

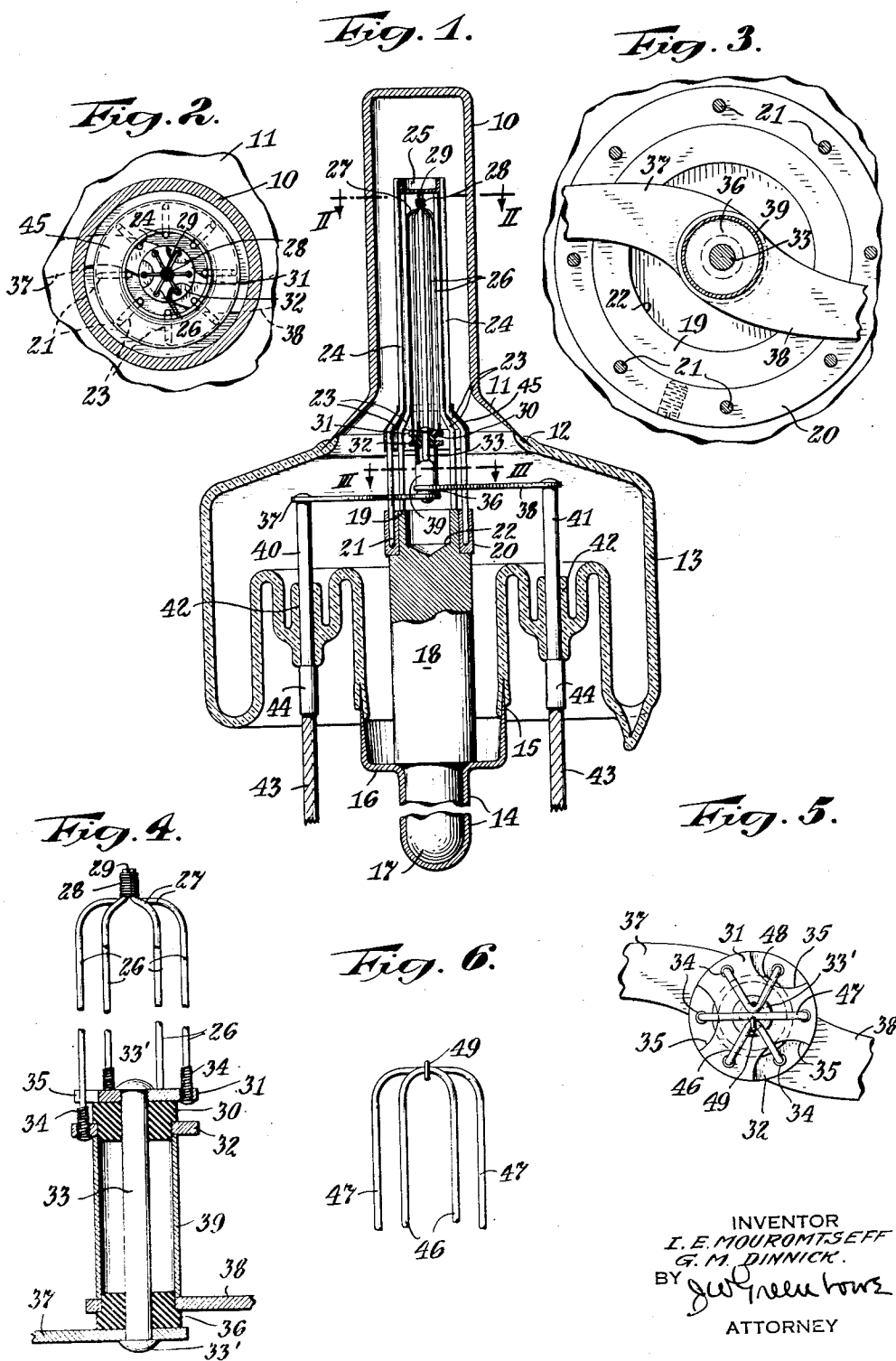
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ULTRA HIGH FREQUENCY TUBE

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ULTRA HIGH FREQUENCY TUBE

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The invention relates to electron discharge devices and particularly such devices that are suitable for ultra high frequency.

An object of the invention is to provide a discharge tube for ultra high frequency having an output of 100 watts and even up to 250 or 300 watts output.

Another object of the invention is to provide a discharge device having a minimum of inductance between the leads to the electrodes.

Other objects and advantages of the invention will be apparent from the following description and drawing, in which:

Fig. 1 is a view, partly in cross-section and partly in elevation, of a tube embodying the invention.

Fig. 2 is an enlarged view on lines II—II of Fig. 1.

Fig. 3 is an enlarged view on lines III—III of Fig. 1.

