Nov. 16, 1943. E. H. BICKLEY 2,334,471

PHOTO-ELECTRIC TUBE

Filed June 7, 1941

Fig. 1.

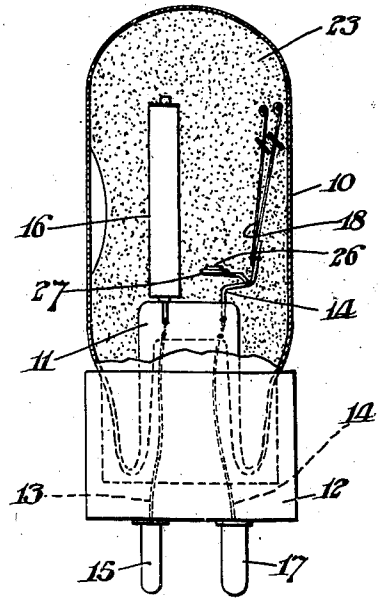


Fig. 2.

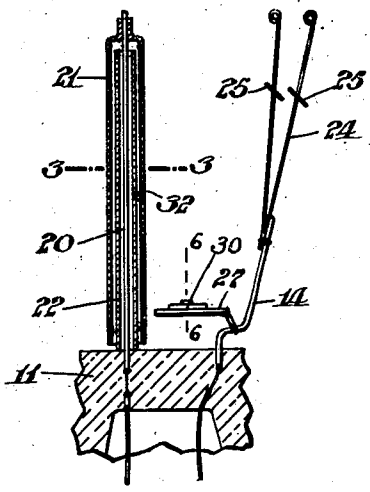


Fig. 3.

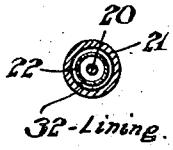


Fig. 4.

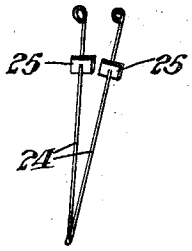


Fig. 5.

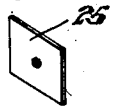
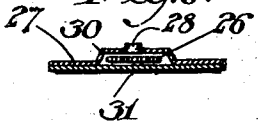


Fig. 6.



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PHOTOELECTRIC TUBE

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Application June 7, 1941, Serial No. 397,004

4 Claims. (Cl. 250—165)

The present invention relates to electronic tubes and more particularly to photo-electric tubes.

In tubes of the photo-electric type it is important that the tube be not only highly sensitive to light values but that the sensitivity be of lasting quality. Also such tubes must be so constructed as to avoid internal short circuits or leakage since these destroy the effectiveness of the tube. In tubes as heretofore constructed, these highly desirable features have not been completely attained and sensitivity is more or less variable while short circuits are of common occurrence.

Some of the objects of the present invention are to provide an improved photo-electric tube; to provide a photo-electric tube wherein sensitivity is prolonged and the life of the tube materially increased; to provide a photo-electric tube wherein the action tending to produce a short circuit is reduced to a minimum; to provide a photo-electric tube wherein the cathode coating is confined to the proper area of the inside of the tube and is prevented from being deposited upon the top of press or other areas locally adjacent current conductors; to provide means for heating insulating parts of a photo-electric tube which are in close proximity to current conductors, such heating being particularly during the discharge of the capsule or subsequently from exterior means; to provide means to ensure a certain and effective contact between the cathode and the cathode lining of the tube; and to provide other improvements as will hereinafter appear.

In the accompanying drawing Fig. 1 represents a side elevation, partly broken away, of a photo electric tube embodying one form of the present invention; Fig. 2 represents a side elevation on an enlarged scale of one form of electrode assembly for the tube showing the anode in longitudinal section; Fig. 3 represents a section on line 3—3 of Fig. 2; Fig. 4 represents a detail of the cathode terminal; Fig. 5 represents one of the slider contact members enlarged; and Fig. 6 represents a section on line 6—6 of Fig. 2.

Referring to the drawing, one form of the present invention comprises an evacuated envelope 10 of generally cylindrical shape including a press 11 and base 12 of usual form. The press 11 carries the terminal wires 13 and 14, the former leading from the exterior prong 15 to the tube anode 16, and the latter leading from the exterior prong 17 to the cathode lead-in 18. Connections between the wires 13 and 14, and the respective parts are preferably by welded joints.

As here shown the anode 16 is formed by a metal rod 20 supported upon the press 11 and suspending a metal sleeve 21 from its free end, the rod 20 forming the axis of the sleeve and being spaced therefrom. The attached end of the sleeve 21 is closed by crimping the sleeve into contact with the rod 20 where it is welded and thus provides a closed end for the tube. The opposite end of the sleeve 21 is open and is mounted very close to the press, but not touching it, to restrict the entrance of vapors and present large surfaces on which these can condense before they will form a continuous conducting layer. The relatively large diameter of the sleeve 21 gives added sensitivity as compared to the ordinary construction using a small anode. This is due to the fact that the sleeve gets hot when the tube is being bombarded and radiates heat which heats the deposit while it is being formed on the glass. A tubular sleeve gets hotter than a wire under bombarding.

