

April 17, 1945.

L. E. FLORY

2,373,752

PICTURE TRANSMITTER TUBE MOSAIC SCREEN

Filed Jan. 25, 1941

FIG. 1.

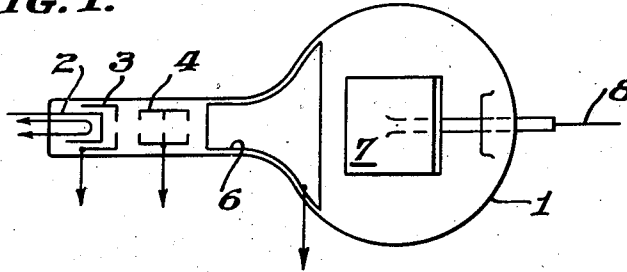


FIG. 2a.

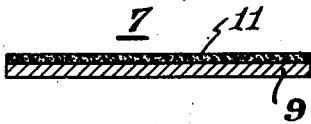


FIG. 2b.

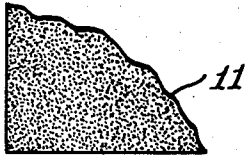


FIG. 3.

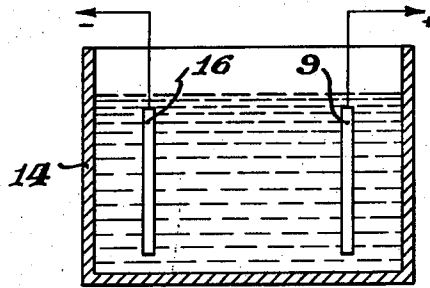
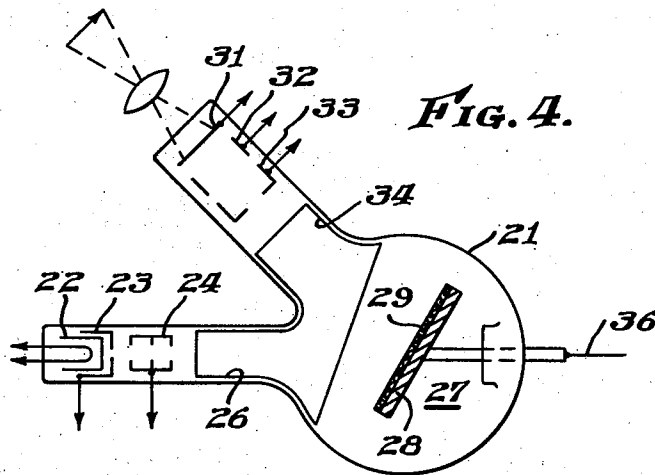


FIG. 4.



Inventor
Leslie E. Flory

By

J. J. Huff
Attorney

UNITED STATES PATENT OFFICE

2,373,752

PICTURE TRANSMITTER TUBE MOSAIC
SCREENLeslie E. Flory, Oaklyn, N. J., assignor to Radio
Corporation of America, a corporation of Dela-
ware

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2 Claims. (Cl. 250—167)

My invention relates to cathode ray tubes designed for picture transmission and particularly to tubes of this type having therein a novel screen structure to be scanned by the cathode ray.

An object of the present invention is to provide an improved cathode ray tube for picture transmission and in particular to provide an improved screen structure or mosaic for such tubes.

A further object of the invention is to provide an improved method of making a screen structure or mosaic for cathode ray tubes.

In accordance with the present invention the necessity for evaporating a film of silver on a layer of powder is avoided by mixing a silver compound, such as silver oxide or silver carbonate, with an insulating powder, such as china clay, and then depositing this mixture of powders upon the metallic surface which is to function as the signal plate of the tube.

The quantity of silver compound which is mixed with the insulating powder is made small enough so that the conductivity of the powder layer is not appreciably increased as compared with the conductivity of a layer of china clay alone.

After the mixture of powders has been deposited on the signal plate, preferably by means of cataphoresis, the particles of silver compound at the surface of the powder layer may be suitably photosensitized. It will be understood that it is only surface particles that are photosensitized, the powder layer being so dense that the caesium or other photosensitizing material will not penetrate the powder layer.

The final mosaic, when made as just described, functions the same as the well known iconoscope mosaic, that is, each photosensitized particle is insulated from adjacent photosensitized particles and from the signal plate whereby each photosensitive particle may acquire a certain charge and store this charge. For some tube designs, it is not necessary to make the surface particles of silver or the like photosensitive, it being sufficient if they emit secondary electrons when an electron image is projected upon the mosaic.

