Oct. 8, 1940. J. R. HEFELE ET AL 2,217,168

ELECTRON DISCHARGE DEVICE

Filed Feb. 19, 1938

FIG. 1

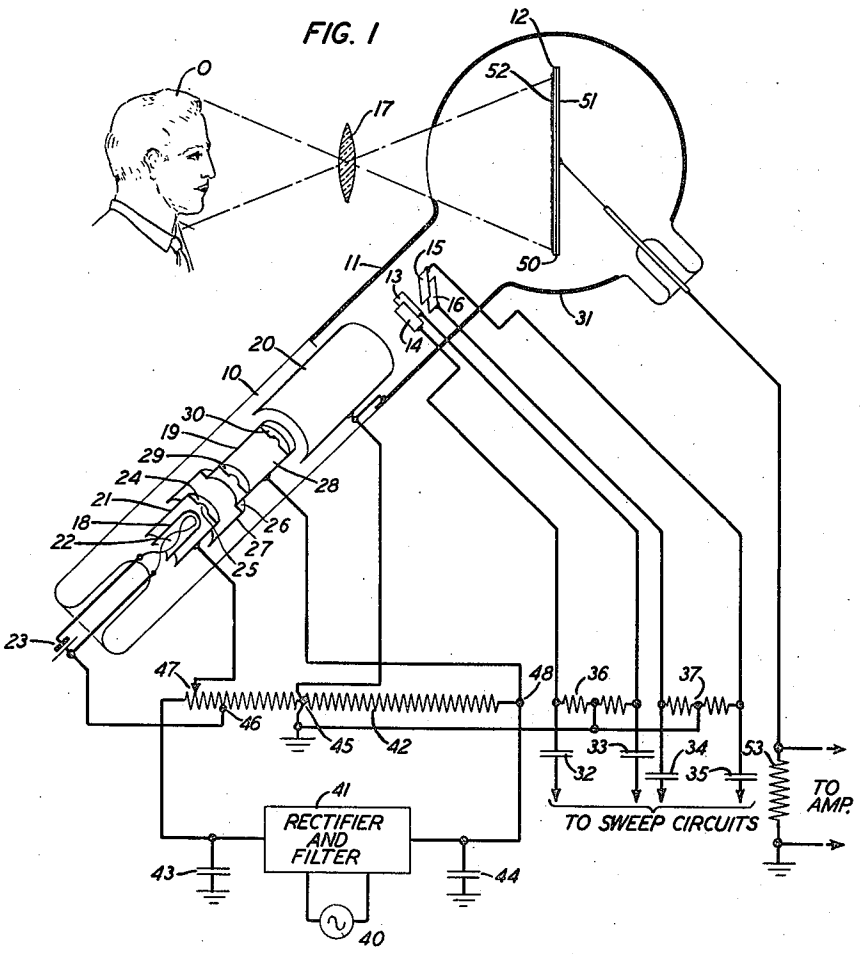
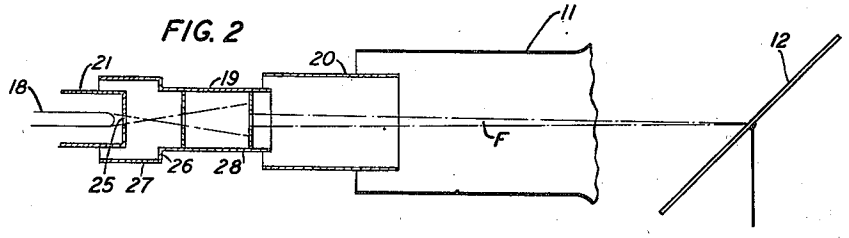


FIG. 2



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ELECTRON DISCHARGE DEVICE

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15 Claims. (Cl. 250—27)

This invention relates to electron discharge devices and more specifically to electronic pick-up devices for the transmission of television images.

In television operation with a cathode ray type of pick-up device at the transmitter and a cathode ray receiving tube for reproducing the image, trouble was encountered in the form of a diffused dark area in the approximate center of the receiving tube screen. An experimental investigation of this phenomenon has resulted in the determination of its cause and the provision of means for eliminating this effect. The present invention is based upon the discovery that this diffused dark area results from a spray of secondary electrons surrounding a focussed beam in the cathode ray pick-up device at the transmitter.

