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Weijland

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[54] **TELEVISION CAMERA TUBE WITH CONTROL DIAPHRAGM**

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Related U.S. Application Data

[63] Continuation of Ser. No. 267,001, June 28, 1972, abandoned.

[30] **Foreign Application Priority Data**

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[52] **U.S. Cl.** **313/389;** 313/448

[51] **Int. Cl.²** **H01J 29/56;** H01J 31/38

[58] **Field of Search** 313/365, 372, 379, 382

[56] **References Cited**

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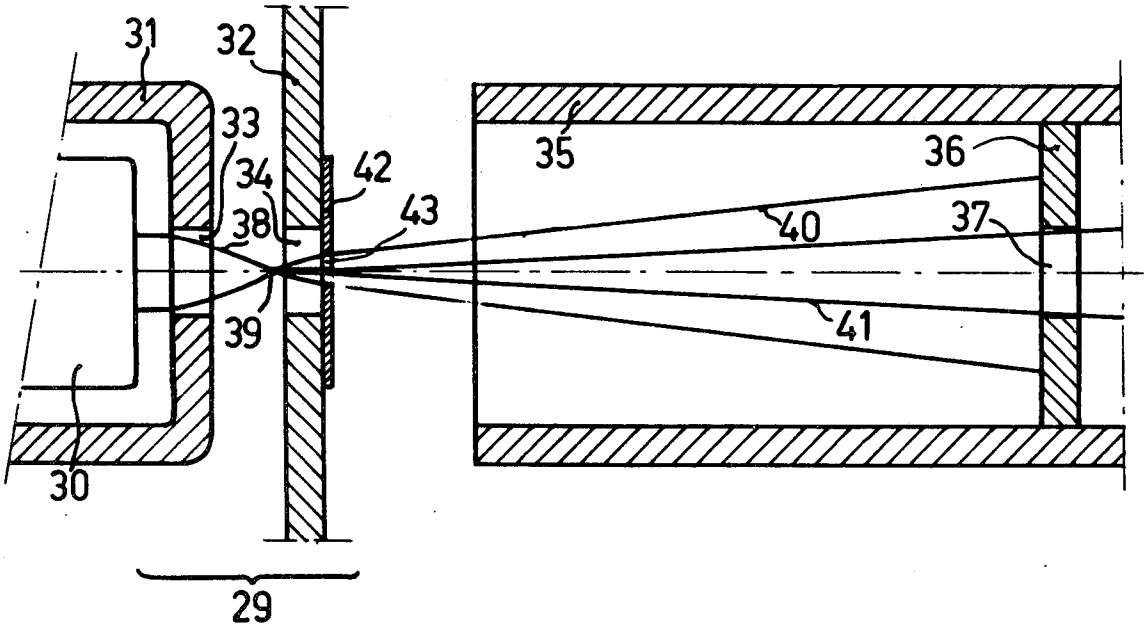
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[57] **ABSTRACT**

A television camera tube (vidicon) comprising a cylindrical electrode having a diaphragm to restrict the cross-section of the electron beam and an anode having an aperture which substantially passes the whole electron beam but is chosen to be so small that the detrimental return beam is intercepted substantially entirely.

