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ELECTRON DISCHARGE TUBE

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*Fig. 1*

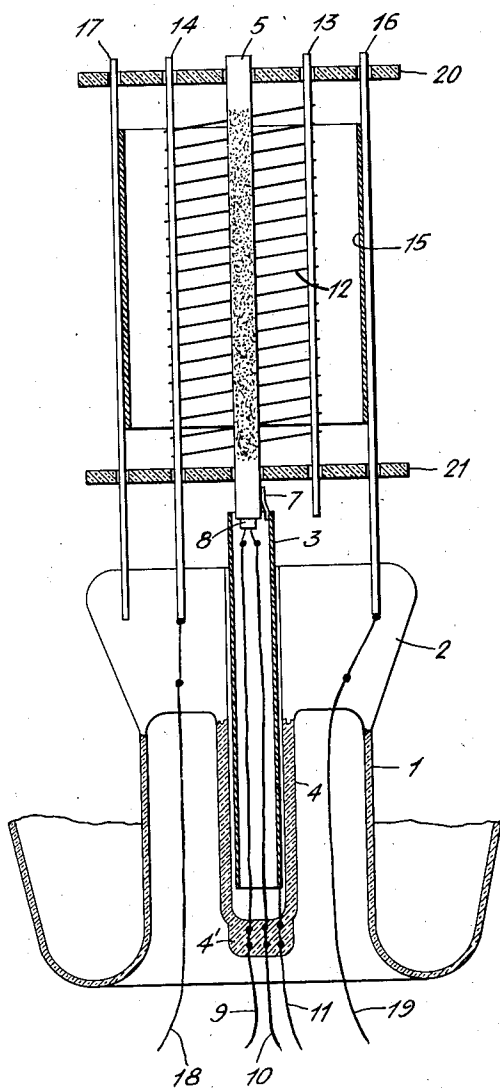
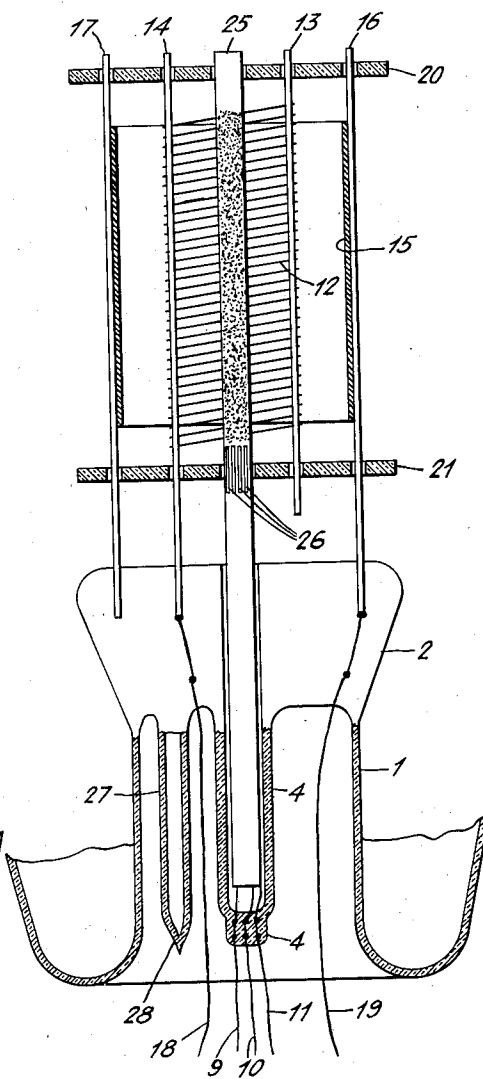


*Fig. 2*



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## UNITED STATES PATENT OFFICE

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## ELECTRON DISCHARGE TUBE

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7 Claims. (Cl. 250—27.5)

The present invention relates to an electron discharge device and more particularly to a thermionic tube comprising an indirectly heated cathode, which is to be supplied with alternating current.

The primary object of this invention is to reduce the humming noise, which is caused in a telephone receiver or loudspeaker by the alternating heating current.