It is an object of this invention to provide electrode arrangements for cathode ray pick-up tubes which prevent the above-mentioned spray of secondary electrons around the focussed beam.

In the single embodiment of this invention which is herein described by way of example, a cathode ray tube is provided comprising an electron gun arrangement for generating, accelerating and focussing a beam of electrons upon a photosensitive target which comprises a dielectric element which may be of glass and which may have a coating on the surface thereof remote from the beam of suitable metallic material and a globular layer of photosensitized silver elements on the surface thereof near said electron gun, and two pairs of deflecting plates for causing the beam to scan in turn the respective elemental areas of a field on the target. The electron gun arrangement preferably comprises a cathode, a first anode adjacent the cathode comprising a cylindrical portion having one or more metallic apertured diaphragms therein, and a second anode which is preferably a metallic cylinder of larger diameter than the cylindrical portion of the first anode. The first anode is placed at a relatively high potential with respect to that of the cathode, that is of the order of 3000 volts, while the second anode is placed at a potential which is positive with respect to that of the cathode but which is substantially negative with respect to the potential of the first anode, as, for example, from 800 to 900 volts with respect to the potential of the cathode. Due to the fact that the second anode is at a negative potential with respect to that of the first anode, the secondary electrons emitted by the primary beam impinging upon one or the other of the diaphragms of the first anode are repelled by the second anode. Inasmuch as the electrons in the primary beam are of high velocity, the electrons thereof are decelerated by the second anode but are not prevented from reaching the screen or target. Between the first anode and the cathode is preferably arranged a control element for varying the intensity of the primary electron beam, which element in the preferred embodiment constitutes a cylindrical member having a metal cap in which is located a circular aperture. This cylinder is placed directly around the cathode.

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 schematically a cathode ray pick-up device for television transmission embodying the principles of this invention; and

Fig. 2 is a schematic diagram of the electron lens system of the tube shown in Fig. 1.

Referring more particularly to the drawing, Fig. 1 shows a cathode ray tube 10 and associated apparatus and circuits to render the tube suitable for a pick-up device for the transmission of television images to a receiving station. The device 10 preferably comprises a gas-tight container 11 enclosing an electron gun for producing a moving beam of electrons and for focussing and accelerating this beam toward a screen or target 12 which is mounted in the end of the tube remote from the electron gun, and means such as two pairs of deflecting plates 13, 14 and 15, 16 for deflecting the beam along a predetermined path of the screen 12, which path successively covers the elemental areas of a field on the screen. External to the tube 10 is mounted a suitable lens system, which is represented by way of example as a single convex lens 17, for focussing an image of an object or field of view 0 upon a surface of the screen or target 12, which will be hereinafter designated the front surface.

The electron gun arrangement comprises a cathode 18, a first anode 19, a second anode 20, and a control element 21 directly surrounding the cathode 18.

The cathode 18 is heated by a heater element 22 which is supplied with heating current from a source of direct current potential 23. A portion of the cathode 18 near the control element 21 is preferably coated with a thin layer of electron emissive material.

The control element 21 preferably comprises a cylindrical member having a cap 24 with an aperture 25 therein opposite the portion of the cathode 18 having the electron emissive coating. The control element 21 is placed preferably at a negative potential with respect to that of the cathode 18 by means which will be described more fully below. The purpose of the control element is to vary the intensity and the size of the electron beam.

The first anode 19 comprises portions of two cylinders of different diameters joined by a ring-

shaped connecting member 26. The cylindrical portion 27 is of larger diameter than and extends up closely to the control element 21 while the cylindrical portion 28 is of approximately the same diameter as that of the control element 21 and extends toward the screen 12. The portion 28 preferably encloses two apertured diaphragms 29 and 30, to assist in the focussing of the electron stream generated by the cathode 18.

