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INDIRECTLY HEATED ELECTRON EMITTER
FOR POWER TUBES AND THE LIKE
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Fig. 1.

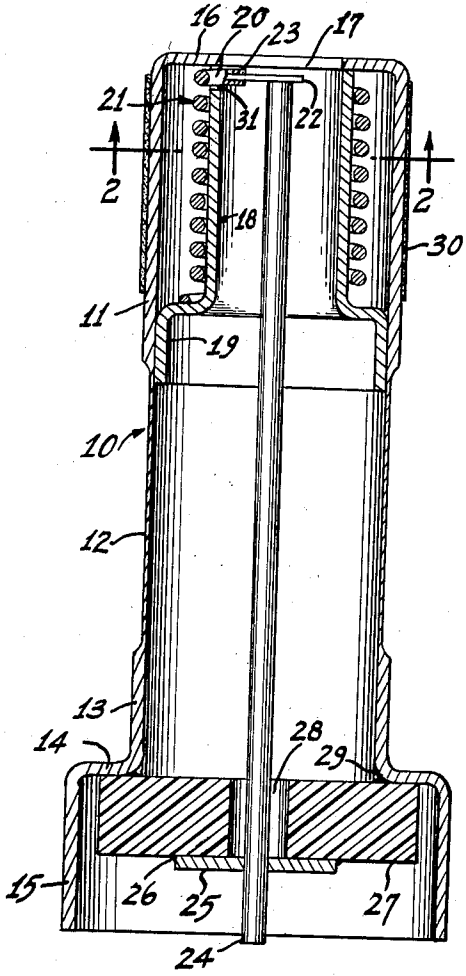
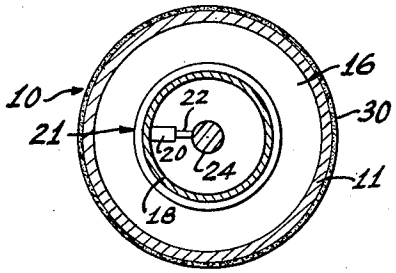


Fig. 2.



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INDIRECTLY HEATED ELECTRON EMITTER FOR POWER TUBES AND THE LIKE

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9 Claims. (Cl. 313—337)

This invention relates to electron emitters, and more especially it relates to emitting cathodes of the so-called indirectly heated kind.

A principal object of the invention is to provide a novel and simplified heater-cathode device for electron tubes, which device is especially useful in tubes of the power kind, for example such as are used in radio and television transmitters and the like.

A feature of the invention resides in a heater-cathode device which is rugged in construction and can be manufactured from a minimum of prefabricated parts and with a minimum of welded joints.

Another feature relates to a heater-cathode unit wherein the heater element is substantially completely enclosed within a closed annular chamber, the inner wall of which chamber constitutes a support for the heater element in the form of a coiled wire, and the outer but closely spaced wall of the said annular chamber carries externally the electron emissive material.

Another feature relates to an improved heater-cathode unit for power tubes wherein the cathode is formed with two sections, one of which is a thin walled section of single wall thickness to act as a heat isolating and support element, and another section is a double walled section to house a coiled heater element, the external surface of the double walled section constituting the electron emitter.

A further feature relates to the novel configuration, construction and location and interconnection of elements which together constitute a rugged and efficient heater type cathode for electron tubes and the like.

Other features will appear from the ensuing descriptions, the appended claims, and the attached drawing.

In the drawing, which shows one typical and preferred embodiment,

Figure 1 is an elevational view in section of a heater-cathode device according to the invention;

Figure 2 is a sectional view of Figure 1, taken along the line 2—2 thereof and viewed in the direction of the arrows.

Referring to the drawing, there is shown a typical embodiment of a heater-cathode unit according to the invention, which can be used as the electron emitter for any well known construction of the electron tube. Since the invention is concerned primarily with such a unit, the remaining parts of the tube with which the cathode unit cooperates are omitted. It will be understood, of course, that the cathode unit is mounted within any well known evacuated bulb or envelope and is surrounded by one or more electrodes, one of which is an anode, and at least one intervening grid between the cathode and anode. For an illustrative construction of an electron tube in which the device may be used, reference may be had to the application of Nekut and Shrader entitled, "Power Tubes For Operation at High Frequencies," Serial No. 505,388 and filed concurrently herewith on May 5, 1955.

