

[54] **CATHODE-RAY TUBE** 2,913,611 11/1959 Field 313/76
[75] **Inventor: Hans Georg Gerlach, Emmasingel, Netherlands** 2,997,615 8/1961 Adler 313/82 R
3,286,113 11/1966 Benway 313/83

[73] **Assignee: U.S. Phillips Corporation, New York, N.Y.**

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[21] **Appl. No.: 320,866**

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[30] **Foreign Application Priority Data**
Jan. 19, 1972 Netherlands 72722

[52] **U.S. Cl.** 313/424, 313/445
[51] **Int. Cl.** **H01j 29/84**
[58] **Field of Search** 313/76, 82 R, 82 T, 83, 313/85 R

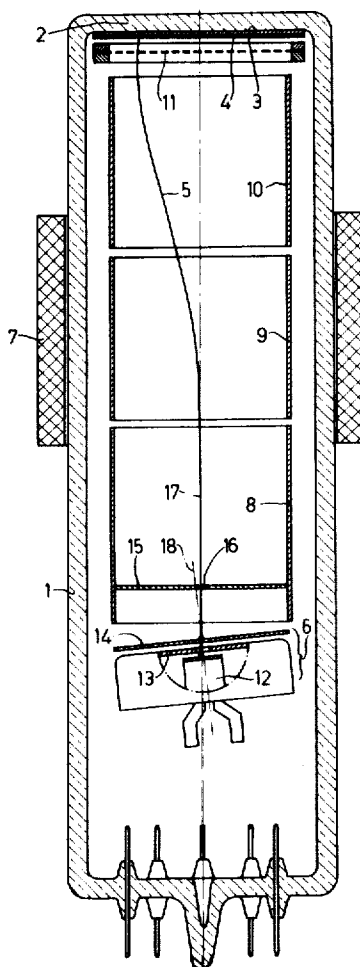
[56] **References Cited**
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2,903,612 9/1959 Van Ormer 313/76

[57] **ABSTRACT**

A cathode ray tube having an electron gun which is arranged obliquely relative to the main axis of the tube. The gun is rotated about the cross-over which is formed by the electron beam in the gun. A diaphragm lets pass only a partial beam which is emitted by an eccentric part of the cathode. Positive ions impinge mainly on the centre of the cathode and therefore have no detrimental influence on the emission properties of the effective cathode surface. Extra deflection, as in an ion trap, is superfluous.

