April 2, 1940. W. G. WAGENER 2,195,474

ELECTRON DISCHARGE DEVICE

Filed Oct. 19, 1937

Fig. 1

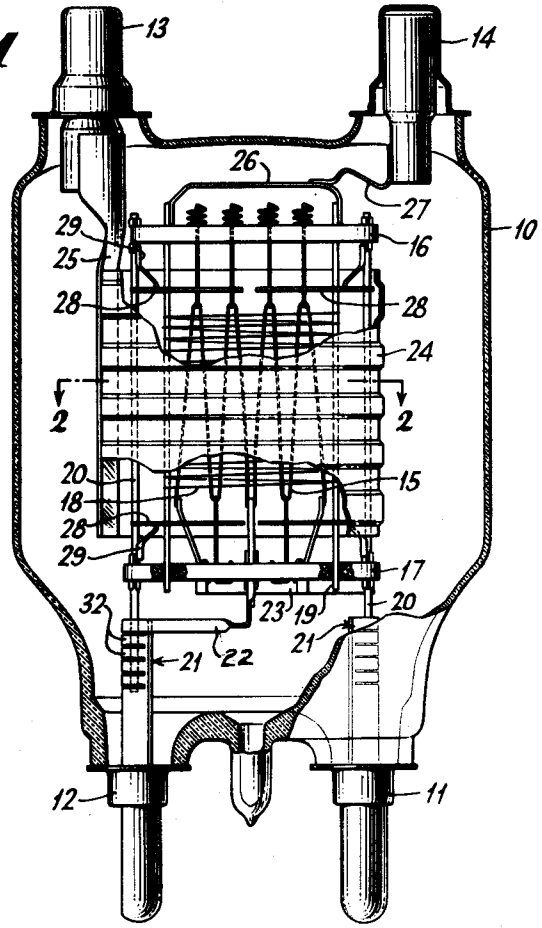


Fig. 3

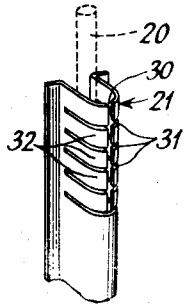


Fig. 2

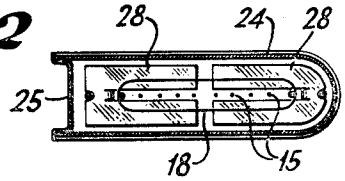
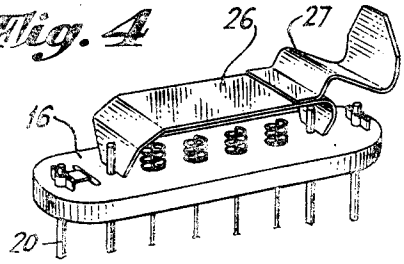


Fig. 4



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ELECTRON DISCHARGE DEVICE

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Application October 19, 1937, Serial No. 169,770

7 Claims. (Cl. 250—27.5)

My invention relates to an electron discharge device, more particularly to such a device suitable for high power output purposes at high frequencies.

In tubes intended for use for high power output purposes at high frequencies the electrode capacitance and lead inductance must be made as small as possible so that they approach the ideal of a section of a transmission line. The tube must be capable of dissipating a large amount of power per unit area and of withstanding the high temperatures associated with the dissipation of these large amounts of power in order that the physical size of the tube may be small. The electrons traveling between the cathode and the anode must travel short distances and must be confined to the intended short paths of travel.

It is therefore the principal object of my invention to provide an electron discharge device capable of large power outputs at high frequencies, which is efficient, requires a low driving power and permits flexibility in circuit design.

The novel features which I believe to be characteristic of my invention are set forth with particularity in the appended claims, but the invention itself will best be understood by reference to the following description taken in connection with the accompanying drawing in which Figure 1 is a side view with parts broken away and parts in section to show details of construction of an electron discharge device made according to my invention; Figure 2 is a transverse section taken along the line 2—2 of Figure 1; Figures 3 and 4 are perspectives showing details of construction of an electron discharge device made according to my invention.

The preferred embodiment of an electron discharge device made in accordance with my invention is of the triode type having a multi-filament cathode in which the filaments lie in a common plane, the cathode being surrounded by a flat grid and plate. The cathode and grid are supported as a unit from one pair of terminals extending from one end of the envelope, and the anode is independently supported from the opposite end of the envelope and connected to one of another pair of terminals extending from the opposite end of the envelope from the first pair, the second of this last pair of electrodes being connected by means of a wide flexible strap to the upper end of the grid. The features of my invention will be more readily understood by referring to the figures of the drawing.

