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ELECTRON DISCHARGE DEVICE

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Fig. 1

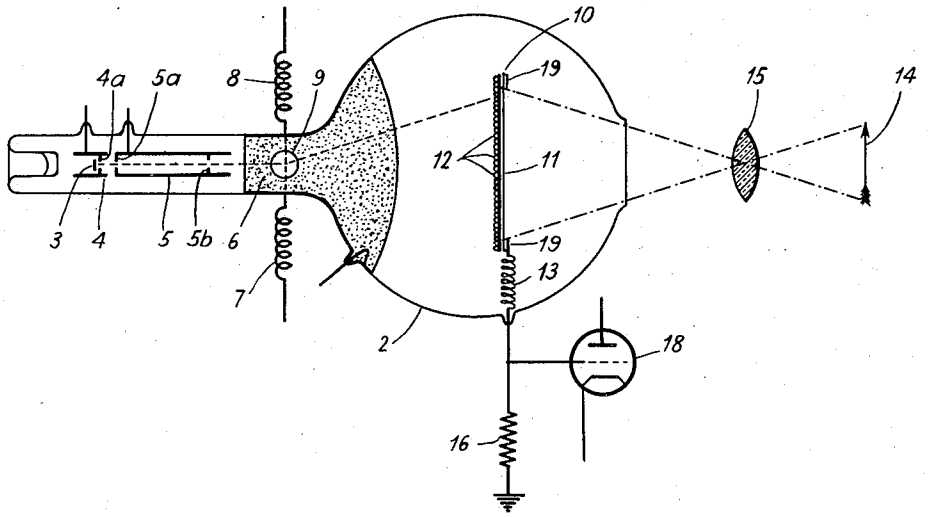
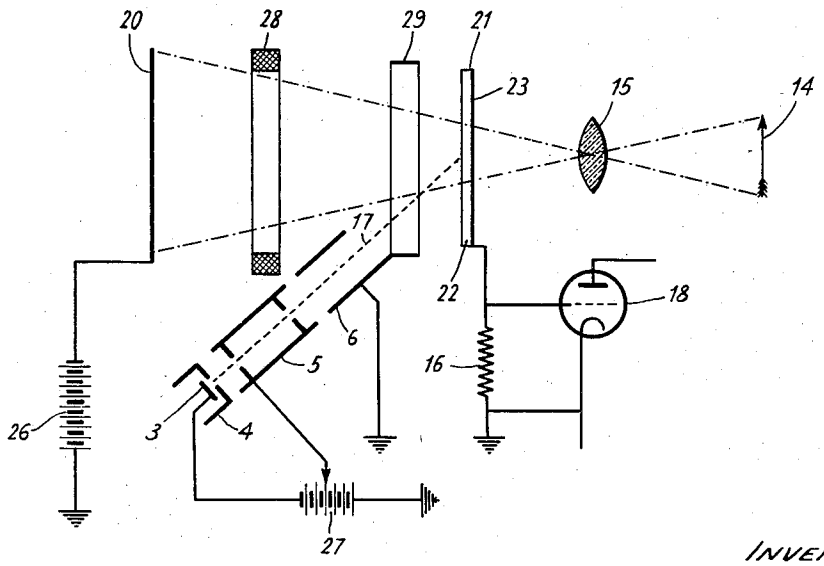


Fig. 2



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ELECTRON DISCHARGE DEVICE

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8 Claims. (Cl. 250—153)

The present invention relates to cathode ray tubes of the kind suitable for use in television transmission. The present invention is concerned with tubes in which a mosaic screen is employed. As will hereinafter appear the terms "mosaic screen" is intended to include not only screens embodying a multiplicity of mutually insulated conductive elements, but also those in the form of a sheet of material, such as mica, having a high resistance in directions parallel to its major surfaces (referred to for convenience as materials having a high transverse resistance).

In all cases where mosaic screens are used for television purposes, an electrostatic image of the subject to be transmitted is formed on the screen and the charges constituting the electrostatic image are periodically neutralized by scanning.

