Aug. 23, 1932. C. V. LITTON 1,872,991

VACUUM TUBE

Filed Oct. 22, 1929

Fig. 1

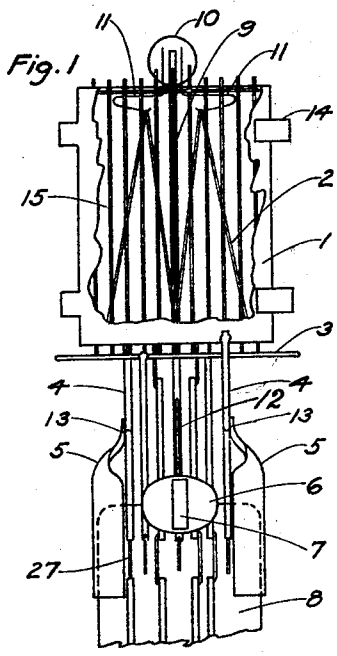


Fig. 2

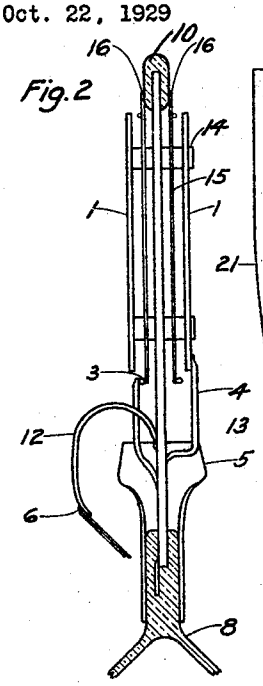


Fig. 9

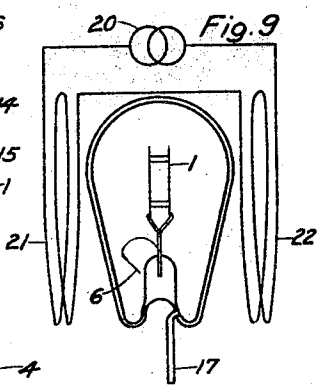


Fig. 3

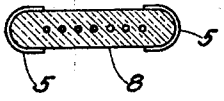


Fig. 8

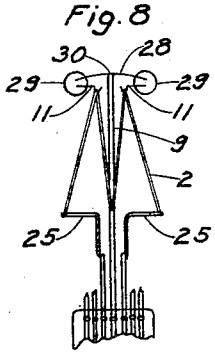


Fig. 5

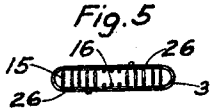


Fig. 6

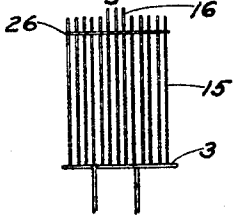


Fig. 7

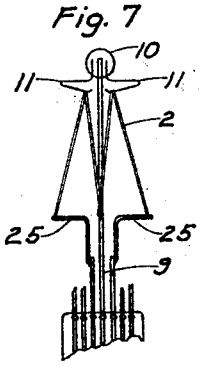
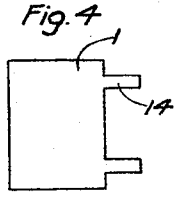


Fig. 4



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UNITED STATES PATENT OFFICE

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VACUUM TUBE

Application filed October 22, 1929. Serial No. 401,398.

This invention relates to vacuum tubes and their manufacture and particularly to the construction of low power tubes such as are used in radio receiving sets.

The broad object of the invention is to reduce the cost of manufacturing small vacuum tubes. This is accomplished, first, by reducing the structure for supporting the electrodes to wires rising from the press of the tube and reinforcing these wires, where necessary, with trough shaped members fitting over the edges of the press; second, by utilizing a getter support of sheet metal placed non-adjacent and at an angle to the anode elements, whereby during evacuation the anodes can be heated by high frequency induction without heating the getter support, although the latter may be heated when it is desired to flash the getter, by shifting the tube into a different position with respect to the high frequency exciting coil.

This and other features of the invention will be explained in the following description in connection with the drawing in which:

Fig. 1 is a view of a complete electrode assembly with part of the anode cut away to show the grid and cathode structure.

Fig. 2 is an edge section through the electrode structure.

Fig. 3 is a section through the press of the tube.

Fig. 4 is a view of one of the blanks from which the anode is constructed.

Fig. 5 is a top view of the grid structure.

Fig. 6 is a side view of the grid structure.

Fig. 7 is a side view of the cathode structure.

Fig. 8 is a side view of an alternative cathode structure and,

Fig. 9 is a schematic drawing showing the method of heating the anode of the tube by high frequency induction.

In Fig. 1 an electrode structure is depicted which comprises an anode 1, grid elements 15, filamentary cathode 2, and means for supporting these various elements.

The cathode assembly is shown to best advantage in Fig. 7. The cathode itself consists of a filament 2 in the shape of an inverted W, the extremities of which are secured to supporting wires 25 rising from the press of the tube, and the mid point of which is welded to a central rod or wire 9 also rising from the press. To provide for expansion and contraction of the filament 2 the upper loops are supported by resilient wires 11 which are secured to the upper end of rod 9, and at the same time insulated therefrom, by a glass bead 10. Bead 10, in addition to serving as an insulating attaching means between element 11 and rod 9, serves to space the cathode structure from the grid, since the bead 10 is flattened as shown in Fig. 2 and fits between elongated grid bars 16.

