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TELEVISION TRANSMITTING TUBE

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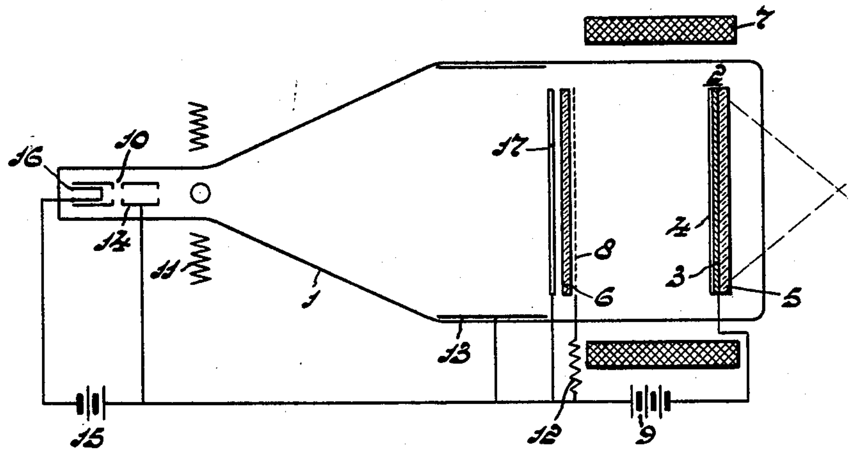

Fig. 1

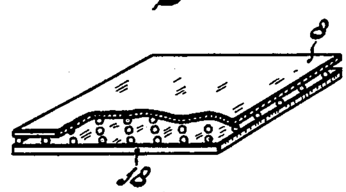

Fig. 2

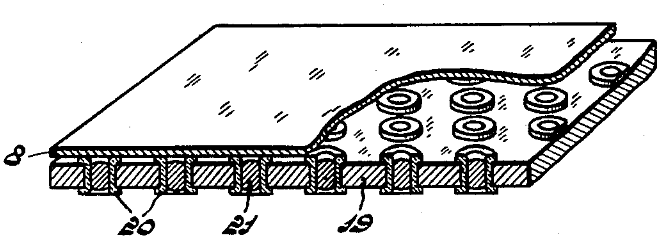

Fig. 3

FLORIS DE BOER
HAJO BRUINING
PIETER SCHAGEN
INVENTORS.

BY Fred M. Vogel

AGENT

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TELEVISION TRANSMITTING TUBE

Floris de Boer, Hajo Bruining, and Pieter Schagen, Eindhoven, Netherlands, assignors to Hartford National Bank and Trust Company, Hartford, Conn., as trustee

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4 Claims. (Cl. 313—67)

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The invention relates to television transmitting tubes comprising a photo-electric cathode onto which the optical image to be transmitted is projected. Thus, photo-electrons are released by the image-forming rays. In many cases these electrons are concentrated into a beam and, under the action of an electric potential difference, caused to travel to an image electrode. Across the sectional area of the beam, the ray intensity corresponds from point to point to the local brightness of the projected image at the corresponding points. The photo-electrons produce electric charges on the image screen, so that a potential pattern is formed, the potential distribution of which corresponds to the brightness distribution of the projected image.

Scanning of the image electrode may take place with the use of a narrow beam produced by an electrode system on the side opposite the cathode, which beam neutralises the electric charges and produces across an external circuit a current which fluctuates in accordance with the brightness differences of the image points. The current conductor in the tube is formed by the so-called signal electrode which is integral with the image electrode or is arranged at a short distance therefrom on the side facing the photo-cathode.

The latter construction is of frequent use, the spacing between the signal electrode and the image electrode being chosen to be a minimum in order to ensure low potential differences in the charge image and little variation in the velocity, preferably constant, with which each point of the image electrode is reached by the scanning electron beam. It has been found possible to reduce the said spacing to 25μ. This construction requires high accuracy of manufacture and thus entails considerable difficulty.

In a known television transmitting tube, the signal electrode is constituted by a grid-shaped screen of fine mesh. The mesh width is preferably less than the diameter of the scanning beam in order to minimize the disadvantage of the grid being reproduced on the image electrode electron-optically by the photo-electrons.

Further, a construction is known in which the surface of the image electrode is coated with a thin layer of insulating material, to which is applied a coherent conductive layer thin enough for the photo-electrons readily to penetrate through this layer. They are also required to pass through the insulating layer in order to reach the surface of the image electrode. The reduction in velocity to which the electrons are

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thus subjected renders this construction suitable only for producing a negative potential pattern, i. e. a pattern in which areas exposed more intensely than others are at a more negative voltage. Consequently, this electrode is only adapted to co-operate with a scanning beam, whereby more secondary electrons are released from the surface of the image electrode than the number of electrons of this beam which strike the surface. The electrode is, for example, unsuited for use in a television transmitting tube in which the image electrode is scanned by slow moving electrons.

