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TELEVISION

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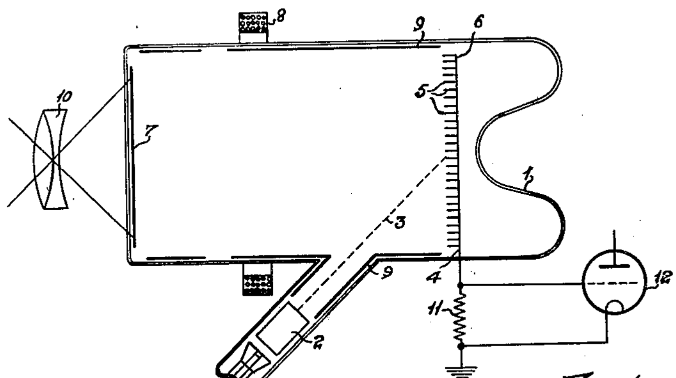

Fig. 1.

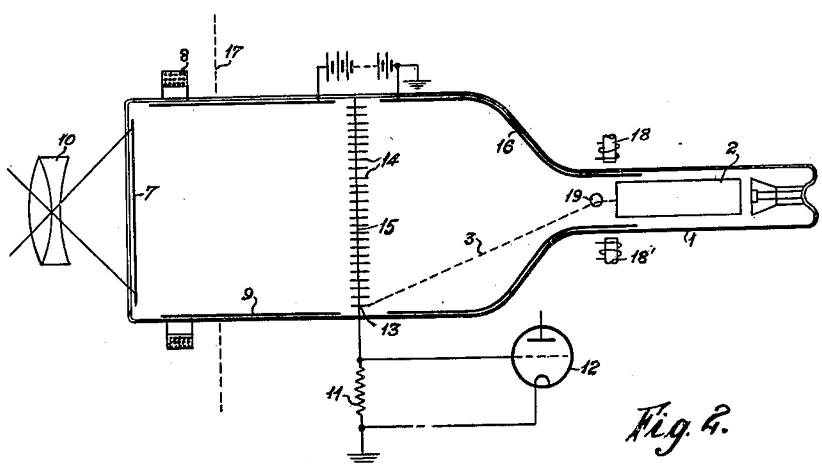

Fig. 2.

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3 Claims. (Cl. 178—7.2)

The present invention relates to improvements in television and is more particularly concerned with a method of transmitting which involves the use of a cathode ray tube.

The present invention provides a method of transmitting images of an object to a distance wherein an optical image of the object to be transmitted is projected upon a photo-electrically active screen, photo-electrons emitted from said photo-electrically active screen are accelerated towards a mosaic electrode of mutually insulated elements and are focused upon the screen to form an electron image thereon by means of an electrostatic or electromagnetic electron lens system and said mosaic electrode is scanned by a primary beam of electrons such as a cathode ray. The velocity of the photo-electrons on impact with the elements of said mosaic may be such that there are emitted from said screen secondary electrons greater in number than the incident photo-electrons, whereby each element acquires a positive charge in the intervals between scans.

The present invention also provides apparatus for transmitting images of an object to a distance, said apparatus comprising an optical system for projecting an image of the object upon a photo-electrically active screen, a mosaic electrode comprising mutually insulated elements this electrode being spaced apart from said screen and being arranged with the screen within an evacuated envelope, focusing means for causing the electrons emitted from said screen to form an electron image upon said mosaic electrode, means for developing a beam of electrons and means whereby said beam of electrons can be caused to scan said mosaic electrode.

Although the mosaic electrode usually comprises a multiplicity of discrete conducting elements insulated from one another, it may in some cases take the form of a sheet of material of high transverse resistance, such as a sheet of mica for example. The term "mosaic electrode" throughout this specification is intended to include sheets of material with suitably high transverse resistance, such sheets, in effect, comprising a multiplicity of mutually insulated elements.

Other features of the invention will appear from the following description and the appended claims.

The invention will be described with reference to the accompanying drawing in which are shown diagrammatically by way of example two embodiments of the present invention.

Referring to Fig. 1, television transmitting apparatus comprises a cathode ray tube 1 having a cathode gun 2 of any suitable kind for generating a fine or focused primary beam of electrons 3 and means (not shown) for deflecting the primary beam so that it can scan a mosaic electrode 4 disposed within the tube at an acute angle to the mean direction of the primary beam 3.

The mosaic electrode 4 comprises a multiplicity of elements 5 which are insulated from one another and from a common, conductive plate 6 which will be called a "signal" plate. The elements may be of silver, for example, and may be disposed upon a mica sheet which in turn is disposed upon an aluminium "signal" plate. The signal plate may be connected to earth through a resistance.

Also disposed within the tube, in a plane substantially parallel to the plane of the mosaic electrode 4, is a photo-electrically active screen 7 of non-mosaic character; it may be, for example, a coating, on the side of the glass wall facing the mosaic electrode 4, of silver having a silver oxide surface on which is deposited a layer of caesium. This coating is so thin as to be semi-transparent. The mosaic electrode 4 is disposed so that the elements 5 may be scanned by the cathode ray and so that the elements 5 face towards the photo-electrically active screen 7.

