Oct. 28, 1941. R. H. FIDLER 2,260,308

IMPROVED HEATER STRUCTURE FOR THERMIONIC DEVICES

Filed Oct. 4, 1939

Fig. 1.

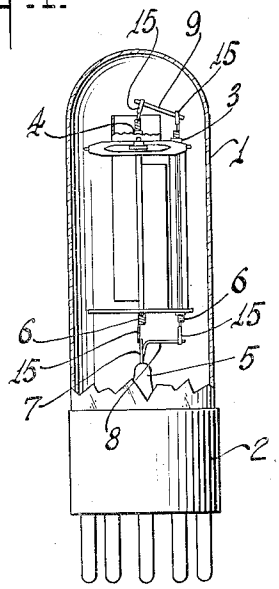


Fig. 2.

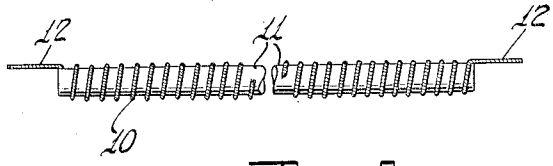


Fig. 3.

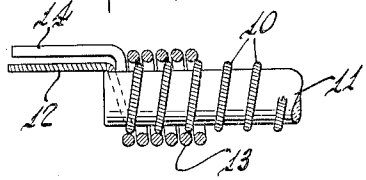


Fig. 4.

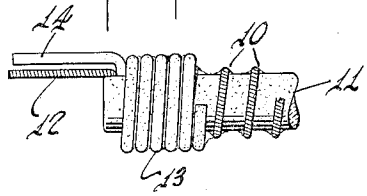


Fig. 8.

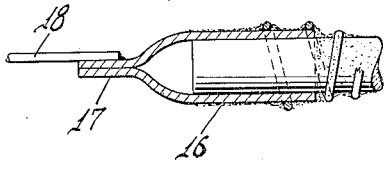


Fig. 5.

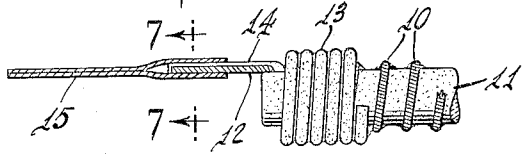


Fig. 7.

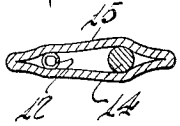
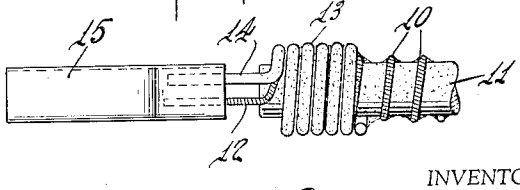


Fig. 6.



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IMPROVED HEATER STRUCTURE FOR THERMIONIC DEVICES

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Application October 4, 1939, Serial No. 297,805

11 Claims. (Cl. 250—27.5)

This invention relates to thermionic devices, such, for example, as radio tubes.

The invention relates generally to that type of thermionic device or radio tube which embodies an indirectly heated cathode and one object of the invention is a tube of this character embodying a high voltage low current filament heater for the cathode or cathodes which is characterized by its endurance and long life under the service conditions.

A further object of the invention is a thermionic device or radio tube comprising a novel and improved high voltage low current filamentary heater structure for the cathode.

Further objects of the invention will hereinafter appear.

For a better understanding of the invention reference may be had to the accompanying drawing forming a part of this application wherein—

Fig. 1 is a side view of a radio tube embodying the invention with parts broken away and omitted for convenience in illustration;

Fig. 2 is a view illustrating one step in the manufacture of the improved filamentary heater structure;

Figs. 3, 4, 5 and 6 illustrate further steps in the manufacture of the heater;

Fig. 7 is a sectional view along the line 7—7 of Fig. 5; and

Fig. 8 is a view of a modification.

Referring to the drawing, I have shown the invention as embodied in a radio tube having the conventional bulb 1 and the plug base 2. In the particular embodiment shown the tube is a combined rectifier and output tube, but the invention is applicable to other types of tubes. The tube embodies two cathodes 3 and 4 which are mounted in any suitable manner upon a mount resting upon the press 5. Disposed in heat transfer relation with the cathodes 3 and 4, as, for example, being contained therein, are the heater elements 6, these heater elements 6 being connected in series across the terminals 7, 8 carried by the press 5 and leading to the high voltage circuit. These heater elements 6 are connected at their upper ends by a jumper connection 9.

Each of the heater elements 6 comprises a high voltage low current filament 10 mounted on a ceramic core 11. The filament 10 is designed for operation on a high voltage circuit, as for example, on the conventional 117 volt circuit with the two heater elements 6 being connected in series and with half the voltage of the circuit applied to each separate filament 10. In conventional structures the filament 10 with the ceramic core 11 is sprayed with a ceramic or refractory coating, then baked in a high temperature furnace and the heater element is then mounted by attaching the terminals 12 to the connections of the thermionic mount. Considerable difficulty has been experienced in the premature failure or rupture of the heater by the breaking of terminals 12 of the filament, and particularly when the necessary fine filament 10 is employed for high voltage operation.

