Aug. 29, 1933. A. J. McMASTER 1,925,054

PHOTO ELECTRIC TUBE

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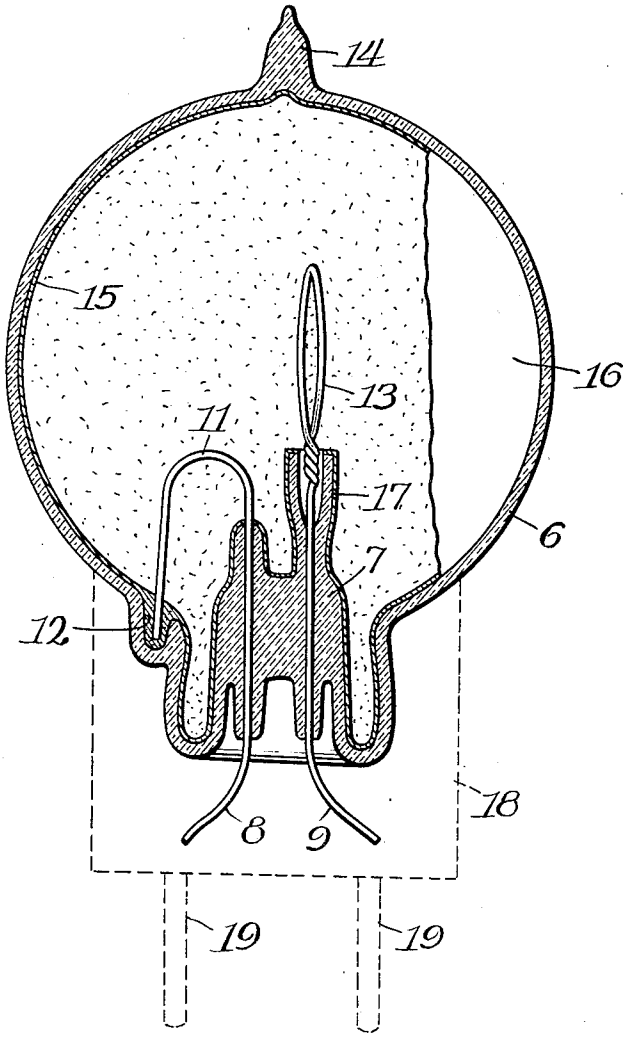

Fig. 1

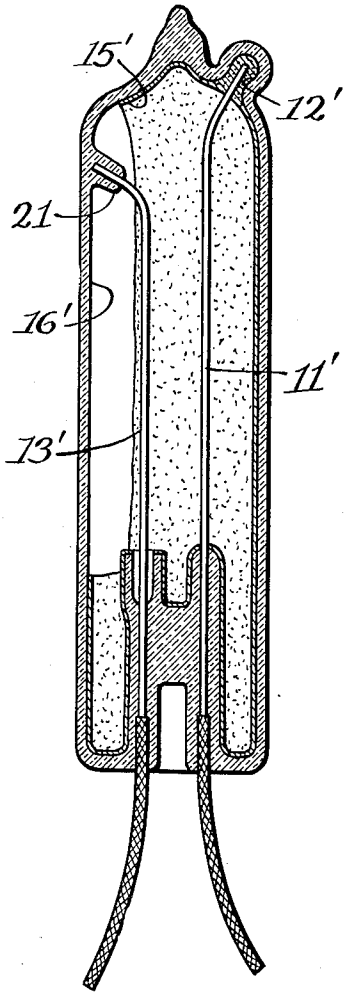

Fig. 2

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PHOTOELECTRIC TUBE

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9 Claims. (Cl. 250—27.5)

My invention relates to photoelectric tubes and more particularly to photoelectric tubes of the type in which the electron emission of an element is variable in accordance with the intensity or light striking the element.

One type of photoelectric tubes comprises an envelope or bulb which has a portion of its inner surface coated with an electron emissive substance forming a cathode from which an electron flow takes place incident to light falling upon the cathode, to an anode located within the bulb when the anode is at a higher potential than the cathode. In order to establish a difference of potential between the cathode and anode these elements must be insulated from each other and leads brought out from the bulb. It is extremely important from the standpoint of convenience and practicability that the leads be brought out from the base of the tube.