Fig. 4 is an enlarged view of the filament and connecting supporting structure illustrated in Fig. 1.

Fig. 5 is a top view of a modification of the filament structure.

Fig. 6 is a front elevation of the top portion of the filament structure of Fig. 5.

The invention in particular relates to electron discharge devices suitable for high frequencies of 60 to 260 or 300 megacycles and having a wave length of approximately one to five meters. Tubes utilized in high frequency work have heretofore been limited to a very small power output. The difficulty has been to efficiently dissipate the heat generated in the grid. Prior schemes for cooling the grid of large size tubes are obviously inapplicable to the ultra high frequency tube where the electrodes must be closely spaced together for high frequency use. One of the specific objects of our invention is to provide means for effectively dissipating heat from the grid structure to the casing of the discharge device without interfering in any way with the spacing between the grid and the other electrodes.

Another difficulty in the design of these tubes has been the inductance between the leads to the electrodes. The design of our leads provides a minimum of inductance between the leads of the device.

In the drawing, we have illustrated a preferred embodiment such as illustrated in Fig. 1. The figure is drawn to approximately a 50% greater size than the actual tube constructed according to our invention. An exterior anode 10 is utilized in a hollow tubular form having a flare 11 making

a feather edge seal 12 with the glass insulating portion 13 of the casing. The diameter of the active portion of the anode is very small for tubes of this wattage capacity and may be of an interior diameter of a half to three-quarters of an inch as an example. It will be noted that the insulating part of the casing 13 is enlarged to several times this diameter to provide a wide spacing for the other electrode leads therethrough.

At the opposite end of the tube is a metal portion 14 having a feather seal 15 with the insulating portion. This metal portion 14 is preferably of a cup or knobbed shape having a flare 16 terminating in the feather seal. Fitting into this cup or knobbed shape 14 is a knob of copper 17 having a very tight engagement with the copper portion 14. The knob 17 and the enclosing casing 14 are of sufficient length to provide adequate air cooling and dissipation of heat therefrom. Any suitable shape fins may, of course, be made integral with or to fit upon the knob of the casing 14. Integrally attached to the knob 17 is a shaft 18 extending towards the upper part of the tube. This shaft of copper is of such a size and thickness that there is substantially temperature equilibrium between the tip of the knob 17 and the inner terminal 19 of the shaft 18. In case the inner tip 19 is at 100, 150 or 200 degrees, the knob 17 will not be more than 10 degrees different therefrom. Around the inner end 19 of this copper shaft is a ring or collar 20 securing the ends 21 of the grid wires thereto. This support for the grid wires may take any well-known mechanical form such as the ring 20 sweated on to the end of the copper portion with holes providing the very tight frictional fit drilled into the ring 20. The top of the copper shaft may have a hole 22 drilled therein to help the compression of the ring 20 thereon. The top of the copper shaft may also be split about the hole 20 and have the ends of the grid wires 21 in contact thereto and the ring 20 be in the form of a clamp compressing the ends 21 to the top of the copper shaft. As illustrated in the drawing, the grid wires are spaced about the top of the copper shaft to provide for an assembling of the cathode connection to be hereafter described and then these grid wires are bent inwardly at 23 and then extend parallel and longitudinal at 24 with the desired spacing from the anode 10 which encloses them. The grid wires, as illustrated, comprise eight, although a greater or less number can be used. An inverted cap 25 is preferably welded to the top of these grid wires to maintain them in place.

Inside of the grid are the filament wires 26 preferably of thoriated tungsten extending parallel and concentric with the grid wires and the anode. This filament construction is more clearly disclosed in the enlarged detailed view in Fig. 4. The top of the grid wires are bent over at 27 and have another smaller wire 28 binding their ends 29 together. The wire 28 and the ends 29 may be welded or soldered together. The number of filament wires illustrated is six although of course this number may be varied. It is desirable, however, to have the number an even one. An insulator 30 preferably of a ceramic material supports two discs 31 and 32. The top disc 31 rests on the insulator and is fastened thereto by a bolt 33 extending through the insulator 30. Every other filament 26 terminates adjacent the periphery of this disc 31 preferably by having a wire 34 wound around the end of the filament and welded or soldered to the disc where the filament 26 passes there-through. The disc 32 is placed on a lower reduced portion of the insulator 30 which arrangement maintains it in spaced relationship from the disc 31 on top of the insulator. The upper disc 31 has a cut out portion 35 located at the portions of the periphery intermediate the places of connection of the ends of the filament 26 that are connected thereto. This cut out portion 35, is sufficiently large so that the alternating filaments may extend down to the disc 32 to be secured thereto in a manner corresponding to the attachment of the other filaments to the disc 31. The upper disc 31 accordingly has the shape of a circle with parts regularly removed about its periphery. Other shapes, however, may be used to provide a clearance for the alternating filaments to reach the lower disc 32. The bolt 33 preferably passes through another insulator 36 and a flat arm 37 makes contact with the bolt 33 at the lower surface of the insulator 36. Another arm 38 encloses a reduced diameter of the insulator 36 and a hollow sleeve 39 connects this flat arm 38 and the disc 32.

