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McIntyre, deceased

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[54] **ELECTRON GUN**

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[52] **U.S. Cl.**..... **315/14;** 315/31 R; 315/5.34; 315/5.39; 315/382; 313/452

[51] **Int. Cl.**[2]..... **H01J 29/46;** H01J 29/56

[58] **Field of Search**..... 315/13 ST, 14, 15, 16, 315/31 R, 5, 5.34, 5.39, 5.41, 5.49, 382; 313/346 R

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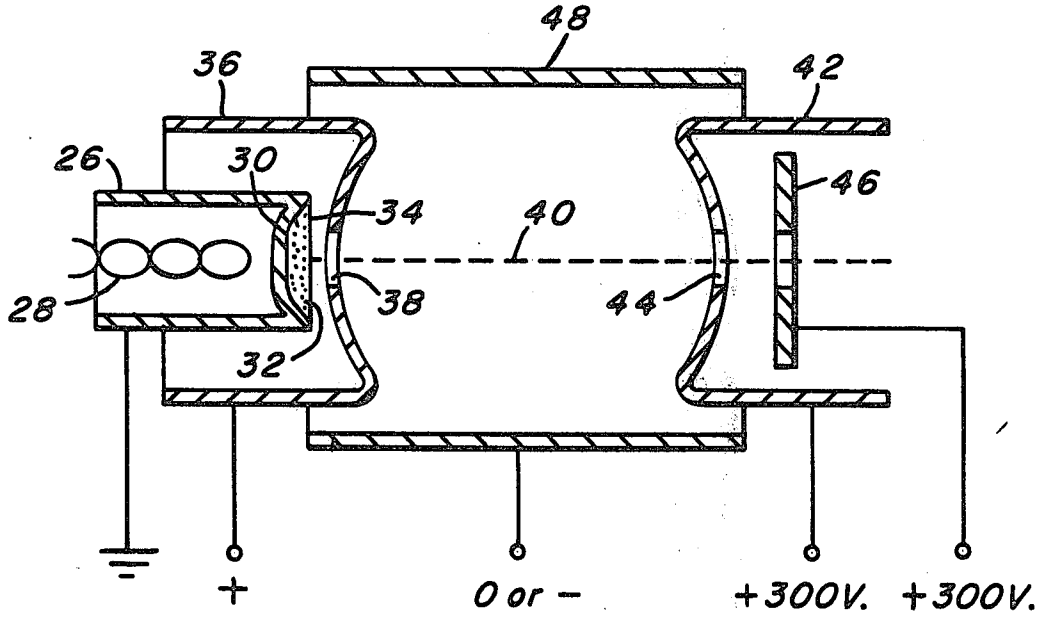
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[57] **ABSTRACT**

An electron gun structure for cathode ray tubes, particularly cathode ray tubes employing high quantum efficiency silicon as a photoconductor target. Electrons from a cathode are formed into an electron beam of high current density with small beam diameter by means of a specially-shaped control grid and anode, together with a cylindrical focus electrode between the control grid and anode which prevents the electrons in the beam from diverging due to mutual electrostatic repulsion.

7 Claims, 2 Drawing Figures



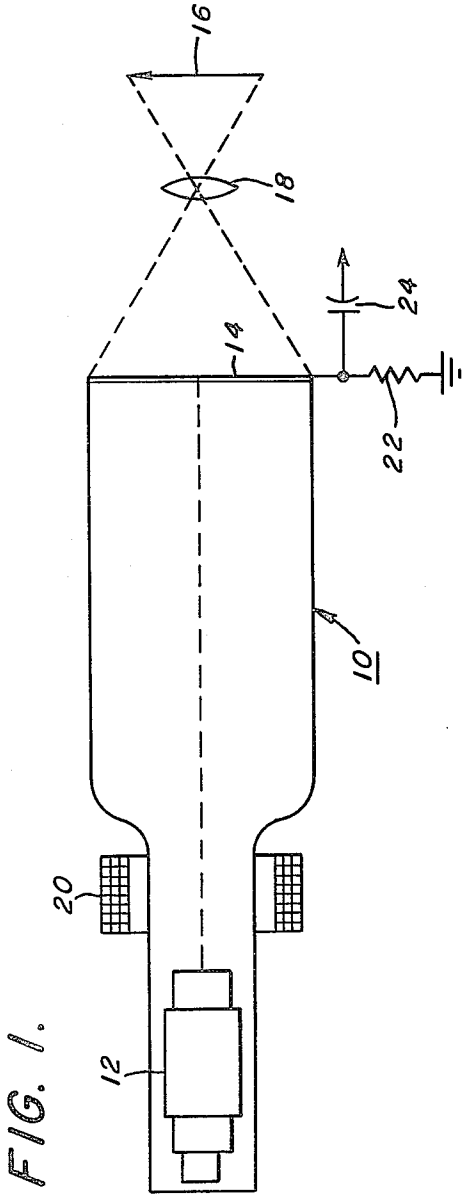

16
18
24
14
22
10
20
12

FIG. 1.

