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TELEVISION TRANSMITTING TUBE

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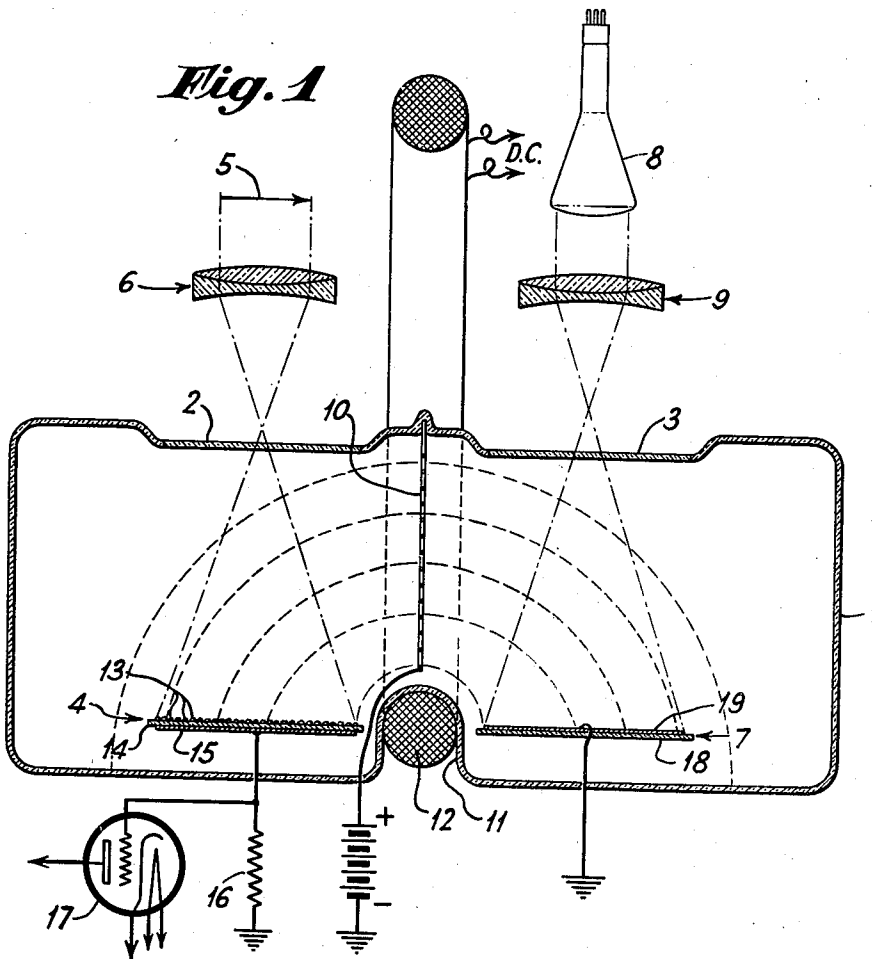
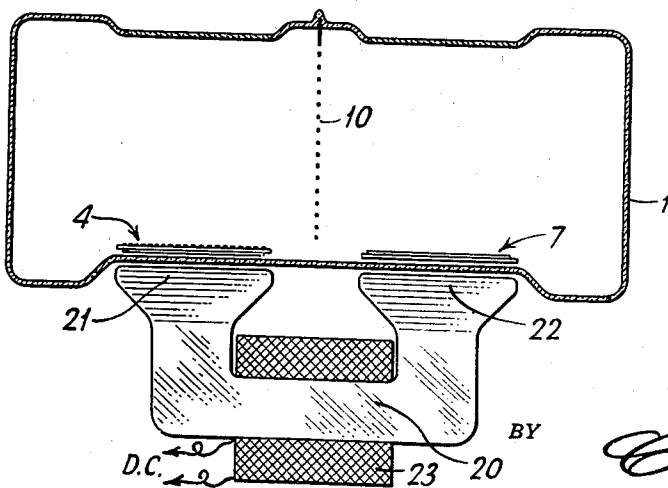


Fig. 2

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TELEVISION TRANSMITTING TUBE

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6 Claims. (Cl. 250—153)

My invention relates to cathode ray tubes of the television transmitting type and more particularly to improved television transmitting tubes of the low electron velocity type and methods of operating such tubes in transmitting systems.