Around the space between the photo-electrically active screen and the mosaic electrode is disposed a coil 8 constituting when suitably energised a magnetic electron lens of large aperture designed to form an electron image of the screen upon the mosaic electrode.

Between the electron lens 8 and the mosaic electrode 4 is disposed an electrode 9 in the form of a cylinder of conducting material placed coaxially with the tube, the purpose of which is to accelerate the photo-electrons from the screen 7 and to collect a secondary emission of electrons which occurs from the elements of the mosaic electrode during the operation of the tube. This electrode is held at a suitable positive potential relatively to the screen 7. An optical lens system shown diagrammatically at 10 is provided outside the tube 1 for focusing an optical image of the object to be transmitted upon the side of the photo-electrically active screen 7 remote from the mosaic electrode 4.

The operation of the tube is as follows:

Electrons are emitted from the various points of the photo-electrically active screen 7 to an extent proportional to the intensity of the light falling on this screen from the object. The electrode 9 accelerates these photo-electrons towards the mosaic electrode 4, and the magnetic electron lens system 8 produces a magnetic field which has the effect of focusing the photo-electrons emitted from any one point of the photoelectric screen 7 upon a corresponding point on the mosaic electrode 4.

Secondary electrons emitted from the bombarded surfaces of the mosaic elements 5 are collected by the electrode 9 and the potential of each of the elements 5 will change in accordance with the number of photo-electrons reaching it and hence in accordance with the brightness of illumination of the corresponding point on the screen 7. If the number of secondary electrons emitted exceeds the number of primary photoelectrons arriving the element will become more positive and if the number of primary electrons exceeds the number of secondary electrons, the element will become more negative.

Each element 5 of the mosaic electrode 4 forms a small condenser with the common signal plate 6, and in between successive scans each of these small condensers is charged, as described above, to an extent dependent upon the intensity of the photo-current striking the element.

The velocity of the scanning beam 3 is so chosen in relation to the nature of the mosaic surface that the potential of each element when scanned is changed to an equilibrium value. If the effect of the photo-electrons is to raise the potential of an element, the scanning beam is arranged to reduce the potential of the element. The condenser formed between the element 5 and the signal plate 6 is thus discharged, and the discharge current is dependent upon the charge which the condenser acquired since the last scan. This is in turn dependent upon the intensity of the photo-current striking the element 5 of the condenser which is furthermore dependent upon the light intensity of a corresponding point in the object. Thus as the scanning beam sweeps over the multiplicity of elements 5, there are developed across the resistance 11 in the lead to the signal plate 6 voltages which are dependent upon the light intensity of corresponding points in the object. These "picture" voltages are amplified for instance by being applied to the grid and cathode of a valve 12, and are transmitted in any known or suitable manner.

Instead of screen 7 being, as described, in the form of a continuous photo-electrically sensitive coating, it may take the form of a photo-electric coating upon a wire mesh structure. Where the photo-electric coating is of the continuous type it may be formed upon a part of the wall of the tube envelope. If the photo-sensitive coating and any backing layer which may be provided is sufficiently transparent, the image may be thrown thereon as shown in Fig. 1. Alternatively the image may be formed on the side of the screen 7 facing the mosaic electrode 4. Where the mosaic electrode 4 is in the form of a transparent sheet, such as a sheet of mica, the optical image may be thrown on to the photo-electric screen 7 through the mica sheet.

It will be noted that as the cathode ray 3 scans the mosaic surface it strikes either an end surface of one of the conducting elements 5 or else the insulating material between elements.

In the embodiment of the invention described above the cathode ray and the photo-electrons are incident upon the same face of the mosaic electrode. The photo-electric screen and the electron lens must therefore be disposed at some distance from the mosaic electrode in order that they may not obstruct the cathode ray. Systems are known, however, in which an optical image is projected upon one side of a mosaic electrode, and this electrode is scanned upon the opposite side. The present invention may be applied to such a system with apparatus arranged as shown diagrammatically in Fig. 2.

In the arrangement of Fig. 2, the cathode ray gun 2 and the photo-electrically active screen 7 are on opposite sides of the mosaic electrode 13, which in this case consists of conductive elements 14 studded in a conductive signal plate 15 and insulated therefrom, each element extending right through the plate, and the plate being connected to earth through a resistance 11. Thus the mosaic electrode 13 may take the form in which the signal plate is constituted by a wire mesh having its wires coated with glass and having the conductive elements 14 in the form of conducting rivets located in the interstices of the mesh.

In making such a screen, one set of wires coated with glass may be laid parallel to one another in the grooves of a suitable mould and a second set may be laid above the first set and at right angles thereto. A second grooved mould plate is laid above the upper set of glass coated wires with these wires in the grooves and by heat and pressure the two sets of coated wires are caused to weld together so that the upper and lower faces of the screen so formed are substantially flat. The rivets may be formed in the interstices of the mesh by plating or otherwise.

