Jan. 14, 1947. H. BRANSON 2,414,137

ELECTRON TUBE

Filed Feb. 29, 1944

FIG. 1.

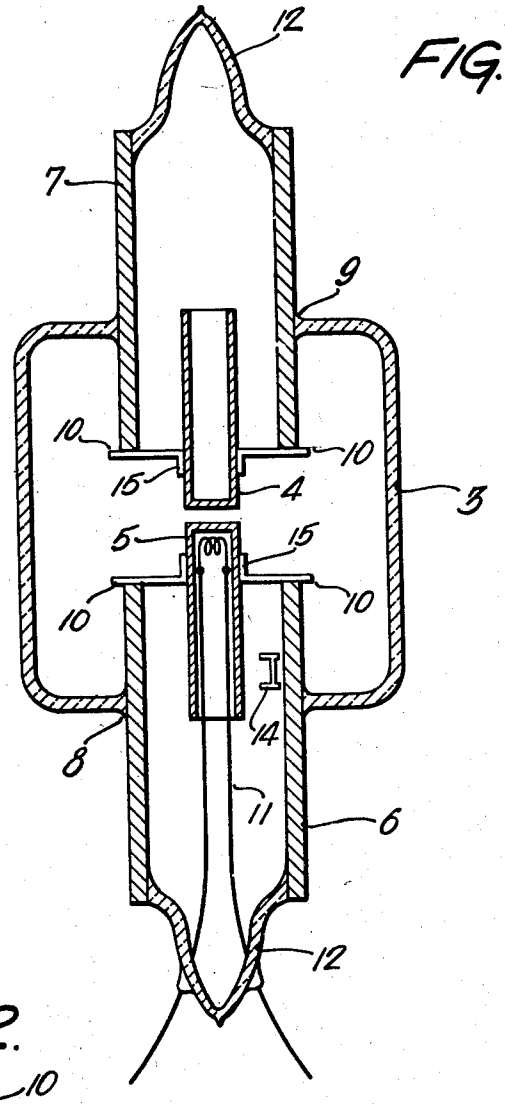
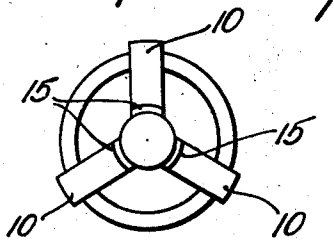


FIG. 2.



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ELECTRON TUBE

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5 Claims. (Cl. 250—27.5)

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This invention relates to space discharge devices, such as vacuum tubes, and is especially concerned with the construction of the tube elements and the conducting leads therefor.

A critical, predetermined spatial relationship must be maintained between the electrodes of vacuum tubes, and the flexibility and relatively small diameter of the electrode supporting members commonly employed heretofore have resulted in substantial problems during manufacture. The difficulties will be apparent when it is understood that it is common to support and space the elements during the manufacturing process by gripping that portion of the support members which projects outwardly of the envelope area; and that it has proved extremely difficult to maintain the critical relationship between the tube elements, due to the flexibility of the wire leads supporting them and their consequent susceptibility to vibration and displacement.

Accordingly, it is a primary object of the present invention to provide a vacuum tube device having rigid supporting-conducting leads of a novel character which permit positive retention of the tube elements in precise spacing and alignment, during the manufacture of the tube.

More particularly, the invention contemplates the provision of rigid metal sleeves adapted to support anode and cathode elements at their free ends within the envelope, said sleeves further providing an exceedingly stable support for said elements during the manufacture of the vacuum tube, and thereafter.

A further object of the invention resides in the provision of a vacuum tube in which the electrode leads are of unusually large diameter, thereby resulting in relatively low lead inductance. It is also an object of the invention to provide a vacuum tube in which the leads are conveniently disposed and adapted for connection to external circuits.

A further object relates to the provision of a vacuum tube having an indirectly heated cathode, in which the heater circuit is well shielded from the radio frequency circuit.

