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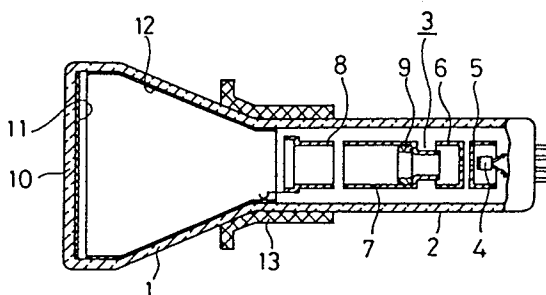
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54 **Cathode ray tube.**

57 A cathode ray tube of energy saving type which has no metal-back layer and is free from ion burning, wherein a phosphor screen (11) is irradiated by a defocused electron beam in an aging period.



Title of the Invention

Cathode ray tube

Background of the Invention1. Field of the Invention:

The present invention relates to a method of making a cathode ray tube, and more particularly to a cathode ray tube for power saving type small picture tube.

2. Description of the Prior Art:

For view-finder of a video camera, a miniature type cathode ray tube having a small face panel of 1.5 inch or 1 inch or the like diagonal line is generally used. Such small type cathode ray tube is, in most cases driven by battery. Accordingly it is desirable to be operated efficiently with a very small power consumption.

In such miniature cathode ray tube, power consumption for deflection is a considerable part of the total power consumption for the cathode ray tube, accordingly saving of the deflection power largely contributes to saving of power consumption of battery. The deflection power is proportional to anode voltage, therefore such the deflection power can be decreased by lowering the anode voltage. But simple lowering of the anode voltage makes it difficult to produce a sufficient brightness required for phosphor screen. Among cathode ray tubes, those having no metal back layer on the back face of phosphor screen is possible to produce a

necessary screen brightness with a relatively low anode voltage, but are liable to produce ion-burning on phosphor screen face. On the other hand, the anode voltage can be lowered by making the thickness of aluminum vacuum deposited layer of the metal back layer very thin. But, even when the thickness is halved from the ordinary one to $0.03 \mu\text{m}$ for instance, for an anode voltage of 2 KV, the screen face brightness in comparison with that of the cathode ray tube without the metal back layer becomes almost halved and is insufficient.

In the electrostatic deflection type cathode ray tube, not only electron beam but also ion beam are deflected, and accordingly there is no fear that the ion beam is focused at a center on the phosphor screen. On the other hand, in the electromagnetic deflection type cathode ray tube, the electron beam is deflected but the ion beam is not deflected, accordingly the ion beam is focused on the central part of the screen, thereby resulting in ion-burning. By the way, in the electromagnetic focusing, the ions are not focused substantially, therefore in the central part of the phosphor screen, the ions are not centered, and accordingly there is no fear of ion-burning of the phosphor screen. Accordingly, the ion-burning is the problem only in the electrostatic focusing type and electromagnetic deflection type cathode ray tube only.

When the cathode ray tube initiate operation,

the residual gas in the tube is ionized by the electron beam, and most of same are adsorbed by getter film which is formed on the inner wall of the tube by vapor deposition of the getter material. But thereafter by further producing of the gas due to electron beam bombardment on metal components or valve glass or the like, further gas accumulates, and accordingly the vacuum in the enclosure rapidly decreases as shown in FIG. 1. Accordingly, the ion-burning of the phosphor film is likely to be made at rather initial stage of operation.

A conventional method of fabricating a cathode ray tube is known from the GB-A-2 076 216, wherein a scanning process is carried out in such a manner that a high-speed electron beam is emitted from a cathode of an electron gun to a phosphor screen while it is deflected to scan a space in the tube successively and repeatedly with the electron beam. This electron beam is scanned by additional deflection means outside of the tube in order to avoid burning of the screen.

Summary of the Invention

The purpose of the present invention is to provide a method of making a cathode ray tube which does not have a metal back layer and is free from ion-burning.

A method of making a cathode ray tube in accordance with the present invention comprises the steps of forming a phosphor screen on an inside wall of a transparent face panel of a vacuum enclosure, disposing an electrostatic focusing type electron gun in a neck part of the vacuum enclosure, sealing the vacuum enclosure, forming a getter layer on a predetermined part of the inside wall of the vacuum enclosure, characterized in that the phosphor screen is irradiated by a defocused electron beam in an aging period.

Brief Description of the Drawing

FIG. 1 is a cross-sectional side view of a cathode ray tube embodying the present invention.

FIG. 2 is a schematic geometric diagram showing convergence of electron beam in the cathode ray tube in accordance with the present invention.

