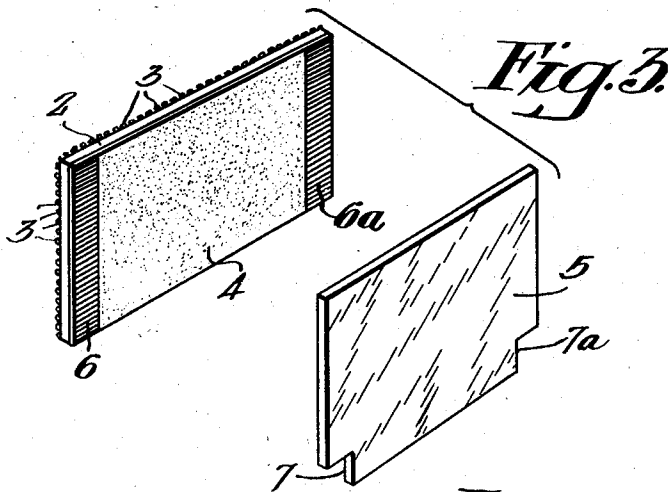
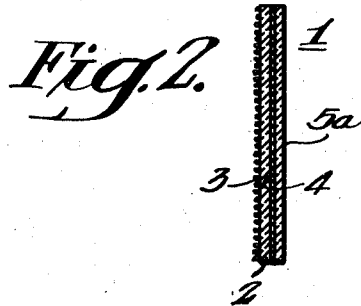
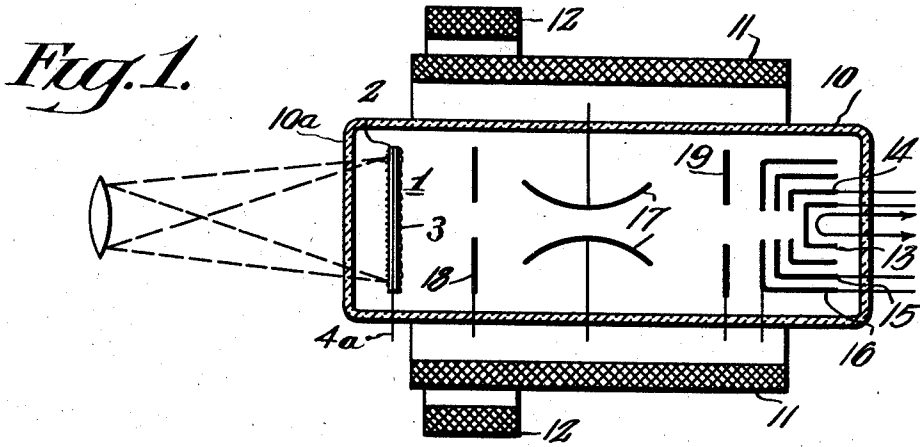


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PHOTOSENSITIVE ELECTRODE

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PHOTOSENSITIVE ELECTRODE

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3 Claims. (Cl. 250-167)

This invention relates to transparent and semi-transparent photosensitive electrodes and to methods of making the same. The invention has special reference to the provision of improvements in photosensitive electrodes of the type employing a conductive backing or "signal plate." Photosensitive electrodes employing conductive backings are commonly used in cathode ray tubes of various types (such for example as "iconoscopes," "orthicons" and other television "pick-up" tubes) for converting a light image into a train of signal impulses.

It is an object of the present invention to provide an electron discharge tube incorporating an improved translucent photosensitive cathode having an electrically conductive backing or signal plate.

Another object of the invention is to provide a photosensitive cathode having an electrically conductive signal plate of any desired thinness and transparency, and one not adversely affected by conditions encountered during the subsequent assembly and evacuation operations incident to the manufacture of electron tubes.

Another and important object of the invention is to provide an improved method of manufacturing an electron discharge device having a translucent photosensitive cathode, and one which in its practice affords the minimum number of non-usable devices.

Other objects and advantages together with certain details of construction will be apparent and the invention itself will be best understood by reference to the following specification and to the accompanying drawing, wherein:

Fig. 1 is a longitudinal sectional view of a magnetically controlled cathode ray television tube which incorporates a translucent photosensitive screen constructed in accordance with the principle of the invention;

Fig. 2 is an enlarged sectional view of the translucent electrode of Fig. 1, and

Fig. 3 is an exploded view of another embodiment of a translucent photosensitive electrode within the invention.

Referring now to the drawing wherein like reference characters designate the same or corresponding parts in all figures.