2 Claims, 3 Drawing Figures



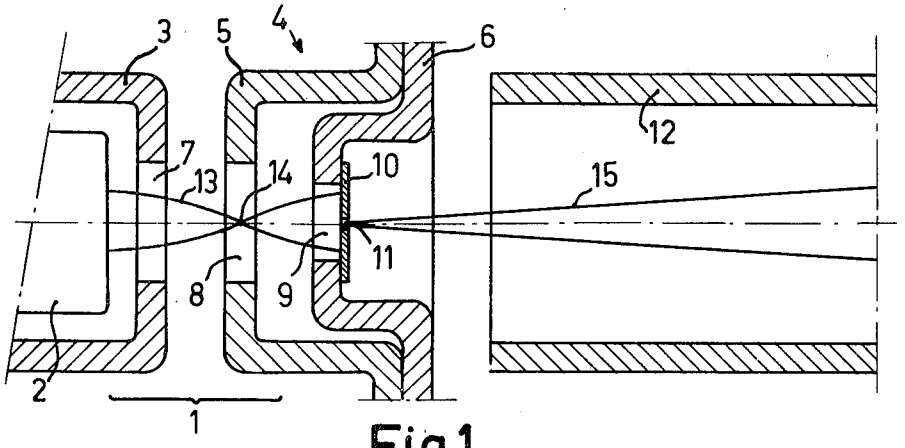


Fig.1

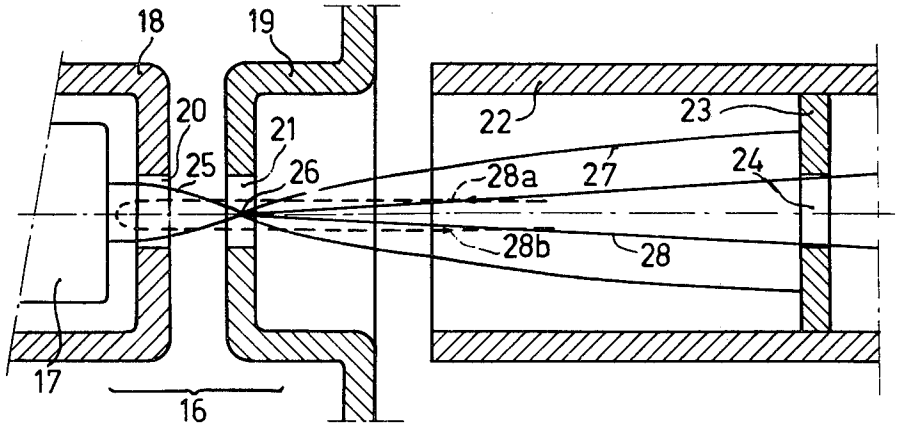


Fig.2

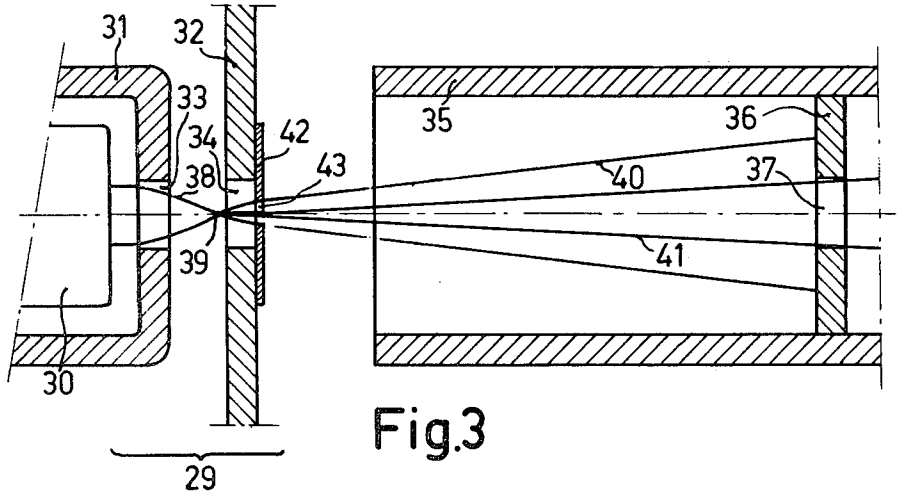


Fig.3

TELEVISION CAMERA TUBE WITH CONTROL DIAPHRAGM

This is a continuation of application Ser. No. 267,001, filed June 28, 1972, now abandoned.

The invention relates to a television camera tube comprising an electron gun having a cathode, a grid and an anode, a photoconductive layer which is provided on a transparent, conductive signal layer, and a hollow cylindrical electrode between the electron gun and the photoconductive layer, on which photoconductive layer a potential distribution is formed on the surface which is not in contact with the signal layer by projecting an optical image on the photoconductive layer, which potential distribution is periodically reduced to the potential of the cathode by scanning the photoconductive layer with an electron beam produced by the electron gun.

Such a television camera tube is generally known and is termed vidicon. The operation of a vidicon is as follows: Under the influence of deflection fields an electron beam of a sufficient current strength scans the free surface of the photoconductive layer according to a given frame and brings said surface point-wise at the potential of the cathode which is termed zero volts. Between two successive scans, the potential of each point of the surface of the photoconductive layer increases under the influence of a positive potential which is applied to the signal layer and under the influence of photoconductivity which is produced in the photoconductive layer by the optical image projected on it. Each point, or more exactly each elementary surface element, of the photoconductive layer together with the signal layer constitutes a capacitor. The charge of said capacitor is replenished periodically by the scanning electron beam, for which more charge is necessary according as more light impinges upon the relevant point. The current which consequently flows through the connection of the signal layer comprises the information of the projected image as a function of time.

The current strength of the electron beam must be sufficiently large to provide elementary capacitors which are strongly discharged as a result of great light intensity, with sufficient charge. As soon as the free surface of the photosensitive layer has been reduced to zero volts in a given point, the electrons of the electron beam can no longer reach said point. Their velocity becomes zero and then they are accelerated in the reverse direction and constitute the so-called return beam. Said return beam also experiences the influence of the deflection fields. It has been found that the return beam at certain instants can pass the apertures in all the elctrodes of the electron gun and can reach the space between the cathode and the anode. Many electrons thus no longer have sufficient energy to reach the cathode, which as a matter of fact has a potential of zero volts, and are accelerated once again in the reverse direction. These electrons constitute a secondary beam which together with the original primary electron beam scans the photoconductive layer in a place differing from the original electron beam dependent upon the distance between the primary and the secondary beam in the aperture in the anode. As a result of this a disturbing signal is formed which is visible in the picture to be displaced.

