June 24, 1930. C. E. HUFFMAN 1,765,487

ELECTRON DISCHARGE DEVICE WITH INDIRECTLY HEATED CATHODE

Filed July 1, 1927

FIG. 1.

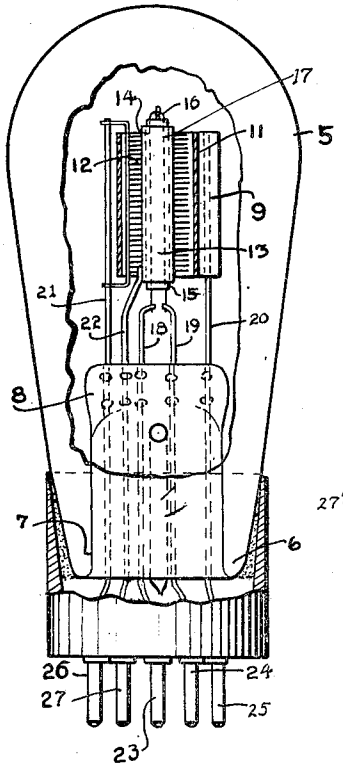


FIG. 3.

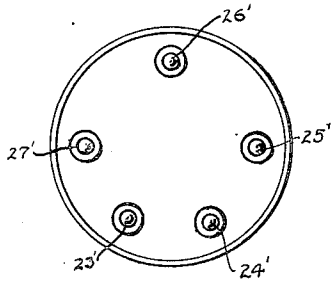


FIG. 4.

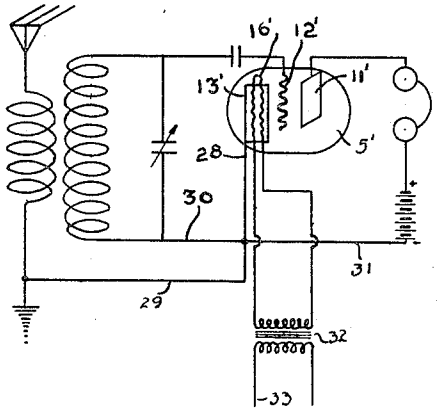
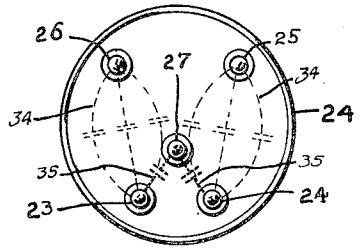


FIG. 2.



INVENTOR
C. E. HUFFMAN
BY M. F. C. Pegues
ATTORNEY

Patented June 24, 1930 1,765,487

UNITED STATES PATENT OFFICE

CHARLES E. HUFFMAN, OF MONTCLAIR, NEW JERSEY, ASSIGNOR TO WESTINGHOUSE LAMP COMPANY, A CORPORATION OF PENNSYLVANIA

ELECTRON-DISCHARGE DEVICE WITH INDIRECTLY-HEATED CATHODE

Application filed July 1, 1927. Serial No. 202,812.

This invention relates to an electron discharge device and more particularly to such a device having an anode, cathode and one or more grid electrodes in which alternating current is employed for heating the cathode to an electron emitting temperature.

The invention is especially concerned with electron discharge devices designed for use in radio receiving apparatus and having the cathode heated by radiation or conduction from a heater element, electrically insulated therefrom and energized by alternating current of suitable voltage, although it is applicable to other types of devices in which the cathode is heated by the direct passage of alternating current therethrough.

Heretofore, in the construction of indirectly heated cathode tubes, difficulty has been experienced due to the objectionable hum produced by the interfering action of the alternation of current in the leads supplying the heater element, upon the leads of the control electrode. To overcome this difficulty, it has been the practice to bring out the leads for the grid at the opposite end of the tube from the alternating current supply leads. In the usual construction, the grid, anode and cathode leads terminate in the usual base and the alternating current leads were brought out through the top of the tube to separate terminals. This construction is also objectionable in that it necessitates the draping of the alternating current supply conductors over the tops of the tubes in more or less close proximity to the induction coils, thus causing the alterations in current to be induced therein. This construction is further objectionable in that it requires that the heater conductors be joined to and disconnected from the tube terminals whenever it is desired to remove or replace a tube.

One of the objects of the present invention is to overcome the above mentioned difficulties and enable the alternating current heater leads to be brought out through the same end of the tube as the remaining leads.

A further object is to provide an arrangement of electrode leads in which the interfering influence of the alternating current leads on the grid lead is rendered negligible.

A further object is to provide an arrangement of terminal prongs in the base whereby the grid electrode terminal is protected from the influence of the alternating current supply terminals.

A still further object is to provide a terminal arrangement for an indirectly heated cathode radio tube which will facilitate replacement of the tube in receiving apparatus.

Another object is to provide an arrangement of terminal prongs in the tube base by which the magnetic fields set up by the heater terminals will be partially neutralized.

Other objects and advantages will hereinafter appear.

In accordance with my invention, I seal the leading-in wires for the heater element in the same press with the grid, anode and cathode leads and so shield the grid lead from the alternating current heater leads that they do not induce any objectional currents therein. I have found that when a conductor maintained at substantially ground potential is interposed in the press between the alternating current leads and the grid lead, that the hum which ordinarily results when the heater leads are brought out through the same end of the tube as the grid lead, is materially reduced. This shielding conductor may conveniently be the cathode lead, although a separate conductor may be employed if desired.