The present invention contemplates and its practice provides a transparent or semi-transparent photosensitive electrode, indicated generally at 1 in all figures, comprising a supporting plate or sheet 2 of mica, or of glass or the like, which is provided on one of its major surfaces with a photosensitive mosaic 3 and on its other

major surface with a signal plate comprising a transparent metallic layer or film 4 which may be of the order of, say, one hundred molecular layers thick. In accordance with the invention the transparent metallic film 4 is protected by a superimposed sheet, film or layer of a transparent insulating material such, for example, as a sheet of glass 5 (Fig. 3) or an evaporated film 5a (Fig. 2) constituted of quartz, barium borate, cryolite or other transparent insulating material which is substantially immune to the thermal and other conditions to which it may be exposed during the evacuation and other processes incident to the manufacture of electron tubes.

In the event that the protective transparent insulating backing for the transparent metallic film 4 is in the form of a self-supporting sheet 5, as in Fig. 3, suitable means such for example as a frame or a number of clamps (not shown) are provided for maintaining the said sheet 5 in intimate contact with the metallic film 4 which it is designed to protect.

An electrode lead which may comprise an opaque metallic ribbon or ribbons 6, 6a is disposed, preferably beneath and in intimate contact with the conductive film 4, along one or more of the edges of the supporting surface 2.

In carrying the invention into effect it is preferable to start with a clean transparent sheet of mica, say about .002 of an inch thick, and to first apply the conductive ribbon or ribbons 6 along edges of one of its major surfaces. Where two oppositely located ribbons 6, 6a are employed the electrical resistance of the subsequently applied metallic film 4 may be more easily be measured. The ribbons 6 may conveniently be applied in the form of a paint constituted of a colloidal solution of platinum chloride, in which case the wet edges of the plate may subsequently be heated to a temperature of say 400° C. for a brief period to reduce or convert the solution into pure platinum. With the ribbons 6 in place the mica sheet 2 is then preferably mounted in a transparent evacuable bell jar, not shown, which is provided with separate heating coils one of which contains a pellet of chromium, platinum, tungsten or other metal of which the film 4 is to be constituted, and the other containing a pellet of quartz, barium borate, cryolite or other material of which the protective transparent insulating layer 5a is to be formed. Each of these heating coils, as in the standard evaporation technique, is arranged at a point in line with the surface of the mica to be treated. The bell jar is provided with electrical connections to the

ribbons on the surface of the mica so that the conductivity of the metallic film 4 to be applied to the said surface may be measured and hence controlled during the evaporation process. Means are also provided for measuring the transparency of the metallic film 4 at various stages of its deposition. When the evaporated metal comprises chromium a film which passes substantially 70% of the incident light from a testing lamp will ordinarily be found to exhibit satisfactory electrical as well as optical performance. Tungsten films may be made which will pass even a larger percentage of light, however, in commercial practice, satisfactory performance is ordinarily achieved when the film 4 comprising the "signal plate" is so thin that it passes from 50 to 70 per cent of the light.

Subsequent to the formation of the conductive layer 4 the quartz or similar pellet is vaporized, in vacuo, to deposit the protective insulating layer 5a thereon.

The thickness of the transparent protective sheet 5 or layer 5a is by no means as critical as that of the conductive layer 4 and indeed may be of any desired thickness without seriously affecting the overall transparency of the electrode. Evaporated transparent insulating layers of the order of 200 to 500 molecular layers thick have proven satisfactory. The lower limit of thickness where the insulation comprises a discrete self-supporting sheet 5 of glass (as in Fig. 3) is approximately five one-thousandths of inch (.005"), the said thickness dimension being that of glass plates now commercially available.

It is of course necessary that the intermediate conductive layer or signal plate 4 be accessible for purposes of establishing an electrical connection 4a (Fig. 1) thereto and, to this end, a portion or portions of the ribbons 6, 6a may be masked during the deposition of the evaporated transparent insulating material. Alternatively and as indicated at 7, 7a, Fig. 3, the glass plate 5 may be cut away to provide an exposed portion of the ribbon. Ordinarily when a plurality of connections, 6, 6a to the signal plate are provided they are connected together so that but a single external lead (4a, Fig. 1) need be provided in the discharge tube in which it is to be used.

