Feb. 28, 1933. E. L. KOCH 1,899,039

AUDION TUBE

Filed Sept. 28, 1927

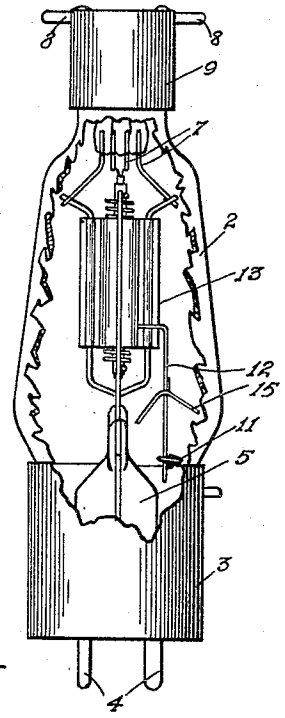


Fig. 1.

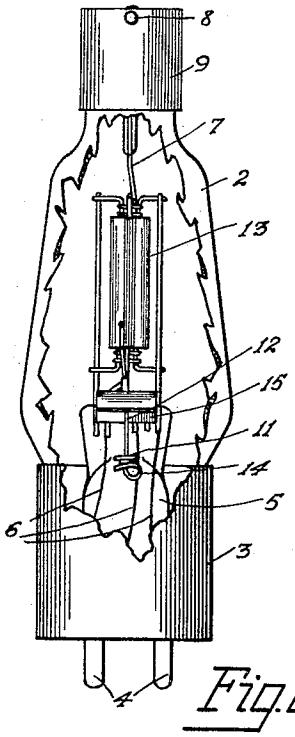


Fig. 2.

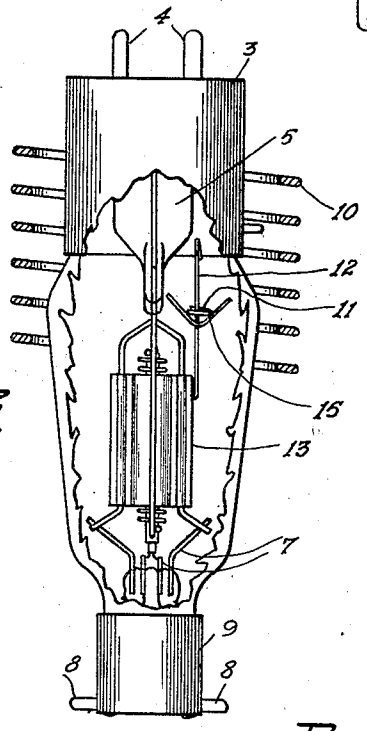


Fig. 3.

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Patented Feb. 28, 1933 1,899,039

# UNITED STATES PATENT OFFICE

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## AUDION TUBE

Application filed September 28, 1927. Serial No. 222,418.

My invention relates to a method of evacuating an audion tube and particularly to the method of cleaning up the gases remaining in an audion tube after the initial evacuating process, and to the tube structure which permits carrying out my invention.

In evacuating audion tubes it is common practice to heat the tube elements by induction by means of a radio frequency coil in order to drive out the gases during the evacuating process, and to assist in obtaining a more perfect evacuation of the tube a piece of magnesium or like metal is secured to one of the tube elements and flashed during the evacuating process.

The object of this invention is the provision of means whereby the process of vaporizing a piece of magnesium within the tube may be carried out after the initial evacuating process has been completed and preferably, but not necessarily, after the tube has been sealed and based; thus providing means to clean up the gases remaining in the tube.

A feature of my invention is the provision of a novel gettering means and supporting means therefor within the tube structure whereby, during the initial heating of the tube elements during the evacuating process to drive out the occluded gases, a small sheet of metal is heated simultaneously with the tube elements to drive out the occluded gases in the metal sheet without flashing the gettering material, the magnesium ring being maintained displaced from the metal sheet so that no vaporization thereof takes place. The supporting means is so formed and the magnesium ring so supported thereon that the same may subsequently be brought into engagement with the metal sheet and by a subsequent heating of the same, without materially heating the tube elements, the magnesium is vaporized by the heated metal sheet, thereby cleaning up the gases remaining in the tube. If the metal sheet is made of tantalum it will operate as a gas absorbent.

Another feature of my invention is the provision of the tantalum sheet which when heated to vaporize the magnesium ring enables the condensation of the vaporized magnesium to be concentrated in the lower part of the bulb thereby leaving the bulb substantially free from magnesium deposit. This permits a view of the tube elements after the tube is completed and the more ready dissipation of heat.

The above features as well as others not specifically pointed out will be more fully described in the ensuing specification and claims.