The electron discharge device shown in Figure 1 is provided with an envelope 10 and the terminal members 11, 12, 13 and 14 comprising cup-shaped members sealed to the envelope proper. The lower cup-shaped terminals 11 and 12 provide the cathode filament leads, the terminal 13 the anode lead, and the terminal 14 the grid lead. This arrangement permits ready incorporation of the tube in circuits of the transmission line type which are particularly suitable for high frequency work.

The mount assembly comprises the multi-filament cathode 15, the filaments of which lie in a common plane, and which is supported between the insulating spacer members 16 and 17. The flat grid 18 surrounding the filament is supported on the grid side rods 19 mounted in the insulating spacer members 16 and 17 so that the lower ends may have relative movement with respect to the lower spacer 17 when absorption or radiation of heat from the grid side rods causes change in the length of these side rods. A stop not shown may be secured to one of the side rods on the under side of spacer 17 to limit movement of the grid as a whole. The cathode filament and grid are supported as a unit between the spacers 16 and 17, which are secured to the mount support rods or posts 20 electrically connected to and supported in turn by the channel members 21 secured to the terminals 11 and 12. The mid-point of the cathode is connected by a conducting strap and lead 22 to one of the channel members 21 and the outside ends by a bus 23 to the other of the channel members 21 through rod 20 so that the two sections of cathode filaments are connected in parallel. A flat transversely corrugated U-shaped anode 24 closely surrounds the cathode and grid and is provided along one edge with a stiffening and supporting channel member 25 to which the legs of the U-shaped anode are secured. This channel member forms a portion of the anode proper. This channel member is secured and electrically connected to the cup-shaped terminal 13 which provides the only support for the anode 24. The transverse corrugations stiffen the anode transversely and the channel member 25 provides a stiffening member longitudinally of the anode so that the whole results in a very rigid member. The upper ends of the grid side rods 19 are electrically connected together by means of a wide ribbon strap 26, best shown in Figure 4, and electrically connected to the terminal 14 by means of the flexible strap 27. This wide strap 26, which lies close

to the surface of the envelope, provides a low inductance lead which may lie close to and parallel to an anode lead properly positioned externally of the envelope. Not only does the placement of the terminals 13 and 14 render flexibility of connection to the tube so that it can be readily incorporated in various types of circuits, particularly of the transmission line type, but the wide spacing between these terminals and the cathode filament terminals insures a very low leakage loss through or across the surface of the glass when high voltages are applied to the various electrodes during operation of the tube.

During assembly the various elements are maintained in fixed position by jigs and in order to insure an easy fit between the supporting posts or mount rods 20 and the filament lead post channels, I provide the upper end of each channel member with a longitudinal slot 30 and transverse slots 31, as best shown in Figure 3, so that flexible fingers 32 are provided. During assembly these fingers may be readily bent to conform to the position of the mount posts 20 and are welded to the mount post 20, the welding returning the rigidity to the channel member which it originally had before the fingers were cut into the end of the channel member. The result is that any slight variations in the relative positions of the posts in the channel members are readily taken care of so that no strains are placed upon the seals between the envelope and the cup-shaped terminals 11 and 12.

It is necessary to confine the electrons to the inner cathode anode space during operation of the tube. This is done by means of pairs of shield members 28 mounted within the anode adjacent the ends of the mount and extending between the cathode and the anode and are supported and electrically connected to the mount posts 20 by means of the conducting straps 29.

A tube made according to my invention has all of the desirable characteristics of an electron discharge device intended for use at high frequencies and is capable of dissipating large amounts of power. Because of the close spacing between the electrodes, the electrons travel short distances so that the transit times are small permitting operation at high frequencies, the shields confining the electrons so that they do not strike the wall of the envelope or reach the anode along longer paths and thus interfere with the proper operation of the tube. This results in higher plate efficiencies and charged bulb effects caused by stray electrons are eliminated. Terminals are widely spaced and leads are arranged to give low lead inductances. Since the filament lead-in posts also serve as the external terminal connector posts the resulting structure provides a short heavy filament connection and the total inductance of the filament lead is greatly reduced. By making the plate of tantalum it is possible to eliminate the usual getter so that the bulb is free of dielectric and charging current losses. The cathode filament lead post channels compensate for any misalignment that takes place so that the resulting tube may be accurately made and have consistent characteristics from one tube to another. Actual tests on a tube of the type described show that the tubes have normal efficiency at frequencies up to as high as 45 megacycles, the efficiency dropping to only 60% at 90 megacycles.