FIG. 3 is a graph showing time change of vacuum in a cathode ray tube.

Description of the Preferred Embodiment

A cathode ray tube in accordance with the present invention comprises a vacuum enclosure having a transparent face panel and an electrostatic focusing type electron gun and a phosphor screen formed on the inner wall of said face panel directly facing said electron gun without an overriding metal back layer. The electron gun has a permanent magnet for forming substantially uniform static magnetic

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field, which is substantially parallel with axis of the cathode ray tube, (i.e., axis of electron beam) and disposed between said cathode and a deflection part of the cathode ray tube.

The method of making cathode ray tube in accordance with the present invention is characterized in that in the manufacturing a defocused electron beam is emitted from the electron gun for a predetermined time in aging at the initial stage before actual service of the cathode ray tube, thereby positively producing ions in the evacuated enclosure, so that the ions are adsorbed by getter mirror layer, evading concentration of the ion beam bombardment on a small spot in the central part of the phosphor screen.

As shown in FIG. 1, electrostatic focusing type electron gun 3 is sealed in an evacuated enclosure 1 such as of glass having a transparent face panel 10 and a tubular neck part 2. The electron gun comprises a cathode 4, a control grid 5, an acceleration electrode 6, a focusing electrode 7, and anode 8. And conductive coating 12 on the inner face of a cone part between the face panel 10 and the neck part 2 is electrically connected to the anode 8. A short tubular permanent magnet 9 is provided in a coaxial relation with axis of the tube, i.e., axis of the electron gun or ion beam, and the permanent magnet 9 is magnetized to have a static and preferably uniform magnetic field, which is in coaxial relation with the electron beam and has a substantially uniform distribution for the space where the electron beam passes. The permanent magnet has substantially

ring-shaped poles which are disposed apart in a direction of the electron beam and each ring-shaped poles are disposed substantially coaxially with said electron beam.

The face panel 10 has on its inner wall a phosphor screen 11, but has no metal back layer thereon. Therefore, the phosphor screen 11 faces directly to the electron gun 3 without a metal back layer inbetween.

The electron beam, which is of course modulated by a video signal given across the control grid 5 and the cathode 4, is focused by the electrostatic focusing type electron lens, and then deflected by known deflection yoke 13 applied on the neck part of the tube, where horizontal and vertical deflection magnetic fields are applied, thereby to produce a monochrome video picture on the phosphor screen 11.

The anions generated around a cross-over point are converged like the electron beam by the electrostatic lens, but the former have a large mass and therefore receive substantially no effect of the magnetic fields. Accordingly, the anions are converged insufficiently and do not form a sharp focused point at the center of the phosphor screen when not deflected but produce a scattered defocused image on the phosphor screen 11, thereby resulting in a low concentration of bombardment energy at the phosphor screen.

The above-mentioned is described further in detail with reference to FIG. 2, which schematically shows electron beam path. In FIG. 2, solid lines show electron beam path which is converged both by the magnetic lens constituted by the permanent magnet 9 and the electrostatic lens 3' cooperatively is focused sharply on one point P of the phosphor screen 11, but on the other hand the anion beam 17 shown by dotted lines is converged only by the electrostatic lens 16. Accordingly, the ion beam is not sufficiently converged on a point P of the phosphor screen 11 but dispersed on a broader area B on the phosphor screen 11 as shown by dotted lines. Accordingly, in this example even though the metal back layer is not formed on the phosphor screen 11, no ion-burning is produced by the anion beam.

The inventors trially produced a small type cathode ray tube having a face plate of 25.4 mm diagonal size embodying the present invention. In the embodiment, the tubular permanent magnet has about 70 Gauss magnetic field lens, and a beam spot of about 0.15 mm diameter is obtained on the phosphor screen. On the other hand, in the same cathode ray tube, but with the tubular permanent magnet 9 removed, the diameter of the beam spot became about 1.5 mm, and accordingly the diameter of the ion spot was assumed of this size, that is about 10 times as large as the electron beam spot. This means that the ion spot of 10 times diameter has about 100 times area. When a P45 phosphor ($Y_2O_3S: Tb$) which is strong against the ion-burning,

is used for the phosphor screen of the above cathode ray tube and life test was made, there was no indication of ion-burning even after 1000 hours of service time. After the service of 1000 hours, the vacuum in the enclosure is generally improved little by little and ion generation is decreased. Accordingly there is no fear of ion-burning in a short time, and the cathode ray tube is well usable for actual use.

