May 16, 1933. A. J. McMASTER 1,909,701

PHOTOELECTRIC TUBE

Filed Aug. 17, 1929

Fig. 1

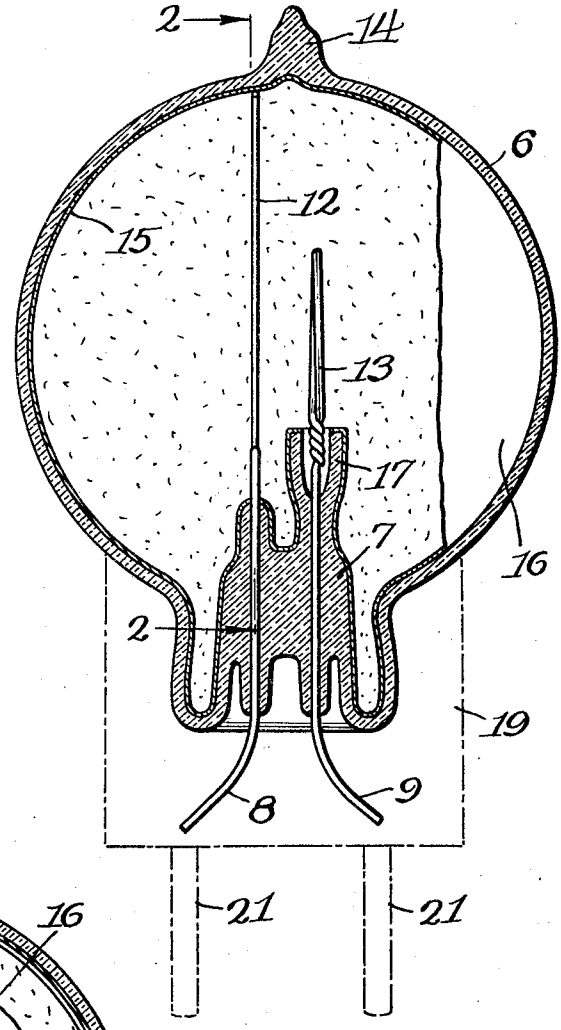
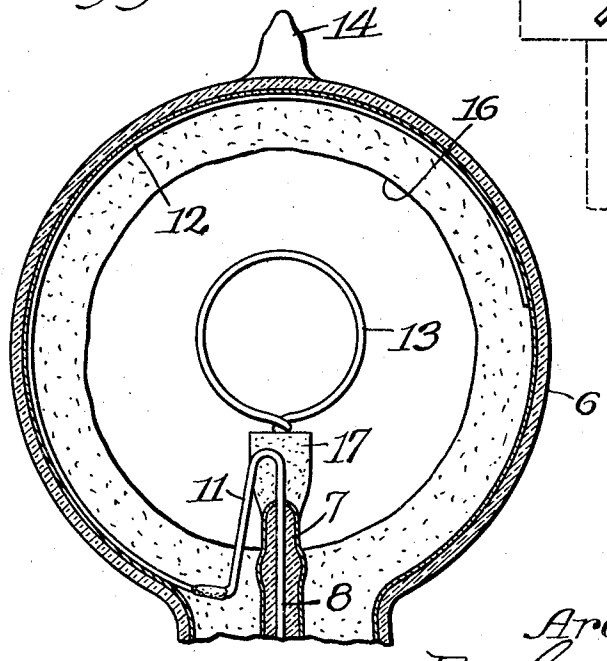


Fig. 2



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UNITED STATES PATENT OFFICE

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PHOTOELECTRIC TUBE

Application filed August 17, 1929. Serial No. 386,526.