Another object is to enhance the mechanical stability of the electrode system. Further objects will become apparent when the specification is perused in connection with the accompanying drawing.

In order to suppress interfering noises in an amplifying tube containing an indirectly heated cathode, it is necessary to keep down the capacity between the control electrode and the heater as low as possible. This is of particular importance, when indirectly heated A. C. cathodes are operated on the full main line voltage. Likewise it may be important for tubes with an extremely large amplification factor, even if operated on low heating voltages.

According to the present invention a small capacity between the control grid and the heater is attained by means of a special press, whereby a metal tube is squeezed into a vitreous press, the said tube being the continuation of the cathode and electrically connected to it. While hitherto some difficulties have been experienced in hermetically embedding metal tubes into a press, these difficulties are overcome in accordance with this invention by slipping a vitreous tube over the metal tube and squeezing both together into the press. When the press is formed, the material of the stem and of the glass tube is softened and fused together. The glass tube extends beyond the outward end of the metal tube and is sealed off there. Furthermore connection wires to the heater and the metal tube itself may be led immediately through this seal. As a result of this construction leakage between the metal tube and the glass in the press is prevented.

The joint between the metal tube and the emitting cathode may be screened by an additional shield, so that no lines of force going out from the heater may reach the control electrode and the capacity between the heater and the control electrode is reduced to a practically negligible value.

An utmost effective screening is attained, when the metal tube projects to such an extent into the interior of the evacuated vessel that it

may serve as support of the emitting layer. The heater is drawn into the interior of the metal tube in the usual manner. To prevent heat losses from the incandescent cathode by thermal conduction away towards the press, slots may be provided near the end of the incandescent part of the cathode.

When the vitreous tube slipped over the metal tube is not sealed off at the outward end and the connection wires are led through the side wall of the tube, it may be used for connecting the discharge device to the exhausting pump. If the square section of the metal tube is filled up by the heater, another exhaustion tube is to be sealed into the press.

If the metal tube squeezed into the press is strongly connected to the cathode, it renders the whole electrode system very resistant to mechanical shocks and vibrations so that tubes manufactured in accordance with this principle exhibit a relatively small microphonic effect.

Fig. 1 shows one form of my invention.

Fig. 2 shows a modified form of my invention.

One method of carrying this invention into effect will now be described with reference to Fig. 1 of the drawing. A reentrant stem is indicated by 1. The vessel enclosing the electrode system and fused to the stem is omitted. 2 is the press, where the leading-in wires and the supports carrying the electrodes are sealed in. 3 denotes a metal tube, preferably consisting of a refractory metal, while 4 is vitreous tube slipped over the metal tube 3. Both are squeezed together into the press. The lower end of the vitreous tube 4 is sealed off at 4'. The metal sleeve carrying the emitting layer of the cathode is indicated by 5; it is connected to the metal tube 3 at 7. As shown, the metal tube 3 laps over the lower edge of the cathode sleeve 5 thereby perfectly shielding the heater against the discharge space. Inside the cathode sleeve the heater 8 is located. Current is supplied to the heater through the wires 9, 10, which are sealed into the glass tube at 4'. Another leading-in conductor 11 is connected to the metal tube 3 and thereby also to the cathode sleeve 5.

The cathode 5 is surrounded by a grid electrode consisting of a wire 12 helically wound on two supporting rods 13, 14, which are sealed at their lower ends into the press 2. A cylindrical anode 15 enclosing the grid is mounted on two rigid supporting rods 16, 17, which are also sealed into the press 2. The supports 14, 16 are connected to leading-in wires 18, 19 respectively. Insulating bridges 20, 21 keep the electrodes in

proper spaced relation and render the electrode system stable.

In Fig. 2 a modified form of the invention is illustrated, which is in many respects similar to the construction of the tube in Fig. 1. In both figures like reference numerals are used to designate like parts. The cathode sleeve and the shielding metal tube are combined as a single metal tube 25. In this way the mechanical stability of the electrode system is considerably enhanced and more effective shielding between the control electrode and the heater is accomplished. In order to prevent too rapid thermal conduction away from the emitting part of the cathode, slots 26 are provided in the metal tube between the press 2 and the incandescent part of the cathode. A separate exhaust tube is indicated by 27, which is drawn off at 28.

