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2,082,839

FILAMENT STRUCTURE FOR ELECTRON DISCHARGE DEVICES

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Fig. 1

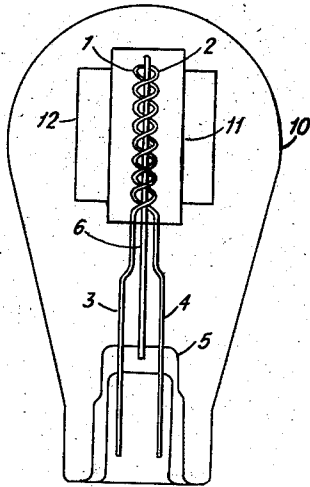


Fig. 3

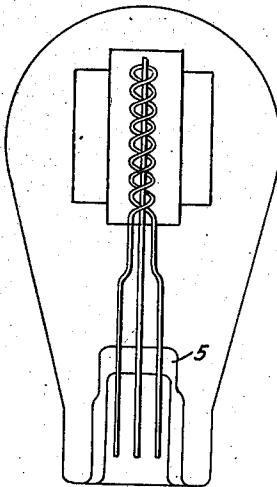


Fig. 2

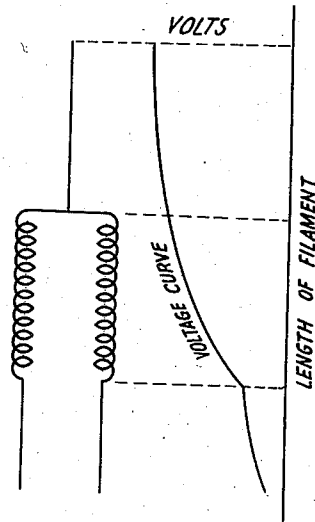


Fig. 4

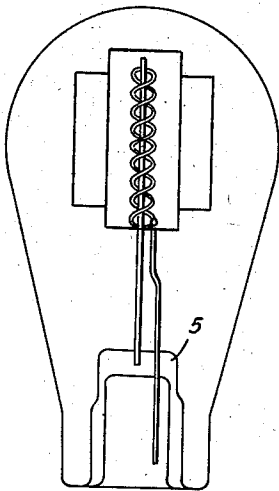


Fig. 5

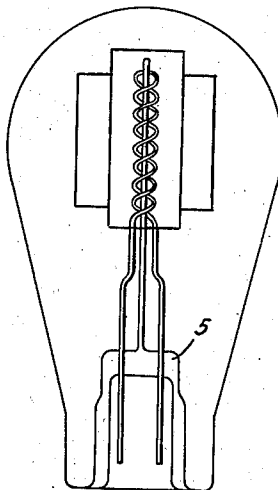
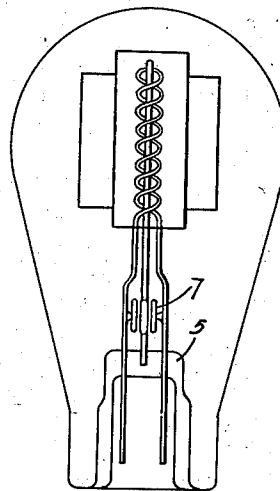


Fig. 6



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FILAMENT STRUCTURE FOR ELECTRON
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6 Claims. (Cl. 250—27.5)

This invention relates to electron discharge devices and in particular to the construction of the filament electrode of such devices.

In thermionic apparatus, the filament which serves the function of emitting electrons may take the form of a double, reversely wound helix, the spirals being continuations of one another and having their free ends sealed into the press of the envelope. Due to the considerable length of the filament, the helix may tend to sway and change the spacial relation with respect to the associated electrodes, and for this reason it has been customary to provide a support, usually of metal, in the form of a standard rising from the press of the envelope which serves to maintain the upper ends of the filament in a centrally aligned position, and at the same time offers substantially no impediment to the normal expansion of the heated member in a longitudinal direction. It has been found, however, that when filaments of this type are employed in circuits utilizing ultra high frequencies of the order of 300,000,000 cycles and higher, that considerable heat occurs in the filament structure. This heating, it has been noted, is distributed unevenly over the filament, a matter which is undesirable from the standpoint of filament structure design. A further difficulty has been found to exist in the uneven voltage distribution along the filament electrode for currents of these very high frequencies, a result which is thought to be due to the considerable distributed capacity of the metallic supporting rod as against that of the filament spirals, the latter being also known to have considerable distributed inductance. These difficulties are manifested by the uneven heating of the filament and exist only at the short wave lengths where the size of the filament becomes comparable with that of the wave length utilized.

An object of the present invention is to overcome the foregoing difficulties, and this is accomplished in one particular embodiment of the present invention by providing a supporting stem for the filament which extends through the press, together with the filament leads. Other ways of effecting the desired result are to provide a supporting stem which is part of the press of the envelope, and to increase the capacity effect between the lower portion of the stem and the filament leads for effecting a detuning action and equalizing the radio frequency potentials at both ends of the filament.