The invention is based on recognition of the fact that it is possible to manufacture metal foils of such thinness that the electrons penetrate through them with very small losses of energy.

According to the invention, a television transmitting tube comprising a photo-electric cathode onto which the image to be transmitted is projected, an image electrode, on which the photo-electrons produce a potential pattern and an electrode system for producing a scanning electron beam, the elements being arranged in the said order within an evacuated envelope, is characterized in that an electrically conductive metal foil screen through which the electrons travelling to the image electrode can penetrate is arranged on the side of the image electrode facing the photo-cathode and the spacing between the screen and the surface of the image electrode is of the order of the line spacing.

It is known that difficulties arise in attempting to provide that the current variations in the signal electrode output correspond throughout the surface of the image electrode with the brightness differences in the projected image. In other words, the ratio between the current strength produced on the scanning beam striking a point which at that instant is struck by only few electrons from the photo-electric cathode, and the current strength produced on the scanning beam moving across an intensely irradiated point does not correspond with the ratio between the brightnesses of the corresponding areas in the projected luminous image. The contrasts in the reproduced image will consequently differ from those in the original image.

This is due to the occurrence of secondary emission. The secondary electrons tend to move towards points on the surface of the image electrode which are at a higher potential than the point at which they are produced. The potential of said points is thus reduced and the current variations occurring are consequently smaller. The use of the tube according to the invention prevents the secondary electrons from moving through great distances and a troublesome disadvantage is thus mitigated. With the television transmitting tube according to the invention most of the secondary electrons will strike a foil and the few electrons having insufficient energy to do so fall back to the immediate proximity of their starting point. It has been found that redistribution of secondary electrons over the surface of the image electrode is thus reduced and a tube can be obtained in which the signal current variations and the brightness distribution in the projected image substantially correspond.

In the manufacture of the tube according to the invention, use may be made of the known art of coating granular surfaces with thin coherent metal layers. The difficulties involved in anchoring a metal gauze at a short distance from the surface of the image electrode are thus largely obviated.

The image electrode may be constituted by a thin plate of such material that while the gradually produced charge on the surface facing the photo-cathode is capable of moving, within the period during which complete scanning of the surface is effected by the beam, through the electrode to the other surface, charge shift towards the surface is substantially obviated. In practice use may be made of a glass film having a definite specific resistance and a thickness of a few microns. The use of a thin glass film in television transmitting tubes to constitute the image electrode is known. The thin coherent metal layer may constitute a coating of the tops of elements projecting from the surface of the image electrode. These elements may be constituted by grains applied to the surface and may be produced by spreading metal powder or a powder of insulating material over the surface.

As an alternative, the image electrode may be constituted by a so-called double-sided mosaic screen, the thin metal layer being applied at the required small distance by spreading it over the insulator, which separates the mosaic elements from the grid-shaped signal plate and which projects slightly beyond the surface of these elements.

In order that the invention may be more clearly understood and readily carried into effect, it will now be described more fully with reference to the accompanying drawing, in which:

Fig. 1 shows a television transmitting tube of the type known as an "image iconoscope."

Fig. 2 is a sectional view of a part of the tube to which the invention relates in particular.

Fig. 3 shows an alternative construction of the same part as Fig. 2.

Referring now to Figure 1, a discharge tube 1 has a photo-electric cathode 2, comprising a thin, transparent metal layer 3, which, on the side remote from the end wall of the tube, is coated with a film of light-sensitive material 4. The conductive layer is generally precipitated on a screen of transparent, insulating material 5, such as glass or mica. As an alternative, the photo-cathode may be precipitated on the end face of the tube, which, for this purpose, is generally required to be flat.

Electrons emitted by the photo-electric cathode 2, when an optical image to be transmitted is projected onto the cathode 2 are collected by an image electrode 6. By utilising a magnetic field which may be developed with the use of a coil 7, the photo-electrons are caused to travel axially of tube 1 in paths directed to the electrode 6 under the action of a voltage difference between the conductive layer 3 of the photo-cathode and a screen 8 arranged adjacent the electrode 6. Said voltage is supplied from a battery 9. The electrons reaching the electrode 6 set up local charges which produce potential variations with the result that a potential pattern is produced on the surface of the electrode 6 facing the photo-cathode. The potential distribution in this pattern corresponding to the brightness distribution in the luminous image required to be transmitted.

