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ELECTRON CAMERA TUBE

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FIG. 1

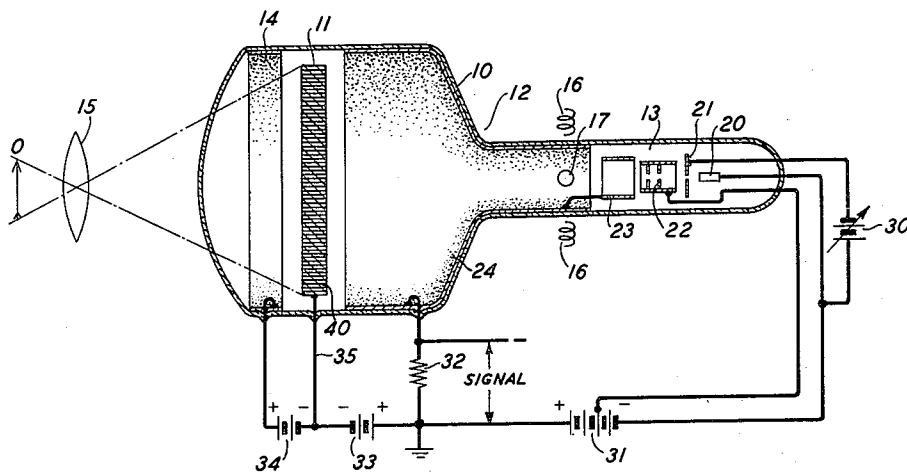


FIG. 2

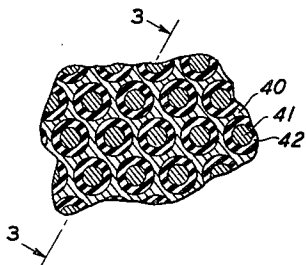
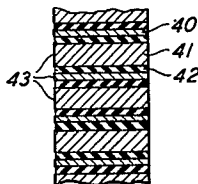


FIG. 3



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ELECTRON CAMERA TUBE

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10 Claims. (Cl. 315-11)

This invention relates to electron optical devices and more specifically to electron camera tube arrangements for television.

Many forms of electron camera tubes employing storage are known in the prior art, including some incorporating a target member of the two-sided mosaic type, that is, a target which is adapted to have radiations from an object applied to one side and a moving scanning beam of electrons applied to the other side.

It is a principal object of the present invention to provide an arrangement including an improved electron camera tube of the type incorporating a two-sided mosaic target.

In accordance with the invention there is provided a television camera tube which, because of suitable potentials applied to various electrodes therein, has at all times a saturated collecting field for photoelectrons between the light sensitive particles on one face of the two-sided mosaic target and a collecting electrode, and provides for complete electric field isolation of each light sensitive particle so that no charge transfers of any kind can occur among the particles.

In accordance with one aspect of the invention, there is provided a novel cathode ray television transmitter tube arrangement employing a two-sided mosaic having a matrix which is maintained at a negative potential with respect to the collecting electrodes for the secondary electrons and photoelectrons, respectively, emitted from said mosaic.

In accordance with a preferred embodiment, chosen by way of example to illustrate the principles of novelty of the present invention, an arrangement including a television camera tube is provided which tube comprises an evacuated envelope enclosing means for generating a beam of electrons, a target for the beam, and two collecting electrodes on opposite sides of the target. The mosaic target comprises a conducting matrix having a plurality of apertures therein, an insulated filament being provided for each aperture. The matrix is placed at a potential which is negative with respect to both collecting electrodes. The end of each filament remote from the electron beam is photosensitized. An image of an object is projected upon the photosensitized side of the target and the other side is scanned with the beam of electrons. The ends of the filament are made flush with the matrix on both sides of the target.

