

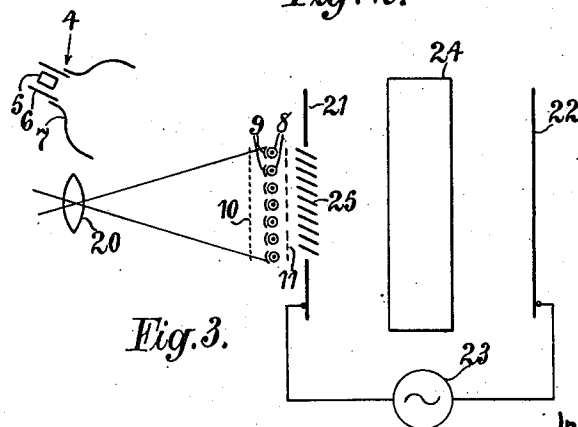
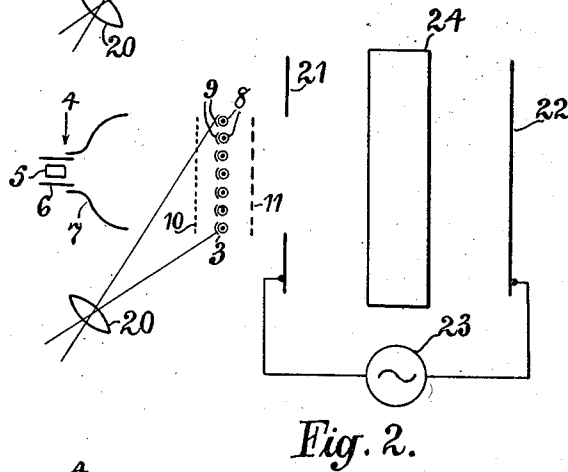
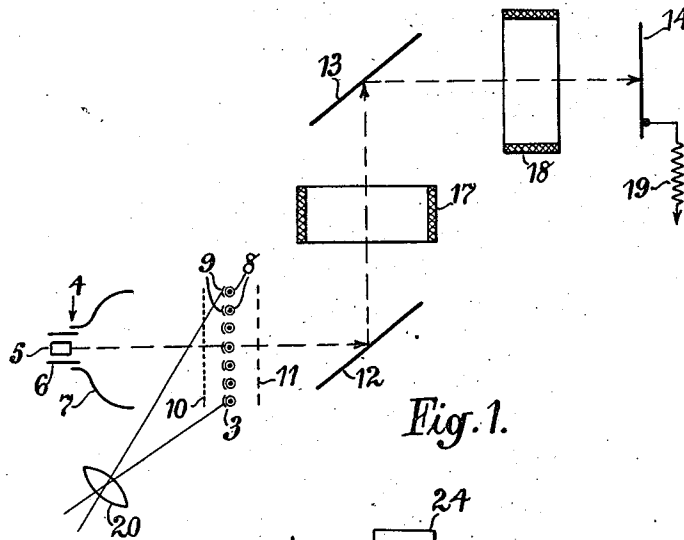
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ELECTRON DISCHARGE DEVICE

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ELECTRON DISCHARGE DEVICE

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This invention relates to electron discharge devices of the kind in which an image of an object is projected upon a light-sensitive structure, such as a mosaic screen composed of photo-electric elements.

The invention is particularly, but not exclusively, concerned with an electron discharge device suitable for use in the transmission of images, the image of the object to be transmitted being projected on to the light-sensitive structure for the purpose of obtaining picture signals for transmission.

It is an object of the present invention to provide an improved electron discharge device which is capable of providing a larger power output, such as picture signals, than has been obtainable heretofore.

According to the present invention, an electron discharge device for use in television and like systems comprises an evacuated envelope containing a structure arranged to store electrostatic charges and permeable by electrons, a source of electrons for producing an electron beam for scanning said structure and being adapted to be modulated by the electrostatic charges developed in said structure on projection of an image thereon, a first target electrode arranged on that side of the structure remote from the source of electrons and a collecting electrode or anode arranged in a position to receive electrons liberated as a result of impact of said cathode ray beam on said first target electrode. The said structure is preferably in the form of a mosaic grid-like structure of light-sensitive elements, so constructed that when light is projected thereon, photo-electrons are liberated causing electrostatic charges to be accumulated on the elements of the mosaic, according to the intensity of the incident light.

