

[72]	Inventor	Joseph Burns Pequannock, N.J.
[21]	Appl. No.	754,840
[22]	Filed	Aug. 23, 1968
[45]	Patented	Apr. 27, 1971
[73]	Assignee	Fairchild Camera and Instrument Corporation

Primary Examiner—John Kominski
Assistant Examiner—V. Lafranchi
Attorney—Laurence B. Dodds

**[54] HIGH-RESOLUTION DIRECT-VIEW STORAGE
TUBE**
4 Claims, 3 Drawing Figs.

[52] U.S. Cl..... 313/71,
313/68, 313/85, 313/92, 315/12

[51] Int. Cl. H01j 29/18,
H01j 29/41, H01j 29/50, H01j 31/48

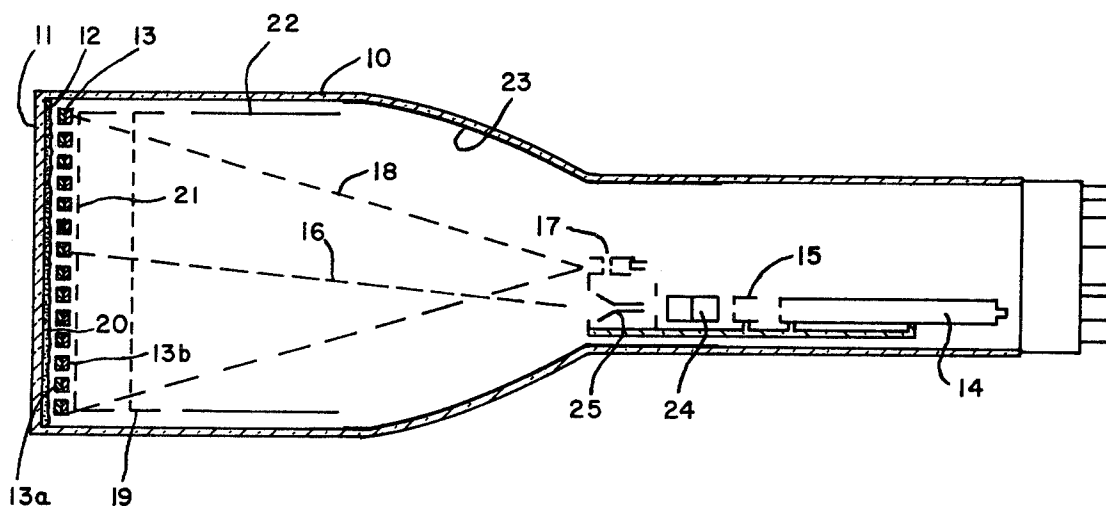
[50] **Field of Search**..... 313/71, 85,
68; 315/12

[56] **References Cited**

UNITED STATES PATENTS

2,998,541	8/1961	Lempert.....	315/12
3,031,597	4/1962	Davis.....	315/12
3,302,054	1/1967	Courtan	313/71X

ABSTRACT: A high-resolution direct-view storage tube comprises an envelope having a viewing face, a phosphorescent screen on the inner surface of the envelope face, a wire mesh signal-storage electrode adjacent the phosphorescent screen, an electron beam write-gun disposed to scan the storage electrode, a wide-angle flood-gun disposed to flood the storage electrode with relatively low-velocity electrons, and a collector electrode disposed between the storage electrode and the two guns. The tube further comprises a conductive coating for the phosphorescent screen effective to develop an electric field between such screen and the storage electrode for attracting electrons to the screen and a wire mesh control electrode adjacent the storage electrode for developing an electric field therebetween having a potential gradient approximately equal to that of the electric field on the opposite side of the storage electrode, whereby divergence of the electron streams passing through the storage electrode can be controlled by adjustment of the potential of the control electrode, preferably to minimize such divergence.