The principle of operation of this tube is as follows: While it is under the scanning beam spot, each filament attains an equilibrium poten-

tial which is somewhat greater than that of the matrix but still considerably less than that of the collecting electrode on the electron beam side of the target, which collecting electrode may be the final anode of the electron gun utilized for generating the scanning beam of electrons. Between successive scans each filament acquires a positive charge through the loss of photoelectrons to the photoelectron collector electrode and its potential rises above the equilibrium potential at a rate determined by the amount of light falling upon it. The matrix is thus always negative with respect to every filament, as every filament is at or slightly above the equilibrium potential at all times. Being thus completely surrounded by a negative potential barrier, the secondary and photoelectrons from one filament are unable to pass over this barrier to any other filament; they must either continue on to the final anode of the gun or to the collector electrode for the photoelectrons, respectively, or return to the filament from which they started. On the photosensitive side of the mosaic, sufficient collecting field is provided to draw every photoelectron to its collector electrode. On the scanning side of the mosaic, however, the equilibrium potential that the filaments assume while under the scanning beam is such that (at equilibrium) only as many secondary electrons have sufficient energy to reach the final anode as there are primaries arriving in the beam and the remainder of the secondaries have too little energy to reach the final anode and fall back inside the potential barrier to the filament from which they were emitted. The variation in the current to the final anode constitutes the video signal current. Because the tube provides for complete collection of every photoelectron and prevents substantially all redistribution losses, this tube has a maximum signal output.

In the tube of this invention, the matrix has a dual role in that it not only provides a barrier grid action on both sides of the mosaic but also serves as the "signal plate" at the same time. In the ordinary tube of this general type, one screen is used for the signal plate while a separate screen is used to provide a barrier grid action on one side of the mosaic facing the scanning gun only. The combining of these functions in one matrix simplifies the mechanical design of the mosaic structure.

The invention will be more readily understood by referring to the following description taken in connection with the accompanying drawing forming a part thereof in which:

Fig. 1 is a schematic representation of a cathode ray tube of this invention and certain of its associated circuits;

Fig. 2 is an enlarged cross-sectional view of a portion of the mosaic target of Fig. 1 taken in a plane parallel to the surface upon which the scanning electrons impinge.

Fig. 3 is an enlarged cross-sectional view taken in a plane indicated by line 3—3 in Fig. 2.

Referring more particularly to the drawing, Fig. 1 discloses, by way of example to illustrate the principles of this invention, a cathode ray television transmitter tube 10 employing a two-sided mosaic 11 together with certain of its associated circuit connections. The tube 10 comprises an evacuated envelope 12 enclosing the mosaic target 11, an electron gun 13 for generating, focusing and accelerating a beam of electrons towards this target, a collecting electrode 14 for photoelectrons emitted from the target when radiations from an object or field of view are applied to the side thereof remote from the beam of electrons by means of a suitable optical system represented by the lens 15, and two sets of magnetic coils 16, 16 and 17, 17 for causing the beam of electrons to scan every elemental area in turn of a field of view on the mosaic target 11.

The electron gun 13 preferably comprises a cathode 20, a modulating electrode or member 21, a first anode member 22, and a second and final anode member comprising a cylindrical member 23 and a coating 24 of conducting material on the inside walls of the envelope 12 extending from the region of the cylinder 23 to the region of the mosaic target 11. The collecting electrode 14 for the photoelectrons emitted from the left-hand side of the mosaic target 11 in Fig. 1 also preferably comprises a conducting coating (in the form of a ring) on the inner walls of the envelope 12. The coatings 14 and 24 are separated and electrically isolated from one another.

The modulating electrode 21 is placed at any suitable negative potential with respect to the potential of the cathode 20 by means of an adjustable source 30; the first anode 22 and the final anode 23, 24 are placed at appropriate positive potentials with respect to the cathode 20 by means of the source 31. An inner terminal of this source is connected directly to the anode member 22 while the positive terminal of the source 31 is connected through a signal resistor 32 to the final anode members 23, 24. The negative terminal of the source 31 is connected to the cathode 20. The potentials applied to the various electrode members are such that a beam of focused electrons strikes the target 11 and this beam is deflected over a suitable field or raster thereon by means of appropriate currents passed through the deflecting coils 16, 16 and 17, 17 by means of suitable sweep circuits (not shown). Any sweep circuits suitable for operation with magnetic deflecting coils for a cathode ray tube are satisfactory for the purpose.