2 Claims, 3 Drawing Figures



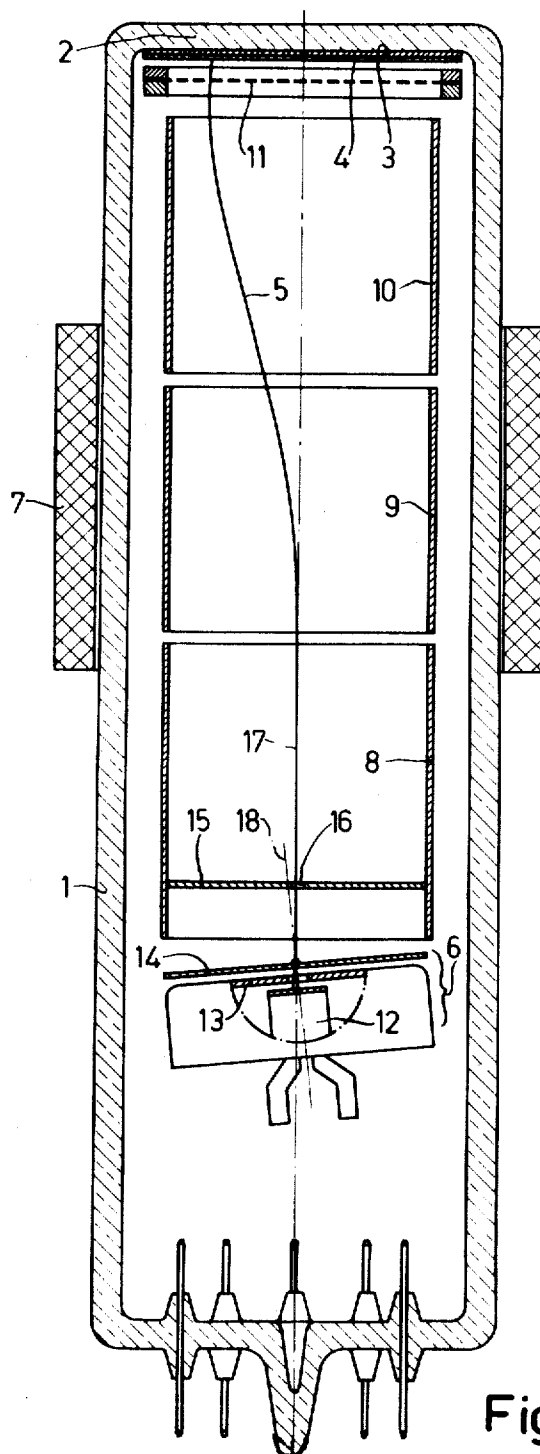


Fig.1

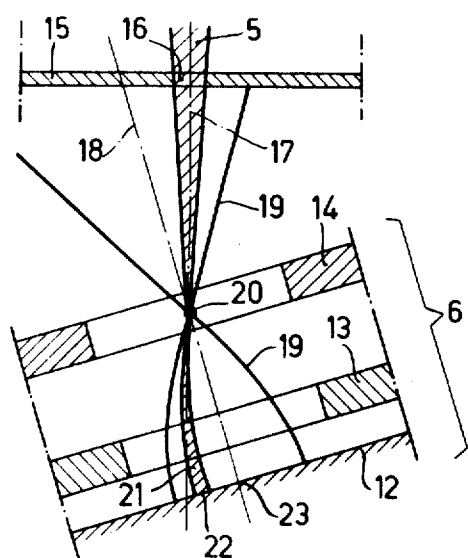


Fig. 2

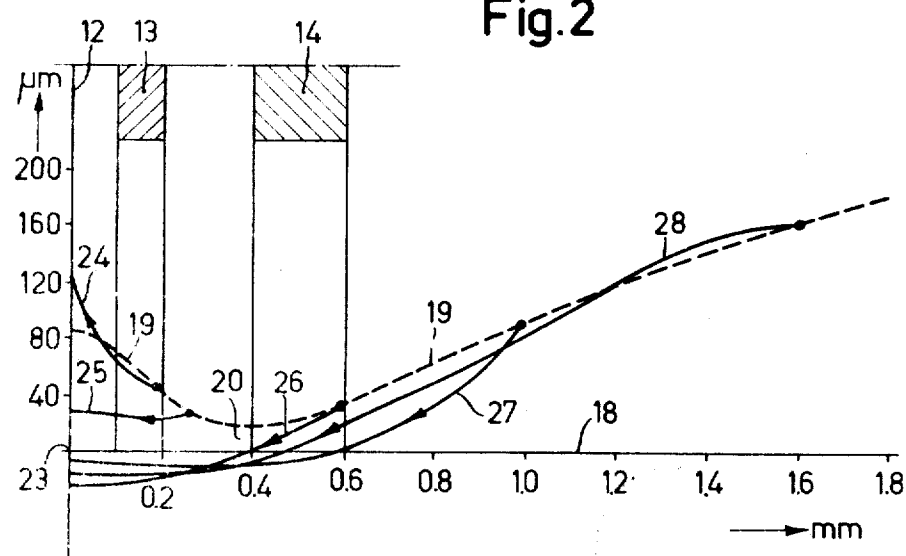


Fig. 3

CATHODE-RAY TUBE

The invention relates to a cathode ray tube comprising an electron gun having electrodes centered along a first axis for producing an electron beam with a cross-over on the first axis, and comprising electron optical means centered along a second axis for focusing the electron beam, said first axis and said second axis intersecting each other at an acute angle.