The electrode leads are all secured to terminal prongs in a common base, the prongs of which are likewise arranged to prevent undesirable fields being set up about the grid terminal.

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

Fig. 1 is a sectional view of a vacuum tube constructed in accordance with my invention;

Fig. 2 is a plan view of the base showing one arrangement of terminal prongs;

Fig. 3 is a plan view of the base showing a different arrangement of terminal prongs; and,

Fig. 4 is a circuit diagram in which the tube of Figs. 1, 2 and 3 is employed.

Referring to Fig. 1, there is shown an envelope 5 having a neck 6 to which the usual

stem 7 is sealed. A press 8 is formed at the upper end of the stem, through which the leading-in conductors are sealed and from which the electrode assembly 9 is supported. The electrode assembly comprises a cylindrical anode 11, grid or control electrode 12 disposed therein, and a cathode 13 concentric with the anode and grid. The cathode 13 comprises a metal sleeve 14 coated with an electron emitting material, such as alkaline earth oxide, and is supported on an insulating body 15 having a refractory, filamentary heating element 16 threaded through apertures 17 in the insulating support for heating the cathode to an electron emitting temperature. This specific construction is old in the art and forms no part of the present invention.

The alternating current leads 18 and 19 for the heater element 16 are sealed through the press somewhat centrally thereof and the anode lead 20 is sealed at one side thereof. The grid lead 21 is arranged at the opposite side of the heater leads and the cathode lead 22 is interposed between the grid lead and the heater leads. Of course, it is to be understood that other arrangements of the leading-in conductors in the press may be employed, the essential feature being that the grid lead be shielded from the alternating current lead by an interposed conductor which is maintained at substantially ground potential. This interposed conductor serves to prevent the alterations in the cathode heating current from setting up undesirable currents in the grid lead which would be amplified in the plate circuit.

The conducting leads 18, 19, 20, 21 and 22 are joined to the terminal prongs 23, 24, 25, 26 and 27 respectively which may be arranged in the manner illustrated in Figs. 2 or 3. In Fig. 2, the alternating current heater terminals 23 and 24 are disposed relatively close together so as to partially neutralize the changing magnetic fields caused by the alternating current flow through the leading-in wires contained therein. The grid prong 26 and plate prong 25 are disposed a relatively long distance from the heater prongs to reduce interfering influence of the heating current. Interposed between the heater prong and the grid and plate prongs is the cathode prong 27 which serves to distort the electro-static field between the heater prongs and grid and plate prongs and thereby prevents undesirable alternating charges being set up, particularly in the grid leads.

In Fig. 3 a different arrangement of terminal prongs is shown in which each of the prongs is arranged on the circumference of a circle concentric with the base. The heater terminal prongs are indicated as 23′ and 24′ and are disposed relatively close together and a relatively long distance from the grid prong 26′. The grid prong, it will be noted, is spaced a uniform distance from each of the heater prongs 23′ and 24′ and consequently the magnetic fields set up by the two heater terminals in the region of the grid prong neutralize each other.

The cathode prong 27′ and the anode prong 25′ are arranged intermediate the heater prongs and serve to overcome the interfering influence of the heating current.

In Fig. 4, I have illustrated a conventional circuit employing an indirectly heated cathode tube. In this diagram the tube 5′ is provided with the cathode 13′, heater element 16′, grid 12′ and anode 11′. The cathode 13′ is grounded through the conductors 28 and 29 and the grid and plate returns are connected to the cathode by conductors 30 and 31 respectively, through the conductor 28. The cathode heater element 16′ is provided with alternating heating current by a suitable transformer 32 from the alternating current lines 33.

It will be evident from the foregoing, that the cathode lead being grounded will serve as a shield to prevent the electro-static coupling between the leads of the heater element and the grid lead, both in the base and through the press.

The dotted lines 34 shown in Fig. 2 represent the static fields which would ordinarily exist if the cathode prong 27 was not interposed between the grid prong 26, plate prong 25 and the alternating current prongs 23 and 24. These fields are diverted away from the grid prong and to the cathode prong when the cathode prong is so interposed, as indicated by the dotted lines 35.

I have described and claimed in a copending application Serial No. 201,292 filed June 25, 1927, an adapter for enabling the indirectly heated cathode tube of the present invention to be applied directly in radio receiving apparatus designed for tubes having a directly heated cathode. This adapter when inserted in the socket of the receiving apparatus and alternating current heating leads joined thereto, serves as a socket for the present tube, enabling the same to be inserted in or removed from the apparatus without connecting or disconnecting any of the supply leads, thus rendering the tubes readily interchangeable and replaceable.

While I have described some particular embodiments of my invention, it is to be understood that the invention is susceptible to many changes and modifications without departing therefrom.

What is claimed is:

An electron discharge device including an anode, control electrode, cathode, and a separate heating element for said cathode, a base for said device, terminals for each of said electrodes and heating element on said base arranged on the circumference of a circle, the terminals for said heating element being

positioned next to each other and the terminal for said control electrode being spaced at an equal distance from each of said terminals for said heating element.

In testimony whereof, I have hereunto subscribed my name this 30th day of June, 1927.

CHARLES E. HUFFMAN.