One known form of television transmitting tube, known as an "Iconoscope", has a mosaic screen assembly comprising a plurality of mutually insulated photo-electric elements formed on the front surface of an insulating member such as a sheet of mica, a metallic signal plate being arranged on the back of the mica sheet; the mosaic screen is arranged, together with an electron gun, within an evacuated envelope and an image of an object to be transmitted is projected on to the photo-electric elements. The cathode ray beam from the electron gun is caused to scan the photo-electric elements for the purpose of generating picture signals in a circuit associated with the signal plate.

In co-pending application No. 19,752 filed May 4, 1935, there is described a method of and a cathode ray tube for transmitting images of an object to a distance wherein an optical image of the object to be transmitted is projected upon a continuous photo-electrically active screen, photo-electrons emitted from said photo-electrically active screen are accelerated towards a mosaic screen, and are focused upon the mosaic screen to form an electron image thereon by means of an electron lens system and the mosaic screen is scanned by a cathode ray beam.

In transmitting tubes embodying mosaic screens it is preferable to project the optical image normally upon the photo-electrically active screen (whether this be in the form of a mosaic or continuous). In certain embodiments of the tubes referred to, it has not hitherto been possible to achieve this normal projection of the optical image owing to the necessity of providing electrodes in certain positions in the tube, which electrodes obstruct the passage of light to the photo-electrically active surface.

It is an object of the present invention to provide a cathode ray tube having a mosaic screen so formed that normal projection of the optical image upon the photo-electrically active surface may be achieved, whether this photo-electrically active surface is on the mosaic screen itself or on a separate screen.

According to the present invention there is provided a cathode ray tube of the kind suitable for transmitting images of an object to a distance, in which there is provided a mosaic screen comprising a sheet of substantially transparent material having two major surfaces, and having on the first major surface a substantially transparent layer of conducting material, to form a signal plate.

Fig. 1 shows the application of the invention to a transmitting tube of the "Iconoscope" type and

Fig. 2 shows the application of the invention to a transmitting tube having a continuous photo-electrically active screen and a mosaic screen.

Referring now to Fig. 1, the evacuated envelope of an "Iconoscope" consists of a neck portion 1 and a bulbous portion 2. In the neck portion 1 is arranged a cathode ray gun comprising a cathode 3, cathode shield 4, first anode 5 and second anode 6. The cathode shield 4 and first anode 5 are in the form of metal tubes provided with annular diaphragms 4a, 5a and 5b, and the second anode 6 has the form of a coating of metal (e. g., silver) on the wall of the neck portion 1, and extending within the bulbous portion 2. Two pairs of scanning coils are provided adjacent the portion of the second anode 6 which lies in the neck portion 1 of the tube. In the figure one pair of coils is shown at 7 and 8 and the other pair indicated at 9.

In the bulbous portion 2 of the tube, arranged perpendicularly to the axis of the neck portion 1 is arranged a photo-electrically active mosaic screen assembly. This assembly comprises a mica sheet 10 on the side of which remote from the cathode ray gun is formed a transparent layer of conducting material constituting a signal plate 11. The layer may be formed of a metal, alloy or the like which does not aggregate on baking to form discrete globules and may be deposited on the mica sheet 10 by cathode sputtering or in any other known or suitable manner. Suitable metals are aluminium and nickel, but many other metals are also suitable. It has been found possible to produce a signal plate which is a sufficiently good electrical conductor and which nevertheless absorbs only about 25% of the light

passing therethrough, and can therefore be regarded as substantially transparent.

On the side of the mica sheet 10 facing the cathode ray gun are formed a large number of photo-electrically active elements 12. These elements may be formed by coating the mica sheet with a thin coating of silver, and baking the sheet, whereby the silver collects into a large number of discrete globules. These globules are then oxidised and coated with a layer of caesium, or other photo-electrically active material. Such a process of preparing photo-electrically active mosaic screens is well known, and is more fully described in copending application No. 46,254 filed October 23, 1935. In the present case the layer of elements is arranged to be such that light can pass without great obstruction to the photo-sensitive material. As an alternative to using a mosaic screen consisting of a large number of discrete elements, there may be used a continuous photo-electrically active layer which is made so thin that it has a very high transverse resistance, the effect of which is to give it the properties of a mosaic screen; the individual molecules or crystals of the layer act as the mosaic elements. In this specification the term "mosaic screen" is intended to include a screen which has a high transverse resistance, so that the molecules, crystals or other particles of which the screen is composed have the effect of a number of mutually insulated elements.