Reference will now be made to Figs. 2 and 3 which show enlarged portions of the mosaic target 11. Fig. 2 is a cross-sectional view taken in a plane parallel to the large surfaces of the mosaic target while Fig. 3 is a cross-sectional view taken in a plane indicated by the line 3—3 in Fig. 2. The mosaic target 11 preferably comprises a matrix 40 of conducting material having a plurality of apertures therein which are filled with filaments 41 having insulated coatings 42 around them. The matrix 40 is placed at a nega-

tive potential with respect to the conducting coating 24 and the cylinder 23 by means of source 33 and at a negative potential with respect to the collecting electrode 14 by means of source 34. The left-hand ends of the filament 41 (in Figs. 1 and 3) are photosensitized in any manner known in the art. Both ends of the filament are made flush with the corresponding surfaces of the matrix 40. This feature simplifies the manufacture of the mosaic target 11.

The target 11 may be made in a number of ways. One example of a satisfactory way of making this target is known as the "wire bundle" method. To make a two-sided mosaic by this method, wire of very small diameter is first coated with a thin uniform layer of a suitable dielectric material and then coated with a very thin metallic layer. This forms a miniature cable which can then be reeled up (perhaps with further metal being used to fill the spaces between the cables) in such a way that after it has been bound together and a thin slab has been formed by cuts perpendicular to the direction of the wires, the desired structure will have been formed. As a specific example of one way of performing this method, aluminum wire can be anodically oxidized to insulate it, and then coated with a thin layer of "Hanovia silver" suspension and baked. "Hanovia silver" is a suspension of silver and small amounts of other metals such as antimony in oil. While the resulting miniature cable is being layer-wound around a thin flat board, a tinfoil made of an alloy of about 80 per cent aluminum and 20 per cent silver is wound between each layer. When the cross section of the coil has reached the correct dimensions, as for example about 5 inches wide and 2 inches deep, and after the flat board has been removed, the coil is squeezed together eliminating the space where the board has been. This assemblage is then baked to a temperature which is sufficient to melt the foil but which is below the melting temperature of the aluminum wire. Thus the foil is fused into a matrix. If desirable, pressure is applied at the same time to squeeze the wires together and to make sure that the matrix completely fills every interstice. Slabs, perhaps of the order of 1/4 inch thick, are then formed by cuts perpendicular to the wires and silver is electroplated upon the exposed wire ends and the exposed matrix on one side of the tube. If necessary to get the silver to stick, a preliminary plating of nickel may be found necessary. After mounting the slab in the tube the usual processes of oxidation and treatment with caesium are used to produce photosensitivity on the left-hand side of the mosaic as shown in Figs. 1 and 3. The photosensitivity of the matrix 40 makes possible control of the average intensity at each instant of the reproduced image at a suitable receiver. The current flowing in the lead wire 35 connected to the matrix 40 is directly proportional to the average intensity at each instant of the object or field of view projected upon the left-hand side of the mosaic target 11 by means of the lens system 15. By means familiar to the art, the variations of this current can be transmitted along with the video signal. The amplitude of the blanking pulse can be controlled by this current.

The principle of operation of the tube shown in Fig. 1 is as follows: Radiations from an object or field of view are projected upon the left-hand side of the mosaic target 11 by means of the lens system 15. The beam of electrons generated by