Thus, the present invention, more briefly stated, is based on the combination of a mosaic light-sensitive structure, upon which an optical image of an object to be transmitted is projected, with a device of the kind known as an electron-multiplier. The mosaic is arranged to be scanned by a cathode ray beam, and to be permeable by electrons; the scanning beam furnishes electrons for discharging the mosaic elements, the remainder of the beam passing through the mosaic. The beam thus becomes modulated in intensity in accordance with the potentials of the elements of the mosaic.

If desired, an electrostatic screen may be arranged between the mosaic and the electron multiplier. The cathode ray beam may be deflected over the mosaic by any known or suitable means, such, for example, as electro-magnetic deflecting coils.

The arrangement of target and collecting electrodes forming the electron multiplier may be ar-

ranged to function in the manner of what is known as a direct current electron multiplier or in the manner of a high frequency multiplier as hereinafter more particularly referred to.

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

Figure 1 is a diagrammatic illustration of an electron discharge device in accordance with the invention and embodying an electron multiplier of the direct current type.

Figure 2 is a diagrammatic illustration of a further embodiment of the invention in which a high frequency electron multiplier is employed and

Figure 3 is a modification of Figure 2.

The two examples shown are particularly for use in a television transmitting system in which an image of the subject for transmission is resolved into picture signals suitable for transmission.

As shown, the electron discharge device of Figure 1 is in the form of a cathode ray tube comprising an evacuated envelope of suitable form, not shown, containing a mosaic 3 of photo-electric elements, to which more detailed reference will be made hereinafter, and an electron gun 4, the latter comprises a cathode 5 and two anodes 6 and 7 which are adapted, when maintained at suitable positive potentials relatively to the cathode, to act as an electron lens, and thus to focus electrons from the cathode upon the photo-electric elements of the mosaic 3.

A preferred method of constructing the mosaic is as follows: a grid or mesh 8 is prepared of fine insulated filaments, such as glass or enamel covered wires, or the like, and a thin layer of silver is formed on one side of the grid. The coated grid is then treated, for example, by baking, to cause the silver coating to break up into discrete elements or globules indicated generally at 9, and a photo-electric material, such as caesium, is deposited on the silver elements.

The mosaic 3 is arranged within the tube with its photo-electric side facing the electron gun 4. On the same side of the mosaic is arranged a collecting electrode 10 of fine wire mesh for collecting the emitted photo-electrons, while on the other side thereof is arranged an electrostatic screen 11, and a first target electrode arranged at an angle to the mean direction of the beam from the electron gun, so that electrons passing through the mosaic impinge on the first target electrode. Means may, if desired, be provided for concentrating electrons on the first target electrode. The screen 11 serves to shield the target electrode 12 electrostatically from the mosaic 3. Secondary electrons emitted from the first target electrode may be collected directly by

a collecting electrode, or may be caused to impinge on a second target electrode to effect the liberation of tertiary electrons. The latter may be collected, or caused to liberate quaternary electrons from a third target electrode, and so on. In the example shown in Figure 1, secondary electrons from the target electrode 12 are caused to impinge on a second target electrode 13, the tertiary electrons liberated from the electrode 13 being collected by a collecting electrode or anode 14. The elements described above are of course all arranged in the same evacuated envelope.

It may be arranged that the scanning beam from the electron gun 4 is decelerated before it reaches the mosaic 3, so that the sensitivity of the mosaic in controlling the intensity of the electron beam is increased. The deceleration of the beam may be effected by means of a grid electrode, not shown, arranged in front of the mosaic and maintained at a suitable low potential, for example or by arranging that the mosaic screen is stabilised, when scanned by the beam, to the neighbourhood of the potential of the cathode of the gun.

The electron multiplier shown diagrammatically in Figure 1 may of course be associated with the usual auxiliary devices normally employed in multipliers. For example it is necessary where more than one stage of electron multiplication to provide electrostatic or electromagnetic means for focusing electrons liberated by one target electrode upon the next. In the example shown electromagnetic means are employed for this purpose, indicated by the coils 17 and 18.

The apparatus described is employed for generating picture signals in the following manner, the collecting electrode 10, the screen 11 and the electrodes 12, 13 and 14 of the electron multiplier are all maintained at positive potentials relatively to the cathode, the positive potentials of the multiplier electrodes increasing progressively by suitable amounts from the first target electrode 12 to the collecting electrode 14. The external circuit of the latter contains a resistance 19 across which picture signal voltages are set up.