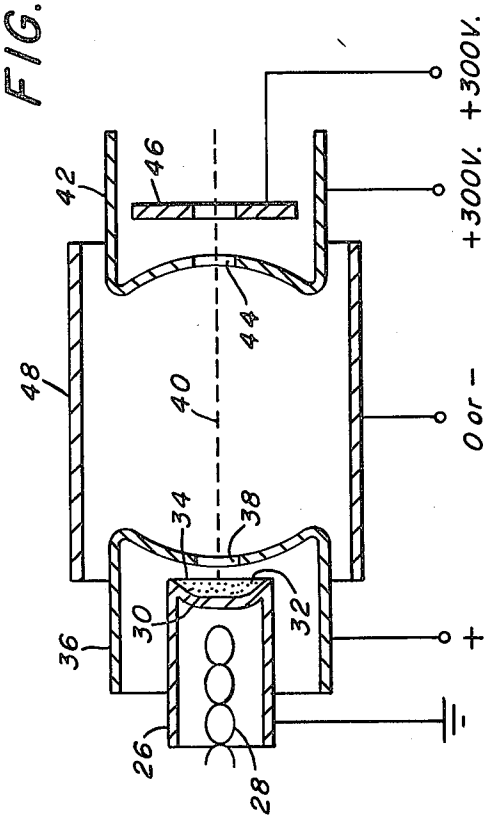

+300V.
+300V.
0 or -
+
42
46
44
48
40
34
38
30
32
36
26
28

FIG. 2.

ELECTRON GUN

BACKGROUND OF THE INVENTION

In the normal electron gun system, electrons emitted from an oxide coating on a cathode pass through apertures formed in a control grid, an accelerating anode and a beam limiting aperture. Normally, the control grid is maintained at a negative potential with respect to the cathode, which is grounded; while the accelerating anode and beam limiting aperture are normally maintained at a positive potential, typically about +300 volts.

The electrostatic lens formed by prior art electron guns of this type causes all of the electrons to be emitted from a very small area in the center of the cathode. The prior art lens system of this type also causes electrons to have a radial velocity component which produces a crossover and a diverging beam beyond the crossover point. This reduces the beam density at the plane of the limiting aperture; and most of the electrons that pass through the limiting aperture will have radial components of velocity. These radial components of velocity cause the beam to have a large cross section at the focal point where fields are applied to focus the beam at the target surface.

Under ideal conditions, the current load on the cathode of an electron gun should be spread over a large area if long life is to be achieved. Furthermore, the electrons passing through the limiting aperture should not have radial components of velocity if a small focal point is desired; and the electrons should not be permitted to travel a diverging path when approaching the beam limiting aperture if high current densities are required.

SUMMARY OF THE INVENTION

In accordance with the present invention, a high current density, high resolution electron gun is provided which produces a high current density electron beam of small diameter, particularly adapted for use in cathode ray tubes employing high quantum efficiency silicon as a photoconductor target.

Specifically, there is provided an electron gun structure comprising a cathode for emitting an electron beam, the cathode comprising a layer of an oxide adapted to emit electrons and having a smooth, shaved surface. A dish-shaped control grid is positioned beyond the cathode and has a central aperture through which electrons from the cathode can pass and in which the convex side of the dish-shaped grid faces the cathode. A dish-shaped accelerating anode, similar in shape to the control grid, is spaced ahead of the control grid and in the path of travel of the electrons from the cathode. This accelerating grid has a central aperture at the bottom of its dish-shaped configuration through which electrons can pass, the concave side of the dish-shaped accelerating anode facing the control grid. Finally, a generally annular focus electrode surrounds the electron beam between the control grid and the accelerating anode.

The cathode is maintained at ground potential; while the control grid is maintained at ground potential or slightly positive. Likewise, the focus electrode is maintained at ground potential or slightly negative to form an electrostatic field between the focus electrode, control grid and accelerating anode which will impart a small component force to the electrons to prevent them from diverging due to mutual electrostatic repulsion. As in conventional electron guns, a beam limiting aperture is provided in the path of travel of the electrons from the cathode beyond the accelerating anode.

The above and other objects and features of the invention will become apparent from the following detailed description taken in connection with the accompanying drawings which form a part of this specification, and in which:

FIG. 1 is a schematic diagram of a cathode ray tube having the electron gun of the invention incorporated therein; and

FIG. 2 is a detailed cross-sectional view of the electron gun structure of the invention.

