

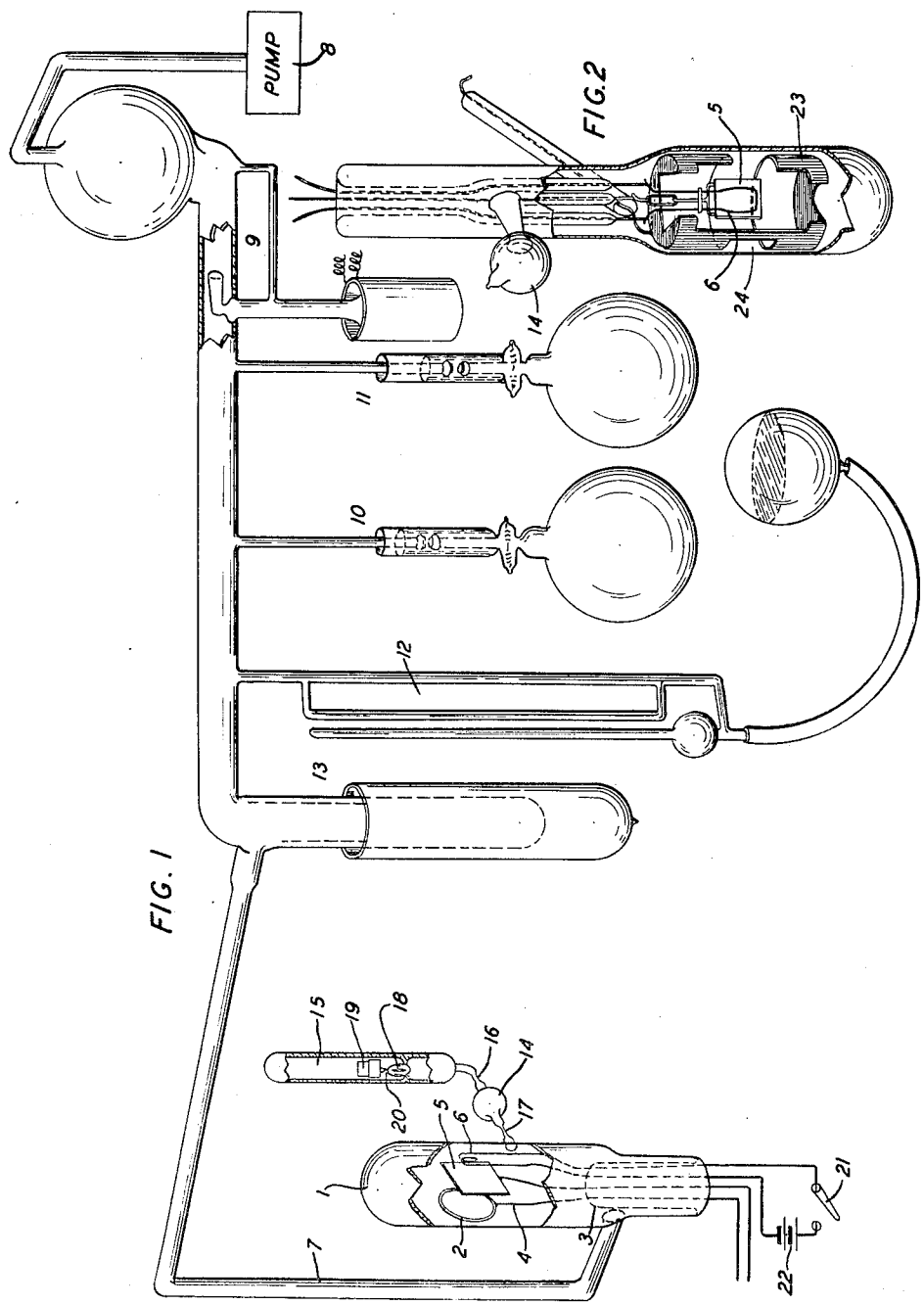
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PHOTOELECTRIC TUBE

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PHOTOELECTRIC TUBE

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The present invention relates to electro-optical apparatus and more particularly to photoelectric tubes and a method of making them.

It has heretofore been proposed to provide light sensitive devices comprising a bulb enclosing an anode and a cathode consisting of a self-supporting element of conductive metal, the surface of which is treated with a substance having characteristics different therefrom whereby the surface is coated with a black spongy layer of extended area, with respect to the area of the element, to which is applied a film of light sensitive material. The electrodes are carried by supports secured to stems so that they do not contact with the walls of the bulb.

This invention is directed to an improved photoelectric tube of the type described above.

An object of the present invention is to produce a light sensitive electrode comprising a self-supporting metallic conductive plate with which is chemically combined a substance having characteristics different from those of the plate to produce a surface layer upon which is deposited a film of light reactive material.

According to one embodiment of the invention, the light sensitive electrode comprises a tungsten plate, having a polished surface, supported in a glass bulb but out of contact with its walls. In the process of producing the light sensitive electrode the tungsten plate is heated to a high temperature in the presence of oxygen, whereby the oxygen is caused to enter into chemical combination with the metal of the plate to produce an oxidized surface, which is subjected to caesium vapor.

A detail description of the embodiment, briefly described above, follows and is illustrated in the attached drawing.

Fig. 1 illustrates a schematic layout of apparatus for producing a photoelectric tube in accordance with the invention; and

Fig. 2 shows another design of photoelectric tube involving this invention.