The mosaic assembly may be mounted in the bulbous portion of the tube by means of three symmetrically spaced springs, one end of each of which is fastened to the edge of the screen, the other end being sealed into the glass wall of the envelope. In the diagram one of these springs is shown at 13. This spring also acts as a lead to the signal plate 11 which is connected through the spring 13 and a signal resistance 16 to earth.

In operation light from an object 14 is projected by means of an optical system shown diagrammatically at 15 on to the mosaic screen assembly. The light passes through the transparent signal plate 11 and the mica sheet 10 on to the photo-electrically active material of the elements 12. These elements become charged by the loss of photo-electrons which pass to the second anode 6. The cathode ray 17 from the gun, as it is deflected over the screen by means of the deflecting coils 7, 8 and 9, periodically restores the potential of the elements 12 to an equilibrium potential. The discharge of the elements sets up a potential difference across the resistance 16 as the charge passes to earth. This potential difference is amplified by an amplifier indicated by the valve 18, and transmitted.

If desired, the picture formed at the receiver from signals produced by the above apparatus may be made to have a black border. This effect is obtained by forming round the signal plate 11 a border of material which is substantially or completely opaque. This border may be of the same material as the signal plate, and is indicated in Fig. 1 at 19. The elements 12 immediately behind this border are therefore never illuminated by light from the object 14. When the cathode ray beam 17 scans these elements picture signals corresponding to black are developed, and give rise to a black border in the received image.

From the above description it will be seen that the present invention enables both the cathode ray beam in the undeflected condition and the optical image to fall normally on the screen. The well known disadvantages of oblique scanning are thus eliminated.

In Fig. 2 there is shown apparatus for television transmission having a continuous photo-electrically active screen 20 and a mosaic screen 21. The mosaic screen 21 according to the present invention comprises a sheet 22 of transparent material having a high transverse resistance. Such a material is mica. On the side of the sheet 22 remote from the screen 20 is a transparent signal plate 23.

A cathode ray gun comprising a cathode 3, cathode shield 4, first anode 5 and second anode 6 is provided to scan the mosaic screen 21 with a cathode ray beam 17. The means for causing the ray to scan the screen are not shown on the drawing but may comprise two pairs of electromagnetic deflecting coils surrounding the second anode 6. The operation of the tube is as follows:

The photo-electrically active screen 20 and the cathode 3 are held at high negative potentials relative to earth, for example by means of the batteries 26 and 27 respectively. The first anode 5 is connected to a tapping on the battery 27 and the second anode 6 is earthed. The signal plate 23 is connected to earth through the signal resistance 16 across the ends of which are connected the grid and cathode of the valve 18.

Light from an object 14, an image of which is to be transmitted, is projected by means of the optical system 15 through the mosaic screen 21 on to the photo-electrically active screen 20.

Photo-electrons emitted from this screen are accelerated towards the mosaic screen 21, (the particles of which are always in the neighbourhood of earth potential) by reason of the field existing between the two screens, and are focused on to the mosaic screen by means of a magnetic focusing coil 28. The potential of the battery 26 is preferably so adjusted that the velocity of the electrons on striking the mosaic screen 19 causes secondary electrons to be emitted from the mosaic screen in number either greater or less than the number of incident photo-electrons. In this way each "element" that is each particle of the mosaic screen 21 acquires a positive or negative charge, the value of which at any point corresponds to the intensity of the light falling on the corresponding point on the photo-electrically active screen 20. The cathode ray beam 17 periodically restores these elements to a datum potential, by causing the emission from each element of less or more secondary electrons than primary electrons incident thereon.

Secondary electrons emitted from the mosaic screen by the impact of photo-electrons or of primary electrons from the cathode ray beam 17 are collected by the ring electrode 29, which is connected to the second anode 6.

Since the invention is not concerned with the exact nature of the operation of the apparatus of Fig. 2 this has not been fully described. The operation of similar apparatus is fully described in co-pending applications Nos. 19,752 filed May 4, 1935, and 62,898, filed February 8, 1936.

In this apparatus the photo-electrically active screen 20 may be opaque to light, and yet, because the mosaic screen 21 is transparent, the image of the object 14 may be projected normally thereon.