In many cathode ray television transmitting tubes an optical image is projected on a mosaic electrode which causes the elemental areas of the mosaic to acquire electrostatic charges which form what may be termed an electrostatic image of the projected optical image and which are neutralized to produce picture signals by scanning the mosaic electrode with a high velocity electron beam. When such high velocity scanning is used, the surface of the mosaic electrode at the point of impact of the beam emits secondary electrons which tend to flow to those elemental areas of the mosaic which are more highly illuminated and therefore more positive than other areas, so that the distribution of the secondary electrons is non-uniform and consequently neutralization of the charges on these elemental areas is unequal. The non-uniform distribution of secondary electrons may produce a spurious signal commonly referred to as "dark spot" signal, and in addition, the return of secondary electrons at random to the active surface of the mosaic electrode decreases the quantity of electrons utilized in generating the signal with a consequent loss in efficiency of operation. It has been proposed to so reduce the velocity of the electron scanning beam that it will produce little or no secondary electron emission upon impingement with the mosaic electrode by providing an auxiliary cathode which is scanned by a moving spot of light to generate photoelectrons which are projected at low velocity on the mosaic electrode. The auxiliary cathode is provided closely adjacent and parallel to the mosaic electrode but while this arrangement is suitable with mosaic electrodes of the double sided type, it is not equally advantageous with mosaic electrodes of the single sided type because the radiant energy from the moving spot of light on the auxiliary cathode is reflected by or transmitted through the auxiliary cathode and becomes incident upon the mosaic electrode resulting in background illumination which diminishes the overall contrast of the optical image to be transmitted.

One object of my invention is to provide a television transmitting tube of the single sided mosaic electrode type which electrode may be scanned without the introduction of spurious signals such as caused by background illumination or the generation of dark spot phenomena. An-

other object of my invention is to provide a tube of greater sensitivity capable of producing television signals which are of greater intensity than those obtained in the usual way and which may be obtained without appreciable distortion.

In accordance with my invention, an electrostatic image, corresponding in electrostatic energy distribution to the light distribution of an optical image, is formed on a mosaic electrode preferably of the single sided type which is scanned by magnetically directed low velocity electron streams originating at a flying spot produced where a scanning light beam or beam of radiant energy impinges on a scanned photoelectron emissive surface which is displaced from the mosaic electrode in such a manner that light or radiant energy from the flying spot cannot be reflected or transmitted in such a manner as to be incident upon the mosaic electrode.

A better understanding of my invention will be obtained and other objects, features, and advantages of my invention will appear from the following description taken in connection with the accompanying drawing in which;

Figure 1 is a longitudinal perspective view partially in section illustrating one form of my television transmitting tube and its attendant circuits; and,

Figure 2 is a perspective view of a modification of the structure shown in Figure 1.

Referring to the drawing and particularly to Figure 1, my television transmitting tube comprises a highly evacuated cylindrical envelope or bulb 1 having two optically uniform windows 2 and 3. Within the envelope and opposite the window 2 is positioned a flat mosaic electrode 4 of the single sided type to receive an optical image of an object such as represented by the arrow 5 and focused on the mosaic electrode by the lens system 6. A photocathode 7 is positioned within the envelope opposite the window 3 with its photosensitive surface electronically exposed along semi-circular paths wholly within the envelope to the photosensitive surface of the mosaic electrode 4 and in substantially co-planar relationship with the mosaic electrode 4 and also in such a position as to be scanned by a moving spot of light generated in the cathode ray tube 8 and focused through the window 3 and upon the photocathode 7 by the lens system 9. To assist in scanning the electron image, which is developed on the mosaic electrode by light incident thereon, there is between the mosaic electrode 4 and the photocathode 7 a coarsely woven fine wire mesh electron permeable accelerating electrode 10