Broadly, it is an object of the invention to provide a vacuum tube which is susceptible of extremely simple and inexpensive manufacture.

It is a more particular object of the invention to provide a vacuum tube having rigid generally cylindrical sleeve-like leads which are readily adaptable to jig assembly.

The invention also contemplates the provision of a vacuum tube having a novel getter arrangement, by means of which it is possible to localize the getter deposit in an area removed from the insulating envelope.

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A further object of the invention resides in the provision of a vacuum tube in which the exhaust tubulation is simplified.

These and other objects and advantages of the invention will be best understood by making reference to the following description taken together with the accompanying drawing, in which:

Fig. 1 is an enlarged sectional view of a vacuum tube constructed in accordance with the present invention, the illustration showing the tube tipped up 90° from its normal position, the getter cup 14 being secured to member 6 by welding or other appropriate means; and

Fig. 2 is a plan view of one of the tube elements and the mounting therefor.

Referring more particularly to the drawing, there is illustrated a vacuum tube which comprises, generally, a glass envelope 3, spaced anode and cathode elements 4 and 5, respectively, and cylindrical metal sleeves 6 and 7, adapted to support said cathode and anode elements, and to serve as conducting leads. The sleeves are preferably formed of "Kovar" (the thermal coefficient of expansion of this material being substantially equal to that of the glass commonly employed) and are sealed into opposed walls of the envelope as shown at 8 and 9. Although the invention is not limited to vacuum tube devices in which the tube elements are arranged in confronting relation, as shown, such is desirable by reason of the reduction in lead capacitance. Similarly, it will be understood that the invention is also useful with tubes of other than the diode type, although the description is limited to such types in the interests of clarity.

The anode and cathode elements 4 and 5 are supported within the sleeves 6 and 7 by means of small strap members 10, preferably of Nichrome, which, as best seen in Fig. 2, may be secured to the free end of the sleeve structure, as by butt welding or the like. The inner ends of these straps are provided with upwardly turned flange portions 15 which are secured (as by welding) to the outer cylindrical surface of the anode and cathode elements. It will be understood that the face of the cathode element incorporates a suitably treated surface and, as illustrated, the cathode is indirectly heated by the resistance element shown schematically at 11. The cylindrical sleeves project outwardly of the envelope a distance sufficient to permit their

engagement with a suitable jig, during the manufacturing operation, and have their outside ends sealed with an exhaust tubulation 12. Connection to the sleeves may be accomplished in any desired manner.

As is well understood, high frequency currents applied to the anode-cathode circuit of the diode will tend to travel along the outer surface of the sleeves 6 and 7, and this fact has been utilized to keep such high frequency currents out of the heater filament circuit. Such shielding of the filament circuit in high frequency applications is extremely desirable, since any induced current in the filament circuit reduces the efficiency of the tube. Moreover, the sleeve 6 functions as a shield structure to shield the diode circuits from the magnetic field about the heater wires 11.

A feature of the improved construction resides in the location of the getter cup 14 within the sleeve 6. When the getter is fired, the deposit of getter material is localized within the conducting sleeve, thereby preventing any reduction of the insulating qualities of the envelope.

While the device has been illustrated on a greatly enlarged scale, it should be understood that the construction lends itself well to the manufacture of extremely small and compact vacuum tubes, for example, tubes in which the greatest dimension of the envelope may not be greater than ½-inch; the diameter of the conducting sleeve being in the neighborhood of ¼-inch.

In constructing the tube, the anode and cathode elements are first suitably positioned within and secured to the sleeves 6 and 7, after which the outer ends of said sleeves may be positioned in a supporting jig and the distance between the cathode and anode elements fixedly established. Following this, the glass envelope is applied to the assembly, being sealed to the sleeve members as by glass welding. The tube is then evacuated and the exhaust tubulation accomplished in any manner which may prove convenient to one skilled in this art, no lead-supporting "pinch" being necessary.