Making of a cathode ray tube in accordance with the present invention is as follows: A cathode ray tube has a phosphor screen of about 25.4 mm diagonal size is made by using a phosphor of $Y_2O_2S:Tb$ and provided with a bi-potential type electron gun but without a metal back layer. The cathode ray tube has a designed ratings of last stage acceleration electrode potential E_b of about 2.0 KV, focusing electrode voltage E_{c_3} of about 0.3 KV, and beam spot diameter of about 0.3 mm. Before operating on the designed rating, the above-mentioned small type cathode ray tube is worked by the condition of $E_b \approx 2$ KV, $E_{c_3} \approx 1$ KV and $I_b \approx 50 \mu A$, for about one hour. That is the cathode ray tube was operated under a weakened electrostatic lens. Then, the electron beam was in a defocused state, and the beam spot diameter of the ion beam became large, and the ion beam emanating on the phosphor screen 11 was scattered. That is, the ion-burning was drastically decreased. And the defocused beam made gas within the vacuum enclosure ionize and many of the ionized ions were permanently adsorbed

onto the getter mirror film. Accordingly, by the above-mentioned aging processs with defocused beam emanation, the vaccum in the enclosure is improved. In the above-mentioned defocused aging process, the electron beam is not necessarily deflected for the small type cathode ray tube, but the defocused aging should be carried out at least for about 1 hour, preferably more than two hours, so that ion-burning after initiation of service under the desinged rating is drastically decreased.

As has been described in detail with respect to the preferred embodiments, undesirable ion-burning of phosphor can be substantially eliminated, and a stable small type cathode ray tube of low power consumption is obtainable.

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CATHODE RAY TUBE

Claims

1. Method of making a cathode ray tube comprising steps of

forming a phosphor screen (11) on an inside wall of a transparent face panel (10) of a vacuum enclosure (1),
disposing an electrostatic focusing type electron gun (3) in a neck part (2) of said vacuum enclosure (1),
sealing said vacuum enclosure (1),
forming a getter layer on a predetermined part of said inside wall of said vacuum enclosure (1),
characterized by

said phosphor screen (11) is irradiated by a defocused electron beam in an aging period.

2. Method of making a cathode ray tube in accordance with claim 1, wherein said irradiation is carried out at least for one hour.