As shown in Fig. 1 the photoelectric tube comprises a bulb 1, enclosing an anode 2 of polished conductive material for example, a polished platinum ring, supported from a stem 3 by a lead-in wire 4, and a cathode 5 of polished tungsten supported by a lead-in wire and having oxygen chemically combined with its surface to provide an oxide coating upon which is deposited a film of caesium.

The anode and cathode are self-supporting, are substantially homogeneous, are parallel to each other and are so mounted that they do not con-

tact with the walls of the bulb. The anode is illustrated as a ring and the cathode as a flat plate, so positioned that a beam of light may be projected through the ring upon the light sensitive film of the cathode. Within the bulb is a filament 6 supported from the stem 3 by lead-in wires through which current is supplied to heat it to the proper temperature to cause it to emit electrons.

Connected to the bulb by a tube 7 is a pumping system comprising a vacuum pump 8, a mercury vapor pump 9, an arrangement 10 for introducing oxygen, an apparatus 11 for supplying an inert gas, a McLeod pressure gauge 12 and a liquid air trap 13.

A side tube 15, provided with restricted portions 16 and 17 and an enlargement or reservoir 14, encloses a capsule 18, and a weight 19 of magnetic material provided with a pointed projection 20 directed toward the capsule 18. The capsule encloses a fixed amount of pure caesium.

In the manufacture of a tube, the pumping system is put into operation, the glass bulb 1 is heated either in an oven, by a hot flame or other suitable means to drive off gases absorbed by its glass walls. The switch 21 is closed and current is supplied from the source 22 to the filament 6, which is thereby heated to electron emitting temperature, whereby the electrodes are ionically bombarded to drive out gases absorbed thereby. The occluded gases, driven out of the glass walls and electrodes, are evacuated by the pumping system. When the bulb and electrodes are completely degassed, and the proper degree of vacuum has been attained within the bulb, the heating and pumping operations are discontinued.

Oxygen is now admitted to the bulb from the apparatus 10 and cathode member 5 is again bombarded, whereby the oxygen is caused to chemically combine with the metal of the member, to produce a surface layer of metallic oxide, after which the pumping system is started to remove the oxygen as well as any gaseous impurity and is continued in operation until the bulb is exhausted to the desired degree of vacuum, when the pumping operation is discontinued.

The capsule 18 is now broken by raising the weight 19 with a magnet and allowing it to drop. Heat is then applied to the side tube 15 to cause the caesium to distill into and deposit upon the walls of the enlargement or reservoir 14.

The side tube 15 is now sealed-off at the restriction 16 and the reservoir 14 is heated to evaporate the caesium which distills into and is deposited upon the walls of the bulb 1, and the

reservoir 14 is sealed-off at the restriction 17. The pumping operation may be continued for a short time to evacuate gas impurities and is then discontinued. The bulb is now sealed-off from the tube 7 and is afterwards heated to vaporize the caesium, carried by the glass walls, which deposits upon the oxidized surface of the member 5, when the tube is ready for use as a vacuum light sensitive tube.

If it is desired to provide a gas-filled tube, the tube 7 is not sealed-off immediately after the oxygen has been pumped out but remains connected to the bulb until after the caesium has been deposited on the member 5. The inert gas, for example, argon, at the desired low pressure is then admitted to the bulb from the apparatus 11 after which the tube 7 is sealed-off.

Fig. 2 illustrates another design of tube which may be manufactured as described above. This tube is provided with a polished cathode member 5, which after being oxidized has a film of light sensitive material deposited on the oxidized surface, an electron emitter 6, and a reservoir 14 which has been sealed-off from the side tube. These elements are similar to and are employed for the same purpose as the elements identified by the same reference characters in Fig. 1. The anode 23 comprises a polished conductive member encircling the cathode 5, with a portion removed to provide a window through which a beam of light may be projected upon the light sensitive film carried by the member 5 as in the tube of Fig. 1. The cathode 5, anode 23 and filament 6 are supported by lead-in wires so that they do not contact with the glass walls of the bulb.

The member 5 may be a self-supporting element of any suitable conductive material, for example, copper, silver, platinum, etc., and substances other than oxygen, such as sulphur, etc., may be used to combine with the surface of the metal plate to constitute the absorbing layer for

the light sensitive material. Any light sensitive material may be substituted for caesium. For example, rubidium, sodium or potassium may be used in accordance with the method herein described. Barium is an additional photo-sensitive material which may be employed. These materials in the form of thin films may be used in accordance with this invention without immersion in an atmosphere of inert gas, such as argon. However, when caesium and rubidium are used, since they are more volatile at ordinary room temperature than potassium and sodium, it is preferable to employ such an atmosphere.

What is claimed is:

1. A method of producing a cathode in a photo-electric tube embodying a container enclosing a self-supporting member, which comprises supporting the self-supporting member out of contact with the walls of the container, combining with the surface of said self-supporting member a substance having characteristics different therefrom, distilling caesium into the container to deposit on its walls, and heating the walls of the container to vaporize the caesium and thereby cause it to deposit upon the composite surface of said member.

2. A method of producing a cathode in a photo-electric tube embodying a container enclosing an anode and a metallic member, which method comprises forming an oxide on one surface of said metallic member, evacuating the container by pumping, stopping the pumping operation when the container is evacuated to a desired degree, introducing caesium vapor into the container to deposit on the walls of the container while the pump is stopped, sealing the container off from the pump, and heating the sealed off container to vaporize the caesium deposited on its walls and thereby cause it to deposit upon the composite surface of said member.

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