For a clearer understanding of my invention reference may be had to the accompanying drawing in which like references, in the several views, denote like parts and in which,

Fig. 1 is a view of an audion tube in its upright or normal position and showing the magnesium ring displaced from the tantalum sheet.

Fig. 2 is a view similar to Fig. 1 but viewing the audion tube from the right with reference to Fig. 1, and

Fig. 3 is a view of the audion tube illustrated in Fig. 1 in an inverted position showing the magnesium ring in contact with the tantalum sheet.

Referring now more in detail to my invention as illustrated in the accompanying drawing 2 indicates a glass bulb or envelope having a base 3, from which project the contact terminal pins 4. The glass bulb or envelope 2 has integrally formed therewith a stem 5 through which the conductors 6 extend, each conductor 6 terminating at its lower end in one of the contact terminal pins 4 and at its upper end in one of the tube elements.

The audion tube illustrated in the accompanying drawing and disclosed in the ensuing specification is of the character in which the cathode is associated with a heating element, such as a porcelain or silica cylinder which is heated by a resistance element, which results in the heating of the cathode. The resistance heating element (not shown) is joined to the conductors 7 which in turn are connected to the terminal contact pins 8, secured and carried by a cap member 9. The tube structure thus far described is shown and described in prior applications and forms no part of the present invention.

In the process of evacuating tubes, it is

common practice to place the audion tube within a coil 10 as shown in Fig. 3 through which alternating current from a proper source is passed in order to heat the tube elements and drive off the gases contained therein during the evacuating process. It is also a usual practice to secure a piece of magnesium or like material to one of the tube elements, as the plate for instance, and to flash the same during the heating and evacuating process just described, in order to assist in the evacuating process and render it more complete.

Certain types of audion tubes such as the one disclosed having the silica or porcelain heating element are not readily evacuated by the process just referred to. One reason for this is that the cathode structure continues to give off gases for a material length of time, thus making the evacuation of the tube difficult, and to overcome this difficulty I have devised means whereby the magnesium is so mounted within the tube that when the tube is in its upright or normal position the magnesium is so positioned relative to the elements of the tube so as not to be vaporized during the initial evacuation.

Referring to Figs. 1 and 2, the magnesium is shown as a small ring 11 loosely or slidably supported on a piece of wire 12 one end of which is secured to the plate element 13 of the audion tube, the other end of the wire 12 being formed into a small loop 14. A small sheet of tantalum 15 or other material bent substantially U-shaped is provided with an orifice through which the wire 12 passes and this sheet of tantalum 15 is suitably secured to the wire 12 substantially intermediate of its ends. The ring of magnesium 11 supported on the wire 12 lies between the tantalum sheet 15 and the looped end 14 of the wire 12, and when the audion tube is in its upright or normal position as shown in Figs. 1 and 2, the magnesium ring 11 will slide to the bottom of the wire 12 and rest against the looped end 14 away from the tantalum sheet 15. The tantalum sheet 15 is so fixed to the wire 12 that it is in the plane of heating, relative to the coil 10, during the heating of the tube elements. Thus during the initial evacuating process, with the tube in its normal position as shown in Figs. 1 and 2, when the tube elements are heated, the position of the tantalum sheet 15 relative to the plate 13 as above described also allows the tantalum sheet 15 and elements to be heated simultaneously in order that they may be thoroughly degasified by driving out the occluded gases. It may also be seen that with the tube in its upright or normal position the tantalum sheet 15 may be heated without vaporizing the magnesium ring 11, and after the initial evacuation the tube may be sealed and the base and cap applied.

The audion tube after being sealed and the base 3 and cap 9 secured thereto is supported in a suitable fixture in an inverted position with the coil 10 placed around the tube at the end nearest the tantalum sheet 15. The magnesium ring 11 slides down the wire 12 into engagement with the tantalum sheet 15 when the tube is in this inverted position, as just described and clearly illustrated in Fig. 3, and when current is again passed through the coil 10 the tantalum sheet 15 is brought up to a sufficient temperature, without appreciably heating the plate 13 of the tube, to accomplish the vaporization of the magnesium ring 11.

This method of vaporizing the magnesium ring 11 in association with the tantalum sheet 15 has many advantages over previous methods, one being that tantalum itself makes an excellent gas absorber under certain condition. That is, tantalum when thoroughly degasified in a rarified atmosphere, as is done during the initial heating and evacuating process as just described, is in condition to subsequently absorb quantities of gas. The gas absorbing quality of the tantalum sheet 15 in addition to that of the magnesium ring 11 upon vaporization results in cleaning up the gases remaining in the tube and producing a much more perfect vacuum.