The invention may be applied to television transmission apparatus in which effects other than the photo-electric effect are employed. Apparatus has, for example, been proposed in which a conductive plate forming a signal plate is

coated with a layer of a material, such as zinc selenide or zinc sulphide, which exhibits the photo-conductive effect. The plate so prepared forms a light sensitive screen. The screen is arranged in an evacuated envelope, and an image of an object to be transmitted is projected thereon. The screen is scanned by means of a cathode ray beam.

According to the present invention in such an arrangement the sensitive screen may be formed by depositing on a sheet of transparent material such as mica a transparent layer of metal (for example nickel) and forming on the transparent metal layer a layer of zinc selenide or other material exhibiting the photo-conductive effect. The axis of the gun producing the scanning cathode ray beam may then be arranged normally to the screen; the image of the object is projected through the transparent sheet of mica or like material and the transparent signal plate on to the photo-conductive layer. The cathode ray beam is arranged to scan the screen on the side on which the photo-conductive layer is formed.

In any of the above described arrangements it may be found that if the signal plate is made very thin, its high resistance impairs the operation of the tube. To avoid this, narrow strips of the signal plate may be thickened, and these strips may be formed opposite spaces between mosaic elements. Alternatively there may be formed on the signal plate a mesh structure of thicker metal, and the elements may be arranged opposite the holes in the mesh.

Having now particularly described and ascertained the nature of our said invention, and in what manner the same is to be performed, we declare that what we claim is:

1. In a cathode ray tube, a mosaic screen comprising a transparent sheet member having two major surfaces, a transparent signal plate mounted on one of the major surfaces, a plurality of isolated photoelectric elements mounted on the other major surface, and a light opaque border supported on said signal plate and extending completely around the boundary of said signal plate.

2. In a cathode ray tube, a mosaic screen comprising a transparent insulating sheet member having two major surfaces, a transparent signal plate mounted on one of the major surfaces, a plurality of mutually insulated conductive elements mounted on the other major surface, and a light opaque border supported on said signal plate and extending completely around the boundary of said signal plate.

3. In a cathode ray tube, a mosaic screen comprising a mica sheet member having two major surfaces, a transparent signal plate mounted on one of the major surfaces, a plurality of isolated photoelectric elements mounted on the other major surface, and a light opaque border supported on said signal plate and extending completely around the boundary of said signal plate.

4. In a cathode ray tube, a mosaic screen comprising a transparent sheet member having two major surfaces, a transparent signal plate mounted on one of the major surfaces, a plurality of mutually insulated conductive elements mounted on the other major surface, cathode ray scanning means for scanning the mutually insulated conductive elements, and electron collecting means positioned intermediate the cathode ray means and the mosaic screen.

5. In a cathode ray tube, a mosaic screen comprising a transparent sheet member having two major surfaces, a transparent signal plate mounted on one of the major surfaces, a plurality of isolated photoelectric elements mounted on the other major surface, cathode ray scanning means for scanning the isolated photoelectric elements, and electron collecting means positioned intermediate the cathode ray means and the mosaic screen.

6. In a cathode ray tube, a mosaic screen comprising a transparent sheet member having two major surfaces, a transparent signal plate mounted on one of the major surfaces, a plurality of mutually insulated conductive elements mounted on the other major surface, a photoelectric cathode positioned parallel to the mosaic screen and facing the major surface thereof upon which the mutually insulated conductive elements are mounted, an electron focusing system positioned intermediate the cathode and the mosaic screen, and cathode ray means for scanning the mutually insulated conductive elements.

7. In a cathode ray tube, a mosaic screen comprising a mica sheet member having two major surfaces, a transparent nickel signal plate mounted on one of the major surfaces, a plurality of isolated photo-sensitive elements mounted on the other major surface, and a light opaque border supported on said signal plate and extending completely around the boundary of said signal plate.

8. In a cathode ray tube a mosaic screen comprising a mica sheet member having two major surfaces, a transparent aluminum signal plate mounted on one of the major surfaces, a plurality of isolated photo-sensitive elements mounted on the other major surface, and a light opaque border supported on said signal plate and extending completely around the boundary of said signal plate.

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