In the accompanying drawing, Figure 1 is given merely to illustrate prior art practice in

the design of the filament structure; and Figure 2 to show graphically the uneven voltage distribution present throughout the length of such prior art filament structures when the electron discharge device is used either as a frequency multiplier or as a Barkhausen oscillator at frequencies having wave lengths of the order of one meter or less. In Figures 3, 4, 5 and 6, however are illustrated various embodiments in accordance with the present invention for equalizing voltage distribution along the length of the filament.

Referring to Figure 1, there is shown a well known type of filament structure in an electron discharge device comprising a double wound filament helix 1, 2 having leads 3, 4 extending through a supporting glass or quartz press 5 from which there extends a supporting stem 6 which is arranged to connect with the joined end of of the double spiral filament. Surrounding the double spiral filament is the grid element 11 and anode 12. A glass envelope 10 encloses the electrodes. Due to the distributed capacity of the supporting rod 6 and the considerable distributed inductance of spirals 1, 2 there is obtained, at the very high frequencies under consideration, a voltage distribution curve such as is represented by the graph of Figure 2. This curve indicates clearly that the voltage distribution for currents of very high frequencies is different for different points on the filament.

Figures 3 and 4 indicate preferred embodiments for obtaining maximum performance of the electron discharge device due to a more uniform voltage distribution along the filament structure. In Figure 3 the supporting stem is merely extended through the glass press to the base of the tube and thus provides a sufficient capacity effect between the elements to reduce the whip end effect illustrated in the graph of Figure 2.

Figure 4 shows a somewhat different embodiment wherein the double spiral is joined at both ends and fed from one end through the stem and at the other end through a lead, both stem and lead extending parallel to one another to the base of the tube.

Figure 5 illustrates a still further embodiment wherein the supporting stem consists of quartz material joined to the glass stem.

In Figure 6 there is shown a condenser electrode arrangement 7 which provides a sufficiently great capacity by having the electrodes interposed between the stem and the filament leads to equalize the radio frequency potentials at both ends of the filament.

It should be noted from the foregoing that the invention is not limited to the precise arrangement of apparatus shown, since various other modifications may be made without departing from the spirit and scope of the invention.

I claim:

1. An electron discharge device adapted for use with ultra high frequencies having wave lengths of an order of a meter or less comprising an envelope having a stem, anode and grid electrodes within said envelope, a filament supported from said stem and having leads extending there-through externally of said envelope, a support for said filament comprising a riser connected to the stem and rigidly fixed to that end of the filament remote from the stem, and capacity means within said envelope comprising condenser electrodes interposed between said riser and filament leads for insuring an approximately equal voltage distribution on said filament for currents of ultra high frequencies.

2. An electron discharge device adapted for use with ultra high frequencies having wave lengths of an order of a meter or less comprising an envelope having a stem, anode and grid electrodes within said envelope, a filament supported from said stem and having leads extending there-through externally of said envelope, a support for said filament comprising a riser connected to the stem and rigidly fixed to that end of the filament remote from the stem, capacity means within said envelope and coupling said filament leads with said riser for insuring an approximately equal voltage distribution on said filament for currents of ultra high frequencies.

3. An electron discharge device adapted for use with ultra high frequencies having wave lengths of the order of a meter or less comprising an envelope having a stem and enclosing electrodes, a filament supported from said stem and having leads extending therethrough externally of said envelope, a support for said filament comprising a riser connected to the stem and rigidly fixed to that end of the filament remote from the stem, said riser being located intermediate said filament leads, and capacity means within said envelope and coupling said filament leads with said riser for assuring an approximately equal voltage distribution on said filament for currents of ultra high frequencies, said capacity means comprising three separated plates, one plate being located on said

riser and each of said other plates being individual to one of said filament leads.

4. An electron discharge device adapted for use with ultra high frequencies having wave lengths of the order of a meter or less comprising an envelope having a stem and enclosing electrodes, a filament supported from said stem and having leads extending therethrough externally of said envelope, a support for said filament comprising a riser connected to the stem and rigidly fixed to that end of the filament remote from the stem, said riser being located intermediate said filament leads, and capacity means within said envelope and coupling said filaments leads with said riser for assuring an approximately equal voltage distribution on said filament for currents of ultra high frequencies, comprising a condenser whose opposite plates are connected to said filament leads and whose electrical center is connected to said riser.

5. An electron discharge device adapted for use with ultra high frequencies having wave lengths of an order of a meter or less comprising an envelope having a stem, anode and grid electrodes within said envelope, a filament supported from said stem and having leads extending there-through externally of said envelope, a support for said filament comprising a metallic rod connected to the stem and rigidly fixed to that end of the filament remote from the stem, and a plurality of capacitance electrodes within said envelope and interposed between said leads for capacity coupling said filament with said metallic rod for insuring an approximately equal voltage distribution on said filament for currents of ultra high frequencies.

6. An electron discharge device comprising an envelope having a stem portion, anode and grid electrodes within said envelope, a double helical filament within said envelope and having leads extending to said envelope, a metallic supporting rod rigidly affixed to that end of said filament which is remote from the stem portion of said device, said rod running substantially parallel to said leads extending to the stem portion of said device, a plurality of condenser electrodes coupled between said stem and said leads whereby the voltage distribution on said filament at the very high frequencies is approximately uniform.

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