In order to provide a relatively long narrow labyrinth passage through the sleeve 21 and to reduce the chance of a short circuit, a glass tube 22 is supported on the press of such diameter as will fit within the metal sleeve 21 and encircle the rod 20 without touching either of the parts.

For ensuring an effective contact of the cathode lead-in 18 with the metallic coating 23 on the inner wall of the envelope 10, a spring 24 of hair pin shape is welded to the entering cathode wire 14 and is so adjusted that the fingerlike ends of the spring rest against the envelope 10. Each arm of this spring 24 carries a polygonal shaped slider 25 formed of metal and which is free to ride along the spring arm upon which it is mounted. When the electrode assembly is inserted within the envelope 10, prior to evacuation and prior to coating the envelope, the sliders 25 are positioned near the welded end of the spring so that each is out of contact with the envelope and so remains until after the coating 23 has been applied. To bring the slider or sliders 25 into contact with the coating 23, the outer end of the envelope 10 is bumped in such a manner as to cause the sliders 25 to travel along the spring arms and finally bite into the coating where each is held by the spring action, and a good contact maintained indefinitely.

For producing a uniform coating upon the wall of the envelope, a capsule or pellet 26, of any composition well known to the art, which releases condensable vapors upon being heated, is mount-

ed upon a metal base plate 27 supported from the cathode lead-in 18 transversely of the envelope at a point relatively close to the press 11 and also near the longitudinal axis of the envelope. This plate 27 becomes heated during the bombarding of the capsule and radiates heat to the press so that the latter becomes hot and prevents deposition of the cathode vapors thereon. A port 28 in the pocket 30 of the plate 27 serves to release the vapor upwardly into the envelope 10. The plate 27 is opposite the press 11 while the port through which the capsule discharges faces the interior of the tube, thus the surface of the flag or capsule is at right angles to the axis of the tube to make an efficient construction for action by an encircling bombarding coil. Since the plate 27 is relatively thin the edge exposed to the nearest glass wall surface is small and hence local heating by radiant energy is greatly reduced. However the face of the plate 27 juxtaposed to the press 11 is of considerable area and the radiant heat thereof now serves a useful purpose in that it keeps the press so hot that it is left very clear when the tube is complete. Hence the time required to form any conductive film is greatly increased and the danger of short circuits thereby reduced to a minimum. As a further means to delay the formation of a conducting film on the press a portion of the face of the plate 27 can be coated with some material 31 such as carbon, graphite, or aquadag, as it has been discovered graphitic compositions have a great affinity for the deposited metallic coating of the tube and thus tend to obstruct its deposition on top of the press, or reduce it if already deposited.

As a further safeguard against short circuit it is preferable to coat the inside of the sleeve 21 with a graphitic material 32 which acts along the path of the vapor to prevent metallic deposit which normally cause a short circuit. This construction functioning with the long path of travel for the vapor results in a very long life of the tube. The metal sleeve 21, especially when blackened, maintains itself at a higher temperature when in the path of radiant energy thereby retarding the tendency of vapors to enter the tube and increasing the efficiency as compared to tubes using the glass boot alone.

Having thus described my invention, I claim:

1. A photo-electric tube comprising a glass envelope and an electrode assembly therein including a press, an anode, a photo-cathode and a cathode lead-in carried by said press, and conductor wires leading respectively from said anode and cathode lead-in to the exterior of said envelope, a capsule to release vapor when heated to form said photo-cathode on the inside of said envelope, a plate of heat conducting material mounted in close proximity to said press whereby when heated said plate radiates heat to said press to prevent condensation of said vapor on said press, and an area of graphitic composition on said plate to supplement the action of the heat in deposit prevention.

2. A photo-electric tube comprising a glass envelope and an electrode assembly therein including a press, an anode, a photo-cathode and a cathode lead-in carried by said press, said anode being formed of a conducting rod, a sleeve of conducting material connected to and encircling said rod, and a tube of insulating material between said rod and sleeve forming an annular passage within said sleeve, and conducting wires leading respectively from said anode and cathode lead-in to the exterior of said envelope.

3. A photo-electric tube comprising a glass envelope and an electrode assembly therein including a press, an anode, a photo-cathode and a cathode lead-in carried by said press, said anode being formed by a glass tube, a rod passing axially through said tube, a metal sleeve of cap form suspended by said rod about said tube, and a coating on said sleeve to retard the deposit of cathode vapor in the vicinity of said anode to prevent short circuits, and conducting wires leading respectively from said anode and cathode to the exterior of said envelope.

4. A photo-electric tube comprising a glass envelope and an electrode assembly therein including a press, an anode and a cathode lead-in carried by said press, said cathode lead-in terminating in a spring arm, a cathode deposit on the interior of said envelope and a metal slider mounted on said arm and pressed by said arm into contact with said cathode deposit on said envelope.

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