Such a cathode ray tube is known from the U.S. Pat. No. 2,903,612. A cathode ray tube generally comprises an elongate evacuated envelope which comprises on one side an electron gun and on the other side a target for the produced electron beam. Electron optical means focus the electron beam onto the target and under the influence of deflection means the electron beam scans the target according to a given frame. The target may comprise a layer of an electroluminescent material for displaying a visible picture. The target may also comprise a photosensitive layer and be constructed for producing electric picture signals corresponding to an optic picture projected on the target. The said U.S. Patent Specification states that gas residues in such a tube can be ionized by the electron beam. The positive ions formed by ionization are accelerated in the direction opposite to that of the (negative) electrons of the electron beam and are thus capable of reaching the cathode. Many of the ions which impinge upon the cathode have a sufficient energy to disturb the emission properties of the cathode. According to the said Patent Specification it is prevented that the positive ions reach the cathode by arranging the electron gun obliquely relative to the main axis of the tube and deflecting the produced electron beam by means of a non-symmetrical electron lens parallel to the main axis. The positive ions also experience the influence of the deflection field but as a result of their difference in energy relative to the electrons they do not reach the cathode but are captured elsewhere in the electron gun. The drawback of such a measure is that the focusing of the electron beam is also influenced by the non-symmetric deflection field as a result of which aberrations occur. Such a non-symmetric influence is difficult to compensate for. It has furthermore been found that the deflection field in practice results in an increase of the length of the tube. Other means for deflecting the electron beam, for example, the magnetic field of the permanent magnet, also exhibit these drawbacks. The large distance between the cathode and the deflection field is also an important drawback in connection with the fact that the positive ions which are formed in the region between the cathode and the deflection field do not experience the influence of the deflection field.

It is the object of the invention to provide a cathode ray tube in which the detrimental influence of ions which impinge upon the cathode is prevented without deflection fields for directing the electron beam parallel to the main axis being necessary.

According to the invention, a cathode ray tube of the type mentioned in the first paragraph is characterized in that the point of intersection of the first axis and the second axis coincides with the cross-over and that the cathode ray tube comprises a diaphragm having an aperture which is centered relative to the second axis, said aperture letting pass less than one quarter of the electron beam, the first axis intersecting the diaphragm outside said aperture. The invention is based on the consideration that a partial beam consisting of elec-

trons which are emitted by a small region on the surface of the cathode after passing the cross-over makes a larger angle with the axis of the electron beam according as the emissive region is further remote from the axis of the electron beam. This makes it possible to consider the axis of one of the partial beams, after passing the cross-over, as an axis of the effective electron beam and to cause it to coincide with the main axis of the tube. The other partial beams should be intercepted by a diaphragm. So in a tube according to the invention the central partial beam which is emitted by the centre of the cathode is not used but a partial beam is used which is emitted by a region at some distance from the centre. The invention is based on the recognition of the fact that the positive ions which are formed in the electron gun are concentrated on a very small region in the centre of the cathode. The result of this is that the emission properties of the centre of the cathode are disturbed. Since in a tube according to the invention the effective electron beam is not emitted by the centre of the cathode but by a region at some distance therefrom, this has no influence on the operation of the tube. Of course, the greater part of the electrons emitted by the cathode are intercepted by the diaphragm. In many types of tubes, however, this is no drawback since in said tube a diaphragm is used all the same to obtain a very small electron spot on the target.

The invention is particularly operative with a small angle between the axis of the electron gun (first axis) and the main axis of the tube (second axis) from 2° to 8° .

The invention will be described in greater detail with reference to the accompanying drawing, of which

FIG. 1 shows a cathode ray tube according to the invention;

FIG. 2 shows diagrammatically a part of said tube, and

FIG. 3 shows a few calculated ion tracks in the electron gun of the tube.

The cathode ray tube shown in FIG. 1 is a television camera tube of the vidicon type. The tube comprises a glass envelope 1 having a transparent face plate 2 on which a transparent conductive signal layer 3 is provided as well as a photoconductive layer 4. The free surface of the photoconductive layer 4 is scanned by an electron beam 5 which is produced by an electron gun 6 and is deflected by a set of deflection coils 7. The electron beam 5 is focused onto the layer 4 by means of the electrodes 8, 9 and 10 which constitute a focusing lens. The electron beam 5 impinges upon the surface of the layer 4 in a perpendicular direction under the influence of a collimation lens which is formed by the electrode 10 and a gauze-like electrode 11. The signal layer 3 should be connected, via a resistor, to a positive potential relative to the cathode 12 of the electron gun 6. The electron beam 5 brings the potential of each surface element of the free surface of the layer 4 periodically at zero volt relative to the cathode 12. Under the influence of the positive potential to which the signal layer 3 is connected and under the influence of photoconduction in the layer 4 the potential of each surface element of the free surface of the layer 4 increases between two successive scans to a certain positive value. This value is higher according as more light impinges upon the surface element in question. The light distribution over the layer 4 is determined by an optical image projected on the layer 4. The charge