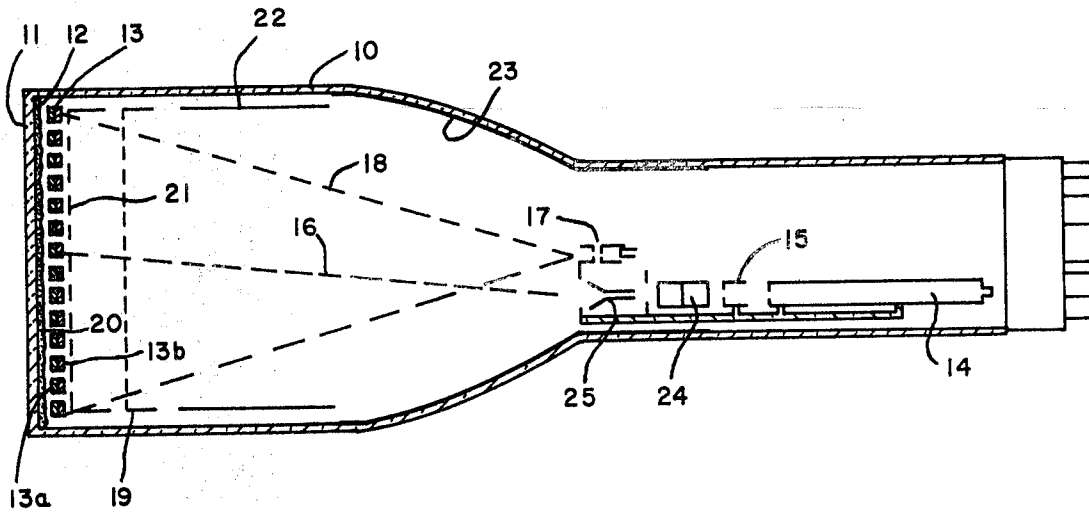


FIG. 1

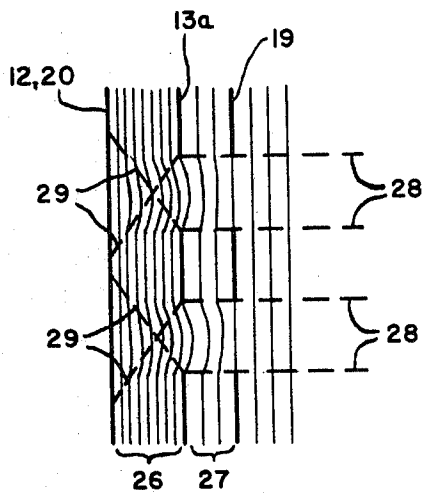


FIG. 2a
PRIOR ART

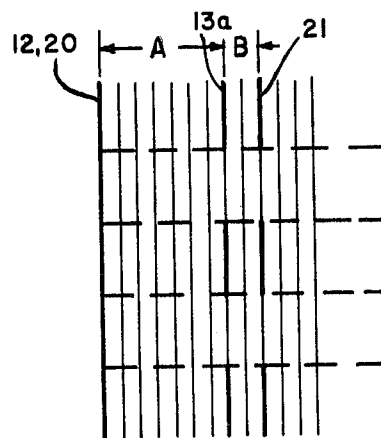


FIG. 2b

HIGH-RESOLUTION DIRECT-VIEW STORAGE TUBE

BACKGROUND OF THE INVENTION

The invention relates to direct-view storage tubes providing high resolution and brightness adequate for daylight viewing. Such tubes have come into use in many applications, particularly as radar display devices.

In prior direct-view storage tubes the resolution of the tube has been limited by beam divergence in the storage grid-phosphorescent screen region for tubes operating with high brightness and with normal positive writing. Such divergence results from penetration of the high-gradient electric field on the phosphor screen side of the storage grid through its apertures to the low-gradient electric field region on the collector side of the storage grid. The high-gradient electric field is developed by the high phosphor screen potential necessary to produce the high brightness display.

While it is possible to reduce such beam divergence in conventional direct-view storage tubes by adjustment of the tube parameters and operating potentials, such adjustments have imposed other undesirable characteristics on the tube such as impairment of the collimation of the writing beam or the flood beam, or both, reduction in screen brightness, and reduction in resolution by space charge repulsion.

It is an object of the invention, therefore, to provide a new and improved high-resolution direct-view storage tube in which divergence of the elementary electron streams passing through the apertures of the storage electrode may be minimized or otherwise controlled, while obviating the disadvantages resulting from minimizing such beam divergence by changing the parameters of conventional direct-view storage tubes.

