Sept. 6, 1932. B. LOEWE 1,875,744

ARRANGEMENT FOR DISPERSING BADLY CONDUCTIVE SUBSTANCES IN VACUUM VALVES

Filed May 23, 1929

Fig. 1.

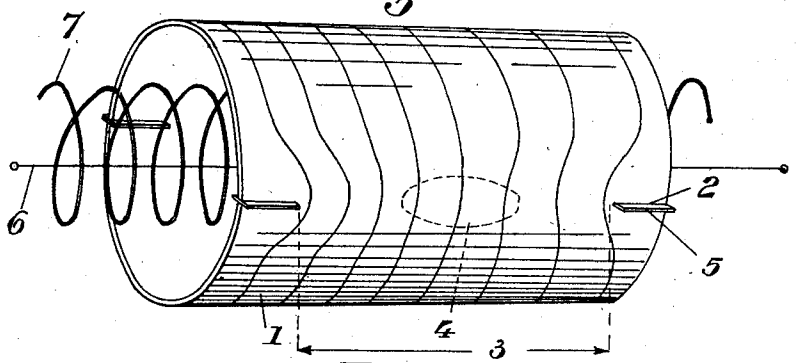
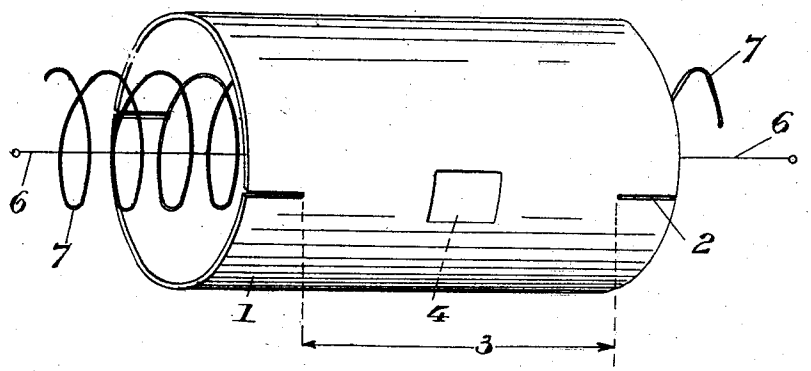


Fig. 2.



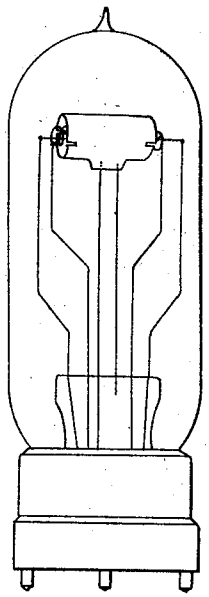


Fig. 3.

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Patented Sept. 6, 1932

1,875,744

UNITED STATES PATENT OFFICE

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ARRANGEMENT FOR DISPENSING BADLY CONDUCTIVE SUBSTANCES IN VACUUM VALVES

Application filed May 23, 1929, Serial No. 365,340, and in Germany May 12, 1928.

The invention relates to an arrangement for dispersing substances in vacuum valves. It is possible by means of the arrangement according to my invention to evaporate substances both during the process of manufacturing the valve and afterwards, should an evaporation be necessary during the operation or putting into service of the valve.

In this respect the device according to my invention differs from other known devices where the substances to be dispersed are arranged, for instance, on an auxiliary wire which, prior to the manufacture of the valve, is so strongly heated that, once the valve has been put into service, the process of dispersal cannot be continued.

It is a further well known practice to scatter substances in vacuum valves by heating them by eddy currents. In this manner, however, only substances with certain conductivities may be dispersed with some degree of effectiveness. If, moreover, such shape is given to the substances that eddy currents of sufficient strength may be generated in the substances by means of a field generated outside the valve, it is possible to evaporate, for instance, getter substances such as magnesium within the valve by eddy current heating.

If, however, salts or other badly conductive, respectively non-conductive or electrolytic substances are to be evaporated or even only heated, this process may not be applied because in badly conductive substances eddy currents cannot be induced to a noteworthy degree. The arrangement according to my invention, however, permits also of badly conductive substances to be evaporated within a valve.

According to my invention substances of conductive material are in the neighbourhood produced in such manner that individual points may be heated to a particularly increased temperature if a magnetic field of suitable frequency is allowed to act upon the valve from the outside. As close as possible to these points to be heated with particular intensity the substance to be heated may, according to my invention, be arranged. If, more particularly, the substance to be heated is non-conductive, it may be arranged in such manner that it directly encloses the point to be heated intensely and may thus be heated by heat conduction. If, however, it possesses a certain amount of conductivity it may be advisable to arrange it at a moderate distance from the point to be heated intensely in order that the conduction of the eddy currents in the portion or element to be heated intensely may not be impaired by the presence of such substance.

The dispersal of substances according to my invention is applied in the first place in the manufacture of highly emissive cathodes. The tablet of barium oxide and silicon or ferro-silicium and aluminium to be used according to my invention described in application No. 342,930 and filed February 26th, 1929, is generally such material of very small electric conductivity or contains such materials. If such material is to be dispersed in the shape of a tablet or lozenge on the inner surface of the anode by eddy current heating it is necessary for the anode to be heated with particular intensity at the point of attachment. According to my invention the anode is provided with two slots for the substance to be dispersed at the side of the place of attachment and the point of attachment itself therefore forms a bridge for the eddy current paths which, in this embodiment are compressed on a small area and in this manner effect a stronger heating.