The major surface of the supporting plate 2 which is opposite to the major surface on which the conductive layer 4 is applied may be photosensitized in any of several known ways. By way of example, satisfactory results have been achieved by depositing a thin layer of silver on said surface and then heating the silver layer to cause it to break up into a discontinuous film formed of minute globules of silver which are then oxidized and subsequently caesiated. Alternatively, the said surface may be provided with a film of photosensitive material so thin that the molecules or small groups of molecules comprising the film are physically separate. In either event to prevent damage due to handling or to mere exposure to the atmosphere, the mosaic surface should preferably be formed with the otherwise completed electrode mounted in place in the tube in which it is to be used. In this case the transparent insulating backing 5 serves also to protect the metallic film 4 during and prior to the mounting operation.

Fig. 1 shows a photosensitive electrode constructed in accordance with the invention incorporated in a so-called "orthicon" television transmitting or "pick-up" tube of the type de-

scribed in co-pending application Serial No. 276,106 filed May 27, 1939, to Harley A. Iams and Albert Rose, and Serial No. 222,153 filed May 30, 1938, to Albert Rose, which applications are assigned to the same assignee as the instant case. The device here shown comprises a highly evacuated cylindrical envelope 10 surrounded by two coils 11 and 12 and containing, adjacent one end, an electron gun which consists of an indirectly heated cathode 13, a control electrode 14 and accelerating electrodes 15 and 16. Adjacent the opposite end of the tube is the transparent photo-sensitive electrode 1 of the invention mounted with its mosaic surface 3 presented to the gun. Intermediate the gun and the mosaic are mounted a pair of deflecting plates 17 and an apertured electrode 18 which is provided for shielding purposes. Another apertured electrode 19 adjacent the gun is provided for collecting the electrons from the beam which do not reach the mosaic surface 3.

An image, such as the image of a frame of a motion picture film (not shown) is projected through the end 10a of the tube. The image impinges the transparent insulating film or plate 5, and passes through the conductive signal plate or film 4 and the supporting mica or glass sheet 2 to appear on or adjacent the photosensitive gun side 3 of the said supporting member. By means of the focusing coil 11 the electron beam leaving the electron gun is focused to a small spot on the mosaic surface 3 and the beam caused to scan the said surface by means of the deflecting plates 17 and deflecting coils 12.

As explained in the above identified Rose application the electrons of the electron beam are directed upon the mosaic surface 3 of the image cathode 1 with a very low velocity, that is, a velocity approaching zero velocity at the point of impact. The reason for employing this low velocity is that the electrons of the beam should approach the point of impact on the mosaic surface with a velocity such that the ratio of secondary electrons to primary electrons is less than unity.

In operation, elemental areas of the mosaic electrode 1 acquire electrostatic potentials proportional to the intensity of light incident thereon. Particles of the mosaic which are more highly illuminated acquire the most positive electrostatic charge with respect to the unilluminated particles. The positive charges representing an electrostatic image of a picture to be transmitted are neutralized by the scanning beam electrons. When the electrons of the scanning beam are directed toward those particles of the mosaic which are negative with respect to the cathode, they cannot reach those particles because of their low velocity. These electrons, since they are prevented from impinging on the mosaic, are returned to the electron collecting electrode 19 adjacent the electron gun. The scanning means which cause the electron beam to scan the mosaic electrode or target are so chosen as to prevent those electrons of the beam which do not reach the target from returning to the electron gun but rather causes them to be re-directed along paths other than those followed by those electrons in traversing the distance between the electron gun and the target.

Various modifications of the invention such for example as utilizing the end wall 10a of the tube (10 Fig. 1) as the protective transparent insulating end piece 5 of the photo-sensitive electrode of the invention will suggest themselves to

those skilled in the art. It is to be understood therefore that the foregoing is to be interpreted as illustrative and not in a limiting sense except as required by the prior art and by the spirit of the appended claims.

I claim as my invention:

1. A photoelectric cathode comprising a light transmitting supporting surface, a photosensitive layer on one side of said surface, a light transmitting conductive film on the other side of said surface and a transparent insulating layer on the outer surface of said conductive film and intimately bonded to substantially the entire surface thereof.

2. Method of manufacturing a transparent photosensitive electrode which comprises providing a light transmitting insulating supporting sheet with a conductive light transmitting layer

on one surface thereof, then so applying a transparent insulating backing to said conductive surface that it is intimately bonded to substantially the entire surface thereof, and subsequently photosensitizing the opposite surface of said insulating supporting sheet.

3. Method of manufacturing an electron discharge device having a transparent photosensitive electrode which comprises providing a transparent insulating supporting sheet mounted in vacuo with a light transmitting metallic film on one surface thereof, and evaporating an insulating transparent layer on said conductive film, breaking said vacuum and mounting said supporting sheet in the envelope of said discharge device, and subsequently photosensitizing the opposite surface of said supporting sheet.

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