The heater-cathode unit, according to the invention, comprises a cylindrical tubular member or sleeve **10** of any suitable alloy or metal. Member **10** has its upper section **11** and its lower section **12** formed with different cross sectional wall thickness. The lower section **12** is preferably formed as an integral part with the section **11**, for example by rolling down to the required thinness consistent with the desired rigidity of the member **10** as a whole, and consistent with the desired heat isolating properties for section **12**. In other words, the section **12** acts to cut down as much as possible, heat conduction between the section **11** and the base of the cathode, while at the same time providing a rigid support for the cathode as a whole. The base portion of the cathode member **10** may be in the form of another relatively thick cross section portion **13**, which is bent at right angles to form a substantially flat annular flange **14** and an integral downwardly depending cylindrical skirt **15**. It will be understood, of course, that the sections **11**, **12**, **13**, **14** and **15** are preferably formed from a one-piece metal blank. The upper end of member **10** is provided with a flat annular rim **16**, having a central circular opening **17** for purposes to be described.

Welded to the lower end of section **11** is another cylindrical metal member **18** having the right angled flange portion **19** which is spot welded to the lower end of section **11**. The straight cylindrical wall of member **18** preferably extends upwardly into contact with the flat rim **16**, and the said upper end is provided with a window **31** through which the end **20** of an insulated heating coil **21** emerges. Thus, the section **11** and the member **18** define a cylindrically annular substantially closed chamber within which is housed the heater element **21**. The element **21** is in the form of a coiled refractory heater wire **22** carrying a suitable refractory insulator coating **23**. The lower end of the wire of coil **21** is spot welded to the horizontal portion of the flange **19**. The opposite end of the coil which extends through the window **31** is spot welded to the upper end of a rigid metal rod **24** which passes centrally through the member **10**. It is for this reason that the opening **17** is provided in the cap **16** to facilitate the insertion of a suitable spot welding tool.

The rod **24** has welded thereto a metal disc **25** which is arranged to be sealed in a vacuum-tight manner, for example by brazing, as indicated by the numeral **26**, to the lower face of an annular insulator member **27** preferably of ceramic. The rod **24** passes centrally through the opening **28** in ceramic **27**. The ceramic member **27** seats flat against the flange **14**, to which it can be vacuum-tight sealed, for example by brazing, as indicated by the numeral **29**. The section **11** is provided on its external periphery with a coating **30** of any well known electron emissive material such as conventionally used in electron tubes, especially those of the power kind.

The finished unit can then be mounted within a suitable enclosing envelope in the proper concentric relation to the remaining electrodes, after which the enclosing bulb or envelope can be evacuated and processed in the conventional ways. The foregoing described cathode-heater unit employs a minimum of prefabricated parts. Furthermore, the part **18**, in addition to constituting one wall of the enclosed annular heating chamber, can also be used as a winding spool upon which the heater element **21** can be wound. If desired, of course, the coil **21** can be previously wound to the desired internal diameter so as to be closely telescoped over the member **18**. In any event, the cost of manufacture is greatly reduced since only three spot welding operations are required, namely the spot welding between the section **11** and the flange **19**, and the spot

welding of one end of the coil with the flange **19** and the spot welding of the opposite end of the coil with the rod **24**. It is believed that the manner of assembly of the parts will be clear from the foregoing description.

In general, the pre-wound heater coil **21** is assembled over the member **18** and the lower end of the coil is spot welded to flange **19**. This assembly of member **18** and coil **21** can be placed over a suitable mandrel and inserted into the member **10** and spot welding is effected between the member **10** and the flange **19**. The mandrel may then be removed and the assembly, consisting of the elements **24**, **25** and **27** can be inserted into the member **10**, whereupon the end of the heater wire **22** can be spot welded to rod **24**. The necessary brazing at the regions **26** and **29** can be effected thus constituting a rigid and efficient heater-cathode unit.