An object of the invention is to provide an improved photoelectric tube.

A further object is to provide a simple and effective connection between a lead-in wire and the cathode.

A further object is to provide an effective means for insulating the cathode from the anode.

Other objects and advantages will appear as the description proceeds.

In the manufacture of photoelectric tubes it has been common practice to deposit a layer of silver on the interior surface of a glass bulb to form a conducting base for an electron emissive substance. Connection with an electrical circuit was made either by partially embedding an electrical conductor in the glass under the conducting base and leading the conductor out of the bulb through the stem or by introducing a conductor through the wall of bulb into electrical contact with the conducting base.

The method of embedding the conductor in the glass of the bulb under the conducting layer possesses the disadvantage that the glass is materially weakened at this point and many failures of tubes of this type are due to this construction. Furthermore, considerable difficulty is involved in properly embedding the conductor in the glass so as to leave it partially exposed for contact with the conducting base. The other method of introducing a conductor thru the wall of the bulb is equally difficult of execution and possesses the further disadvantage that connection cannot be as easily or conveniently made with the conductor as is the case where the conductor terminates in a prong attached to the base of the bulb.

I have also found that when a conducting base such as silver is used in the cathode certain impurities are inevitably present in the metal which after a time appear to penetrate to the electron emissive substance and deleteriously affect the operation of the tube. In accordance with the construction of my invention, I have been able to secure good electrical contact with the cathode without using a silver base for the cathode thereby greatly improving the operating characteristics of the tube.

In the drawing—

Fig. 1 is a cross sectional view of a photoelectric tube embodying my invention; and

Fig. 2 illustrates a modified form of the invention.

Referring to the drawing and particularly Fig. 1 thereof, a vitreous bulb 6 is shown which may be made of quartz or pyrex for the purpose of admitting ultra-violet rays to which the cathode is extremely sensitive. A stem or press 7 is sealed into the bulb thru which leads 8 and 9 are lead into the bulb. Lead 8 is connected to a conductor 11 which terminates in a pocket or depression 12 in the bulb. The other lead 9 is connected to a looped conductor 13 which forms the anode of the tube.

When the stem and conductors are in place as shown in Fig. 1 the bulb is exhausted thru tip 14 and an electron emissive alkali-metal, preferably potassium is introduced into the tube and volatilized. The volatilized metal is allowed to condense forming a uniform deposit or layer on the interior wall of the bulb and filling or substantially filling pocket 12. A portion of the bulb is maintained at such a temperature that none of the metal will be deposited thereon, thereby forming a window 16 thru which light is admitted to the interior of the bulb. By depositing the electron emissive substance directly on the wall of the non-conducting glass or vitreous wall of the tube the effects of using a conducting base are avoided. The difficulty of making electrical contact with the electron emissive substance is solved by extending the conductor 11 into depression 12 which is substantially filled with the alkali metal deposit, thus making a good electrical contact with the entire cathode.

It has been found that in depositing the alkali metal in the tube the deposit has a tendency to extend to the anode 13 and short circuit the electrode. In order to overcome this difficulty I provide the stem 7 with a tubular extension 17 which is spaced from the anode leaving a restricted annular space between the anode and the extension. The alkali-metal will not deposit in this space due to certain inherent characteristic properties of the vaporized metal so that a complete insulation of the cathode and anode will result.

When the layer of alkali-metal has been deposited on the interior wall of the tube, the tube is exhausted and hydrogen is introduced. A glow discharge between the cathode and anode

converts the alkali-metal into a hydride of the metal which has the property of emitting electrons in accordance with the intensity of the light impinging thereon. After the hydride has been formed the tube is evacuated and in some cases an inert gas is introduced. The tube may be provided with a base having prongs for securing the tube in a socket. In a two electrode tube of the class described, only two prongs are required to electrically connect the tube in an electric circuit, although more prongs may be provided to mount the tube in a standard socket.