An optical image of an object to be transmitted is projected upon the photo-electric side of the mosaic 3, through a lens 20, and the cathode ray beam is caused to scan the mosaic in a series of substantially parallel lines by any known or suitable means, such as deflecting coils, not shown, fed with saw-tooth currents of suitable different frequencies.

As the cathode ray beam scans the screen 3, the electrostatic charges accumulated on the elements of the screen due to the liberation of photo-electrons which are collected by the electrode 10, are restored to an equilibrium potential by the beam, and thus the beam becomes modulated according to the electrostatic charges on the elements. The portion of the beam passing through the mosaic 3 after modulation falls on the first target electrode 12. Electron multiplication then occurs, in two stages in the specific example shown, due to the provision of the second target electrode 13, the tertiary electrons liberated from the second target electrode 13 being collected by the collecting electrode or anode 14, picture signals being established across the resistance 19 which are then fed to a suitable amplifier for transmission. As a result of the provision of the electron multiplier the power

output at picture signal frequencies of the arrangement is relatively high.

The charges held by the elements of the mosaic may be allowed, without detriment, to leak away slowly to the wire cores of the constituent filaments, since it can then readily be arranged that substantially all of the photo-electrons emitted are taken up by the collecting electrode.

The electron multiplier shown in Figure 1 is what is known as a direct current electron multiplier and in the embodiment of the invention shown in Figure 2 a high frequency electron multiplier is shown. In this embodiment the cathode ray gun, mosaic screen, electrodes 10 and 11 are the same as shown in Figure 1, but the cathode ray beam after modulation by the screen 3 passes through an apertured electrode 21 arranged parallel with an electrode 22 each of which constitutes target electrodes of the multiplier. The electrodes 21 and 22 are maintained at a suitable relatively low positive potential and are connected to a high frequency oscillator indicated at 23 in such a manner that the electrodes 21 and 22, during operation, are caused to fluctuate in potential in opposite senses. This causes the electrons rapidly to bombard the electrodes successively and at each bombardment multiplication occurs, the electrons being eventually collected by an electrode 24 maintained at a high positive potential. The electrodes 21, 22 and 23 are arranged in the same envelope as the associated elements 3, 5, 6, 7, 10 and 11.

Although in the specific description of the two embodiments of the invention reference has been made to the transmission of images, it is to be understood that the invention is not limited thereto as the electron discharge device can be used for purposes or systems other than television systems, for example, if desired, the collecting electrode or anode 14 may be replaced by a fluorescent screen, in which case an intensified image of the object projected on the mosaic 3 will be caused to appear on the fluorescent screen.

It will be observed from Figures 1 and 2 that the image is projected obliquely on to the mosaic 3, whilst the mean position of the cathode ray beam is normal to the said screen. In some cases, however, this arrangement may be reversed, the image in such a case being projected on to the mosaic screen substantially normally and the cathode ray caused to scan the screen obliquely.

With the H. F. multiplier shown in Figure 2 there is a possibility that the excursions of the electrons between the electrodes 21 and 22 may result in some of the electrons being dissipated through the aperture in the electrode 21. Where, however, the image is projected on to the screen normally and the cathode ray scans the screen obliquely, as shown in Figure 3, this dissipation of electrons may be prevented by inserting in or adjacent to the aperture in the electrode 21 a plurality of louvres or slats 25 inclined in such a manner as to be substantially parallel to the scanning beam so that on scanning the screen 3 the modulated electron beam is permitted to pass through the spaces between the louvres or slats 25 to be accelerated by the field between the electrodes 21 and 22. Since the louvres or slats are inclined, as stated above, secondary electrons emitted from the electrode 22 will impinge upon the louvres or slats, such impingement liberating secondary electrons which are

accelerated toward the electrode 22. Thus, there is no free passage for the secondary electrons liberated from the electrode 22 such as occurs with the construction shown in Figure 2.