the electron gun 13 is deflected over a field of the mosaic target corresponding to the area covered by the radiations from the object by means of deflecting currents supplied to the deflecting coils 16, 16 and 17, 17. While it is under the scanning beam spot, each filament 41 attains an equilibrium potential somewhat greater than that of the matrix 40 but still considerably less than that of the final anode 23, 24 of the scanning gun. The matrix 40 is placed at a negative potential with respect to the final anode 23, 24 and at a constant potential with respect to ground by means of the source 33. The ends of the filaments, however, are not connected to any source of constant potential and the potential of the filaments rises due to the secondary electrons given off from the filaments 41 by the impingement of the primary electrons from the gun 13 thereon. Between scans, each filament 41 acquires a positive charge through the loss of photoelectrons from the coating 43 to the collecting electrode 14 for the photoelectrons, which is placed at a positive potential with respect to the matrix 40 by means of the source 34. The potential of each filament 41 thus rises above the equilibrium potential at a rate determined by the amount of light falling upon it from a corresponding elemental area of the object or field of view O. It follows then that every element is at or slightly above the equilibrium potential at all times and this being so the matrix is always negative with respect to every filament. Being thus completely surrounded by a negative potential barrier, secondary electrons and photoelectrons from one filament are unable to pass over this barrier to any other filament; they must either continue on to the second anode (that is, the collecting electrode 24) or to the collector electrode 14 for the photoelectrons, respectively, or return to the filament from which they started. On the photosensitive (left-hand) side of the mosaic, sufficient collecting field is provided to draw every photoelectron to the collector electrode 14. On the primary beam side of the mosaic (the right-hand side in Figs. 1 and 3) however, the equilibrium potential at the filament 41 while under the scanning beam is such that (at equilibrium) only as many secondaries have sufficient energy to reach the second or final anode 24 as there are primaries arriving in the beam and the remainder of the secondaries have too little energy to reach the final anode 24 and fall back inside the potential barrier to the filament from which they were emitted. During each scanning sequence, the scanning beam from the gun 13 replaces successively at each filament 41 the number of photoelectrons that filament has lost since the previous scan, and the instantaneous total number of secondary electrons going to the final anode 24 is therefore diminished by the number of replacement electrons being taken by the filament 41 being scanned at that instant. The variation in this final anode current constitutes the video signal current, and this current passes through the signal resistor 32 which is connected to the input circuit of an amplifier in a manner well known in the art. Because it provides for a complete collection of every photoelectron and prevents substantially all redistribution losses, the tube of this invention has a maximum signal output.

As pointed out above, an outstanding feature of this tube is the dual role performed by the matrix 40. This matrix not only provides a barrier grid action on both sides of the mosaic but it also serves as the signal plate at the same time. Ordinarily in tubes of the two-sided mosaic type, one screen is used for the signal plate while a separate screen is used to provide a barrier grid action on the one side of the mosaic facing the scanning gun only. Combining these functions in the matrix simplifies the mechanical design of the mosaic structure. Preferably, as pointed out above the ends of the filaments are flush with the respective surfaces of the matrix. This is possible in accordance with this invention because no special indentations or protuberances are necessary to produce the barrier action.

Various modifications may be made in the embodiment described above without departing from the spirit of the invention, the scope of which is indicated by the appended claims.

What is claimed is:

1. An electron camera tube arrangement comprising an envelope enclosing means for generating a beam of electrons, a target for said beam comprising a matrix of conducting material having a plurality of insulated conducting elements therein, said conducting elements being so positioned that each has an exposed face on each side of the target, a photosensitive coating on the face of each element remote from the beam, collecting means for secondary electrons generated when said beam impacts said target, a collecting electrode for photoelectrons emitted from the photosensitive portions of said element, and means for placing said matrix at a fixed potential which is at all times negative with respect to that of said collecting means and said collecting electrode.

2. An electron camera tube arrangement comprising an envelope enclosing means for generating a beam of electrons, a target for said beam comprising a conducting member having a multiplicity of apertures therein, an insulated conducting element in each aperture so positioned that each element has an exposed face on each side of the target, said faces being substantially flush with the surfaces of said conducting member, a photosensitive coating on the face of each element remote from the beam, collecting means for secondary electrons generated when said beam impacts said target, a collecting electrode for photoelectrons emitted from the photosensitive portions of said element, and means for placing said conducting member at a fixed potential which is at all times negative with respect to that of said collecting means and said collecting electrode.