My invention may be best understood with reference to the accompanying drawing.

Fig. 1 represents the electrode system assembled in a vacuum valve.

Fig. 2 shows another electrode system with the arrangement according to my invention.

Fig. 3 shows an electron discharge device with the system according to Fig. 1 or 2.

More particularly in Fig. 1 the anode 1 in a cylindrical shape is shown plainly. This anode 1 is not homogeneous along its entire circumference, but at one point is provided with slot-like indents 2, only a narrow bridge 3 thus remaining free. During eddy current heating, for instance, by means of a coil held from the outside across the glass jar or the electrode system and whose axis is coincident with the axis of the cylindrical anode, the induced eddy current lines run at the cylindrical jacket of anode 1 essentially in circles which, however, on account of the slots 2 are greatly compressed on bridge 3 and a particularly strong heating, such as described, therefore takes place at such point. It is possible to arrange the substance to be evaporated according to my invention in the shape of a lozenge 4 on the bridge 3. If the substance is non-conductive, the current conduction is not essentially changed by the presence of such substance and in bridge 3 the same quantity of heat is therefore produced as would be produced without the presence of the substance 4. Part of the heat developed in the bridge 3 is drained off through the body 4 and the effect to be produced by the heat is therefore produced in the body 4.

The element or body 4 is attached on the bridge on the inner surface of the anode and may consist of a reactive compound according to my invention described in application No. 342930 and filed February 26th, 1929. The effect to be produced by the heat is the dispersal of the substance 4 for purposes of forming a highly emissive layer on the cathode 6. The electrode system according to Fig. 1 is complemented by the grid 7.

The slots 2 in the anode may be made very narrow; if, however, notwithstanding such narrowness interferences may be expected in particularly sensitive valves by the leakage of electrons through these slots, the slots may additionally be covered by non-conductive material; it is possible, for instance, in the manner indicated in the figure to make them as wide as a mica-sheet is thick and to insert one or several mica plates 5 into the slots 2.

Fig. 2 shows a further embodiment of my invention where an element of conductive material is to be heated. In this case it will not be advisable to arrange the lozenge 4 immediately on the bridge 3 of the anode. For this purpose, on the contrary, the bridge may be made particularly narrow in order to effect a very strong heating, and the substance to be heated and which may be badly, yet noticeably conductive may be arranged outside the anode across bridge 3, thus being without conductive connection with the anode and being heated merely by heat radiation from bridge 3.

The element 4 may be a piece of magnesium or some other suitable getter substance. For the dispersal of getter substances an embodiment like that on Fig. 3 is particularly appropriate. By giving the getter substance 4 proper dimensions and by arranging it at a correct distance from anode 2 we may produce the result that in the manufacture of the valve the dispersal of the magnesium takes place only after the outgassing of the metal elements.

Whilst the arrangement according to my invention as shown in Fig. 2 is preferred for the dispersal of a getter substance, the arrangement according to Fig. 1 is suitable in the first place for the production of a high emission cathode.

There is, however, no objection to arranging the substance to be dispersed as getter substance immediately on the outer surface of the anode. In the exemplary embodiment of Fig. 2, moreover also, mica strips 5 may be inserted in slot 2.

Whatsoever may be the embodiment of my invention, the fundamental principle of it is always, to determine the distribution of eddy current lines in a metal conductor by a certain shape in such a way that at one or several places the temperature produced by the eddy currents is higher than that at other places.

I claim:

1. A vacuum tube comprising an electrode system consisting of a cathode, a grid and a cylindrical anode, lead-in wires for the system, an eddy current arrangement outside the tube consisting of a high frequency current coil for heating the anode at a destined place to a higher temperature than at neighbouring places the anode being slit along a line across said place.

2. A vacuum tube comprising an electrode system consisting of a cathode, a grid and a cylindrical anode, lead-in wires for the system, an eddy current arrangement outside the tube consisting of a high frequency current coil for heating the anode at a destined place to a higher temperature than at neighbouring places the anode being slit along a line across said place and non-conductive substances arranged at said place these non-conductive substances being scattered.

3. A vacuum tube comprising an electrode system consisting of a cathode, a grid and a cylindrical anode, lead-in wires for the system, an eddy current arrangement outside the tube consisting of a high frequency current coil for heating the anode at a destined place to a higher temperature than at neighbouring places the anode being slit along a line across said place and a reaction mixture arranged at said place this reaction mixture being scattered and precipitated at the surface of the cathode as a highly emissive layer.

4. A vacuum tube comprising an electrode system consisting of a cathode, a grid and a cylindrical anode, lead-in wires for the sys-

tem, an eddy current arrangement outside the tube consisting of a high frequency current coil for heating the anode, a lozenge of barium oxide and silicon attached to the inner surface of the anode in the middle of a shell line, the anode being slit from both ends along said shell line.

5. A vacuum tube comprising an electrode system consisting of a cathode, a grid and a cylindrical anode, lead-in wires for the system, an eddy current arrangement outside the tube consisting of a high frequency current coil for heating the anode, a lozenge of barium oxide and silicon attached to the inner surface of the anode in the middle of a shell line, the anode being slit from both ends along said shell line, and mica sheets inserted in these slots of the anode.

In testimony whereof I have affixed my signature.

BERNHARD LOEWE.