FIG. 1

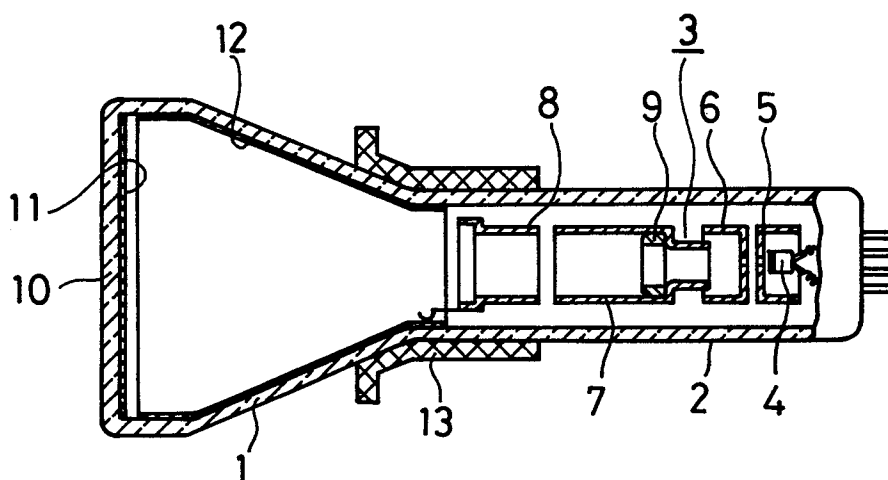


FIG. 2

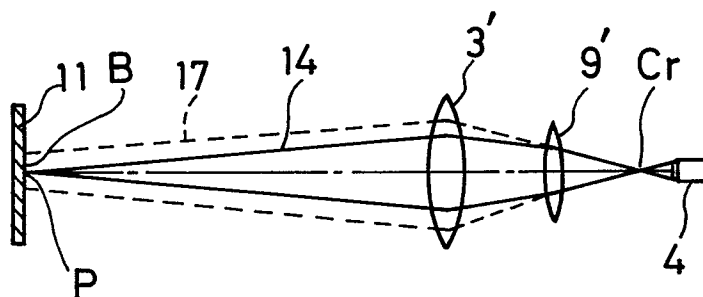
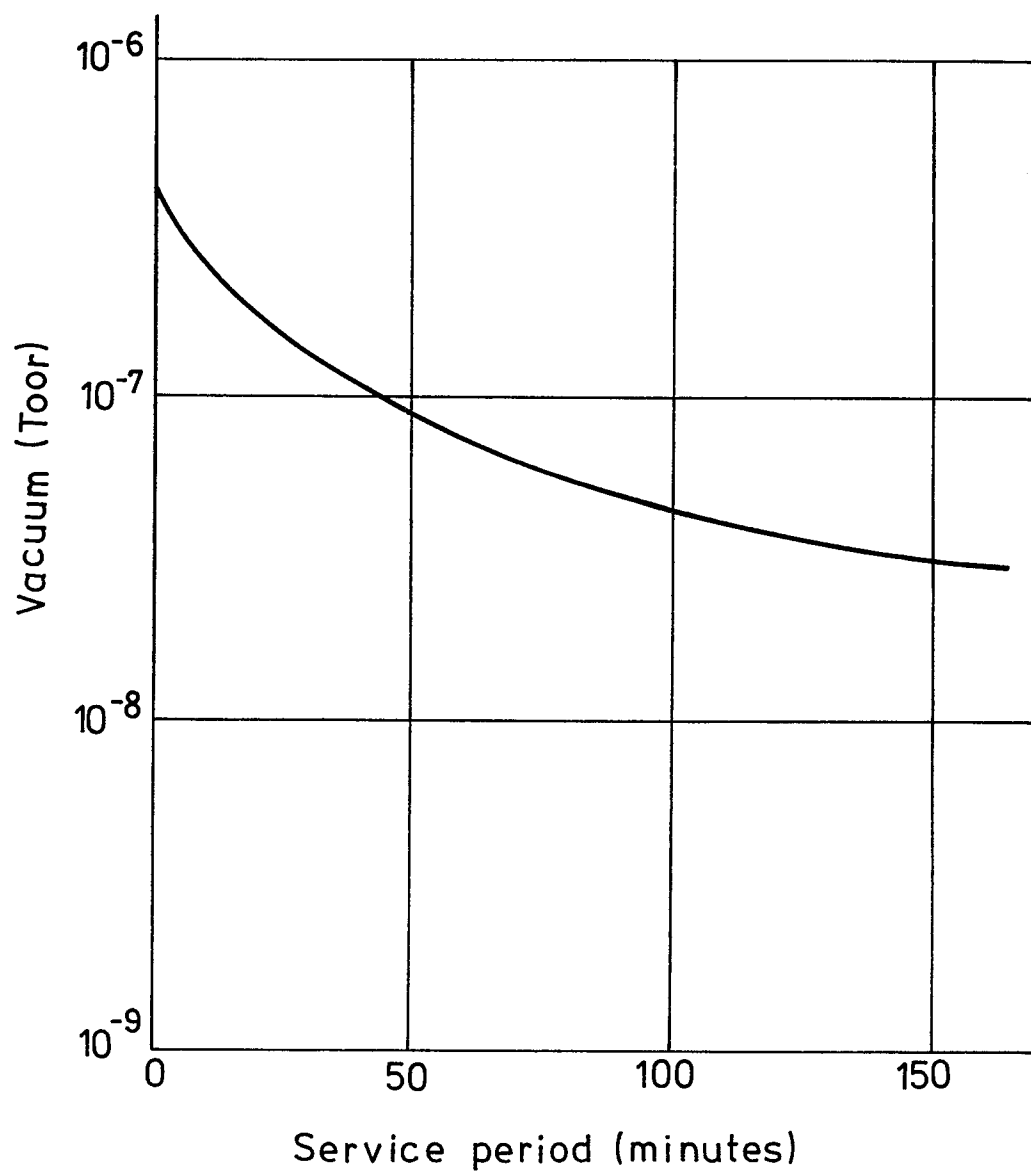


FIG.3





European Patent
Office

EUROPEAN SEARCH REPORT

0206216
Application number

EP 86 10 8224

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.4)
Y	PATENTS ABSTRACTS OF JAPAN, vol. 5, no. 113 (E-66)[785], 22nd July 1981; & JP-A-56 52 839 (HITACHI SEISAKUSHO K.K.) 12-05-1981	1	H 01 J 9/44
D, Y	GB-A-2 076 216 (HITACHI LTD.) * Page 1, lines 50-61; page 2, lines 5-52; figures 1,2 *	1	
A	-----	2	
			TECHNICAL FIELDS SEARCHED (Int. Cl.4)
			H 01 J
The present search report has been drawn up for all claims			
Place of search THE HAGUE		Date of completion of the search 13-10-1986	Examiner DELANGUE P.
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			