

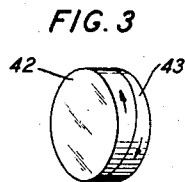
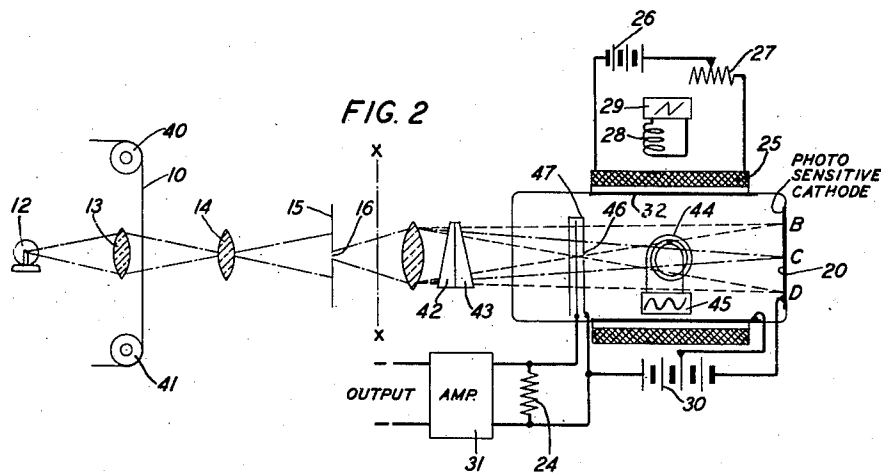
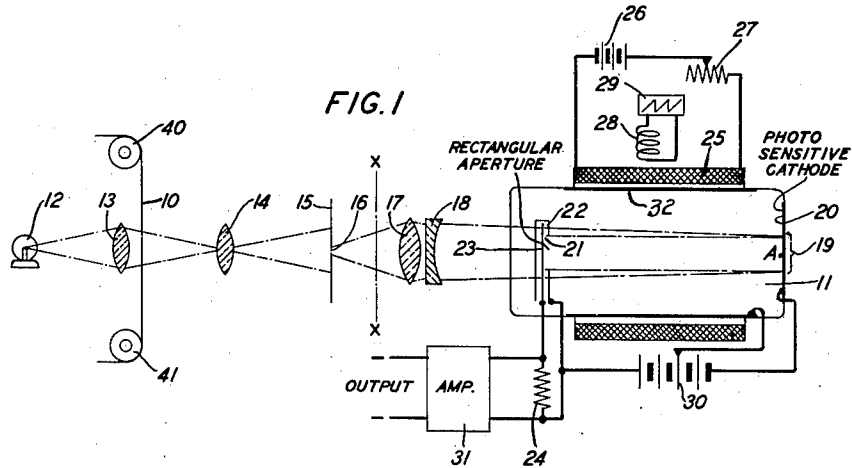
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ELECTRON CAMERA

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ELECTRON CAMERA

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16 Claims. (Cl. 178—7.2)

This application relates to electron discharge devices and more specifically to electron camera tubes used as television transmitters.

One well-known electron camera tube used as a television transmitter is known as the dissector. In tubes of this general type an image of an object is thrown upon a photoelectric cathode within the tube giving rise to a moving electron stream, the various elemental portions of a cross-section of which correspond respectively to the corresponding elemental areas of the object. By means of suitable electromagnetic deflecting coils, this stream is caused to move across a scanning aperture in such a way that each elemental portion of the stream enters the aperture once during each scanning interval. The electrons passing through the scanning aperture strike an anode member, which usually is the first electrode of an electron multiplier in the output circuit of which is connected a signal resistance through which passes the television image current resulting from the scanning.

The dissector tube can be used to scan a moving motion picture film in successive transverse lines, the movement of the film providing the slower of the two scanning movements. An obstacle to satisfactory performance is the presence of irregularity of sensitiveness of the photoelectric surface on which the film line image is projected. An irregularity in a photoelectric cathode will be more pronounced in a line scanning dissector than it will be in one employing scanning in two directions as a spot irregularity in a linear cathode shows up as a line in the received picture.

It is an object of this invention to provide methods of and apparatus for compensating for irregularities in the photoelectric surface of a cathode in a dissector employed as a line scanning apparatus.