The invention is not limited to any particular materials, providing the arrangement, configuration and interconnection of parts described above is employed in the final unit.

Various changes and modifications may, therefore, be made in the disclosed embodiment without departing from the spirit and scope of the invention.

What is claimed is:

1. An electron emitter device for electric discharge tubes, comprising a first tubular metal member and a second tubular member forming at one end of said first member an annular and substantially closed chamber, a heater element supported within said chamber, a rigid metal rod passing through said members in spaced relation to the inner wall of said chamber, one end of said heater being electrically connected to said rod, the other end of said heater being electrically connected to a wall of said chamber, and electron emissive material on the external peripheral wall of said chamber.

2. An electron emitter device for electric discharge tubes, comprising a tubular metal member having relatively thick walled ends with an intermediate thin walled portion joining said end portions to act as a heat isolator, one of said ends having on its outer surface an electron emissive material, another tubular metal member fastened interiorly of said end but of smaller radius to define with said end an annular substantially closed chamber, a heating element supported within said chamber having one end electrically connected to said housing, a metal rod passing centrally through said member, means insulatingly supporting said rod from the opposite end of said member, means electrically connecting one end of the heating element to said member, and means electrically connecting the opposite end of said heating element to said rod.

3. An electron emitter device for electric discharge tubes, comprising a tubular metal sleeve having a double walled section at its upper end defining a substantially closed heater housing at said upper end, a heater element supported within said housing, one end of said heater element being electrically connected to said sleeve, and a metal member insulatingly supported adjacent the lower end of said sleeve and electrically connected to the opposite end of said heater element.

4. An electron emitter device for electric discharge tubes, comprising a tubular metal sleeve having a double walled section at its upper end defining a substantially closed annular chamber at said upper end, a heater element supported within said chamber, an insulator member vacuum-tight sealed to the lower end of said sleeve, a metal rod passing through said insulator, means vacuum-tight sealing said rod adjacent its lower end to said insulator, means electrically connecting one end of said heater to said rod, and means electrically connecting the opposite end of said heater to said sleeve.

5. An electron emitter device for electric discharge tubes, comprising a tubular metal sleeve having a double walled section at its upper end defining a heater housing, a heater element surrounding and supported by the inner wall of said double walled housing, said sleeve having intermediate its upper and lower ends an intervening tubular thin walled heat isolating section, an insulator member vacuum-tight sealed to the lower end of said sleeve, and a connector member vacuum-tight sealed through said insulator member and connected to one end of said heater element.

6. An electron emitter for electric discharge tubes, comprising a cylindrical metal sleeve, a cylindrical metal member within one end of said sleeve and fastened to the interior wall of said sleeve to define therewith an annular heater housing within said sleeve at its upper end, a coiled heater wire within said housing surrounding said cylindrical member and supported thereby, means for vacum-tight sealing the opposite end of said sleeve, means vacuum-tight sealed through said sealing means and extending interiorly of said sleeve but insulator therefrom for making electrical contact with one end of said heater element, and electron emissive material on the external surface of said sleeve at its upper end.

7. An electron emitter according to claim 6 in which said vacum-tight sealing means includes an annular ceramic member and said metal sleeve is rigidly supported from said ceramic member by a thin walled heat insulating continuation of said sleeve.

8. A unitary heater-cathode assembly for power tubes, comprising a tubular metal sleeve having a relatively thick walled section at its upper end, a relatively thick walled section at its lower end, an intervening thin walled heat isolating section between said end sections, a flat annular flange formed with said lower end section, a ceramic member vacuum-tight sealed to said flat flange, a tubular metal member attached to the upper end of said sleeve and spaced therefrom to form an annular heater housing localized at said upper end of the sleeve, a coiled insulated heater wire surrounding said tubular metal member and supported thereby, and means vacuum-tight sealed through said ceramic for making electrical connection to one end of said heater wire.

9. A unitary heater-cathode assembly according to claim 8 in which said upper end section, said lower end section, and said intervening section are formed from a single metal blank, and said tubular metal member is telescoped interiorly of the upper end of said sleeve and is provided with an offset flange portion which is welded to said upper end to constitute said heater housing.

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