The second anode 20 preferably comprises a metallic cylindrical member of approximately the same diameter as the cylindrical portion 27 of the first anode 19. The member 20 extends from a point near the end of the first anode 19 toward the screen 12. If desired, it may be connected to a conducting coating 31 located on the inside walls of the tube 10. This conducting coating may be of any material suitable for the purpose such as, for example, aluminum, platinum or gold. The coating may be in the form of a cylinder of thin sheet aluminum or other metal, or it may be an evaporated film of the aluminum, platinum or gold.

In order to cause the electron beam, generated by the electron gun apparatus described above, to scan every elemental area of the image or field of view on the screen or target 12, suitable deflecting means, such as, for example, two pairs of deflecting plates 13, 14 and 15, 16, the axes of which are located at right angles to each other, are provided. To the deflecting plates 15, 16 are applied deflecting voltages of framing frequency and having a saw-tooth wave form to produce the vertical deflection of the beam while deflecting voltages of line scanning frequency and of saw-tooth wave form are applied to the deflecting plates 13, 14 to produce the horizontal deflection of the beam. Any suitable sweep circuits (not shown) may be used to generate these horizontal and vertical deflecting voltages. For example, reference may be made to Patent 2,178,464, issued October 31, 1939 to M. W. Baldwin, Jr., which discloses appropriate balanced sweep circuits for this purpose. Connections may be made from the balanced sweep circuits to the pairs of plates 13, 14 and 15, 16 by means of coupling condensers 32, 33, and 34, 35 respectively. High coupling resistors 36 and 37 are respectively connected across the pairs of plates 13, 14 and 15, 16. The mid-points of the resistors 36 and 37 are connected to the second anode 20 in order that the average potential of the deflecting plates is at all times substantially equal to the potential of the second anode 20. For a full description of the advantages of balanced sweep circuits, reference may be made to the above-mentioned Baldwin patent and also to Patent 2,209,199, issued July 23, 1940 to Frank Gray.

The direct current potentials for biasing the different elements of the electron gun with respect to the cathode are derived from an alternating current oscillator 40, the output of which is rectified and filtered by a device represented schematically by the block 41, which has in its output circuit a potentiometer resistor 42 having a plurality of taps from which the various voltages may be taken. An alternating current ground is provided for two spaced-apart terminals of the potentiometer resistor 42 by means of condensers 43 and 44 which are connected between these terminals and ground. An inner tap 45 of the potentiometer resistor 42 is connected to ground and also to the second anode 20. A second tap 46, representing a potential which is approximately 800 to 900 volts negative with respect to that of the tap 45, is connected to the cathode 18, and an adjustable tap 47, which represents a potential which may be varied within a region of from −60 to −90 volts with respect to that of the cathode 18, is connected to the control element 21. Tap 48 is connected to the first anode 19 and represents a potential which is approximately 3000 volts positive with respect to the potential of the cathode 18, that is, with respect to the potential of the tap 46, and a potential which is 2100 to 2200 volts positive with respect to that of ground and with respect to the potential of the second anode 20. It will be understood that the above values are given only by way of example and that the invention is not limited thereto.

The screen or target 12 preferably comprises a dielectric member 50 of glass or mica having a conducting backing 51 of a suitable material such as silver or platinum and a globular layer 52 of silver which has been oxidized and photosensitized with photoelectric material, such as caesium. For a description of a method of preparing photosensitized screens or targets similar to that described above, reference may be made to Patent 2,173,923, issued September 26, 1939 to Gordon K. Teal.

Between the metallic backing plate 51 of the target 12 and the second accelerating anode 20 is connected a signal resistor 53 which may also be placed in the input circuit of an amplifying device (not shown). If desired, a biasing battery, (not shown) may be connected between the resistance 53 and the second accelerating anode 20 although the device is operative without this battery.