In an embodiment of the invention, fully described below and illustrated in Fig. 1 of the drawing, there is provided an arrangement in which a distorted line image from a continuously moving film is formed on a photosensitive cathode surface by means of a lens combination which is slightly cylindrical about a horizontal axis. The effect of the cylindrical lens is to spread out the line image into a broad band covering a large number of granules or particles of the photosensitive surface. A vertical magnification of from 5 to 10 will generally be sufficient. A vertical slit is provided in the dissector to scan the electron stream from the cathode, instead of the square aperture usually used, in

order to pick up simultaneously all of the electrons emitted from an elemental transverse strip of the band. In a modification, by local intense magnetic focusing of the electron stream, the usual square aperture can be used. The effect of any irregularity sensitized spot of the photoelectric cathode is thus minimized by being averaged down in the image current.

In a second embodiment of the invention, shown in Fig. 2, a special slit aperture is not required, the essential feature of this arrangement being the oscillation of the image on the dissector cathode by optical means and the following of these oscillations exactly by the use of deflecting magnetic sweeps which are not otherwise used in the line method of scanning. The optical device producing the oscillations can be a pair of prisms rotating in opposite directions or a flat plate oscillating about an axis. The speed of oscillation of the image should not be exactly in phase with the frame or lateral sweep frequency, thus avoiding the use of the same element of the dissector screen by successive images.

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 shows a television scanning system according to the invention;

Fig. 2 shows a second embodiment of the invention; and

Fig. 3 is a top view of the optical means for producing movement of the image on the photo-sensitive cathode of the dissector shown in the system of Fig. 2 after this means has been rotated 90 degrees from the position shown in Fig. 2.

Referring more specifically to the drawing, Fig. 1 shows one system for carrying out the principles of the invention. In the television transmitter system shown in Fig. 1, a film contains successive frame images, the vertical scanning component of which is supplied by the continuous movement of the film over rollers and while horizontal scanning is accomplished by the use of a dissector tube adapted to be used as a line scanner.

An image of a portion of the object on the film is formed by a suitable optical system, represented by the source, and lenses, upon a diaphragm having a slit aperture therein. The slit allows the image of a single line to pass therethrough, which slit image is magnified in a vertical direction by the cylindrical optical system, comprising the convex lens

17 and the concave cylindrical lens 18, to form a distorted line image 19 on the photosensitive cathode 20 of the dissector 11. An electron image of this line 19 is formed at the plane of the rectangular aperture or slit 21 in the pick-up electrode 22 behind which is located a target anode 23 which is schematically shown in Fig. 1 as being connected directly to an output resistance 24 but which is in the more usual practice connected to this resistance through an electron multiplier, the first electrode of which is the target member 23. Such an electron multiplier arrangement is well known to those skilled in the art. The focusing is preferably done by magnetic coils 25 acting in a manner well known to those skilled in the operation of dissector tubes. These focusing coils receive their current from a source 26 acting through variable resistance 27. The electron image, corresponding to a distorted line image, is caused to move horizontally across the slit aperture 21 by means of sweep coils schematically represented by the coils 28 receiving current of saw-tooth wave form from an oscillator 29. It will be understood that the coil 28 is merely representative of two coils usually used, which coils are generally as long as the tube. Any well-known magnetic sweep circuit may be used to generate the saw-tooth oscillations. The output resistance 24 is also connected to the diaphragm 22 which is positively biased with respect to the photosensitive cathode 20 by means of the source of potential 30. A conducting coating 32 is connected to an internal point of the source 30. The resistance 24 is connected in the input circuit of an amplifier 31 the output of which may be connected by means of suitable wire or radio channels to a receiving station. The tube 11 is preferably, with the exception of the special rectangular aperture 21 and the omission of the vertical sweep coils, of the type of tube well known to the art as the "dissector."

In order to better understand the operation of the arrangement shown in Fig. 1, consider that there is a small spot A falling within the distorted line image 19 on the photosensitive cathode 20. If this spot has a photoelectric irregularity this irregularity in the usual arrangement appears as a streak or line in the received picture assuming that the dissector is used as a line scanner. By amplifying the slit image 16 in one direction to form the distorted image 19, the spot A is a much smaller part of the total width of the image 19, and its effect (due to its irregularity of sensitiveness) is greatly minimized inasmuch as the elemental areas across the whole width 19 go into making up the signal which appears in the resistance 24 and in the output circuit representative of a single elemental area of the object. The continuous movement of the film 10 which is driven between the rollers 40 and 41 in a manner well known and the horizontal movement of the electron image of the strip 19 across the slot 21 forms the other direction of scanning so that the image current produced in the resistance 24 is representative of a two-dimensional subject.