The picture to be transmitted is imaged upon the photo-electrically sensitive screen 7 by an optical system 10. The photo-electrons are accelerated by the electrode 9 which is maintained positive with respect to the screen 7 and are focused upon the mosaic electrode 13 by a magnetic electron lens 8. An electrode 16, which may be constituted as in the case of electrode 9 by a conductive coating on the walls of the envelope 1, is provided around the space between the electron gun 2 and the mosaic electrode 13. The cathode ray beam 3 from the gun 2 is deflected so as to scan the mosaic electrode 13 by means of two pairs of electromagnetic deflecting coils placed at right angles. One pair is shown diagrammatically at 18 and 18', and one coil of a second pair at 19.

In order that the magnetic deflecting fields shall not affect the focusing field due to the coil 8, a suitable screen indicated at 17 may be placed around the tube in order to screen the two magnetic systems from one another. Similar screening means may be provided in tubes in which electrostatic focusing or deflecting means are used. If desired such means or a part thereof (whether they act as electrostatic or electromagnetic screens or as both) may be incorporated in the interior of the tube.

First it may be assumed that the electrode 16 is maintained at zero or earth potential and that the cathode of the electron gun 2 is at −1000 volts. The surfaces of the mosaic elements 14 facing the gun and the voltages applied are assumed to be such that the ratio of secondary electrons leaving the mosaic electrode to primary electrons reaching it from the gun is greater than unity and the elements 14 when scanned will take up an equilibrium potential near to zero volts. Electrode 9 may be held at 50 volts positive to earth and the screen 7 may be held at −500 volts.

Considering any one element 14 just after it has been scanned, its potential is nearly zero and the primary photo-electrons reaching it from a corresponding point on the screen 7 are arranged to release a greater number of secondary electrons, substantially all these secondary electrons being collected on the electrode 9. The element will thus become more positive at a rate dependent upon the brightness of the corresponding point on the screen 7. When the ray next reaches the element, the potential of the element will be reduced again to its equilibrium value near zero volts.

The velocity of the photo-electrons impinging on the mosaic electrode is so great that the weak reverse electrostatic field between electrodes 9 and 13 will not appreciably distort the photo-electron stream. On the other hand the slow moving secondary electrons will substantially all be drawn on to the electrode 9.

One advantage of the arrangement just described is that a so-called double sided mosaic electrode can be used with the attendant advantage that both the optical axis of the system 10 and the electron gun axis can be arranged normal to the mosaic electrode, and that nevertheless it is not necessary to render either side of the mosaic photo-electrically sensitive. Furthermore the arrangement permits an amplified response to be obtained because the ratio of secondary electrons to primary photo-electrons can be maintained greater than unity.

We claim:

1. In apparatus for transmitting images which comprises a photo-electrically active screen upon which a light image is adapted to be directed to release photo-electrons and a mosaic electrode formed from a multiplicity of mutually insulated elements adapted to be scanned for transmission by a cathode ray beam, the method which comprises the steps of directing the released photo-electrons along a focussed path toward the mosaic electrode, accelerating the focussed electrons in their path through the mosaic so that under impact of the impinging photo-electrons upon the mosaic, secondary electrons are released whereby to leave the mosaic electrode positively charged to varying degrees proportional to the intensity of the light image projected upon the photoelectrically active screen, collecting the released secondary electrons, scanning the mosaic electrode with the cathode ray beam to neutralize the acquired positive charges, and releasing signalling impulses proportional in magnitude to the acquired charges to the external circuit.

2. A method of transmitting images of an object to a distance with a scanning device comprising an evacuated envelope having within it a photo-electrically active screen, a mosaic electrode element comprising a multiplicity of mutually insulated elements spaced apart from the photo-electrically active screen, and a means for developing a primary beam of electrons which is adapted to scan the mosaic electrode to produce output signal energy comprising the steps of releasing photo-electrons from the photo-electrically active screen by forming an image of an object upon the screen, focusing the released photo-electrons emitted from the photo-electrically active screen upon the mosaic electrode, accelerating the focused photo-electrons in their passage toward the mosaic electrode to a relatively high velocity at impact upon the mosaic electrode, releasing secondary electrons from the impacted surface of the mosaic electrode by impinging high velocity photo-electrons to leave the elements of the mosaic electrode positively charged to a degree proportional to the light intensity impinging at a limited area of the photo-electrically active screen and then scanning the mosaic electrode with the developed primary electron beam to neutralize the stored charge and to produce a used train of signal output energy proportional to the image produced.

3. An electro-optical scanner comprising a double mosaic electrode of elemental condensers, a photoelectric cathode in register and coaxial with the mosaic electrode, accelerating means intermediate the mosaic electrode and photoelectric cathode for accelerating photoelectrons released from the cathode onto said mosaic electrode whereby secondary electrons are ejected from the elemental condensers to store energy therein, and cathode ray means coaxial with the mosaic electrode and the photoelectric cathode and positioned on the opposite side of said mosaic electrode from the photoelectric cathode for developing a cathode ray beam to discharge the stored energy from the mosaic electrode.

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