced points thereon which are out of alignment with said opening, beyond the edges thereof, and on opposite sides thereof, each of said filaments being drawn into the apex of one of said notches, whereby said filaments are held apart at said lower spacer, and tension means positioned above said upper spacer, said filaments being drawn through an opening in said upper spacer and secured to said tension means at points out of alignment with and beyond the edges of said last-mentioned opening.

8. An electrode assembly for an electrical space discharge tube comprising a pair of filaments providing a filamentary cathode, an additional electrode, spacing members comprising upper and lower insulating spacers, said lower spacer having an opening therethrough, said opening having a pair of notches, a common conductor on the lower side of said lower spacer, said filaments being welded to said common conductor at spaced points thereon which are out of alignment with said opening, beyond the edges thereof, and on opposite sides thereof, each of said filaments being drawn into the apex of one of said notches, said filaments extending through an opening in said upper spacer, and tension means positioned above said upper spacer, said filaments being secured to said tension means at points out of alignment with and beyond the edges of said last-mentioned opening but on the same side thereof, whereby said filaments are drawn together at said upper spacer.

ELTON K. KELLEY.

## REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS


| Number | Name | Date |
|---|---|---|
| 1,672,233 | Skinner | June 5, 1928 |
| 2,047,944 | Ackman et al. | July 21, 1936 |
| 2,108,533 | Henry | Feb. 15, 1938 |
| 2,274,554 | Krim | Feb. 24, 1942 |
| 2,328,136 | Gaebel | Aug. 31, 1943 |
| 2,355,083 | Krim | Aug. 8, 1944 |