As a modification, the current supplied to the focusing magnetic coils 25 may be adjusted so that the electron image of the wide or distorted line 19 may be brought down to a small line at the plane of the aperture so that the usual square aperture, such as is used in Fig. 2, may be used instead of the slit aperture 21. The operation is otherwise the same as before.

Fig. 2 shows another embodiment of the invention. In this arrangement the portion to the left of line X—X is the same as that to the left of the line X—X in Fig. 1 and operates in the same manner. In the arrangement of Fig. 2, however, an image of the slit aperture 16 is moved up and down on the surface of the photosensitive cathode 20 by means of a pair of optical prisms 42 and 43 rotating in opposite directions as shown in Fig. 3. Any suitable means may be used to provide this motion. The light emerging from the prisms 42 and 43 oscillates up and down between the boundary positions represented by the points B and D, Fig. 2, according to a sine wave relation. This oscillation is matched by the motion imparted to the electron image by the magnetic field formed by the magnetic coils 44 receiving current from a sine wave oscillator 45 of the same frequency as the oscillation of the line image between points B and D. By means of the magnetic coil 44, the image of every line between B and D is brought to a focus at the aperture 46 in the diaphragm 47. Unlike the aperture 21 used in the system of Fig. 1 the aperture 46 need be only a square as in the usual dissector. Horizontal deflection of the light image across the aperture 46 is produced as in the case of Fig. 1 by means of sweep coils 28 receiving current of saw-tooth wave form from sweep circuit 29. The other portions of the dissector tube and its external circuit are the same as in the system of Fig. 1. In Fig. 2, which is an elevation view, the prisms 42 and 43 are shown in a position which will deflect the image to the line D while in Fig. 3, which is a top perspective view of the prisms after they have been rotated 90 degrees from the position of Fig. 2, there would be no reflection of the beam as the two sides are parallel.

In considering the operation of the system shown in Fig. 2, consider that a point C located between the points B and D is of irregular photosensitivity. By means of the arrangement shown in this figure only once in ten or twenty lines will the electrons emitted from the spot C be focused upon the aperture 46 and this irregularity will thus not be noticed. In all positions of the line image between B and D the field generated by the coil 44 deflects the electron stream to a line at the height of the aperture 46 and the line is moved horizontally across this aperture, that is, at right angles to the plane of the drawing, by means of line scanning field formed by the coil 28. The speed of oscillation of the image between the points B and D should not be exactly in phase with the frame or lateral sweep frequency, that is, the number of frames on the film 10 scanned per second, so as to avoid the use of the same elements of the dissector screen for successive images. This causes any irregularities of a point such as the point C to be even further unnoticed. As a modification, the prisms may be replaced by a flat plate oscillating about an axis.

As a modification of the optical systems in Figs. 1 and 2, a linear portion of the film may be imaged directly on the cathode 20 by removing the diaphragm 15 and placing the lens 17 (or the prisms 42 and 43 of Fig. 3) close to the lens 14.

While the invention has been described above as applicable to the dissector type tube, it will be obvious that certain principles thereof are applicable as well to other types of transmitter tubes, for example, to a tube of the iconoscope type having a beam of a cross-section in which

the longest dimension thereof is transverse to the scanning direction and a photosensitive target upon which an image of a portion of the object, distorted in the direction transverse to scanning, is projected.

Various other modifications may be made in the embodiments described above without changing the invention, the scope of which is indicated by the appended claims.

What is claimed is:

1. An electron stream television camera for setting up image current in combination with means for directing light from single elemental strips in succession of a continuously moving film or picture to be scanned and therewith forming a distorted image field on the light receiving element of said camera for each of said strips in succession thereby giving rise to a stream of photoelectrons, said image field having distortion due to too great a dimension in a direction transverse to the longitudinal axis of said strip relative to the dimension in the direction of said axis, and means comprising the electron stream of said camera for scanning in the direction corresponding to the lengths of said strips and setting up image currents corresponding to the tone values of said field in said direction by sweeping the photoelectronic stream repeatedly, once for each strip, in said direction.