With reference to the drawings, and particularly to FIG. 1, there is schematically illustrated an electron optic pickup tube or camera tube 10 having an electron gun 12 at one end and a photoconductive target 14 at its other end. An optical image 16, for example, is focused onto the photoconductive target 14 by means of a lens system, schematically illustrated at 18. Between the electron gun 12 and the target 14 is a suitable beam deflection system, generally indicated by the reference numeral 20, which causes the electron beam to sweep back and forth across the photoconductive target 14 in a full-frame scanning sequence, well known to those skilled in the art. In the operation of the device of FIG. 1, electrons emitted by the gun 12 and striking the photoconductive target 14 produce a video signal across load resistor 22, this video signal being applied through capacitor 24 to external circuitry, not shown.

The details of the electron gun 12 are shown in FIG. 2. It comprises a cathode 26 having a heating element 28. The cathode 26 is connected to ground as shown. The forward end of the cathode 26 is provided with a cup-shaped depression 30 filled with an oxide 32 such as strontium oxide, barium oxide or calcium oxide.

The forward surface 34 of the oxide coating 32 is shaved, in contrast to a normal oxide coated cathode which has an extremely rough surface. That is, the surface 34 is shaved or planed in order that it has a smoothness of at least 20 microinches or less. In this manner, the electrons emitted from the planar cathode surface will be more uniformly distributed across the surface of the cathode than is the case with the usual rough oxide coating used in electron guns.

Ahead of the cathode 26 is a dish-shaped control grid 36 which preferably has a slightly positive voltage applied thereto with respect to the cathode 26. As shown in FIG. 2, the convex side of the dish-shaped control grid 36 faces the cathode 26 and is provided with a central aperture 38 through which a beam of electrons 40 pass.

Ahead of the dish-shaped control grid 36 is a second, dish-shaped accelerating anode 42 having a central aperture 44 through which the electron beam 40 passes. Note that the concave side of the dish-shaped accelerating anode 42 faces the concave side of the dish-shaped control grid 36. Beyond the anode 42 is a beam limiting aperture 46, the beam limiting aperture 46 and the accelerating anode 42 being connected to a source of positive voltage, typically +300 volts.

Between the control grid 36 and the anode 42, and surrounding the same, is a cylindrical focus electrode 48 which is maintained at zero volts or slightly negative. The slightly positive control grid 36 causes a slightly positive field to exist between the cathode and

control grid such that little or no radial acceleration forces will be applied to the electrons. Furthermore, the electro-static field formed between the focus electrode, the control grid and the accelerating anode will impart a small component of force to the electrons to prevent them from diverging due to mutual electrostatic repulsion of the electrons in the beam. With this arrangement, a high current density, high resolution electron beam will be formed with minimum thermionic cathode loading. An electron beam of this type is particularly adapted to read-out silicon photoconductors and the like with high resolution and low image lag.

Although the invention has been shown in connection with a certain specific embodiment, it will be readily apparent to those skilled in the art that various changes in form and arrangement of parts may be made to suit requirements without departing from the spirit and scope of the invention.

What is claimed is:

1. In a cathode ray tube, an electron gun structure comprising a cathode for emitting an electron beam, said cathode comprising a layer of an oxide having a smooth shaved surface from which electrons are emitted, a dish-shaped control grid having a central aperture through which electrons from said cathode can pass and in which the convex side of the dish-shaped grid faces said cathode, a dish-shaped accelerating anode spaced ahead of said control grid in the path of travel of said electrons from said cathode and having a central aperture at the bottom of its dish-shaped configuration through which electrons can pass, the concave side of the dish-shaped accelerating anode facing said control grid, a generally annular focus electrode surrounding said electron beam between the control grid and said accelerating anode, means connecting said cathode to ground potential, means for applying a positive potential to said control grid and said accelerating anode, and means for applying to said focusing electrode a potential ranging from zero to a negative potential.

2. The electron gun structure of claim **1** including a beam limiting aperture through which said electron beam passes and positioned on the side of said accelerating anode opposite said control grid, and means connecting said beam limiting aperture to a source of positive potential.

3. The electron gun structure of claim **2** wherein a source of **+300** volts is connected to said accelerating anode and to said beam limiting aperture.

4. The electron gun structure of claim **1** wherein said control grid and accelerating anode have cylindrical portions connected to and integral with dish-shaped portions, the diameters of said cylindrical portions being substantially equal to the maximum diameters of said dish-shaped portions.

5. The electron gun structure of claim **4** wherein the diameter of said focus electrode is greater than that of said cylindrical portions of the control grid and accelerating anode.

6. The electron gun structure of claim **1** wherein said cathode has a dish-shaped portion which receives said oxide layer, the smooth shaved surface of the oxide layer facilitating emission of electrons over substantially its entire surface.

7. The electron gun structure of claim **1** wherein said smooth shaved surface has a smoothness of at least **20** microinches or less.

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