While I have indicated the preferred embodiments of my invention of which I am now aware and have also indicated only one specific application for which my invention may be employed, it will be apparent that my invention is by no means limited to the exact forms illustrated or the use indicated, but that many variations may be made in the particular structure used and the purpose for which it is employed without departing from the scope of my invention as set forth in the appended claims.

What I claim as new is:

1. An electron discharge device having an elongated envelope and provided with terminal members extending from opposite ends of said envelope, a multi-filament cathode within said envelope and having the filaments lying in a common plane, and a flat U-shaped anode surrounding said cathode and provided along one longitudinal edge with a U-shaped channel member to which the legs of the U-shaped anode are secured, said channel member forming part of said anode, said anode being provided with transverse corrugations, said channel member being secured to one of said terminal members and serving as the sole support for said anode, said cathode being connected to oppositely extending terminal members.

2. An electron discharge device having an elongated envelope and provided with terminal members extending from opposite ends of said envelope, a cathode within said envelope, a flat U-shaped anode surrounding said cathode and provided along one longitudinal edge with a U-shaped channel member to which the legs of the U-shaped anode are secured, said channel member forming a part of said anode, said channel member being secured to one of said terminal members and serving as a sole support for said anode, said cathode being connected to oppositely extending terminal members.

3. An electron discharge device having an elongated envelope and provided with oppositely extending terminals, a multi-filament cathode having its filaments lying in a common plane and a flat grid surrounding said cathode, insulating spacer members at opposite ends of said cathode and grid for supporting said cathode and grid in spaced relation, mount support rods secured to said spacer members out of electrical contact with said grid and to two of said terminals, a flat anode surrounding said grid and cathode and connected to another of said terminal members, and transversely positioned shielding members positioned within and adjacent the ends of said anode and extending between but out of contact with said cathode and anode and electrically secured to and supported by the mount support rods for confining electrons emitted by the cathode to the inter-cathode-anode space.

4. An electron discharge device having an envelope provided with terminal members and containing cathode, grid and anode electrodes, an insulating spacer member supporting at least one of said electrodes and provided with a support rod, and a channel member having a plurality of flexible fingers at one end and connected at the other end to and supported by one of said terminal members, said flexible fingers surrounding and being welded to said support rod for supporting the insulating spacer and its associated electrode.

5. An electron discharge device having an envelope provided with terminal members and con-

taining cathode, grid and anode electrodes, insulating spacer members supporting at least one of said electrodes and provided with support rods, and channel members each having a plurality of flexible fingers at one end and connected at the other end to and supported by one of said terminal members, said flexible fingers surrounding and being welded to said support rods for supporting the insulating spacers and its associated electrode.

6. An electron discharge device having an envelope provided with electrode terminals sealed to and extending from the envelope, grid, cathode and anode electrodes within said envelope, one of said electrodes being provided with a support rod and lead, and a channel member secured at one end to one of said electrode terminals and provided at its other end with a plurality of parallel flexible fingers, said support rod and lead extending transversely of and between the fingers, and being welded to said fingers whereby misalignment between said channel member and said support rod and lead is compensated for.

7. An electron discharge device including an elongated envelope, a pair of terminal members sealed to and extending from each end of said envelope, a multi-filament cathode having its filaments lying in a common plane, a flat grid surrounding said cathode filament, said grid being provided with a pair of oppositely disposed side rods lying in the plane of said filaments, a pair of insulating members at opposite ends of said grid side rods for maintaining said cathode filaments and grid in spaced relation, a pair of support and lead rods secured to said insulating members and channel members extending from one pair of terminal members and provided with flexible fingers engaging and secured to the support and lead rods, an anode comprising a flat U-shaped member and a U-shaped channel member secured to the legs of said U-shaped anode and forming a part of said anode and secured to one of the other pair of terminal members, said anode being supported solely by said channel shaped member, and a ribbon conducting strap secured to the grid side rods and connected to the other of said other pair of terminal members, said strap lying close to the wall of the envelope of said electron discharge device.

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