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COLD-CATHODE GLOW-DISCHARGE TUBE

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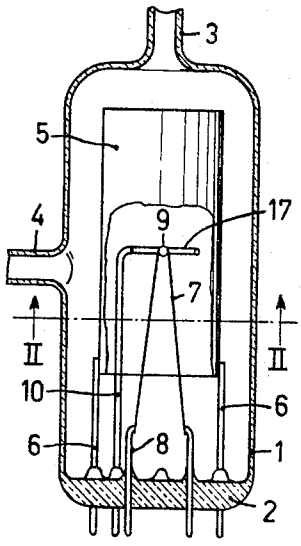


FIG. 1

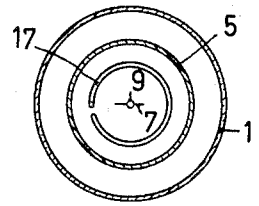


FIG. 2

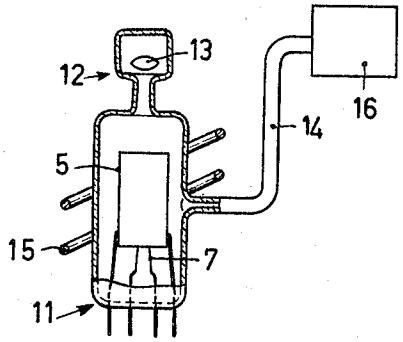


FIG. 3

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COLD-CATHODE GLOW-DISCHARGE TUBE

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3 Claims. (Cl. 313—185)

The invention relates to a glow discharge tube comprising a caesium-activated cathode. It furthermore relates to a method of producing a glow discharge tube of this kind.

With the hitherto known glow discharge tubes of the kind comprising a caesium-activated cathode the activating material consisted of some caesium compound. Thus, it is true, a low value of the maintaining voltage could be attained, but the lifetime was short. The invention has for its object to provide an improvement in this respect.

In a glow discharge tube comprising a caesium-activated cathode, the activating layer consists, in accordance with the invention, of gold, the caesium-gold alloy CsAu and caesium oxide.

In a method of producing a glow discharge tube comprising a caesium-activated cathode caesium is distilled, in accordance with the invention, on a gold surface in the tube and is alloyed to the gold, after which oxidation is performed.

In accordance with the invention the gold may be provided in the form of a gold plate or it may be applied electrolytically to a metal surface or the gold layer may first be formed in the tube by evaporation on a metal plate, for example of molybdenum or on a molybdenum layer applied by evaporation to the wall, on a nickel layer or on a conductive tin oxide layer.

The evaporation of the gold layer may be carried out in vacuo or in a rare gas under low pressure.

In the method according to the invention the gold and the caesium can be alloyed at a temperature of about 100° C. for such a long time that the photo-emission of the alloyed layer reaches a maximum value.

In accordance with the invention the oxidation of the caesium-gold layer can be performed by causing a discharge to be produced in a rare gas towards the alloyed layer and by allowing gradually such a quantity of oxygen to enter that the maintaining voltage attains a minimum value, after which the tube is filled with pure rare gas. In accordance with the invention the oxidation may also take place in vacuo until the thermal emission of the hot layer reaches a maximum at about 100° C. The tubes according to the invention have maintaining voltages which lie considerably below 50 v. not only at the beginning but also after a long operation. This is contrary to the known tubes, also the initial maintaining voltage of which lies above 50 v.

The invention will now be described more fully with reference to the drawing, in which FIGS. 1 and 2 are sectional views of a discharge tube according to the invention parallel to and at right angles to the tube axis respectively and FIG. 3 shows the tube in an arrangement suitable for carrying out the method according to the invention.

Referring to the figures reference numeral 1 designates

the glass wall of the discharge tube, having a bottom 2, through which a number of supply pins are taken in a vacuum-tight manner; 5 designates a molybdenum cylinder which constitutes the cathode and which is mounted on supporting wires 6. A filament wire 7 is supported by wires 8. The filament wire has a thickness of 0.1 mm. and is made of molybdenum with a thin layer of platinum. Around the peak of the V-shaped filament wire 7 there is wound a gold wire 9 of a length of 10 mms. and a diameter of 0.1 mm. Inside the cathode cylinder 5 there is provided the annular anode 17, which is supported by the wire 10. The glass bulb is provided with two glass connections 3 and 4 for connection with the caesium source and with the exhaust pump and gas-filling system respectively.

As is shown in FIG. 3 a side bulb 12 is sealed in a vacuum-tight manner via the upper tube to the bulb 11, said side bulb containing a caesium pellet 13; the exhaust tube 14 leads to the pump and the gas-filling system 16. The bulb 11 is surrounded by a high-frequency coil 15.

The pellet 13 may consist of two parts of silicon and one part of caesium bichromate or, for example one part of silicon and one part of caesium chromate.

First the tube is degassified in a furnace at 350° C. and after cooling the filament wire 7 and the gold wire 9 are degassified by passing current at a temperature such that the gold wire melts and forms a pellet. Then the cathode cylinder 5 is degassified by heating it approximately to red glowing heat by means of high-frequency currents. The caesium pellet is decomposed by means of high-frequency currents, so that the caesium is precipitated in the bulb 12. Then the cathode cylinder 5 is again degassified. After cooking of the cathode cylinder the gold is evaporated in vacuo or in neon of a few mms. pressure. Subsequently the neon, if any, is pumped away and the caesium is evaporated from the bulb 12 towards the cathode cylinder 5 by heating the bulbs 11 and 12 at a temperature of about 100° C. The caesium alloys with the gold and this process is continued until the photo-emission of the cathode layer attains approximately the maximum value. The time required to this end is about one and a half hours. The bulb 12 is then sealed and the bulb 11 is filled with neon of a pressure of 10 mms. A current of 10 ma. is passed through the tube and pure oxygen is slowly allowed to enter until the maintaining voltage has reached a minimum value. Then the tube is filled with pure neon of a pressure between 5 and 20 mms.

It has been found that test tubes manufactured by said method had initially maintaining voltages lying between 31 and 33 v. at a current of 10 ma., which value increased by a few volts after about 1000 hours. Dependent upon the arrangement of the electrodes the ignition voltage could initially even attain the low value of 60 v. If the tubes were filled with helium of a pressure between 3 and 20 mms., the maintaining voltages were initially 22 to 25 v., the fluctuation being, however, greater than with the neon filling. It is remarkable in this case that, in helium, maintaining voltages are attainable which are lower than the ionisation voltage of helium of 24.6 v. Instead of oxidizing the cathode during a glow discharge, it may be oxidized in vacuo, in which case the attainment of the maximum of the thermal emission at 100° C. indicates the correct degree of oxidation.

From investigations it appeared that the cathode may have free caesium.

What is claimed is:

1. A glow discharge tube comprising an envelope filled with an ionizable medium and anode and cathode electrodes disposed therein, said cathode comprising a base having an activating layer thereon consisting of gold, a cesium-gold alloy, and cesium oxide.

2. A glow discharge tube as claimed in claim 1, wherein the ionizable medium consists of neon or helium.

3. A glow discharge tube as claimed in claim 2, wherein a given voltage is required to produce ionization and a lower voltage is required to maintain ionization.

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