2. An electron stream television camera of the dissector type for setting up image current in combination with means for directing light from single elemental strips in succession of a continuously moving film or picture to be scanned and therewith forming a distorted image field on the light receiving element of said camera for each of said strips in succession thereby giving rise to a stream of photoelectrons, said image field having distortion due to too great a dimension in a direction transverse to the longitudinal axis of said strip relative to the dimension in the direction of said axis, and means comprising the electron stream of said camera for scanning in the direction corresponding to the lengths of said strips and setting up image currents corresponding to the tone values of said field in said direction by sweeping the photoelectronic stream repeatedly, once for each strip, in said direction.

3. An electron stream television camera tube for setting up image current in combination with means for directing light from single elemental strips in succession of a continuously moving film or picture to be scanned and therewith forming a distorted image field on the light receiving element of said camera for each of said strips in succession thereby giving rise to a stream of photoelectrons, said image field having distortion due to too great a dimension in a direction transverse to the longitudinal axis of said strip relative to the dimension in the direction of said axis, and means comprising the electron stream of said camera for scanning in the direction corresponding to the lengths of said strips and setting up image currents corresponding to the tone values of said field in said direction by sweeping the electronic stream repeatedly, once for each strip, in said direction, said camera tube comprising means for causing all the photoelectrons emitted from one elemental area only of said image field at any instant to be effective upon the anode of said tube at that instant, said elemental area extending entirely across said field in the direction transverse to the sweeping direction of said stream.

4. In an electron camera arrangement, a photoelectric surface within the electron camera, means for forming an image of a linear portion of an object on said photoelectric surface to cause the emission of a stream of electrons therefrom, the ratio of the height of the area of the photoelectric surface which emits electrons when impinged upon by light from the linear portion of the object to the height of said linear portion being much greater than the ratio of the length of said area to the length of said linear portion, means for deflecting the stream of emitted photoelectrons in a direction parallel to the length of said area, and a scanning electrode for collecting successively electrons from elemental strips of said area, said strips being transverse to the long dimension of said area.

5. In an electron camera arrangement, a photoelectric surface within the electron camera, means for forming an image of a linear portion of an object on said photoelectric surface to cause the emission of a stream of electrons therefrom, the ratio of the height of the area of the photoelectric surface which emits electrons when impinged upon by light from the linear portion of the object to the height of said linear portion being much greater than the ratio of the length of said area to the length of said linear portion, a collecting electrode for the photoelectrons emitted from said surface, and a member having a slit aperture therein in front of said collecting electrode.

6. In an electron camera arrangement, a photoelectric surface within the electron camera, means for forming an image of a linear portion of an object on said photoelectric surface to cause the emission of a stream of electrons therefrom, the ratio of the height of the area of the photoelectric surface which emits electrons when impinged upon by light from the linear portion of the object to the height of said linear portion being much greater than the ratio of the length of said area to the length of said linear portion, a collecting electrode for the electrons emitted from said surface, a member having a slit aperture therein in front of said collecting electrode, and means for deflecting the stream of photoelectrons emitted from said surface across said slit in a direction perpendicular to the long dimension of said slit.

7. In an electron camera arrangement, a photoelectric surface within the electron camera, optical means for forming a distorted image of a linear portion of an object on said photoelectric surface to cause the emission of a stream of electrons therefrom, said image being enlarged in a direction transverse to the long dimension of said linear portion with respect to the direction parallel to said long dimension, and means for collecting the photoelectric emission from successive elemental strips of the area of the photoelectric surface upon which the image is projected, said strips being taken transverse to the long dimension of said area.

8. In an electron camera arrangement, a photoelectric surface within the electron camera, optical means for forming in succession distorted images of successive linear portions of a continuously moving object on said photoelectric surface to cause the emission of a stream of electrons therefrom, said image being enlarged in a direction transverse to the long dimension of said linear portion with respect to the direction parallel to said long dimension, a collecting electrode for attracting electrons emitted from said

photoelectric surface, and a member having a slit aperture therein in front of said collecting electrode, the long dimension of said slit being transverse to the long dimension of said linear portion.

