April 25, 1933. J. W. MARDEN 1,905,035

ELECTRON DISCHARGE DEVICE

Filed Feb. 26, 1929

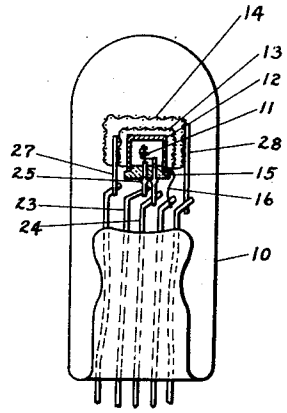


Fig. 1.

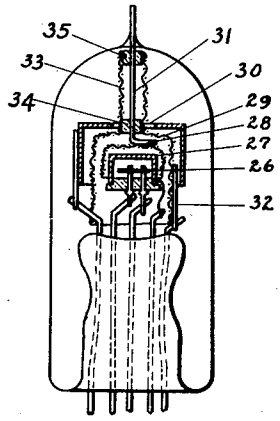


Fig. 5.



Fig. 4.

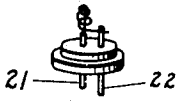


Fig. 3.

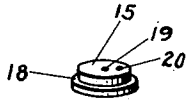


Fig. 2.

INVENTOR
J.W. MARDEN
BY M. F. Cage
ATTORNEY

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UNITED STATES PATENT OFFICE

JOHN W. MARDEN, OF EAST ORANGE, NEW JERSEY, ASSIGNOR TO WESTINGHOUSE LAMP COMPANY, A CORPORATION OF PENNSYLVANIA

ELECTRON DISCHARGE DEVICE

Application filed February 26, 1929. Serial No. 342,787.

This invention relates to an electron discharge device and more particularly to such device of the type in which the cathode is heated indirectly by a heating element disposed adjacent thereto.

One of the objects of the present invention is to produce an electrode structure employing such an indirectly heated cathode, which is compact and rugged and in which the parts thereof are easy to manufacture and assemble.

Another object is to produce a cathode adapted to be heated indirectly by a separate heating element in which the cathode is quickly heated to operating temperature when heating current is applied to the heating element.

Another object is to provide a tube of the above nature in which the heater leads will be short and in which alternating heating current, flowing in the leads will produce a minimum of interference with the other electrode.

Other objects and advantages will hereinafter appear.

In accordance with my invention, I form the cathode into an inverted cup shape, dome shape or similar shape having a closed top and side walls and an open bottom, and I mount the cathode on a disc of insulating material, such as lava rock, thoria, porcelain, etc., which closes the bottom opening of the cathode. The heating element for the cathode is mounted upon the insulating disc, preferably out of contact therewith and serves to heat the cathode, entirely by radiation. The control electrode and anode are of similar shape to the cathode and are nested in proper spaced concentric relation to the cathode.

The electrode assembly is relatively short, projecting only a small distance above the stem of the tube whereby a rigid mount is produced, substantially free from microphonic effects.

In order that the invention may be more fully understood reference will be had to the accompanying drawing in which,

Fig. 1 is a side elevation of a three electrode tube embodying my invention, showing the electrode assembly in section.

Fig. 2 is a perspective view of the insulating disc.

Fig. 3 is a perspective view of disc with a heating element mounted thereon.

Fig. 4 is a perspective view of a modified manner of mounting the heating element, and

Fig. 5 is an elevational view of a screen grid tube showing the electrode assembly in section.

The device shown in Fig. 1 comprises the envelope 10 containing a heater element 11, cathode 12, control electrode or grid 13 and an anode 14. The cathode 12 consists of a cup or cap shaped metal member having preferably a maximum vertical height not greater than the maximum horizontal dimension thereof, and preferably being comprised of nickel having an exterior surface coating of alkaline earth carbonates. It is supported on a disc 15 of insulating material, which completely closes the lower end thereof. Current is conducted to the cathode surface by a wire 16 secured to a leading-in conductor 17 sealed through the press.

The insulating disc 15 is provided with a shoulder or ledge 18 on which the cathode rests and by which it is restricted from movement relative to the heater element 11. The disc is provided with two apertures 19 and 20 arranged respectively at the center and near the edge of the disc, through which the current conducting supports 21 and 22 pass. The supports 21 and 22 are carried by the leading-in wires 23 and 24 and have an enlargement or shoulder 25 upon which the insulator 15 rests.