The electrode 6 is constructed so that the potential image is transferred to the side remote from the photo-cathode. For this purpose the electrode is required to exhibit, in the direction at right angles to the surface an electrical conductivity exceeding the conductivity along the surface. Various materials known as semi-conductors have this property. The electrode may be constituted, for example, by a thin film of glass or mica. It may alternatively be a mosaic screen constituted by a fine metal gauze coated with a thin layer of insulating material, the apertures being filled with metal grains which are accessible from both sides of the screen.

On the side remote from the photo-cathode 2 (the scanning side) the electrode 6 is scanned by an electron beam which is produced by the electrode system 10, the point at which the beam strikes the electrode 6 being moved over the surface of the electrode 6 with the use of variable magnetic fields produced by deflection coils 11. The charge variation produced at any instant by the scanning beam produces in known manner a current variation in the supply conductor to the screen 8. This conductor comprises a resistance 12 across which are set up voltage variations as a result of the current variations occurring.

The screen 8, which is generally referred to as the signal electrode, is constituted by a coherent metal foil which is spaced from the image electrode by a very small distance. This distance is preferably smaller than the line spacing which is obtained by dividing the height of the image by the number of image lines with horizontal scanning of the image.

During the conversion of the electron image produced by photo-electric emission from the photo-cathode into the charge image on the image electrode and also during the scanning thereof with the use of the electron beam, secondary electrons are produced. These electrons are conducted away on the one hand by the signal electrode and on the other hand by an electrode 13, which is conductively connected to the anode 14 of the electrode system 10. The anode 14 is connected to the positive terminal of a voltage source 15, the negative terminal of which is connected to the cathode 16. In order to prevent the secondary electrons released by the scanning beam from travelling to other areas on the surface of the image electrode, an electrically conductive screen 17 is arranged also at a very small distance from the image electrode 6. The screen 17 is thin enough to permit the electrons of the scanning beam to pass through it with a small loss of energy.

An electrode for use in a tube according to the invention and on which the electron image is to be formed is shown in Fig. 2 and comprises a thin plate 18, which corresponds to the image electrode 6 in Figure 1. It is made of semi-conductive material having a high specific resistance and the conductivity of which along the surface is less than the conductivity between two points on either side of the plate. Use may be made of so-called semi-conductive glass. For applying the conductive layer 8 the surface has spread on it a supply of fine granular material constituted by substances which are not altered under the action of the temperatures occurring during the manufacture of the tube. For this purpose, pulverulent glass or pulverulent ferrochromium may be used. The grains are preferably not thicker than 10μ. The conductive layer 8 provided on top of the fine granular material may be about 0.2μ in thickness.

A double-sided mosaic for use in a tube according to the invention is shown in Fig. 3. The image electrode is constituted by a perforated metal plate 19. The apertures are coated at their edges with a layer of insulating material 20, which projects on either side from the surface of the plate 19. The apertures are filled with metal grains 21, which constitute one electrode which together with plate 19 serving as a common electrode constitute a plurality of capacitor elements composing the image electrode. Provision must be made that the grains do not project beyond the edge of the insulation. The conductive layer 8 is spread over the insulating edges care being taken that no electrical contact is made between the layer 8 and the metal grains 21.

Similarly, the image electrode may be provided with a conductive layer on the other side to face the electrode system for the electron beam.

What we claim is:

1. A television transmitting tube comprising a photoelectric cathode onto which the image to be transmitted is projected, an image electrode, on which the photo-electrons produce a potential pattern and an electrode system for producing a scanning electron beam, the elements being arranged in the said order within an evacuated envelope and an electrically conductive metal foil, through which the electrons travelling to the image electrode can penetrate, arranged on the side of the image electrode facing the photocathode, the spacing between said metal foil and the surface of the image electrode being of the order of the line spacing.

2. A television transmitting tube as claimed in claim 1, in which a second metal foil is arranged on the side of the image electrode facing the electrode system, said second foil being positioned at a correspondingly small distance from the image electrode.

3. An image electrode for use in a television transmitting tube as claimed in claim 2, in which the image electrode is provided with elements projecting from the surface which support a conductive metal foil.

4. An image electrode as claimed in claim 3, in the form of a double-sided mosaic, constituted by a plurality of capacitor elements separated from one another by insulating material, the insulating material projecting beyond the capacitor elements and supporting the conductive layer.

FLORIS DE BOER.
HAJO BRUINING.
PIETER SCHAGEN.

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