It will be understood that the embodiments of the invention disclosed are merely illustrative and that many modifications and alterations may be made therein without departing from the spirit and the scope of this invention.

Having described my invention I claim as new and desire to secure by Letters Patent:

1. An electron discharge tube provided with a reentrant stem terminating in a press, an indirectly heated cathode having a metal tube located in the prolongation of the cathode and electrically connected thereto, the metal tube passing through the press and projecting therefrom; current supply wires to the cathode heater led inside the metal tube, a vitreous tube slipped over the projecting part of the metal tube and squeezed into the press at one end and sealed off at the other end.

2. An electron discharge tube comprising an evacuated envelope provided with a hollow reentrant stem terminating in an inwardly projecting press, a plurality of electrodes extending above and supported from said press, an insulating tube fused to and extending outwardly from the press and communicating with the space within the envelope, an indirectly heated cathode mounted above the press and having a prolongation extending within the insulating tube; and a pair of heater leads extending from the cathode through its prolongation and sealed to the outer end of the insulating tube.

3. An electron discharge tube comprising an evacuated envelope provided with a hollow reentrant stem terminating in an inwardly projecting press, a plurality of electrodes extending above and supported from said press, an insulating tube fused to and extending outwardly from the press and communicating with the space within the envelope, an indirectly heated cathode and a heater therefor mounted above the press, a pair of heater leads extending from the cathode through the insulating tube and sealed to the outer end of the insulating tube, and a metallic shielding sleeve surrounding the heater leads and disposed within the insulating tube.

4. An electron discharge tube comprising an evacuated envelope provided with a hollow reentrant stem terminating in an inwardly projecting

press, a plurality of electrodes extending above and supported from said press, an insulating tube fused to and extending outwardly from the press for substantially the full length of the stem and communicating with the space within the envelope, an indirectly heated cathode and a heater therefor mounted above the press, a shielding tube disposed within the insulating tube and extending above the press, and a pair of heater leads extending from the cathode through the shielding tube and sealed to the outer end of the insulating tube.

5. An electron discharge tube comprising an evacuated envelope provided with a hollow reentrant stem terminating in an inwardly projecting press, a plurality of electrodes extending above and supported from said press, an insulating tube fused to and extending outwardly from the press for substantially the full length of the stem and communicating with the space within the envelope, an indirectly heated cathode and a heater therefor mounted above the press, a shielding tube disposed within the insulating tube and extending above the press, and a pair of heater leads extending from the cathode through the shielding tube and sealed to the outer end of the insulating tube, a lead wire for said shielding tube also sealed to the outer end of the insulating tube, and an electrical connection between the shielding tube and the cathode.

6. An electron discharge tube comprising an evacuated envelope provided with a hollow reentrant stem terminating in an inwardly projecting press, a plurality of electrodes extending above and supported from said press, an insulating tube fused to and extending outwardly from the press for substantially the full length of the stem and communicating with the space within the envelope, an indirectly heated cathode and a heater therefor mounted above the press and having a prolongation integral therewith extending within the insulating tube, and a pair of heater leads extending from the cathode through its prolongation and sealed to the outer end of the insulating tube.

7. An electron discharge tube comprising an evacuated envelope provided with a hollow reentrant stem terminating in an inwardly projecting press, a plurality of electrodes extending above and supported from said press, an insulating tube fused to and extending outwardly from the press for substantially the full length of the stem and communicating with the space within the envelope, an elongated tubular sleeve having its lower portion housed within the insulating tube, the upper portion of said tubular sleeve constituting a cathode and being coated with electron emitting material and extending upwardly in cooperative relation with the aforesaid electrodes, said portions having between them a series of longitudinal slats for preventing too rapid heat radiation from the cathode, and a pair of heater leads and a cathode lead sealed to the outer end of the insulating tube.

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