Another advantage is that the vaporization of the magnesium is accomplished by heating only a small sheet of tantalum which has been thoroughly degasified instead of heating the plate proper as has been done heretofore. This greatly minimizes the chances of additional gases being released by the plate when heated to a high temperature as has been done heretofore.

Another advantage of vaporizing the magnesium, as above described, is that it enables the condensation of the vaporized magnesium to be concentrated in the lower part of the bulb, thereby leaving the bulb substantially clear and free from magnesium deposit. This comparatively clear bulb allows the function of the tube to be observed and also allows freer dissipation of heat energy.

It is to be understood that the process herein disclosed can be carried out with structures other than that illustrated and described to complete the gettering or cleaning up process, and the invention, therefore, should be limited only by the scope of the appended claims.

What I claim as new and desire to secure by United States Letters Patent is:

1. In an electron discharge device, a support, an inverted U-shaped deflecting member supported by said support, and a clean-up agent slidably secured to said support, said deflecting member and said clean-up agent cooperating so that when the clean-up agent is volatilized it will be substantially confined to the lower portion of said device.

2. In an electron discharge device, a mem-

ber extending towards the base of said tube, a deflecting member supported by said member, and a vaporizable member slidably secured to said extending member and vaporized by said deflecting member, said deflecting member, confining the deposit of the vaporizable member to the lower portion of the device.

3. In an electron discharge device, a wire support having a dependent end extending downwardly outside of the plane of the tube elements, a vaporizable member slidably supported by said wire support, and an inverted U-shaped deflector positioned by said wire support for vaporizing said vaporizable member, said deflector confining the deposit of said vaporizable member to the lower portion of said device.

4. In an electron discharge device, a wire support extending downwardly outside the plane of the tube element, a flashing member positioned by said wire support, and a vaporizable member slidably secured to said support and vaporized by the heating of said flashing member, said flashing member directing the vapor of the vaporizable member when volatilized to the lower portion of the tube near the supporting press.

5. In an electron discharge device, a supporting member, a clean-up agent slidably supported by said supporting member, a substantially trough-shaped metal member supported by said auxiliary supporting member for vaporizing said clean-up agent, said metal member being positioned below the plane of the tube elements and having its concave surface facing the supporting press to restrict the deposit of the clean-up agent on the lower portion of the wall of the envelope near the supporting press.

6. In an electron discharge device a supporting member extending toward the bottom of the envelope, a vaporizable member slidably supported by said supporting member, and a substantially trough-shaped piece of metal secured to said supporting member and positioned in the lower portion of said envelope for vaporizing said vaporizable member, said piece of metal having its concave surface facing downwardly to direct condensation of the vaporized material in the lower cooler portion of the envelope.

7. The method of preparing electrical discharge devices having conductive bodies inclosed within an envelope, which consists in attaching to one of the conductive bodies a supporting wire extending towards the bottom of the envelope and attaching to said wire a deflecting member and a vaporizable substance, then heating the conductive bodies by high frequency magnetic field to remove the gas therefrom while the vaporizable member remains cool, afterwards heating said deflecting member by a high frequency magnetic field to the vaporization point of the vaporizable substance and confining the deposit of the vaporizable substance to the lower portion of the tube.

8. The method of preparing an electrical discharge device having elements inclosed within a tube which consists in positioning an auxiliary element by means of a tube supporting element and placing a vaporizable substance in position so as not to be vaporized by the auxiliary element, driving out from the electrodes occluded gases, moving said vaporizable substance into engagement with said auxiliary element, then vaporizing said vaporizable substance by inductive heating, and restricting the main deposit of the vaporizable substance to the lower portion of the envelope below the plane of the tube elements.

9. The method of preparing an electrical discharge device having electrodes within an envelope, which consists in supporting a restricting member and a varporizable substance below the plane of the tube elements, separating said member and said substance, driving out from the electrodes the occluded gases, engaging said restricting member and said vaporizable substance, then vaporizing said vaporizable substance by inductive heating of the restricting member and confining the major portion of the vaporizable substance when vaporized to the lower portion of the envelope near the press therein.

10. The method of preparing electrical discharge devices having electrodes inclosed within an envelope, which consists in supporting an auxiliary member by means of the element supports, attaching to the auxiliary member a member heated by inductive heating, supporting a vaporizable substance by said auxiliary member, then heating the tube elements by inductive heating to drive out the occluded gases and moving the vaporizable substance in contact with said member supported by said auxiliary member to vaporize said substance and then directing the main deposit of the vaporizable substance to the lower cooler portion of the tube envelope near the supporting press.

Signed by me at Chicago, in the county of Cook, and State of Illinois, this 26th day of September, 1927.

EARL L. KOCH.