The operation of the device shown in Fig. 1 is as follows: Light from a suitable source (not shown) and reflected from the object or field of view 0 is focussed upon the photosensitive mosaic surface 52 of the target or screen 12 by means of the optical system represented by the lens 17. The photoemissive material 52 on the mosaic screen emits electrons, the degree of emission from any elemental area thereof being dependent upon the intensity of light projected on the front surface of the screen from the object. Each photosensitive globule thus becomes charged because of the condenser action of the dielectric member 50 and the metallic coating 51 and the photoemissive surface 52 on its opposing surfaces, the degree of the charge for any particular globule corresponding to the light-tone value of the corresponding elemental area of the object. Electrons are emitted from the cathode 18 and accelerated toward the anode 19 because of the high positive potential applied thereto with respect to the potential of the cathode. With reference to Fig. 2, it will be seen that there is an electron lens action between the cathode 18 and the control element 21 and between the control element 21 and the first anode 19, which causes the formation of a converging electron beam which would be focussed in a fine spot at point F if it were not for the action of the diverging electron lens action between the first anode 19 and the second anode 20. Due to the negative potential applied to the second anode 20 with respect to that of the first anode 19, the speed of the electrons in the beam is reduced and the electron beam is rendered diverging to the extent that instead of focussing into a spot at the point F, it is forcussed into a spot on the screen or target 12. This electron beam is caused to scan every elemental area in turn of the photosensitive

surface 52 by means of the saw-toothed voltages applied between the pairs of deflecting plates 13, 14 and 15, 16.

This scanning is repeated about twenty-four times a second so that advantage can be taken at the receiving station of the phenomenon of persistence of vision. As the electron beam scans the mosaic surface, it passes over each element in turn, releasing the charge it has acquired and returning it to equilibrium. Due to the fact that each element is coupled by capacity to the backing plate 51, the sudden change of charge of the elements will induce a change of charge on the backing plate 51 and result in a current pulse in the signal resistor 53 in the external circuit. The succession of pulses constitutes the image current. For a more complete disclosure of a tube employing photosensitive mosaics together with a more complete description of a method of operation thereof, reference may be made to an article entitled "The iconoscope" by V. K. Zworykin in the January, 1934 Proceedings of the Institute of Radio Engineers, pages 16 to 32, inclusive, and to an article by the same author in the July, 1936 "R. C. A. Review" page 60, entitled "Iconoscopes and kinescopes in television."

In certain well-known electron gun arrangements of the prior art the primary electrons constituting the beam of electrons are surrounded by a halo of secondary electrons which because of their small velocity and because they are inside the focus of the electron lens formed by the first and second anodes are not focussed on the screen by the lens between the first and second anodes. In the arrangement of this invention, however, while secondary electrons may be generated by the impingement of primary electrons upon the diaphragms 29 and 30 of the first anode 19, they are caused to return to this anode due to the negative potential of the second anode 20 with respect to the potential of the first anode 19. This arrangement has been found to be very satisfactory in practice to prevent the fine spray of secondary electrons from reaching the photosensitive target and at the same time makes possible a sharp focus of primary beam electrons upon the photosensitive screen. The picture received from such a pick-up device the screen of a receiving tube shows no trace of the spurious image usually appearing in the field when well-known electron gun systems of the prior art are used. It was observed that the magnitude of the received signal was considerably greater than heretofore obtained and the resolution of the system seemed improved.

While the invention has been described in connection with a tube employing a target comprising photoemissive material, it is obvious that the invention is not limited to the use of this type of target. For example, the invention is equally applicable to a tube including a target comprising a metal backing plate having a layer of high resistance photoconducting material thereon. Such a target and the use thereof in a pick-up tube is described in Patent 2,150,160, issued March 14, 1939 to Frank Gray.

Various other modifications may obviously be made without departing from the spirit of the invention, the scope of which is defined by the appended claims.

What is claimed is:

1. A cathode ray device comprising a target having a photosensitive portion upon which radiations from an object are applied and which is adapted to be scanned with a beam of electrons to produce image signals, said device being adapted for use in connection with a receiving member on the screen of which an image of said object is reproduced, an electron gun for generating a beam of electrons to impinge upon said target, said electron gun having means normally generating secondary electrons by the impact of the primary electrons upon said means, which secondary electrons will, if they are not suppressed, reach the photosensitive portion of said target to thereby cause the generation of spurious signals which in turn cause the formation of a diffused dark spot over a large portion of the screen area of said receiving member, and means adjacent to or forming a portion of said electron gun for substantially preventing the flow of said secondary electrons to said target and the formation of said dark spot.