SUMMARY OF THE INVENTION

In accordance with the invention, there is provided a high-resolution direct-view storage tube comprising an envelope having a viewing face, a phosphorescent screen on the inner surface of the envelope face, a foraminant signal-storage electrode adjacent the phosphorescent screen and comprising a conductive support having a dielectric coating on the side opposite the screen, an electron beam write-gun disposed to scan the dielectric coating of the storage electrode, an axial wide-angle flood-gun disposed to flood the dielectric coating of the storage electrode with relatively low-velocity electrons, and a collector electrode disposed between the storage electrode and the two guns disposed to collect secondary-emission electrons from the storage electrode. The tube of the invention also comprises means for developing an electric field between the conductive support of the storage electrode and the phosphorescent screen for attracting electrons to the latter and means including a foraminant control electrode between the collector electrode and the storage electrode and adjacent the storage electrode for developing an electric field between the control electrode and the conductive support having a potential gradient approximately equal to that of the electric field on the opposite side of the conductive support of the storage electrode, whereby divergence of the electron streams passing through the storage electrode may be controlled.

For a better understanding of the present invention, together with other and further objects thereof, reference is had to the following description, taken in connection with the accompanying drawing, while its scope will be pointed out in the appended claims.

BRIEF DESCRIPTION OF THE DRAWING

In the drawing:

FIG. 1 is a longitudinal sectional view, partly schematic, of a direct-view storage tube embodying the invention, while

FIGS. 2a and 2b comprise two graphs to aid in explanation of the invention.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring now to FIG. 1 of the drawing, there is illustrated a high-resolution direct-view storage tube comprising a conventional envelope 10 having a viewing face 11 with a phosphorescent screen 12 on the inner face thereof. Adjacent the phosphorescent screen 12 is a foraminant signal-storage electrode 13, preferably in the form of a wire mesh 13a having a dielectric coating 13b on the face opposite the phosphor screen 12, this coating preferably being of a material having a high secondary emission ratio, for example magnesium fluoride or silicon monoxide.

The direct-view storage tube of the invention further comprises an electron beam write-gun 14 having a second accelerating electrode 15 disposed to develop a conventional fine electron beam 16 for scanning the target 13. The tube further comprises a wide-angle flood-gun 17 disposed to flood the storage electrode 13 with a wide-angle beam 18 of relatively low-velocity electrons. A collector electrode 19 is disposed between the storage electrode 13 and the guns 14, 17.

The direct-view storage tube of the invention further comprises means for developing an electric field between the storage electrode 13 and the screen 12 for attracting electrons to the latter. This means is in the form of a conductive coating or backing 20 in the form of an electron-permeable metallic film on the phosphor screen 12. There are also provided means including a foraminant control electrode or wire mesh grid 21 adjacent the storage electrode 13 for developing an electric field therebetween having a potential gradient approximately equal to that of the electric field on the opposite side of the storage electrode.

The tube 10 may further comprise a conventional collimating electrode 22 and a conductive coating 23 on the inner walls of the envelope 10 in the area between the collimating electrode 22 and the write-gun 14. Horizontal deflection plates 24 and vertical deflection plates 25 are provided for deflecting the write beam 16 to scan the target 13 in a conventional manner. The potentials applied to the several electrodes may be relatively proportioned as described hereinafter. The dimensions and spacings of the phosphor screen 12, the target electrode 13, the control electrode 21, and the collector electrode 19 are not to scale but are considerably exaggerated for the sake of clarity.

In considering the operation of the direct-view storage tube described, the action of the control electrode 21 will be initially neglected so that the tube operates in the conventional manner of prior direct-view storage tubes. Assuming that suitable operating potentials are applied to the several electrodes, a high-voltage writing beam from the gun 14 is caused to scan the target 13 by deflection potentials applied to the deflection plates 24, 25. For positive writing, the beam strikes the coating 13b of the target 13 above the first secondary-emission crossover point so that the secondary-emission ratio of this coating is greater than unity and a positive charge pattern, representative of the image to be reproduced, is developed on the target 13. This charge pattern produces space-modulation of the relatively low-velocity flood beam from the gun 17 and elementary electron streams of this flood beam, passing through the target 13, are accelerated to the phosphor screen 12 by the high voltage applied to its conductive coating 20. The result is a high-brightness display of the received image on the phosphor screen 12.

However, in prior direct-view storage tubes the conditions are as represented in FIG. 2a, that is, the high-gradient electric field between the conductive coating 20 on phosphor screen 12 and the target electrode 13 penetrates the apertures in the storage electrode 13, as represented by the equipotential lines 26, distorting the equipotential lines 26 and the equipotential lines 27 of the electric field between the target electrode 13 and the collector electrode 19. The resulting curvature of the equipotential lines in the vicinity of the target 13 causes the elementary streams 28 of the flood beam to diverge, as represented by the dashed lines 29. Obviously, the result is

that each elementary bright spot on the phosphor screen 12 is considerably larger than the cross section of the collimated elementary electron stream, with a corresponding loss of resolution.