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 of 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 through 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 represents a cross sectional view of a photoelectric tube embodying my invention; and

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

Referring to the drawing, a vitreous bulb or envelope 6 is shown, which may be of quartz, pyrex or ordinary glass, depending upon the use to which the tube is to be put. A stem or press 7 is sealed into the neck of the bulb through which leads 8 and 9 are lead into the bulb. Lead 8 is connected to a conductor 11 which is bent into a U-shape and extends downwardly into close proximity to the spherical wall of the bulb 6. Secured to the conductor 11 is a long resilient conductor 12 which is substantially straight before being inserted in the bulb. When the press and conductors 11 and 12 are inserted in the bulb, the conductor 12 is bent into a circular form by the shape of the bulb. Conductor 12 is of such a length as to extend through more than 180 degrees, or more than half-way around the large circumference of the interior of the bulb. Due to this construction and the resiliency of the conductor it is caused to contact with

a large portion of the interior of the bulb. Lead 9 is connected to an anode 13 in the form of a loop.

When the press has been fused into the bulb and the conductor 12 is in the position shown in the drawing, the tube is exhausted through the 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 upon the interior wall of the bulb. 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 through 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, the effects of using a conducting base which inevitably contains impurities are avoided, thereby improving the operating characteristics of the tube.

Experiments have shown that the alkali metal is deposited under the conductor 12 in a very thin layer substantially the same as though the conductor were not present and a pressure contact is maintained between the layer or cathode 15 and the conductor 12. This construction solves one of the most difficult problems involved in the manufacture of photoelectric tubes, namely, the making of a contact between the alkali metal cathode and a conductor by means of which the cathode may be placed in an electrical circuit.

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 electrodes. 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 around the anode. 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 hydrogen is introduced into the tube and 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 inert gas is ionized by the electron flow in the tube and has a tendency to increase the sensitivity of the tube.

The tube may be provided with a base 19 having prongs 21 for securing the tube in a socket. In a two electrode tube of the class described only two prongs are required for placing the tube in an electric circuit. However, it is customary to provide the tube with four prongs for mechanical purposes and also to permit its being used in a standard socket.

It will be understood that the embodiment of the invention herein described and illustrated is merely a convenient and practical embodiment of the invention and that many changes and alterations may be made therein without departing from the spirit and scope of the invention.

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

1. A photoelectric tube comprising an envelope, an electron emissive substance forming a cathode and having a circular window, an elongated resilient arcuate conductor contacting with said cathode at several points and exerting a pressure between said points, said conductor having its axis in alignment with the axis of the window, and an anode for receiving electrons from said cathode.

2. A photoelectric tube comprising an envelope, an electron emissive substance in the inner surface of said envelope forming a cathode, a resilient conductor extending into said envelope and yieldingly engaging opposed points of said cathode to make an electrically conducting pressure contact with the cathode between said points and an anode ring concentric with said conductor for receiving electrons from said cathode.

3. A photoelectric tube comprising a substantially spherical envelope, an anode in said envelope, a stem within said envelope, a cathode in the form of a thin metal deposit on the inside wall of the envelope, and a conductor comprising a relatively small diameter circular wire of resilient material supported by the stem, substantially longer than the diameter of the envelope and normally straight, the wire assuming an arcuate shape solely from its confinement against the envelope and extending in an arc greater than 180°, whereby a substantially continuous surface contact is effective between the wire conductor and said cathode.

4. A photoelectric tube, as defined in claim 3 wherein said cathode is discontinuous over an area of general circular shape to form a window with a circular outline, and the arc of said conductor is substantially co-axial with the outline of the window.

5. A photoelectric tube comprising a substantially spherical glass envelope, an anode in said envelope a stem within the envelope, a deposit of metal on the inside of the envelope forming a light sensitive cathode, a relatively heavy conductor sealed through the stem and bent with its inner end in close proximity to said cathode, a second conductor supported by the first mentioned con-

ductor and in electrical contact therewith, said second conductor comprising a normally straight relatively small diameter circular wire formed of resilient material and having a length greater than half the circumference of the envelope, whereby it assumes an arcuate shape when confined in the envelope and forms a substantially continuous surface contact with the cathode throughout its length.

In witness whereof, I hereunto subscribe my name this 15th day of July, 1929.

ARCHIE J. McMASTER.