2. A cathode ray device comprising a target having a photosensitive portion upon which radiations from an object are applied and which is adapted to be scanned with a beam of electrons to produce image signals, said device being adapted for use in connection with a receiving member on the screen of which an image of said object is reproduced, a cathode for emitting a stream of primary electrons, a first electrode member between said cathode and said target, means for placing said first electrode member at a potential which is positive with respect to the potential of said cathode, said first electrode having a portion thereof in the path of some of the electrons of said stream, which portion tends to give off secondary electrons when struck by said primary electrons, which secondary electrons will, if they are not suppressed, reach the photosensitive portion of said target to thereby cause the generation of spurious signals which in turn cause the formation of a diffused dark spot over a large portion of the screen area of said receiving member, a second electrode member, and means for placing the second electrode member at a potential which is sufficiently negative with respect to the potential of said first electrode member to prevent, at least in large measure, the passage of said secondary electrons to said target and the formation of said dark spot.

3. A cathode ray device comprising a target having a photosensitive portion upon which radiations from an object are applied and which is adapted to be scanned with a beam of electrons to produce image signals, said device being adapted for use in connection with a receiving member on the screen of which an image of said object is reproduced, a cathode for emitting a stream of primary electrons, an anode adjacent said cathode for accelerating said electrons towards said target, the structure of said anode being such that secondary electrons are generated when the primary electrons impinge upon portions thereof, which secondary electrons will, if they are not suppressed, reach the photosensitive portion of said target to thereby cause the generation of spurious signals which, in turn, cause the formation of a diffused dark spot over a large portion of the screen area of said receiving member, and electrode means between said anode and said target to focus said primary electrons into a spot on said target, said electrode means being placed at such a negative potential with respect to the anode that said secondary electrons are substantially prevented from reaching said target and the formation of said dark spot is substantially obviated.

4. A cathode ray device comprising a target having a photoemissive portion upon which radiations from an object are applied and which is adapted to be scanned with a beam of electrons to produce image signals, said device being adapted for use in connection with a receiving member on the screen of which an image of said object is reproduced, an electron gun for generating a beam of electrons to impinge upon said target, said electron gun having means normally generating secondary electrons by the impact of the primary electrons upon said means, which secondary electrons will, if they are not suppressed, reach the photoemissive portion of said target to thereby cause the generation of spurious signals which in turn cause the formation of a diffused dark spot over a large portion of the screen area of said receiving member, and means including a portion of said electron gun for substantially preventing the flow of said secondary electrons to said target and the formation of said dark spot.

5. A cathode ray device comprising a target having a photosensitive portion upon which radiations from an object are applied and which is adapted to be scanned with a beam of electrons to produce image signals, said device being adapted for use in connection with a receiving member on the screen of which an image of said object is reproduced, a cathode for emitting a stream of primary electrons, a first anode comprising a cylindrical member having at least one apertured diaphragm therein which emits secondary electrons when impinged upon by a beam of primary electrons from said cathode, which secondary electrons will, if they are not suppressed, reach the photosensitive portion of said target to thereby cause the generation of spurious signals which, in turn, cause the formation of a diffused dark spot over a large portion of the screen area of said receiving member, a second anode comprising a cylindrical metallic member of larger diameter than the cylinder of said first anode, means for placing said first anode at a relatively high positive potential with respect to said cathode, and means for placing said second anode at a potential which is positive with respect to said cathode but which is negative with respect to said first anode by an amount sufficient to substantially suppress said secondary electrons and, at least in large measure, to prevent the formation of said dark spot.

6. A cathode ray device comprising a target having a photosensitive portion upon which radiations from an object are applied and which is adapted to be scanned with a beam of electrons to produce image signals, said device being adapted for use in connection with a receiving member on the screen of which an image of said object is reproduced, a cathode for emitting a stream of primary electrons, a control member placed around the cathode, a first anode comprising a cylindrical member having at least one apertured diaphragm therein which emits secondary electrons when impinged upon by a beam of primary electrons from said cathode, which secondary electrons will, if they are not suppressed, reach the photosensitive portion of said target to thereby cause the generation of spurious signals which, in turn, cause the formation of a diffused dark spot over a large portion of the screen area of said receiving member, a second anode comprising a cylindrical metallic member of larger diameter than the cylinder of said first anode, means for placing said first anode at a relatively high positive potential with respect to said cathode, and means for placing said second anode at a potential which is positive with respect to said cathode but which is negative with respect to said first anode by an amount sufficient to substantially suppress said secondary electrons and, at least in large measure, to prevent the formation of said dark spot.