9. In an electron camera arrangement, a photoelectric surface within the electron camera, optical means for forming an image of a linear portion of an object on said photoelectric surface to cause the emission of a stream of photoelectrons therefrom, said image being enlarged in a direction transverse to the long dimension of said linear portion with respect to the direction parallel to said long dimension, a collecting electrode for attracting electrons emitted from said photoelectric surface, a member having a slit aperture therein in front of said collecting electrode, the long dimension of said slit being transverse to the long dimension of said linear portion, and means for deflecting the stream of photoelectrons emitted from said photoelectric surface across said slit in a direction transverse to the long dimension thereof.

10. In an electron camera arrangement, a photoelectric surface within the electron camera, means for forming an image of a linear portion of an object on said photoelectric surface to cause the emission of a stream of photoelectrons therefrom, said means including apparatus for moving said image periodically in a direction transverse to the long dimension of the linear portion, an electrode for successively collecting electrons emitted by the various elemental portions of the photoelectric surface struck by light from said object, and means for deflecting the stream of photoelectrons in a direction transverse to the long dimension of said linear portion of said object at a frequency which is the same as that of the movement of the image.

11. In an electron camera arrangement, a photoelectric surface within the electron camera, means for forming an image of a linear portion of an object on said photoelectric surface to cause the emission of a stream of photoelectrons therefrom, said means including apparatus for moving said image periodically in a direction transverse to the long dimension of the linear portion, an electrode for successively collecting electrons emitted by the various elemental portions of the photoelectric surface struck by light from said object, and means for deflecting said photoelectron stream linearly with respect to time in a direction parallel to the long dimension of said linear portion.

12. The method of compensating for irregularities in a photoelectric surface of an electrode in an electron camera tube used as a linear scanner of an object, which comprises forming a distorted optical image of a line of the object upon said surface, the ratio of the height of the image to the height of the linear portion of the object being much greater than the ratio of the length of said image to the length of said object, and utilizing the photoelectric emission from elemental portions taken transverse to the long axis of said image to form an image current, the emission from the entire width of an elemental portion giving rise to a signal representative of a single elemental area of the object.

13. The method of compensating for irregularities in the photoelectric surface of a dissector cathode, the dissector being used as a linear scanner, which comprises projecting a moving line

image upon said cathode to form a corresponding moving electrical image and deflecting said moving electrical image at the same frequency as the moving optical image and in such a phase that the moving line image is continuously focused at the same line, which line passes through the aperture in front of the dissector pick-up electrode.

14. In an electron camera arrangement, a photoelectric surface within the electron camera, means for forming an image of a linear portion of an object on said photoelectric surface to cause the emission of a stream of photoelectrons therefrom, said means including apparatus for moving said image periodically in a direction transverse to the long dimension of the linear portion, an electrode for successively collecting photoelectrons emitted by the various elemental portions of the photoelectric surface struck by light from said object, means for deflecting said photoelectron stream linearly with respect to time in a direction parallel to the long dimension of said linear portion, and means for deflecting the stream of photoelectrons in a direction transverse to the long dimension of said linear portion of said object at a frequency which is the same as that of the movement of said image.

15. In an electron camera arrangement, a photoelectric surface within the electron camera, means for forming an image of a linear portion on an object of said photoelectric surface to cause the emission of a stream of photoelectrons therefrom, said means including apparatus for moving said image periodically in a direction transverse to the long dimension of the linear portion, an electrode for successively collecting photoelectrons emitted by the various elemental portions of the photoelectric surface struck by light from said object, means for deflecting said photoelectron stream linearly with respect to time in a direction parallel to the long dimension of said linear portion, and means for deflecting the stream of photoelectrons in a direction transverse to the long dimension of said linear portion of said object at a frequency which is the same as that of the movement of said image, the frequency of the movement in the direction parallel to the long dimension of the linear portion being different from the frequency of movement in the direction transverse to the long dimension of the linear portion.

16. In an electron camera arrangement, a photoelectric surface within the electron camera, means for forming an image of successive linear portions of a motion picture film on said photoelectric surface to cause the emission of a stream of photoelectrons therefrom, said linear portion constituting a relatively small part of a frame of said motion picture film, said image forming means including apparatus for moving said image periodically in a direction transverse to the long dimension of the linear portion, an electrode for successively collecting photoelectrons emitted by the various elemental portions of the photoelectric surface struck by light from said object, and means for deflecting the stream of photoelectrons in a direction transverse to the long dimension of said linear portion of said object at a frequency which is the same as that of the movement of the image but which frequency is different from that at which complete frames of said motion picture film are scanned.

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