I claim:

1. An electron discharge device suitable for use in television and like systems, comprising an evacuated envelope containing an electron permeable light responsive structure upon which a light image is adapted to be projected and constructed to develop and retain an electrostatic charge image, a source of electrons for producing a focused electron beam of substantially constant current intensity for scanning one side of said electron permeable structure to project electrons through said structure, the electron beam being modulated in intensity in passing through said electron permeable structure during the scanning of said structure by reason of the electrostatic charge image developed on said structure, a first target electrode positioned on the side of the structure opposite the said one side that is scanned, said first target electrode being adapted to receive the scanning beam of electrons projected through said structure, and a collecting electrode or anode arranged in a position to receive secondary electrons liberated as a result of impact of said modulated cathode ray beam on said first target electrode whereby the target electrode and the collecting electrode or anode constitute a direct current amplifier, at least one state of amplification being employed.

2. An electron discharge device comprising an evacuated envelope containing a light-sensitive mosaic including a plurality of discrete elements upon which a light image may be projected, said mosaic being electron permeable, means for producing a beam of electrons adapted for scanning one side of said mosaic, a pair of opposed target electrodes positioned on the other side of said mosaic, a collector electrode or anode associated therewith, and means connected to said target electrodes to produce an alternating high frequency field therebetween, at least one of said target electrodes being adapted to receive beam electrons which are permitted to pass through said mosaic in accordance with the light values projected thereon.

3. An electron discharge device comprising an evacuated envelope containing a light-sensitive mosaic including a plurality of discrete elements upon which a light image may be projected, said mosaic being electron permeable, means for producing a beam of electrons adapted for scanning one side of said mosaic, a pair of opposed target electrodes positioned on the other side of said mosaic, a collector electrode or anode associated therewith, at least one of said target electrodes being adapted to receive beam electrons which are projected through said mosaic in accordance with the light values projected thereon, means to produce an alternating high frequency field between said target electrodes to produce electron multiplication through the production of secondary electrons, and means to restrict the movement of the secondary electrons to the space between the said target electrodes.

4. An electron discharge device comprising an evacuated envelope containing a light sensitive mosaic including a plurality of discrete elements upon which a light image may be projected, said mosaic being electron permeable, means for producing a beam of electrons adapted for scanning one side of said mosaic, a pair of opposed target

electrodes positioned on the other side of said mosaic, a collector electrode or anode associated therewith, at least one of said target electrodes being adapted to receive beam electrons which are projected through said mosaic as determined by the light values projected thereon, means to produce an alternating high frequency field between said target electrodes to produce electron multiplication through the production of secondary electrons, and means to prevent the secondary electrons so produced from striking the mosaic.

5. An electron discharge device comprising an evacuated envelope containing a light sensitive mosaic including a plurality of discrete elements upon which a light image may be projected, said mosaic being electron permeable, means for producing a beam of electrons adapted for scanning one side of said mosaic, a pair of opposed target electrodes positioned on the other side of said mosaic, a collector electrode or anode associated therewith, at least one of said target electrodes being adapted to receive beam electrons which are projected through said mosaic as determined by the light values projected thereon, and means to produce an alternating high frequency field between said target electrodes to produce electron multiplication through the production of secondary electrons, at least a portion of one of said target electrodes being provided with a plurality of louvres so positioned as to be parallel with the scanning beam of electrons but at an angle to the axis of the target electrodes, said means for producing the beam of electrons being positioned to scan said mosaic obliquely.

6. In electron tube apparatus for transmitting television signals, the combination which comprises a perforated photoelectric mosaic screen for receiving an image of a scene to be transmitted, an electrode structure for producing an electron scanning beam, means for scanning said mosaic screen with said beam to cause an electron signal current to be emitted from successively scanned areas of said screen in proportion to the intensity of the image at said areas, a secondary electron-emissive screen disposed to receive said electron signal current and adapted to emit secondary electrons from each point thereof in proportion to the electrons received by said point, said emissive screen being on the side of the mosaic screen opposite that on which the scanning beam impinges, and means for utilizing said secondary electrons to provide a signal.

7. In electron tube apparatus for transmitting television signals, the combination which comprises a photoelectric mosaic screen for receiving an image of a scene to be transmitted, a source of an electron scanning beam, means for scanning said screen with said beam to cause an electron signal current to be emitted from image-points of said screen successively scanned, a series of secondary electron emissive screens positioned on the side of the mosaic screen opposite that on which the scanning beam impinges, the first screen of said series being disposed to receive said electron signal current and adapted to emit corresponding secondary electrons to its successor, and successive screens of said series being disposed to receive electrons from its predecessor and adapted to emit corresponding secondary electrons to its successor, and a final screen for collecting said electrons to form a signal.

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