7. In a television transmitter tube having a target comprising photoelectric material adapted to have an image of an object formed thereon and a primary beam generating electron gun therein, said tube being adapted for use in connection with a receiving member on the screen of which an image of said object is reproduced, the method of preventing, in large measure, secondary electrons emitted by a portion of the electron gun upon which the primary beam strikes from reaching the target and thereby causing the generation of spurious signals which, in turn, causes the formation of a diffused dark spot over a large portion of the screen area of said receiving member which comprises the step of forming a retarding field between the target and the portion of the gun giving rise to the secondary electrons to substantially suppress the flow of said secondary electrons toward said target and, in large measure, obviate the formation of said dark spot.

8. A cathode ray device comprising a target having a photosensitive portion upon which radiations from an object are applied and which is adapted to be scanned with a beam of electrons to produce image signals, a cathode for emitting primary electrons, a first electrode member between said cathode and said target, means for placing said first electrode at a potential which is highly positive with respect to said cathode, said first electrode comprising at least one apertured metallic diaphragm in the path of the electrons, the aperture in which diaphragm has a smaller cross-sectional area than the stream of electrons at the plane of the diaphragm whereby primary electrons strike said diaphragm and cause the emission of secondary electrons which secondary electrons would, if they were not suppressed, reach the photosensitive portion of said target in a fine spray over at least the major portion thereof which spray would cause the generation of spurious signals, a second electrode between said first electrode and said target and closely adjacent said first electrode member, means for placing the second electrode at a potential which is positive with respect to that of said cathode but which is less than half the potential of said first electrode with respect to said cathode and which potential bears the proper relation to the potential of the first electrode to cause the stream of electrons to be focussed to a fine spot at the target, the potential of said second electrode member being sufficiently negative with respect to that of said first electrode member to substantially prevent the passage of said secondary electrons to said target, and means for causing the focussed spot to scan every elemental area in turn of a field on said photosensitive portion of the target.

9. A cathode ray device comprising a target having a photosensitive portion upon which radiations from an object are applied and which is adapted to be scanned with a beam of electrons to produce image signals, a cathode for emitting primary electrons, a first electrode member between said cathode and said target, means for placing said first electrode at a potential which is highly positive with respect to

said cathode, said first electrode comprising at least one apertured metallic diaphragm in the path of the electrons, the aperture in which diaphragm has a smaller cross-sectional area than the stream of electrons at the plane of the diaphragm whereby primary electrons strike said diaphragm and cause the emission of secondary electrons which secondary electrons would, if they were not suppressed, reach the photosensitive portion of said target in a fine spray over at least the major portion thereof which spray would cause the generation of spurious signals, a second electrode between said first electrode and said target and closely adjacent said first electrode member, means for placing the second electrode at a potential which is positive with respect to that of said cathode but which is less than half the potential of said first electrode with respect to said cathode and which potential bears the proper relation to the potential of the first electrode to cause the stream of electrons to be focussed to a fine spot at the target, the potential of said second electrode member being sufficiently negative with respect to that of said first electrode member to substantially prevent the passage of said secondary electrons to said target, means for causing the focussed spot to scan every elemental area in turn of a field on said photosensitive portion of the target, said target being placed in a space the potential of which is substantially equal to that of the second electrode member.