3. An electron camera tube arrangement comprising an envelope enclosing means for generating a beam of electrons, a target for said beam comprising a conducting member having a multiplicity of apertures therein, an insulated conducting element in each aperture so positioned that each element has an exposed face on each side of the target, said faces being substantially flush with the surfaces of said conducting member, a photosensitive coating on the face of each element remote from the beam collecting means for secondary electrons generated when said beam impacts said target, a collecting electrode for photoelectrons emitted from the photosensitive portions of said element, and means for placing said conducting member at a potential which is fixed with respect to that of the cathode of the beam generating means and which is at all times negative with respect to that of said collecting means and said collecting electrode.

4. The combination of elements as in claim 1 in which the exposed faces of said elements are

substantially flush with the surfaces of said matrix, respectively.

5. An electron camera tube arrangement comprising an envelope enclosing means for generating a beam of electrons, a target for said beam comprising a conducting member having a multiplicity of insulated conducting elements there-through, said elements being so positioned that each one of them has an exposed face on each side of the conducting member, a photosensitive coating on the face of each element remote from the beam generating means, collecting means for secondary electrons generated when said beam impacts said target, a collecting electrode for photoelectrons emitted from the photosensitive portions of said elements, means for setting up an electric field between said photosensitive portions of said elements and said collecting electrode to cause substantially all of said photoelectrons to be collected thereby, and means for setting up an electric field between the conducting elements and said conducting member so that secondary electrons are prevented from being emitted from one element to another element.

6. In combination, a target for electrons comprising a first conducting member, insulating material disposed about said member in such a way that two faces of said member at opposite ends thereof are left uninsulated, a second member of conducting material contiguous to said insulating material, a photosensitive surface for one of said faces, a photoelectron collecting electrode adjacent said photosensitive surface for receiving photoelectrons emitted therefrom, means for generating a beam of electrons and for periodically directing it to the other of said two faces, a collecting member for secondary electrons emitted from said other face when impacted by said beam, said emission of secondary electrons and of photoelectrons causing said first conducting member to vary in potential from an equilibrium value when the beam is in contact therewith to values positive with respect to said equilibrium value when the beam is not in contact therewith and when radiations are applied to said photosensitive surface, and means for continuously maintaining said second member at a negative potential with respect to said equilibrium value.

7. In combination, a target for an electron beam comprising a matrix of conducting material having a plurality of insulating conducting elements, said conducting elements being so positioned that each has an exposed face on each side of the target, a photosensitive coating on the face of each element remote from the beam, means for receiving secondary electrons gener-

ated when said beam impacts the target, a collecting electrode for photoelectrons emitted from the photosensitive portions of said element, said emission of secondary electrons and of photoelectrons causing each of said conducting elements to vary in potential from an equilibrium value which is substantially the same for all elements and which each element assumes when the beam is in contact therewith to a value positive with respect to said equilibrium value when the beam is not in contact therewith and when radiations are applied to said photosensitive surface, and means for continuously maintaining said matrix at a negative potential with respect to said equilibrium potential.

8. In combination, a target for electrons comprising an array of insulated parallel conducting members each having two uninsulated ends, metallic material forming a matrix around said insulated members, means for forming a beam of electrons, means for causing said beam to scan a face of said target including an end of each conducting member whereby each member is driven to an equilibrium potential by the passage of the beam over its said end, means for producing electron emission from the other of said ends of some at least of said conducting members, said emission from a member causing the potential thereof to become more positive than said equilibrium potential during the period of time it is not contacted by said beam, and means for maintaining said matrix at all times negative with respect to said equilibrium potential.

9. In combination, a target for electrons comprising an array of conducting members, metallic material between but insulated from adjacent ones of said members, all of said metallic material being maintained at the same potential, means for forming a beam of electrons, means for causing said beam to scan a face of said target including an end of each conducting member whereby each member is driven to an equilibrium potential, means for producing electron emission from the other end of some at least of said conducting members, said emission from a member causing the potential thereof to become more positive than said equilibrium potential during the periods of time it is not contacted by said beam, and means for maintaining all of said metallic material at all times negative with respect to said equilibrium potential.

10. The combination of elements as in claim 9 in which said other end of each of said conducting members is coated with photosensitive material.

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