In Fig. 2, I have shown a modified form of the invention which is in many respects similar to the construction of the tube in Fig. 1. The conductor 11' extends to the top of the envelope and is secured in pocket 12'. The anode 13' instead of being formed as a loop or a ring extends upwardly in the tube and is secured to the wall of the tube by a bead 21 of glass. This construction is preferable for an elongated cylindrical tube, since the anode is thereby substantially equally spaced from all parts of the cathode, and the anode is prevented from vibrating mechanically which vibration is undesirable since it may produce microphonic action resulting in extraneous electrical impulses from the tube.

By securing the upper end of the anode to the wall of the bulb the tendency of the anode to vibrate is eliminated. Bead 21 is located in the upper part of the tube within the space of the window 16' for the purpose of preventing a short circuit between anode 13' and the cathode surface 15'.

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

What I claim as new and desire to protect by United States Letters Patent is:

1. A photoelectric tube comprising a bulb having a depression in its inner surface, a conductor extending from a point within said bulb into said depression, the other end of said conductor being adapted for connection in an electrical circuit, a photoelectric cathode comprising an alkali-metal layer on the inner surface of said bulb and substantially filling said depression, a hydride surface upon said alkali-metal, and an anode for receiving electrons from said hydride surface.

2. A photoelectric tube comprising an envelope, a stem, a plurality of conductors extending from said stem into said envelope, a collar secured to said stem and surrounding one of said conductors, said collar being spaced from said conductor, a depression in said envelope, the other conductor extending into said depression, a layer of conducting material in said envelope, said material substantially filling said depression, an electron emissive layer superposed on said conducting layer forming a cathode for electron transmission to the conductor forming the anode of the tube and an anode for receiving electrons from said electron emissive layer.

3. A photoelectric tube comprising an envelope, a stem therein, a photoelectric cathode on the interior wall thereof, a window for admitting light to the cathode, an anode mounted at one end on the stem for receiving electrons from the cathode, said anode having its other end secured to the envelope in the window portion thereof.

4. A photoelectric tube comprising a bulb having a cup shaped cavity on its inner wall, a photoelectric cathode comprising a coating of an electron emissive substance on the inner wall of said bulb, substantially filling said cavity, a conductor leading from the interior of said bulb into said cavity and terminating therein, said conductor being anchored in the material filling said cavity and an anode for receiving electrons emitted by said coating.

5. A photoelectric tube comprising a bulb having a depression in its inner surface, a conductor extending through the glass and having one end thereof lying within said depression, and a light sensitive cathode in the form of a metal film on an inner surface of said bulb, the metal forming said film filling said depression to entirely surround the end of said conductor to form a low resistance contact with said film, an anode, and a second conductor sealed through the glass and connected to said anode.

6. A photoelectric tube comprising a glass bulb, a photoelectric cathode comprising a film of alkali metal directly attached to the inside surface of the glass bulb, and a light sensitive film on the alkali metal film, an anode, a pair of conductors sealed through the glass envelope, one of said conductors secured to the anode, and a relatively thickened portion of alkali metal forming a continuation of said alkali metal film, the second of said conductors having its end imbedded in said thickened portion to provide a low resistance connection between said conductor and alkali metal film and sensitive coating.

7. A photoelectric tube comprising a glass bulb having a bead on the inside thereof, a cathode in the form of a light sensitive coating on a portion of the inside wall of the bulb leaving a window around said bead, a pair of conductors sealed through said bulb, one of said conductors being connected to said cathode, the second of said conductors having its end sealed in said glass bead and comprising the anode of the tube.

8. A photoelectric tube comprising a glass tube having a stem, a glass bead at one point on the inside wall and a depression at another point, a cathode in the form of a film of light sensitive material covering part of the inside wall and filling said depression, said film leaving a window surrounding the glass bead, and a pair of conductors sealed through the stem, one conductor extending into said depression and sealed into the material filling said depression to form a low resistance contact with the cathode, and the second conductor having an end sealed into said glass bead and forming an anode secured against vibratory movement with respect to the cathode.

9. A photoelectric tube comprising a glass bulb, a photoelectric cathode comprising a film of light sensitive material attached to the inside surface of the glass bulb, an anode, a pair of conductors sealed through the glass bulb, one of said conductors secured to the anode, and a relatively thickened portion integral with and forming a continuation of the light sensitive film, the second of said conductors having its end imbedded in said thickened portion to provide a low resistance connection between said conductor and the light sensitive cathode film.

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