The invention will be better understood from the following description, taken in connection with the accompanying drawing in which

Figure 1 is a view of a cathode ray picture transmitter tube embodying our invention,

Figure 2a is an enlarged view, in section, of the screen structure of mosaic used in the tube shown in Fig. 1,

Fig. 2b is a fragmentary view of said screen structure,

Figure 3 is a view which is referred to in describing our improved screen structure, and

Figure 4 is a view of a combination image tube and cathode ray picture transmitter tube embodying our invention.

Referring to Fig. 1, the invention is shown applied to a cathode ray picture transmitter tube of a well known type. It comprises an evacuated envelope 1 having therein an electron gun comprising an indirectly heated cathode 2, a control electrode 3, a first anode 4, and a second anode 6 and a screen structure 7. A light image is projected upon the screen 7 whereby a corresponding electrostatic image is formed thereon. This is scanned by the cathode ray produced by the electron gun whereby picture signals appear in the output conductor 8.

In accordance with my invention, the screen 7 is made as illustrated in Fig. 2a. It comprises a conducting signal plate 9 which may be a polished metal plate or it may be a glass plate with a metal coating. If a glass plate is used, the metal surface may be formed by evaporating aluminum or some other metal upon the glass surface, or a metal such as platinum may be deposited chemically upon the glass.

The layer 11 is a mixture of an insulating powder such as china clay and a metallic compound such as silver oxide which has been deposited upon the metal surface of the signal plate 9 as previously described.

The percentage of silver oxide, silver carbonate or the like, which is mixed with the china clay or other insulating powder is not critical, the important requirement being that enough material is included to provide a reasonable number of silver particles on the surface of the powder layer to permit the formation of a good mosaic surface, while at the same time the percentage is kept low enough to avoid making the powder layer conductive enough to impair the storage action of the mosaic. In practice, mosaics made with a mixture of china clay and silver oxide, with the silver oxide 6% by weight of the china clay, have been found very satisfactory. Mosaics made with widely different percentages of silver compounds had been found satisfactory, however, some having been made with a percentage of silver oxide as low as 1% and as high as 30%.

Various metallic compounds may be employed as the material to mix with the insulating powder, although one of the silver compounds is preferred. Also, while china clay has been mentioned as a preferred insulating powder, there are other powdered materials that are satisfac-

tory. Such materials, for example, are powdered mica, aluminum silicate, powdered quartz, titanium oxide and MgO.

The powder layer 11 may be put on the plate 9 by various methods as by spraying it on, by settling it on by the process well known in making fluorescent screens, by evaporating a liquid in which the powder is suspended or by cataphoresis. The latter method is preferred and is practiced as illustrated in Fig. 3. In any case, a method is used which results in a dense adhering layer of the mixed powders which will not be penetrated any substantial amount by the caesium or other photosensitizing material. The powder particles must be small to produce a layer of the desired density. In one mosaic, for example, a majority of the particles were less than 0.002 millimeter in diameter, the average diameter of all particles being about 0.001 millimeter.

Referring to Fig. 3, the powder mixture is held in suspension in a liquid which may be in either an insulating or a metal container 14. The insulating powder and silver compound preferably are thoroughly mixed by grinding them together before being suspended in the liquid. The signal plate 9 is placed in this liquid and opposite the plate 9 is placed an electrode 16. By applying a suitable D. C. potential between the plate 9 and the electrode 16 the suspended powder mixture is caused to move over to the plate 9 and deposit thereon as a uniform coating, this movement of the powder mixture to an electrode being due to a difference in the dielectric constants of the powder and the liquid.

Whether the powder goes to the negative electrode or to the positive electrode depends upon the particular powder and liquid used. The china clay and silver oxide mixture goes to the positive electrode, at least in the cases where it is suspended in either acetone or water.

Generally a dispersing agent of some kind should be employed to prevent the suspended powder from collecting in lumps or coagulating. With china clay in acetone, about $\frac{1}{10}$ of 1% nitrocellulose may be added for this purpose. With china clay in water, a few drops of ammonia may be added.

The insulating powder should have the following properties, all of which are found in the above-mentioned powders: (1) it should be very fine grained; (2) it should be chemically inert under the conditions required for activating or processing the tube; (3) it should have a low vapor pressure; and (4) it should have a high resistance.