The corresponding characteristics of the direct-view storage tube of the invention with the addition of the control electrode 21, when properly positioned and excited, is represented in FIG. 2b. With this arrangement, it is seen that the equipotential lines on both sides of the target electrode 13 are substantially equally spaced, indicating equal potential gradients on opposite sides of the electrode 13, so that the equipotential lines remain rectilinear and there is no convergence or divergence of the elementary electron streams 28 passing through the apertures of the target electrode 13, resulting in a maximum resolution.

While the parameters of the direct-view storage tube embodying the invention may be varied over relatively wide ranges of values according to the required performance specifications and the application of the tube, there follow the essential parameters of one such tube of the same general design as the Type 7268 (Du Mont) tube which gave satisfactory performance:

Target electrode 13	500 mesh per inch of electroformed nickel or copper wire with dielectric coating 13b of magnesium fluoride or silicon monoxide
Spacing-Screen 12 to target 13	0.300 inch
Spacing-Target 13 to control electrode 21	0.020 inch
Electrode potentials:	
Coating 20	10,000 volts
Target 13	10 volts
Control electrode 21	667±300 volts
Collector electrode 19	200 volts
Cathode of write-gun 14	-2,500 volts.
Cathode of flood-gun 17	0 volts
Collimating electrode 22	+20 to +80 volts
Conductive coating 23	+10 to +70 volts

By adjusting the potential of the control electrode 21 over the range given in the above table, the focusing of the elementary flood-gun streams through the target 13 may be controlled, thereby controlling the resolution and/or brightness of the display on the phosphor screen 12. To minimize the divergence of the electron streams through the target electrode 13, the ratio of the storage electrode-screen distance 13 to 12 (distance a, FIG. 2b) to the storage electrode-control electrode distance 13 to 21 (distance b, FIG. 2b) is made equal to the ratio of the storage electrode-screen potential difference to the storage electrode-control electrode potential difference.

The direct-view storage tube described has a number of advantages over prior tubes of this general type including:

Reduction of shading by more effective use of the collector electrode in effecting collimation.

Improving the arrival of the flood-gun electrons normal to

the storage grid.

Reducing edge effects by increasing the flood beam velocity between the collector and the control electrode and decelerating it in the relatively short distance to the storage electrode.

Reducing coplanar effects at the storage grid surface.

While there has been described what is, at present, considered to be the preferred embodiment of the invention, it will be obvious to those skilled in the art that various changes and modifications may be made therein, without departing from the invention, and it is, therefore, aimed in the appended claims to cover all such changes and modifications as fall within the true spirit and scope of the invention.

I claim:

1. A high-resolution direct-view storage tube comprising:
 - an envelope having a viewing face;
 - a phosphorescent screen on the inner surface of said face;
 - a foraminat signal-storage electrode adjacent said screen and comprising a conductive support having a dielectric coating on the side opposite said screen;
 - an electron beam write-gun disposed to scan said dielectric coating of said storage electrode;
 - an axial wide-angle flood-gun disposed to flood said dielectric coating of said storage electrode with relatively low-velocity electrons;
 - a collector electrode disposed between said storage electrode and said guns disposed to collect secondary-emission electrons from said storage electrode;
 - means for developing an electric field between said conductive support of said storage electrode and said screen for attracting electrons to the latter; and
 - means including a foraminat control electrode between said collector electrode and said storage electrode and adjacent said storage electrode for developing an electric field between said control electrode and said conductive support having a potential gradient approximately equal to that of the electric field on the opposite side of said conductive support of said storage electrode, whereby divergence of the electron streams passing through said storage electrode may be controlled.
2. A high-resolution direct-view storage tube in accordance with claim 1 in which the potential gradient of the electric fields on opposite sides of said storage electrode are equal, whereby divergence of the electron streams passing through said storage electrode is minimized.
3. A high-resolution direct-view storage tube in accordance with claim 1 in which said storage electrode and said control electrode are in the form of wire meshes.
4. A high-resolution direct-view storage tube in accordance with claim 1 in which the ratio of the storage electrode-screen distance to the storage electrode-control electrode distance is equal to the ratio of the storage electrode-screen potential difference to the storage electrode-control electrode potential difference.