10. A cathode ray device comprising a target having a photosensitive portion upon which radiations from an object are applied and which is adapted to be scanned with a beam of electrons to produce image signals, a cathode for emitting primary electrons, a first electrode member between said cathode and said target, means for placing said first electrode at a potential which is highly positive with respect to said cathode, said first electrode comprising at least one apertured metallic diaphragm in the path of the electrons, the aperture in which diaphragm has a smaller cross-sectional area than the stream of electrons at the plane of the diaphragm whereby primary electrons strike said diaphragm and cause the emission of secondary electrons which secondary electrons would, if they were not suppressed, reach the photosensitive portion of said target in a fine spray over at least the major portion thereof which spray would cause the generation of spurious signals, a second electrode between said first electrode and said target and closely adjacent said first electrode member, means for placing the second electrode at a potential which is positive with respect to that of said cathode but which is less than half the potential of said first electrode with respect to said cathode and which potential bears the proper relation to the potential of the first electrode to cause the stream of electrons to be focussed to a fine spot at the target, the potential of said second electrode member being sufficiently negative with respect to that of said first electrode member to substantially prevent the passage of said secondary electrons to said target, a third electrode member a portion of which is adjacent said target, means for placing said third electrode member at the same potential as said second electrode member, and means for causing the focussed spot to scan every elemental area in turn of a field on said photosensitive portion of the target.

11. A cathode ray device comprising a target having a photosensitive portion upon which radiations from an object are applied and which is adapted to be scanned with a beam of electrons to produce image signals, a cathode for emitting primary electrons, a first electrode member between said cathode and said target, means for placing said first electrode at a potential which is highly positive with respect to said cathode, said first electrode comprising at least one apertured metallic diaphragm in the path of the electrons, the aperture in which diaphragm has a smaller cross-sectional area than the stream of electrons at the plane of the diaphragm whereby primary electrons strike said diaphragm and cause the emission of secondary electrons which secondary electrons would, if they were not suppressed, reach the photosensitive portion of said target in a fine spray over at least the major portion thereof which spray would cause the generation of spurious signals, a second electrode between said first electrode and said target and closely adjacent said first electrode member, means for placing the second electrode at a potential which is positive with respect to that of said cathode but which is less than half the potential of said first electrode with respect to said cathode and which potential bears the proper relation to the potential of the first electrode to cause the stream of electrons to be focussed to a fine spot at the target, the potential of said second electrode member being sufficiently negative with respect to that of said first electrode member to substantially prevent the passage of said secondary electrons to said target, a third electrode member a portion of which is adjacent said target, means for placing said third electrode member at the same potential as said second electrode member, and electrostatic means located completely within a space the potential of which is substantially equal to that of said second electrode member for causing the focussed spot to scan every elemental area in turn of a field on said photosensitive portion of the target.

12. A cathode ray device comprising a target having a photosensitive portion upon which radiations from an object are applied and which is adapted to be scanned with a beam of electrons to produce image signals, a cathode for emitting primary electrons, a first electrode member between said cathode and said target, means for placing said first electrode at a potential which is highly positive with respect to said cathode, said first electrode comprising at least one apertured metallic diaphragm in the path of the electrons, the aperture in which diaphragm has a smaller cross-sectional area than the stream of electrons at the plane of the diaphragm whereby primary electrons strike said diaphragm and cause the emission of secondary electrons which secondary electrons would, if they were not suppressed, reach the photosensitive portion of said target in a fine spray over at least the major portion thereof which spray would cause the generation of spurious signals, a second electrode between said first electrode and said target and closely adjacent said first electrode member, means for placing the second electrode at a potential which is positive with respect to that of said cathode but which is less than half the potential of said first electrode with respect to said cathode and which potential bears the proper relation to the potential of the first electrode to cause the stream of electrons to be focussed to a fine spot at the target, the potential of said second electrode mem-

ber being sufficiently negative with respect to that of said first electrode member to substantially prevent the passage of said secondary electrons to said target, a third electrode member a portion of which is adjacent said target, means for placing said third electrode member at the same potential as said second electrode member, electrostatic means located completely within a space the potential of which is substantially equal to that of said second electrode member for causing the focussed spot to scan every elemental area in turn of a field on said photosensitive portion of the target, and means for making the average potential of said electrostatic means substanially equal to the potential of said second electrode.