which preferably lies in a plane substantially perpendicular to the plane of the mosaic electrode 4 and the photocathode 7. While the accelerating electrode 10 is preferably of the mesh type, it may, however be a ring type electrode of conducting material on the wall of the bulb 1 between the mosaic electrode 4 and the photocathode 7. Surrounding the envelope 1 and preferably extending slightly within the confines of the cylindrical bulb, such as by flaring inwardly that portion of the bulb designated as 11, is an electron focusing coil 12, interposed substantially midway between the electrode 4 and the photocathode 7, a portion thereof being in the plane of these electrodes, for the purpose of focusing electrons from the photocathode 7 to the mosaic electrode 4 which electrons are liberated under the influence of the spot of light generated in the cathode ray tube 8 and focused on the photocathode 7 by the lens system 9. The focusing coil, when energized from a source of direct current, produces a magnetic field having lines of force which are semi-circular or substantially semi-circular and which intersect the mosaic electrode and photocathode in a direction substantially normal to their surfaces. Such a focusing field is substantially free of distortion if the focusing coil 12 is of circular form and has an inside diameter equal to or greater than the maximum distance between the remote edges of the mosaic electrode and photocathode.

It is desirable to make the fluorescent screen of the cathode ray tube 8 of material such as calcium tungstate which has little phosphorescence after being scanned by the cathode ray beam developed in the cathode ray tube 8. This tube is conventional having the usual cathode and electron beam focusing anodes by the co-operative action of which an electron beam is directed to the fluorescent screen in the usual manner.

The mosaic electrode 4 is of the conventional single sided type and comprises a multiplicity of mutually separated and mutually insulated photosensitive particles 13 to provide a discontinuous photosensitive surface deposited on an insulating foundation, such as a sheet of mica 14, provided with a conductive coating 15 preferably on the side of the mica sheet 14 opposite that bearing the photosensitive particles. Such a mosaic electrode, together with its method of manufacture, is shown by S. F. Essig in his U. S. Patent 2,065,570. As is customary in the art, the conductive coating 15 is connected to ground through the usual load resistance 16 and to the input electrode of the translating device, such as the triode 17. The photocathode 7 is maintained at ground potential and the accelerating electrode 10 is maintained at a small positive potential, such as 1 to 20 volts, with respect to ground. The photocathode 7 is of the conventional type and comprises a foundation such as a sheet of mica 18 having a continuous photosensitized surface facing the optically uniform window 3. The methods of forming such photosensitive surfaces are well known in the art but I prefer to form this photosensitive surface by depositing on the mica sheet 18, a thin film of silver 19 which is oxidized and sensitized by exposure to caesium in the usual manner.

In operation, an optical image of an object, such as represented by the arrow 5, is projected and focused upon the mosaic electrode 4 by the lens system 6, electrons liberated from the illuminated surface of the mosaic electrode being

accelerated by and passing through the accelerating electrode 10 and collected by the photocathode 7. Because the photosensitive particles 13 of the mosaic electrode 4 are mutually separated and insulated one from another, a positive electrostatic image is formed on the mosaic electrode by the loss of photoelectrons liberated under the influence of the optical image. The fluorescent screen of the cathode ray tube 8 is scanned by an electron beam to form a pattern preferably consisting of horizontal lines each displaced from the preceding line in a direction normal to the lines. An optical image of the pattern is projected upon the photocathode 7 by the lens system 9 and forms in effect a scanning light spot on the photocathode 7. The word "pattern" is here used because the trace of the cathode ray beam in the tube 8 retraces its path many times per second or at a frequency sufficient for normal operating requirements, and appears as a pattern due to persistence of vision. The focusing coil 12 is energized from a source of direct current (not shown) and generates an electron focusing field having electromagnetic lines of force of semi-circular form normal to the illuminated surface of the mosaic electrode 4 and to the photocathode 7. Electrons liberated from the surface of the photocathode are accelerated by the accelerating electrode 10 and directed along semi-circular paths coincident with the lines of magnetic force while maintaining their same relative positions with respect to their points of origin by the magnetic field generated by the coil 12 and impinge with low velocity on those areas of the mosaic electrode which have received a positive electrostatic charge due to the loss of photoelectrons under the influence of the optical image. Those electrons which are liberated from the surface of the photocathode at the points where the semi-circular electromagnetic lines of force intercept the photosensitive particles 13 having zero or negative potentials are decelerated and accelerated in the opposite direction by the accelerating electrode 10 and returned to the photocathode 7. In this manner the electrostatic image representative of light and shade areas of the optical image projected upon the mosaic electrode are neutralized by the electrons liberated from the photocathode by the moving spot of light. Since the photosensitive particles 13 are in capacitive relationship with the conductive coating 15 and retain an electrostatic charge proportional to the light intensity incident thereon, each time the electrostatic charge is neutralized by the electrons liberated from the photocathode under the influence of the moving light spot, a signal will be generated in the impedance 16 which is applied to the translating device 17 whereupon it is further amplified and transmitted in the usual manner.

