July 26, 1932. A. J. McMASTER ET AL 1,869,342

PHOTO ELECTRIC TUBE

Filed June 14, 1930

Fig. 2.

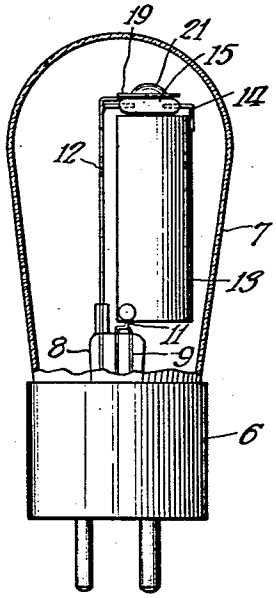
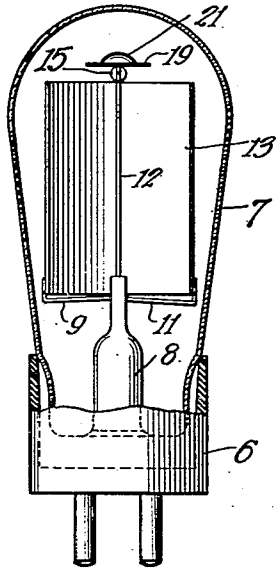


Fig. 1.



Inventors.
Archie J. McMaster.
Charles E. Parson
By: Geo. E. Mueller Atty.

Patented July 26, 1932 1,869,342

UNITED STATES PATENT OFFICE

ARCHIE J. McMASTER AND CHARLES E. PARSON, OF CHICAGO, ILLINOIS, ASSIGNORS TO G-M LABORATORIES, INC., OF CHICAGO, ILLINOIS, A CORPORATION OF ILLINOIS

PHOTO-ELECTRIC TUBE

Application filed June 14, 1930. Serial No. 461,119.

Our invention relates to a photoelectric tube and a method of making the same.

In photoelectric tube a plate of large area is provided which is processed and treated to form a light sensitive electron emissive surface thereon. The final sensitivity of the tube depends upon factors which must be definitely taken into account in treating the cathode in order to obtain uniformly good results.

An object of the invention is to provide a new and improved photoelectric tube and method of making the tube.

A further object is to provide a new and improved method of making a light sensitive electron emitting surface.

A further object is to provide a simple and efficient surface to a plate.

Other objects and advantages will appear as the description proceeds.

Referring to the drawing:

Fig. 1 is a side elevation of a photo-electric tube embodying our invention and made in accordance with the method of our invention, and

Fig. 2 is a similar view of the tube rotated through an angle of 90 degrees.

The tube comprises a base 6 on which an envelope 7 is mounted, and within the envelope is a stem or press 8 upon which the elements of the tube are mounted. A pair of laterally extending supports 9 and 11 is mounted on the stem and carries a plate 13 which constitutes the cathode of the tube. Forwardly of supports 9 and 11 is a support 12 which serves as the anode of the tube. At the upper end of the cathode a support 14 is secured thereto which mechanically connects the cathode with the anode by means of an insulating connecting member 15, preferably of glass or some other refractory material. This mechanical connection between the upper ends of the anode and cathode tends to hold them in fixed spaced relation, and prevents the production of microphonic noises due to relative vibration between the anode and cathode. A disc 19 supporting a pellet 21 is secured to the upper end of the anode. This pellet consists of a salt of alkali or alkaline earth metal, mixed with calcium or some other element having a higher affinity for the element or radical of the salt than the alkali or alkaline earth metal. Upon inductively heating the disc and pellet the calcium replaces the alkali or alkaline earth metal of the salt and liberates metallic alkali or alkaline earth metal.

The cathode 13 consists of a conducting metal such as copper, gold, silver, magnesium, or the like, or it may consist of a copper plate having a coating of silver or gold, electroplated or otherwise deposited thereon as described in our co-pending application, Serial No. 461,117 filed June 14, 1930. The cathode has a coating of barium oxide, strontium oxide, potassium dichromate, or a mixture of two or more of these compounds applied thereto. The process of applying this coating is partially conducted prior to mounting the cathode in the envelope, and is completed in the envelope. The method of coating the cathode with any of the above compounds may be identical. If the coating is to consist of barium oxide for example, barium carbonate is mixed with a solution of nitro-cellulose in methyl alcohol and amyl acetate, and is thoroughly milled in a ball mill to insure an intimate mixture of the ingredients. This mixture is then sprayed upon the cathode, in which process the solvent is substantially evaporated so that the barium carbonate and nitro-cellulose binder reach the cathode in substantially dry form, forming a coating of sufficient hardness to permit handling of the cathode.