I have found that this difficulty may be largely avoided by the structure of the heater element shown in Figs. 2 to 7. Fig. 2 illustrates a step in the manufacture of the heater element when the coiled filament 10 is placed over the ceramic core 11. Fig. 3 indicates the next step wherein an auxiliary short coil 13 of molybdenum or the like is placed over each end of the assembly filament 10 and core 11. This short coil 13 has a diameter which is preferably slightly larger than the diameter of the coil 10, but of small enough diameter to firmly grip and bind the ends of the assembly filament 10 and core 11. The wire of this coil is also of a larger diameter than that of the wire of filament 10 and each of the coils 13 for each of the heater elements 6 is provided with a straight portion 14 forming a terminal parallel to the terminal 12 of the filament 10. This assembly of Fig. 3 is then subjected to the conventional ceramic or refractory coating operation, as, for example, by spraying the ceramic material thereon and then baking in a high temperature furnace. Fig. 4 illustrates the structure after the spraying and baking operations are performed. A metallic tab 15 is then fastened to the terminals 12 and 14 as indicated in Figs. 5, 6 and 7, there being such a tab for each end of the heater. This tab may, as shown, be in the form of a metallic tube of nickel or other suitable metal, the connection being made by pinching the tube firmly about both of the terminals 12 and 14. The heater elements thus formed, as indicated in Figs. 5 to 7, are then mounted within the cathodes 3 and 4 and the tabs 15 are suitably fastened as by welding to the terminals 7 and 8 and the jumper 9.

The heater elements thus constructed and mounted are found to operate unimpaired indefinitely and through the normal life of the tube, the short coils 13 on the ends of the heater elements reinforcing and preserving the same unimpaired notwithstanding the small dimensions and high temperature operations of the filaments 10 and 12. The coils 13 do not in operation

reach as high a temperature as the filament terminals and the filament 10 and are of larger diameter wire as shown in the drawing and preferably of refractory metal.

In Fig. 8 is shown a modification wherein a reinforcing tube 16 of any suitable metal is telescoped over the end of the assembled filament 10 and the core 11 of Fig. 2. The assembly of Fig. 2 with the metallic tube 16 thus telescoped over and into electrical contact with the filaments 10 at each end is then sprayed with a ceramic material and baked in a high temperature furnace. Each of the reinforcing tubes 16 of the assembly is then pinched as indicated at 17 and metallic elements or wires 18 are fastened to the flattened portion 17, as by welding, for mounting the heater element upon the terminals 7 and 8 and forming a means for the jumper connection 9.

I claim:

1. In a thermionic device, a cathode heater element comprising a supporting core including a coil filamentary heater mounted on said core, reinforcing metallic and electrical terminal elements telescopically mounted on the end coils of said filament and core and extending therebeyond to serve as supporting terminals therefor and means mechanically and electrically connecting the filament terminals and the reinforcing elements with the thermionic structure.

2. A thermionic device of the character set forth in claim 1 wherein the reinforcing elements are short metallic coils.

3. A thermionic device of the character set forth in claim 1 wherein the reinforcing elements are short metallic coils, the wire of said coils being of larger diameter than the wire of the filament coils.

4. A thermionic device of the character set forth in claim 1 wherein the reinforcing elements are short metallic coils bindingly mounted upon the ends of the filament and core assembly, the diameter of the wire of the reinforcing coils being larger than the diameter of the filament wire.

5. A device of the character set forth in claim 1 comprising two heater elements connected in series.

6. A device of the character set forth in claim 1 wherein the reinforcing elements are of tubular construction.

7. A heater element for cathodes of thermionic devices comprising a central ceramic core, a coil filamentary heater disposed thereabout, reinforcing metallic and electrical terminal elements telescopically mounted on the end coils of said filament and core and extending therebeyond to serve as supporting terminals therefor, said assembly of core, filamentary heater and metallic elements being coated with a ceramic material and metallic tabs fastened to said reinforcing elements and the ends of the filamentary heater.

8. In a structure of the character set forth in claim 7 wherein the reinforcing elements are short metallic wire coils.

9. A structure of the character set forth in claim 7 wherein the reinforcing elements are tubular elements.

10. A thermionic device having a cathode heater element comprising a supporting core, a coil filamentary heater mounted on said core, reinforcing metallic elements telescopically mounted on the ends of said filament and core, and means mechanically and electrically connecting the filament terminals and the reinforcing elements with a thermionic structure, said reinforcing elements being of sufficient physical strength to support said coil and core.

11. A thermionic device including a cathode heater element comprising a supporting core, a coil filamentary heater mounted on said core, a single reinforcing metallic and electrical terminal element telescopically mounted on the end coils of the filament at each end of said core, and means mechanically and electrically connecting the filament terminals with the thermionic structure.

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