While I have shown, in connection with Figure 1, the main features of my invention, I have found equally advantageous an arrangement such as shown in Figure 2. As best shown in Figure 2, the electrons liberated from the surface of the photocathode 7 are directed along semi-circular paths by a magnetic field developed by the horseshoe type magnet 20 having two pole faces 21 and 22 one of which is closely adjacent, coextensive with, and parallel to the mosaic electrode 4, the other of which is similarly positioned with respect to the photocathode 7. That portion of the cylindrical envelope adjacent the rear surfaces of the mosaic electrode and photocathode are preferably flattened to allow closer posi-

tioning of the pole faces 21 and 22. All of the other structure shown in Figure 2 is similar to, and is similarly referenced as, that shown in Figure 1. The horseshoe type magnet 20 is energized by a coil 23 through which there is caused to flow a direct current of sufficient magnitude to generate the required electromagnetic field which extends as semi-circular lines of force from the surface of the mosaic electrode 4 to the surface of the photocathode 7. I have found that a field strength of approximately 100 gaussses is sufficient to obtain proper focusing of the low velocity electrons which flow between the mosaic electrode and photocathode and vice versa. With such a field strength, the electrons from points on the photocathode are directed to correspondingly spaced points on the mosaic electrode.

It will be evident from the foregoing description of my new and improved device that the electrostatic image generated on the mosaic electrode, and which corresponds in intensity to the light intensity of the optical image, is neutralized by low velocity electrons liberated from the photocathode and directed upon the mosaic electrode by the magnetic focusing field which electrons are incapable of generating secondary electrons on the surface of the mosaic electrode which might be non-uniformly distributed thereby causing spurious signals such as dark spot signals. It is likewise evident that, since the optical axis of the lens system 6 is displaced from and parallel to the lens system 9, there can be no interference between the light of the optical image and the light generated on the fluorescent screen of the cathode ray tube 8. Furthermore, since the mosaic electrode 4 and the photocathode 7 are in the same plane and displaced one from the other, it is virtually impossible for the light of the flying light spot to be reflected or transmitted in such a manner as to become incident upon the mosaic electrode. With this arrangement of the electrode structure, many difficulties with respect to the transmission of background lighting effects are obviated, resulting in a television transmission which is relatively free of spurious signals and background disturbances.

From the foregoing description, it will be apparent that various other modifications may be made in my invention without departing from the spirit and scope thereof and I desire, therefore, that only such limitations shall be placed thereon as are necessitated by the prior art and as set forth in the appended claims.