From the foregoing description it will be evident that the invention provides a vacuum tube which is susceptible of precise fabrication by extremely simple and inexpensive manufacturing methods. In addition to the manufacturing advantages set forth above, the compact rigid construction of the tube improves the performance thereof by the virtual elimination of vibration of the tube elements and consequent microphonics.

In addition, the device of the present invention is susceptible of wide useage, by reason of its ruggedness and its adaptability for use with a variety of external circuits. For example, the rigid sleeve-like leads may be readily inserted within adjacent portions of the internal conductor of a coaxial transmission line.

While a particular embodiment of the invention has been illustrated and described, it should be understood that the invention, in the broadest aspect, is not limited thereto. For example, while hollow cylindrical members are employed, certain advantages of the invention may be realized by the utilization of solid rod-like members of sufficient diameter to impart the desired degree of rigidity. With such an arrangement a directly heated cathode might be utilized. However, it will be apparent that the invention is susceptible of certain changes and modifications within the scope of the appended claims.

I claim:

1. In a space discharge device incorporating at least diode elements, an envelope formed of insulating material and having opposed walls with aligned aperatures therein, a pair of rigid conductive tubular members projecting through said apertures into said envelope and being sealed to said walls with their longitudinal axes in substantial alignment, said members having their inner ends in predetermined spaced relation within said envelope and having their outer end portions extending a substantial distance outside the envelope, anode and cathode elements having substantially plane surfaces supported upon the respective inner ends of said members in substantially perpendicular relation to the longitudinal axes of said members, and means sealing the outer ends of said members.

2. In a space discharge device incorporating at least diode elements, an envelope formed of insulating material and having opposed walls with aligned apertures therein, a pair of rigid conductive tubular members projecting through said apertures into said envelope and being sealed to said walls with their longitudinal axes in substantial alignment, said members having their inner ends in predetermined spaced relation within said envelope and having their outer end portions extending a substantial distance outside the envelope, anode and cathode elements supported upon the respective inner ends of said members, means sealing the outer ends of said members, and heating means for the cathode element extending within the tubular cathode-supporting member and including wires extending through the outer end sealing means for the said member.

3. In a space discharge device incorporating at least diode elements, an envelope formed of insulating material, a pair of rigid conductive tubular members projecting into said envelope and being sealed into the wall thereof with their longitudinal axes in substantial alignment, said members having their inner ends in predetermined spaced relation within said envelope and having their outer end portions extending a substantial distance outside the envelope, anode and cathode elements disposed within and extending from the respective inner end portions of said members, said elements being of hollow cylindrical form and being arranged coaxially with said members and having inner end surfaces in predetermined spaced relation, means securing said elements to the inner ends of said members, and means sealing the outer ends of said members.

4. In a space discharge device incorporating at least diode elements, an envelope formed of insulating material, a pair of rigid conductive tubular members projecting into said envelope and being sealed into the wall thereof with their longitudinal axes in substantial alignment, said members having their inner ends in predetermined spaced relation within said envelope and having their outer end portions extending a substantial distance outside the envelope, tubular anode and cathode elements of relatively small diameter extending from the respective inner end portions of said members substantially in axial alignment and in coaxial relation with said members, said elements having inner end surfaces in predetermined spaced relation, supporting means for said elements extending between the outer walls of said elements and the inner ends of said members, and means sealing the outer ends of said members.

5. In a space discharge device incorporating at

least diode elements, an envelope formed of insulating material, a pair of rigid conductive tubular members projecting into said envelope and being sealed into the wall thereof with their longitudinal axes in substantial alignment, said members having their inner ends in predetermined spaced relation within said envelope and having their outer end portions extending a substantial distance outside the envelope, tubular anode and cathode elements of relatively small diameter extending from the respective inner end portions of said members substantially in axial alignment

and in coaxial relation with said members, said elements having inner end surfaces in predetermined spaced relation, a plurality of supporting straps securing each of said elements to the inner end of its associated member, means sealing the outer ends of said members, a heater for said cathode element disposed within the latter, and current supply wires for said heater extending within the tubular cathode-supporting member through the outer end sealing means therefor.

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