Two known systems are used in practice to form the (primary) electron beam. The first system uses a comparatively large aperture in the anode. A cross-over is formed between the cathode and the anode. This cross-over forms the object for a focusing lens which reproduces the cross-over on the photoconductive layer as readily as possible in a punctiform manner. In order to prevent too wide a beam, a diaphragm to restrict the cross-section of the beam is present between the electron gun and the photoconductive layer. The second system uses a very small aperture in the anode. This aperture is so small that the aperture itself constitutes the object for the focusing lens and is reproduced on the photoconductive layer as readily as possible. With this system, said small aperture in the anode is the diaphragm which restricts the cross-section of the beam and no extra diaphragm is necessary. It is obvious that with this second system the detrimental effect of the return beam does not occur because all the electrons which pass through the small aperture in the anode, both those of the original beam and those of the secondary beam, belong to the object to be reproduced because actually the aperture is chosen to be small enough to serve as an object in its entirety. This is not the case in the first system due to the comparatively large aperture in the anode. Nevertheless, the first system in which the cross-over is reproduced is preferably used in certain types of tubes, namely those in which during the flyback of the electron beam (between two successive frames or frame lines) the current strength is strongly increased and the cathode potential is increased by a few volts, so as to supply, anticipating the scanning, some charge to excessively discharge places of the photoconductive layer (as a result of excessively strong exposure).

According to the invention, in order to prevent the detrimental effect of the return beam, a television camera tube of the type mentioned in the first paragraph is characterized by the combination of an aperture in the anode, the diameter of which at the area of the smallest cross-section is maximum 0.150 mm and minimum is equal to the diameter of the electron beam at that area, and a diaphragm in said hollow cylindrical electrode having an aperture the diameter of which at the area of the smallest cross-section is maximum 10% of the distance between the aperture in the anode and the aperture in the diaphragm. By choosing the aperture in the anode to be as small as possible but still so large that the whole cross-over formed between the cathode and the anode can serve as the object to be reproduced, a considerable part of the return beam is intercepted by the anode. Therefore, the aperture in the anode is preferably chosen to be so large that the diameter at the area of the smallest cross-section is is substantially equal to the diameter of the electron beam at that area. The anode is preferably formed by a mainly flat plate having a comparatively large aperture which is closed by a foil on the side remote from the grid, said foil comprising the said aperture in the anode. As a result of this the electric field between the grid and the anode is formed so that aberrations of the electron beam as a result of the small aperture are counteracted considerably and a small length of the aperture in the anode can be realized so that few impacts of electrons against the wall of said aperture occur.

The effect of the invention is obtained by the combination of a known small aperture in the anode and a known diaphragm aperture. The combination of these

two apertures which was not necessary prior to the discovery of the detrimental effect of the return beam and was even detrimental in connection with the difficulties which are experienced in aligning small apertures, provides the additional advantage that only little light of the cathode can reach the photoconductive layer via the aperture in the anode and can contribute there to increasing the signal current in the absence of light (dark current).

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

FIG. 1 shows a known electrode configuration for a television camera tube,

FIG. 2 shows another known electrode configuration for a television camera tube, and

FIG. 3 shows an electrode configuration for a television camera tube according to the invention.

The known electrode configuration shown in FIG. 1 comprises an electron gun 1 having a cathode 2, a grid 3 and an anode 4. The anode 4 consists of two parts 5 and 6. The grid 3 comprises an aperture 7 having a diameter of 0.9 mm. The anode 4 comprises an aperture 8 having a diameter of 0.9 mm and an aperture 9 having a diameter of 0.8 mm. The aperture 9 is furthermore covered by a foil 10 having an aperture 11 of a diameter of 0.045 mm. The electrode configuration furthermore comprises a cylindrical electrode 12. The electron beam 13 emanating from the cathode 2 forms a cross-over 14 under the influence of electric voltages at the cathode 2, the grid 3 and the anode 4 and is then intercepted for the greater part by the foils 10. The electron beam 15 which passes through the aperature 11 is focused, by focusing means not shown and of which the electrode 12 may form part, onto the photoconductive layer (not shown) of the television camera tube in which the electrode configuration is used. The aperture 11 is so small that it forms the object which is reproduced on the photoconductive layer by the focusing means.