The screen 7 preferably is sensitized in the assembled tube as follows:

After the powder layer has been deposited on the signal plate the mosaic is sealed in the cathode ray tube envelope and the tube is then baked to at least 400° C. to out gas the tube and to reduce the silver compound after which the surface is oxidized by admitting oxygen to the tube and producing an electric discharge. If silver oxide is used, it is slightly reoxidized after the baking step the same as one of the other silver compounds.

A photosensitive material such as caesium is admitted after the oxygen has been pumped out and the tube is then baked. The resulting surface on the powder includes a multitude of very small discontinuous photosensitive elements.

Referring to the tube shown in Fig. 4, it comprises an evacuated envelope 21 having therein an electron gun comprising an indirectly heated

cathode 22, a control electrode 23, a first anode 24 and a second anode 26, and a screen structure 27.

The screen 27 consists of a conducting signal plate 28 and a mixed powder layer 29, the elements 28 and 29 corresponding to the elements 9 and 11, respectively, of Fig. 2a.

The envelope 21 also includes an image tube section comprising a transparent photosensitive cathode 31, and electrostatic focusing ring electrodes 32 and 33 and the accelerating electrode 34. When a light image is projected upon the cathode 31, electrons are released therefrom in accordance with the light intensity and an electron image is focused upon the screen 27 by means of the ring electrodes 32 and 33. An image tube of this general design is described and claimed in Patent No. 2,189,321 entitled "Electro-optical devices," issued February 2, 1940, to G. A. Morton. It will be understood that the electron image may be focused upon the screen 27 by means of electromagnetic focusing, if desired, or by another suitable electron lens.

In a combination tube of this type, it is not necessary to sensitize the surface of the powder layer 29 as a separate step because the surface of layer 29 will become sensitized during the process of sensitizing the cathode 31 as a result of the caesium or other photoelectric sensitizing metal going over to the layer 29. The introduction of oxygen during the process of sensitizing the cathode 31 also plays a part in sensitizing the layer 29.

The process employed in sensitizing the cathode 31 preferably is the same as that described in Patent No. 2,189,322, issued February 6, 1940, to Leslie E. Flory. This process is carried out after the tube has been completely assembled. Briefly, the process comprises evacuating the tube, evaporating silver upon a transparent supporting surface, admitting oxygen and oxidizing the silver by a glow discharge, again evacuating the tube, admitting caesium or the like, and then baking the tube. Preferably a very thin final layer of silver is evaporated upon the cathode 31 after the caesiating step and the tube is again baked as the final step.

It will be understood that if during the time an electron image is projected on the screen by the image tube, the surface of the screen 27 is scanned by the cathode ray produced by the electron gun, picture signals appear in the output conductor 36 leading from the signal plate 28.

The mixed powder layers of screens 7 and 27 do not include any binder in the preferred embodiments, although when some powders are used the finished layer may include a binder. In most cases, however, if the liquid in which the mixed powder is suspended during the process of forming the powder layer is a binder or contains a binder, the binder is evaporated out of the finished product. Thus, if the powder is china clay and silver oxide, the layers 11 and 29 consist of china clay and silver oxide only, there being no binder included.

It may be noted that in Figs. 2a and 4 of the drawing, the thickness of the layer of insulating powder is greatly exaggerated since the true thickness of the powder cannot readily be illustrated. The thickness of the mixed powder layer is not critical as long as the capacity remains a reasonable value and the layer does not get so thin that the signal plate is exposed, but it may be mentioned, by way of example, that a thickness of two mils will be found satisfactory.

I claim as my invention:

1. The method of making a mosaic screen for cathode ray tubes which comprises mixing a powdered insulating material with a powdered silver compound, depositing said mixture as a dense adhering layer upon a conducting surface, reducing to silver at least the silver compound on the surface of said layer, and sensitizing the silver on the surface only of said layer to produce electron emissive elements capable of holding an electric charge.

2. The screen structure for a cathode ray tube which comprises a conducting surface having

thereon a dense adhering layer of powder which is substantially non-conducting, said powder being a mixture of a silver compound and an insulating powder which remains insulating after processing of the tube, said layer having on its surface sufficient photosensitizing material to increase the electron emissivity of said surface while retaining non-conductivity laterally along said surface whereby the resulting electron emissive elements on said surface are capable of holding an electric charge.

LESLIE E. FLORY.