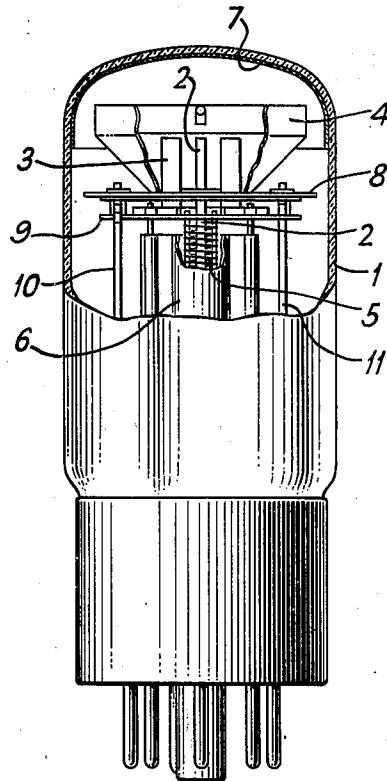


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EMISSION SUPPRESSION MEANS
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EMISSION SUPPRESSION MEANS

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The invention relates to electric discharge tubes with means for suppressing secondary emission and positive charges on the inner wall of the tube and on other insulating members within the tube. The invention, further, relates to a method of manufacturing such tubes.

As is generally known, insulating elements such, for example, as the wall of the tube and spacers, are frequently struck by electrons and it depends on the construction of the electrode system whether a large or a small proportion of the wall is exposed to such electron bombardment. Since these members are struck by primary electrons which travel at a high speed, secondary electrons may be liberated. If the ratio of secondary electrons liberated to the primary electrons is more than 1, which is generally the case with these members at the usual voltages, these secondary electrons produce positive charges. In the present application the ratio between the number of secondary electrons and the number of primary electrons will be denoted by λ .

Electron bombardment not only produces undesired potential conditions but liberates gases from the glass wall and from other bombarded parts with the result that the length of life of the tube is considerably reduced.

To obviate these drawbacks as much as possible different means have been attempted. Thus, for example, it is known to coat the glass wall or other insulating members with a conductive layer, which is connected to a point of fixed or ground potential. It has been proposed to coat the insulating components of the tube with insulating or semi-conductive substances, the properties of the layer applied being in some cases such that a layer is obtained of which λ is less than 1. Thus, for example, it is known to coat the wall of an electric discharge tube with a rough, frequently black layer, for example of carbon, chromium oxide and the like. For this purpose there has been suggested alumina which, however, emits considerable secondary electrons when bombarded with primary electrons accelerated by only 150 to 200 volts. Tubes are known wherein the wall is coated with a layer of aquadag which is connected to a point of determined potential, for example to the cathode. The coated member may thus be given a potential such that primary electrons are not attracted but secondary emission is low only when the velocity of primary electrons is kept low.

According to this invention, one or more constituent parts of the wall or of other insulating

members of an electric discharge tube are coated with a layer which consists of one or more of the oxides or sulphides of tungsten, molybdenum, copper or silver which when applied in a thin coating, preferably porous and fluffy, emits negligible secondary electrons even when bombarded with primary electrons with electron velocities corresponding to over 300 to 350 volts.

These materials afford the advantage that they can be easily applied in a porous fluffy layer and that no electrical connection need be made to the layer to fix its potential. As distinguished from the usual coating materials such as rough carbon and the like, which does not adhere well and easily drops off from the wall or from an other insulating member, the oxides according to this invention adhere very satisfactorily to an underlayer. Up to fairly high voltages these materials have a λ which is less than 1.

The coating compounds of this invention possess the very important property that even in layers so thin that the transparency of walls to heat and visible ray to which the compounds are applied is not impaired, the secondary emission is reduced to a minimum. Tubes constructed according to this invention are particularly useful where considerable heat must be radiated from the electrode and where visibility of the electrodes in the tube is desired. The envelopes of tubes having fluorescent screens, photoelectric tubes, tuning indicators, luminous tubes, ultraviolet radiators and the like may be coated with oxides or sulphides of tungsten, molybdenum, copper or silver without impairing the light efficiency of the tubes. By "transparent" is hereinafter meant a state in which any member can be observed through this layer. None of the known bulb coating materials may be applied with sufficient thinness to obtain both good transparency and reduction in secondary emission. Layers having a thickness which does not exceed two microns is preferred.

The coating on the wall of an electric discharge tube according to the present invention may be produced in a simple manner. A thin tungsten helix is arranged inside the bulb of an electric discharge tube and opposite the wall portion that is to be coated. The bulb is then exhausted down to a pressure of about 2 mm. of air, and then the tungsten helix is heated to a temperature of about 2300° C., during which heating the tungsten vaporizes from the helix. Since this vaporization takes place in a rarefied atmosphere of oxygen a thin layer of blue-colored tungsten oxide, in this case transparent,

is deposited on the wall portion located opposite the helix. The tungsten helix may then be removed and the tube may be provided in a known manner with the electrode system exhausted and sealed off. Alternatively, the desired compound of the desired metal may be vaporized in vacuum or in an atmosphere of inert gas. Or, it is possible to provide the oxides and the like by squirting, painting or dipping the part to be coated. Good results have been obtained with oxides of tungsten or of molybdenum.

The invention will be more clearly understood by referring to the accompanying drawing, in which is shown for purposes of illustration a tuning indicator wherein 1 is the wall of the tube enclosing a cathode 2, a control electrode 3 and a cone-shaped anode or target 4 coated on the inside with a fluorescent material. A control grid 5 and an anode 6 are spaced by insulating members 8 and 9 and supported by members 10 and 11. A portion of the bulb which can most easily be struck by electrons proceeding from the cathode is coated with a layer 7 which consists of one or more of the oxides or sulphides of tungsten, molybdenum, silver or copper. This layer is so transparent that the fluorescent anode can be viewed from the outside without difficulty.

I claim:

1. An electron discharge tube comprising an envelope, a cathode and cooperating electrodes in said envelope, insulating surfaces within said envelope being exposed to electron bombardment from said cathode, means for reducing emission of secondary electrons from said surfaces comprising a coating thereon composed of an element of a group which comprises oxygen and sulphur compounded with a metal of a group which consists of copper and silver.

2. An electron discharge tube with an envelope, a cathode and cooperating electrodes in said envelope, a coating material on insulating surfaces in the envelope for minimizing emission of secondary electrons from said surfaces in said tube exposed to electron bombardment from said cathode consisting of oxygen and an element of the group consisting of copper and silver, the elements from said groups being combined in an oxide compound.

3. An electron discharge tube with internal parts of insulating material coated with a layer of a material to reduce the accumulation of electric charges on the surfaces of said parts, said layer comprising a compound included in the group consisting of oxides and sulphides of metals included in the group consisting of copper and silver.

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