13. A cathode ray device comprising a target having a photosensitive portion upon which radiations from an object are applied and which is adapted to be scanned with a beam of electrons to produce image signals, a cathode for emitting primary electrons, a first electrode member between said cathode and said target, a cylindrical member around said cathode, means for placing said cylindrical member at a negative potential with respect to said cathode to concentrate the electrons from said cathode to a point within said first electrode member, means for placing said first electrode at a potential which is highly positive with respect to said cathode, said first electrode comprising at least one apertured metallic diaphragm in the path of the electrons, the aperture in which diaphragm has a smaller cross-sectional area than the stream of electrons at the plane of the diaphragm whereby primary electrons strike said diaphragm and cause the emission of secondary electrons which secondary electrons would, if they were not suppressed, reach the photosensitive portion of said target in a fine spray over at least the major portion thereof which spray would cause the generation of spurious signals, a second electrode between said first electrode and said target and closely adjacent said first electrode member, means for placing the second electrode at a potential which is positive with respect to that of said cathode but which is less than half the potential of said first electrode with respect to said cathode and which potential bears the proper relation to the potential of the first electrode to cause the stream of electrons to be focussed to a fine spot at the target, the potential of said second electrode member being sufficiently negative with respect to that of said first electrode member to substantially prevent the passage of said secondary electrons to said target, and means for causing the focussed spot to scan every elemental area in turn of a field on said photosensitive portion of the target.

14. A cathode ray device comprising a target having a photosensitive portion upon which radiations from an object are applied and which is adapted to be scanned with a beam of electrons to produce image signals, a cathode for emitting primary electrons, a first electrode member between said cathode and said target, means for placing said first electrode at a potential which is highly positive with respect to said cathode, said first electrode comprising at least one apertured metallic diaphragm in the path of the electrons, the aperture in which diaphragm has a smaller cross-sectional area than the stream of electrons at the plane of the diaphragm whereby primary electrons strike said diaphragm and cause the emission of secondary electrons which secondary electrons would, if they were not suppressed, reach the photosensitive portion of said target in a fine spray over at least the major portion thereof which spray would cause the generation of spurious signals, a second electrode between said first electrode and said target and closely adjacent said first electrode member, means for placing the second electrode at a potential which is positive with respect to that of said cathode but which is less than half the potential of said first electrode with respect to said cathode and which potential bears the proper relation to the potential of the first electrode to cause the stream of electrons to be focussed to a fine spot at the target, the potential of said second electrode member being sufficiently negative with respect to that of said first electrode member to substantially prevent the passage of said secondary electrons to said target, a third electrode member a portion of which is adjacent said target, means for placing said third electrode member at the same potential as said second electrode member, and means for causing the focussed spot to scan every elemental area in turn of a field on said photosensitive portion of the target, said second electrode member comprising a metallic cylinder and said third electrode member comprising a conducting coating on the wall of the device extending from the region of the second electrode to the region of the target.

15. A cathode ray device comprising a target having a photosensitive portion upon which radiations from an object are applied and which is adapted to be scanned with a beam of electrons to produce image signals, a cathode for emitting primary electrons, a first electrode member between said cathode and said target, means for placing said first electrode at a potential which is highly positive with respect to said cathode, said first electrode comprising at least one apertured metallic diaphragm in the path of the electrons, the aperture in which diaphragm has a smaller cross-sectional area than the stream of electrons at the plane of the diaphragm whereby primary electrons strike said diaphragm and cause the emission of secondary electrons which secondary electrons would, if they were not suppressed, reach the photosensitive portion of said target in a fine spray over at least the major portion thereof which spray would cause the generation of spurious signals, a second electrode between said first electrode and said target and closely adjacent said first electrode member, means for placing the second electrode at a potential which is positive with respect to that of said cathode but which is less than half the potential of said first electrode with respect to said cathode and which potential bears the proper relation to the potential of the first electrode to cause the stream of electrons to be focussed to a fine spot at the target, the potential of said second electrode member being sufficiently negative with respect to that of said first electrode member to substantially prevent the passage of said secondary electrons to said target, means for forming a field free space between said second electrode member and said target, and electrostatic means completely within said field free space for causing the focussed spot to scan every elemental area in turn of a field on said photosensitive portion of the target.

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