which the electron beam is to supply periodically to each surface element is proportional to the local light intensity. In this manner a picture signal can be derived from the signal layer 3. The electron gun 6 comprises the cathode 12, a first grid 13 and a second grid 14. The electrode 8 comprises a diaphragm 15 having an aperture 16. The photoconductive layer 4 is manufactured from lead monoxide in connection with which the camera tube is named by its registered trademark "Plumbicon". The voltages used in the tube are:

cathode 12	0 V
first grid 13	-30 V
second grid 14	300 V
electrode 8	300 V
electrode 9	20 V
electrode 10	300 V
gauze-like electrode 11	600 V
signal layer 3	40 V

The main axis of the tube is denoted by 17. The axis of the electron gun 6 is denoted by 18. The axes 17 and 18 enclose an angle of 4° relative to each other.

For explaining the invention, FIG. 2 shows diagrammatically the configuration of electron gun 6 with cathode 12, first grid 13 and second grid 14. This figure also shows the diaphragm 15 with the aperture 16 which passes the electron beam 5 as well as the main axis 17 of the television camera tube and the axis 18 of the electron gun 6. The electron beam emitted by the cathode 12 has a contour 19 and forms a cross-over 20 which is shown diagrammatically by a dot. It may be seen from the figure that the electron beam 5 is formed by a partial beam 21 which is emitted by a surface element 22 which is located beyond the centre 23 of the cathode 12. It is immediately clear from the figure that no extra deflection fields for the electron beam 5 or the partial beam 21 are necessary, but that the curvature of the track of the partial beam 21 is fully determined by the field in the electron beam 6 which results in the cross-over 20.

FIG. 3 shows diagrammatically the cathode 12 and the axis 18 in a rectangular system of axes. This figure also shows the grids 13 and 14. Only the part on one

side of the axis 18 is shown. The broken line 19 is the beam contour which contains 90 percent of the emitted current. In this figure the cross-over 20 has finite dimensions. The lines 24, 25, 26, 27 and 28 denote a few calculated ion tracks with starting velocity zero and with starting points on the beam contour 19. These tracks are independent of charge and mass of the ion provided the starting velocity is zero. It may be seen from the figure that the greater part of the ions impinges within a distance of 40 to 50 μm from the centre 23 of the cathode. The diameter of the surface element 22 which emits the partial beam 21 (FIG. 2) is approximately 10 μm . The angle between the axes 17 and 18 must thus be so large that surface element 22 is approximately 50 to 60 μm remote from the centre 23. It has been found that for that purpose said angle must be 4°.

Experiments to compare tubes according to the invention with known tubes have been carried out by gradually admitting argon to the tubes, starting from a high vacuum. It is found that in known tubes at a pressure of 10^{-7} to 10^{-8} mm Hg the beam current collapses rapidly and substantially entirely. In tubes according to the invention this is out of the question even at a pressure of 10^{-4} mm Hg.

What is claimed is:

1. A cathode ray tube comprising an electron gun having electrodes centered along a first axis for producing an electron beam with a cross-over on the first axis and electron-optical means centered along a second axis for focusing the electron beam, said first and said second axes intersecting each other at an acute angle, characterized in that the point of intersection of the first axis and the second axis coincides with the cross-over and that the cathode ray tube comprises a diaphragm having an aperture which is centered relative to the second axis, said aperture letting pass less than one quarter of the electron beam, the first axis intersecting the diaphragm outside said aperture.

2. A cathode ray tube as claimed in claim 1, characterized in that the acute angle lies between 2° and 8°.

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UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,845,346 Dated October 29, 1974

Inventor(s) HANS GEORG GERLACH

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

On the title page, Section [30] change "72722"
to --7200722--.

Signed and sealed this 11th day of February 1975.

(SEAL)
Attest:

RUTH C. MASON
Attesting Officer

C. MARSHALL DANN
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