After the cathode and other elements have been mounted in the envelope as shown in the drawing, the cathode is inductively heated to burn the nitro-cellulose and convert the barium carbonate to barium oxide by the liberation of carbon dioxide. During this process the envelope is exhausted to carry away the gases produced by the conversion and the envelope is heated in an oven to expel occluded gases therefrom. The tube is now allowed to cool in order to reduce the temperature of the cathode, and after the cell has cooled sufficiently the disc and pellet are inductively heated to liberate the alkali or alkaline earth metal from the pellet and de-

posit it upon the cathode. The envelope is heated in an oven during this time to prevent the metal from collecting on the inner walls thereof. After the metal has been deposited upon the cathode the process of heating and evacuating the tube is continued. The heating at this point has two functions. It causes the formation of an alkali metal oxide which absorbs some of the alkali metal, and a thin adsorbed layer or film of the alkali metal is formed overlying the mutually absorbed alkali metal oxide and alkali metal. The second function of the heating is to expel any excess of alkali metal from the bulb in cooperation with the evacuation of the bulb.

The process has been described in connection with a coating of barium oxide on the cathode. However, the process for coating the cathode with other oxides such as those enumerated above is identical.

Another method of coating the cathode which is also applicable to barium oxide, strontium oxide, potassium dichromate, silver oxide, or a mixture of two or more of these oxides, is to mix the oxide with an aqueous solution of barium nitrate. This mixture is applied to the cathode and allowed to dry. The cathode is then mounted in the envelope as shown in the drawing and the cathode is inductively heated. The cathode is then coated with a thin film of an alkali metal as described above.

The particular type of alkali or alkaline earth metal deposited upon the oxide coating depends upon the final characteristics desired in the tube. If it is desired to produce a tube having a maximum response to long wave lengths such as those in the region of yellow and red of the light spectrum, a cæsium salt is used in the pellet such as cæsium chloride, cæsium carbonate, cæsium nitrate, or the like. If a tube having its maximum response for shorter wave lengths is desired, an alkali salt such as potassium chloride, potassium carbonate, potassium nitrate or the like is used in the pellet. If a tube having its maximum response to still shorter wave lengths is desired, an alkaline earth metal salt such as barium, strontium, or magnesium carbonate may be used in the pellet.

It will be understood that the nature and embodiments of the invention herein described and disclosed are merely illustrative and that many changes and modifications may be made therein without departing from the spirit and scope of the invention.

What we claim as new and desire to protect by Letters Patent of the United States is:

1. A method of producing a light sensitive surface on the cathode of a photoelectric tube which consists of forming a solution of an oxygen compound, applying the solution to the cathode, applying heat to evaporate the solvent, and allowing an oxide to remain on the cathode, and depositing an alkali metal upon said oxide.

2. A method of producing a light sensitive surface on the cathode of a photoelectric tube which consists of forming an alkaline earth metal oxide on the cathode, and depositing an alkali metal on said oxide.

3. A method of producing a light sensitive surface on the cathode of a photoelectric tube which consists of applying a metallic oxide to the cathode, and depositing a light sensitive electron emissive metal upon said oxide.

4. A method of producing a light sensitive surface on the cathode of a photoelectric tube which consists of applying an oxygen compound to the cathode, mounting the cathode in an envelope, converting said compound to an oxide within the envelope, exhausting the gases liberated by the conversion from the envelope, and depositing an alkali metal upon the oxide to produce a light sensitive surface.

5. A method of providing a light sensitive surface on the cathode of a photoelectric tube which consists of applying barium oxide to the cathode, and depositing a film of alkali metal on the oxide, and removing the excess of said metal from the cathode.

6. A photoelectric tube comprising an envelope, an anode and a cathode mounted therein, said cathode having an alkaline earth metal oxide applied thereto, and a film of alkali metal over said oxide.

7. A photoelectric tube comprising an envelope, an anode and a cathode mounted therein, said cathode having an alkaline earth metal oxide applied thereto, and a film of cæsium over said oxide.

8. A photoelectric tube comprising an envelope, an anode and a cathode mounted therein, a layer of barium and strontium oxides on said cathode, and a film of alkali metal over said layer.

In witness whereof, we hereunto subscribe our names this 6th day of June, 1930.

ARCHIE J. McMASTER.
CHARLES E. PARSON.