The heating element 11, as shown in Figs. 1 and 3, consists of a coil or spiral of tungsten having a central vertical wire portion welded to the support 21 and a depending helical portion having its end welded to the support wire 22.

Obviously the heating element may take other shapes but preferably it is supported above the insulator out of contact therewith in order to avoid unnecessary heating of the insulator. In Fig. 4 the heating element is

in the form of a flat spiral 26 supported parallel to and preferably above the surface of the insulator.

The grid 13 and the anode 14 may be pressed into cup shape from sheet nickel mesh and are supported about the cathode in concentric, nested relation by support wires 27 and 28 welded respectively to the grid and anode.

With the construction shown in Fig. 1, employing an anode of about 5 mm. diameter and 5 mm. in height with the cathode and grid entirely contained therein, tubes have been constructed having substantially the same characteristics as the usual form of insulator tube having a cathode of about 25 mm. in length. The short electrode structure may be mounted relatively close to the press on short support wires and thus there is very little tendency of the structure to vibrate.

In Fig. 5 the structure is modified by the inclusion of a shielding or screening grid between the control grid and the anode, to reduce capacity effects therebetween. The electrode assembly comprises the heating element 26, shown also in Fig. 4, cathode 27, control grid 28, screen grid 29 and anode 30. When employing the flat spiral heating element 26, the cup shaped cathode may be made more shallow and the entire electrode assembly correspondingly shortened.

In Fig. 5 the control grid is supported from the end of the tube opposite the plate support by a wire 31 sealed through the dome of the bulb. The shielding grid 29 is supported from the press by the wire 32, and has a neck portion 33 surrounding the control grid support to shield the same from the exterior of the anode. A pair of insulating spacers 34 and 35 prevent displacement of the neck portion 33 and contact thereof with the wire 31.

While specific embodiments of the invention have been described it is to be understood that various modifications and changes may be made without departing from the invention and the embodiments shown and described are to be considered only as illustrative of the invention and not restrictive.

What is claimed is:

1. A cathode structure for an electron discharge tube comprising a disc of insulating material, said disc having a shoulder on the periphery thereof, a hollow cup shaped cathode, having an open end, supported on said disc with the open end thereof engaging said shoulder, said disc having a pair of apertures therein, current conductors extending through said apertures and a heating element supported above said insulator by said conductors.

2. A cathode structure for an electron discharge tube comprising a disc of insulating material, a hollow tubular cathode having a single open end, resting upon said disc, said disc projecting a short distance into and entirely closing the open end of said cathode current conductors extending through said disc into said cathode and a heating element supported on said conductors out of contact with said disc and cathode.

3. An electrode assembly for an electron discharge tube comprising a cup shaped cathode having a single open end, an insulating member closing said open end, a heating element disposed within said cathode, a grid electrode and an anode of substantially the same shape as said cathode, disposed around the cathode in concentric relation.

4. An electrode assembly for an electron discharge tube comprising a hollow inverted cup shaped cathode, having the lower end thereof open, an insulating member fitting in said open end and entirely closing the same, a heater contained within said cathode, the maximum vertical dimension of said cathode being not greater than the maximum horizontal dimension thereof, and a grid electrode and anode conforming substantially to the shape of said cathode and concentrically disposed relative thereto.

5. An electrode assembly comprising a plurality of nested inverted cup shaped electrodes, the smallest electrode constituting the cathode, a disc of insulating material having a shoulder engaging the open end of said cathode and completely closing the same, current conductors extending through said disc and a heating element contained within said cathode and supported out of contact with said insulating disc, by said current conductors.

6. An electron discharge tube comprising an envelope, a cup shaped cathode therein having an open end, an insulating member closing said open end, a heating element within said cathode, a control electrode, screen grid and anode of substantially the same shape as said cathode concentrically disposed about said cathode, said cathode, screen grid and anode being supported from one end of said envelope and said control electrode being supported from the opposite end of the envelope.

In testimony whereof, I have hereunto subscribed my name this 21st day of February 1929.

JOHN W. MARDEN.