The known electrode configuration shown in FIG. 2 comprises an electron gun 16 having a cathode 17, a grid 18 and an anode 19. The grid 18 comprises an aperture 20 having a diameter of 0.6 mm. The anode 19 comprises an aperture 21 having a diameter of 0.6 mm. The electrode configuration furthermore comprises a cylindrical electrode 22 which is provided with a diaphragm 23 having an aperture 24 of a diameter of 0.6 mm. The electron beam 25 emanating from the cathode 17 forms a cross-over 26 under the influence of electric voltages at the cathode 17, the grid 18, the anode 19 and the cylindrical electrode 22. By focusing means not shown, of which the electrode 22 may form part, the cross-over 26 is focused on the photoconductive layer (not shown) of the television camera tube, in which the electrode configuration is used. Since the diameter of the cross-over 26 which is shown diagrammatically by a dot is much larger than the diameter of the aperture 11 in FIG. 1, the cross-section of the electron beam 27 should be restricted as a result of which effectively a small part of the cross-over is used and aberations in the reproduction of the cross-over by the focusing means are prevented. This purpose is served by the aperture 24 in the diaphragm 23, which passes only the electron beam 28. A return beam returning from the photoconductive layer and denoted by the broken line 28*a* can, at certain instants during the scanning of the photoconductive layer, penetrate into the space between the cathode 17 and the anode 19 with the beam 28 via the aperture 24. Electrons which do not have sufficient energy to reach the cathode 17, once more reverse their direction and constitute the secondary beam 28*b* which can reach the photoconductive layer via the aperture 24 but impinges on it in a place different from that of the (primary) beam 28 dependent upon the distance between the cross-over 26 and the secondary beam 28*b*.

The electrode configuration for a television camera tube according to the invention shown in FIG. 3 comprises an electron gun 29 having a cathode 30, a grid 31 and an anode 32. The grid 31 comprises an aperture 33 having a diameter of 0.6 mm. The anode 32 comprises an aperture 34 having a diameter of 0.6 mm. The electrode configuration furthermore comprises a cylindrical electrode 35 provided with a diaphragm 36 having an aperture 37 of a diameter of 0.6 mm. The electron beam 38 emanating from the cathode 30 forms a cross-over 39 under the influence of electric voltages at the cathode 30, the grid 31, the anode 32 and the electrode 35. By focusing means not shown and of which the electrode 35 may form part, the cross-over 39 is focused onto the photoconductive layer (not shown) of the television camera tube in which the electrode configuration is used. Since the diameter of the cross-over 39 which is denoted diagrammatically by a dot, is much larger than the diameter of the aperture 11 in FIG. 1, the cross-section of the electron beam 40 should be restricted as was the case in FIG. 2. This purpose is served by the aperture 37 in the diaphragm 36 which passes only the electron beam 41. In order to intercept as much of the return beam as possible which is denoted by 28*a* in FIG. 2, the anode 32 comprises a foil 42 having an aperture 43. The diameter of the aperture 43 is 0.1 mm and chosen to be so that as much as possible of the return beam is intercepted but the whole beam 38 is passed. The further data of the electrode configuration of FIG. 3 are as follows: the distance between the cathode 30 and the grid 31 is 0.1 mm. The thickness of the grid 31 is 0.2 mm. The distance between the grid 31 and the anode 32 is 0.25 mm. The thickness of the anode 32 is 0.2 mm. The inner diameter of electrode 35 is 10 mm. The distance between the apertures 43 and 37 is 12 mm. During the scanning of the photoconductive layer by the electron beam, the voltages at the electrodes are as follows: The voltage at the cathode 30 is 0 volt. The voltage at the grid 31 is −40 volts. The voltage at the anode 32 and the electrode 35 is 300 volts.

What is claimed is:

1. A television camera tube comprising an electrically conductive transparent layer, a layer of photoconductive material on said electrically conductive layer on which a potential distribution is formed corresponding to an optical image projected thereon through said electrically conductive transparent layer, an electron gun spaced from said photoconductive layer for producing an electron beam for scanning the surface and periodically reducing said potential distribution to cathode potential of said photoconductive layer remote from said electrically conductive layer, said electron gun having a cathode, a grid and an anode, said grid and anode each having an aperture 0.6 mm therein and being spaced apart 0.25 mm for forming an electron beam having a cross-over therebetween, said anode having a second aperture diameter at the area of the smallest cross-section is a maximum of 0.150 mm and a minimum equal to the electron beam diameter at said

area for intercepting returning electrons from the photoconductive layer whereby the beam cross-over formed between the cathode and anode can serve as the object to be reproduced, a hollow cylindrical electrode between said anode and said photoconductive layer, and a diaphragm in said hollow cylindrical electrode having an aperture the diameter of which at the area of the smallest cross-section is a maximum of 10% of the distance between the aperture in the anode and the aperture in the diaphragm said aperture diaphragm distance being **12** mm, and the cathode-grid distance being 0.1. mm.

2. A television camera tube, as claimed in claim **1** wherein the aperture in the anode at the area of the smallest cross-section has a diameter which is substantially equal to the diameter of the electron beam at that area.

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