In Fig. 8 an alternative cathode structure is disclosed in which two glass beads secure the supports to a cross member 28, which is welded at its mid point to the top of rod 9. In this embodiment of the invention either supports 11 or cross member 28 or both, may be of resilient material to tension the filament. It is preferred to reduce the overall height of this cathode structure so that it will lie entirely within the grid structure.

The grid structure as illustrated in Figs. 5 and 6 consists of a plurality of hairpin shaped elements 15 and straight extended center elements 16. These vertical elements are welded to a lower continuous frame member 3, which is welded to supporting wires rising from the press of the tube, and to a pair of straight frame members 26 near the top. The straight bars 16 are provided to permit the filament supporting and aligning bead 10 shown in Figs. 1, 2, and 7, to extend above the tops of the hairpin elements 15, but this is not essential, and the cathode assemblies shown in either Figs. 7 or 8, may be proportioned to lie entirely within the grid, in which case all the grid bars may be of the hairpin type.

The anode consists of two rectangular plates 1 having integral tabs 14. The two plates are secured together to form a rigid assembly by bending the tabs 14 of one plate around and welding them to the other plate as shown in Figs. 1 and 2. The structure is supported in position in the tube by two wires 4 rising from the press and welded to the two plates respectively. The anode sup-

porting elements 4, if chosen of a convenient size for sealing into the press of the tube, lack the strength necessary to prevent lateral displacement of the anodes when the tube is subjected to violent shocks in shipment or handling. To prevent bending of elements 4 they are therefore reinforced with clamps 5, which as shown in Figs. 1, 2, and 3, are shaped to fit snugly over the edge of the press 8 and are welded to supports 4 at points 13. In practice, the clamps 5 are shaped to fit the press 8 but do not grip it tightly, since their only function is to prevent lateral displacement of the anodes toward or away from the grid and cathode structure spaced therebetween.

The supporting wires also serve as conducting leads from the electrodes to the exterior of the tube. They may be formed of an alloy having a coefficient of expansion suitable for sealing into glass, or they may be of some other material such as nickel and be welded to short elements 27 of platinum as shown in Fig. 1. With this sort of construction, the welded joint may lie within the press, and although a tight seal is only obtained between the glass and the portion 27, this has been found to provide a structure which is satisfactory.

In order to remove the last traces of gas and water vapor from a tube during evacuation it is common practice to vaporize a gettering material such as magnesium within the tube while it is being pumped. It is also necessay to heat the electrodes, particularly the anode, during evacuation and it is preferable to vaporize the getter material subsequent to the heating of the anode. To make possible a thorough heating of the anode without affecting the getter, the latter is attached to a disk 6 supported by a wire 12 secured to the center cathode support 9. In Fig. 1, the getter material is shown as a rectangular piece of magnesium 7, but other materials may be used. The disk 6 is set at an angle to the planes of the anode plates 1 as shown in Figs. 2 and 8.

Referring to Fig. 9, the anodes 1 are heated during evacuation of the tube, to drive off occluded gases, by placing the tube within two coils 21 and 22 which are energized with high frequency current from a source 20. Since the anodes 1 and coils 22 lie in parallel planes, large eddy currents are set up in the anodes sufficient to heat them to a desired temperature. The getter supporting disk 6, however, being of smaller area and, what is more important, being mounted in a plane at an angle to the planes of the coils 21 and 22, has relatively little current induced therein and does not get hot enough to vaporize the gettering material on its surface. When the anodes are sufficiently freed of gas, the tube is flashed by twisting it within the coils, or by twisting the coils about the tube, to bring the disk 6 in a plane parallel with the planes of the coils, under which conditions the disk is heated to a high temperature and the getter vaporized.

A further advantage of placing the getter support in the particular position and at the angle shown is that the getter material, after flashing, is deposited largely on the wall of the tube instead of on the electrodes. It has been found that some cathode materials are deleteriously affected by a small deposit of foreign matter.

I claim:

1. A vacuum tube mount comprising a press, an anode, supporting elements sealed into said press and attached to said anode and serving as the sole supporting means of said anode, and reinforcing means secured to said supports and contacting with the exterior surface of said press to resist displacement of said anode.

2. A vacuum tube mount comprising a flattened press, an anode, supporting wires sealed into said press and attached to said anode and serving as the sole supporting means for said anode, and reinforcing means comprising a trough shaped, sheet-metal member fitting over the edge of said press and secured to one of said supporting wires.

3. A vacuum tube mount comprising a flattened press having substantially parallel sides, an electrode, a supporting wire sealed into said press and attached to said electrode and reinforcing means for said supporting wire attached thereto and rigidly positioned against movement perpendicular to the parallel surfaces of said press, by contact with said surfaces.

4. A vacuum tube mount comprising an anode having two opposed parallel portions, a grid positioned between said anode portions comprising a plurality of vertical bars lying in two planes, a cathode within said grid, and cathode supporting means comprising a body of insulating material in contact with, but not secured to, grid bars lying in said two planes.

5. A vacuum tube mount comprising a pair of anode elements, a grid positioned between said anode elements comprising a plurality of vertical bars lying in two parallel planes, some of which extend above the rest, a filamentary cathode within said grid and filament supporting means comprising a flattened body of insulating material positioned between said upwardly extended grid bars.

In testimony whereof, I have hereunto set my hand.

CHARLES V. LITTON.