What I claim is:

1. A television transmitting device including in an evacuated envelope two electron emitting electrodes, one of which is of the mosaic type and comprises a foundation of electrically insulating material, a mosaic of mutually separated and insulated photosensitive particles on one side of said foundation and a conductive coating in capacitive relation with said particles, both of said electrodes being in substantially the same plane, each displaced one from the other and electronically exposed one to the other along semi-circular paths to allow an unimpeded electron flow therebetween, means without said envelope and facing the side of said photocathode exposed to said electrode of the mosaic type for projecting a moving spot of light on said photocathode, means without said envelope and facing the side of said electrode of mosaic type exposed to said photocathode to project an optical image on said electrode of mosaic type, and a magnetic focusing

coil surrounding the envelope and lying in a plane substantially perpendicular to said photocathode and said electrode of mosaic type and substantially midway between the adjacent edges of said electrodes to generate a curved magnetic field which extends between said electrodes and intersects the surfaces of said electrodes to focus electrons from each of said electron emitting electrodes to the other of said electrodes.

2. A television transmitting device comprising an evacuated envelope, two photosensitive electrodes, one of which is of the mosaic type within said envelope positioned in a single plane and displaced one from the other, the photosensitive surfaces of said electrodes facing and being electronically exposed to one another along semi-circular curved paths, means to project light representative of an optical image from the side of and upon the surface of the electrode of mosaic type facing and electronically exposed to said other electrode, means to project a moving spot of light from the side of and upon the corresponding surface of said other electrode, and a magnetic focusing coil having a portion thereof in the plane of said electrodes and surrounding said envelope at a section of said envelope between said electrodes, said coil being displaced from the optical axes along which light representative of said optical image and said light spot are projected.

3. A television transmitting device comprising an evacuated envelope, two photosensitive electrodes within said envelope, side by side and in substantially a single plane, one of said electrodes having a continuous photosensitive surface and the other a discontinuous photosensitive surface, said electrodes each having their photosensitive surfaces facing one another along semi-circular paths wholly within said envelope, means without said envelope to focus electrons from one electrode to the other comprising a magnetic coil lying in a plane substantially perpendicular to and midway between said electrodes to generate a magnetic field having lines of force of substantially semi-circular form extending between and intersecting the surface of each electrode in a direction substantially normal to the surface of each electrode, means facing the discontinuous photosensitive surface of one of said electrodes to project light representative of an optical image along an optical axis parallel to the plane of said coil and on the said discontinuous surface, and means facing the continuous photosensitive surface of the other of said electrodes to project a moving spot of light on said other surface.

4. A television transmitting device having an evacuated envelope, a photosensitive mosaic electrode, and a photocathode in coplanar relation within said envelope, the photosensitive surfaces of said electrode and said photocathode facing one another along semi-circular paths wholly within said envelope, a substantially circular magnetic focusing coil between adjacent edges of said mosaic electrode and said photocathode and surrounding said envelope, said coil having an inside diameter at least equal to the maximum distance between the remote edges of said mosaic electrode and said photocathode, means facing the photosensitive surfaces of said mosaic electrode to project light representative of an optical image directly upon the photosensitive surface of said mosaic electrode to generate an electrostatic image representative of said optical image thereon, and means facing the photosensitive surface of said photocathode to project a

moving spot of light as a scanning pattern on the photosensitive surface of said photocathode to generate a beam of electrons for neutralizing said electrostatic image and generating signals representative of said optical image.

5. A television transmitting device as claimed in claim 4 having in addition an electron permeable accelerating electrode within said envelope between said mosaic electrode and said photocathode and in a plane substantially parallel with the plane of said focusing coil.

6. A television transmitting device including an evacuated envelope having two substantially transparent window portions, a photosensitive mosaic electrode and a photocathode, each opposite one of said window portions and in coplanar relation one with the other with their photosensitive surfaces facing said window portions and electronically exposed one to the other along

semi-circular paths within said envelope, an electron permeable accelerating electrode between said window portions and between and substantially perpendicular to said mosaic electrode and said photocathode, and means without said envelope for focusing streams of electrons from said photocathode upon said mosaic electrode, said means comprising a horseshoe magnet having two pole faces, one of which is closely adjacent, coextensive with, and parallel to the surface of said mosaic electrode opposite the photosensitive surface thereof facing one of said window portions, the other pole face of which is similarly positioned with respect to said photocathode to generate a magnetic field having lines of force extending between and intersecting the photosensitive surfaces of said mosaic electrode and said photocathode.

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