The bolt heads 33¹ acting on the upper disc 31 and the lower contact arm 37 bind the structure together. The flat arms 37 and 38 pass through the space between two of the grid wires and at a suitable distance therefrom are connected at right angles to two solid rod standards 40 and 41 that are sealed through the insulated casing by the broad and extended seal 42 as illustrated. The conducting rods 40 and 41 are in turn connected to flexible conductors 43 by means of a sleeve 44 and in a manner more particularly described in Patent #1,834,132 of W. L. Miller, issued December 1, 1931, for Leading-in conductor.

A shield 45 is preferably placed about the grid wires on a line with the feather edge seal 12 between the anode and the insulating portion of the casing in order that this seal may not be under any electrostatic stress. This shield will also help in maintaining the shape and alignment of the lower portion of the grid wires.

In Figs. 5 and 6 is disclosed a modification of the filament structure of Fig. 4. A thoriated filament 47 is secured to the upper disc 31 and extends upward where it touches the upper portion of two other wires 46 and 48 and is bound thereto by a wire 49 around the very top portion of these three wires. The other end of each of these wires, 46, 47, and 48, then bends downward through the cut out portions 35 of the disc 31 to make contact with the disc 32.

The cathode heating current enters the tube, for example, through the standard 40, passes at

right angles to the flat arm 37 to the bolt 33 and from this bolt, by means of the disc 31, to the one, two, three or more wires connected thereto, through the thoriated filament wires and back to the other disc 32 through the hollow cylinder sleeve 39 to the flat arm connection 38 and then to the standard 41 leading outside the tube.

In operation, the grid will provide an output way beyond the output of the tubes used for the high frequency. This, as previously mentioned, is due to the efficient cooling of the grid. The high temperature of the grid wires will be applied to the upper edge 19 of the copper shaft 18 and due to the thickness of the copper shaft, the knob 17 will be approximately of the same temperature. In other words, the shaft 18 acts as a temperature equalizer between the end of the grid and the middle portion 14 of the casing acting as a grid lead-in. The shaft 18 provides a broad and capable path for the transference of heat from the grid to the exterior of the casing. By reason of this construction, an output of 100, 150, 250 or 300 watts can be realized. Because of the fact that the grid cooling means does not interrupt the spacing of the grid with the filament and anode, a frequency of 60 to 260 or 300 megacycles can be utilized with the construction disclosed.

Many modifications can be made in the form, number and arrangement of the various elements and their combinations in the preferred embodiments illustrated. As an example, the grid structure of Fig. 1 could take the form of the wires bound at the top in Fig. 4.

We claim:

1. A discharge device comprising a container having an exterior anode, grid and cathode, said grid being located within the interior portion of said container and a connection making a contact to said grid within the interior portion of the container and making a contact with said casing and substantially equalizing the temperature within ten degrees at the contact to the casing to the temperature at the contact to said grid, and means to remove heat from both said exterior anode and from the contact of said grid connection with said casing.

2. A discharge device comprising a container having an anode, cathode and grid, said grid being located within the interior portion of said container, a conductive portion of the casing and a connection making contact to the grid within the interior portion of the container and to the said conductive portion of the casing substantially equalizing the temperature between said two contacts within ten degrees.

3. A discharge device comprising a container having an anode, grid and cathode, said grid being located within the interior portion of said container, a cup-shaped conductive portion having its rim sealed in the wall of said container, and a thick connection approximately the diameter of the grid extending from the grid to the interior surface of said cup-shaped portion.

4. An electrode structure comprising a thick rod of high heat conductivity, an opening in one end, said rod having a reduced diameter around said opening, a plurality of wires forming a cage and means fastening said wires about the reduced diameter around said opening.

5. A discharge device comprising a container having an anode, grid and cathode, said grid being located within the interior portion of said container, a rod of high heat conductivity extending from said grid to the container wall, said

rod having a diameter approximately the largest diameter of said grid, said container having a metal cup-shaped portion, and said rod seated in said cup-shaped portion.

6. A discharge device comprising a container 5 having an anode, grid and cathode, said grid being located within the interior portion of said container, a rod of high heat conductivity ex-

tending from said grid to the container wall, said rod having a diameter approximately the largest diameter of said grid, said container having a metal cup-shaped portion bulged outwardly of said container, and said rod seated in said cup-shaped portion.

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