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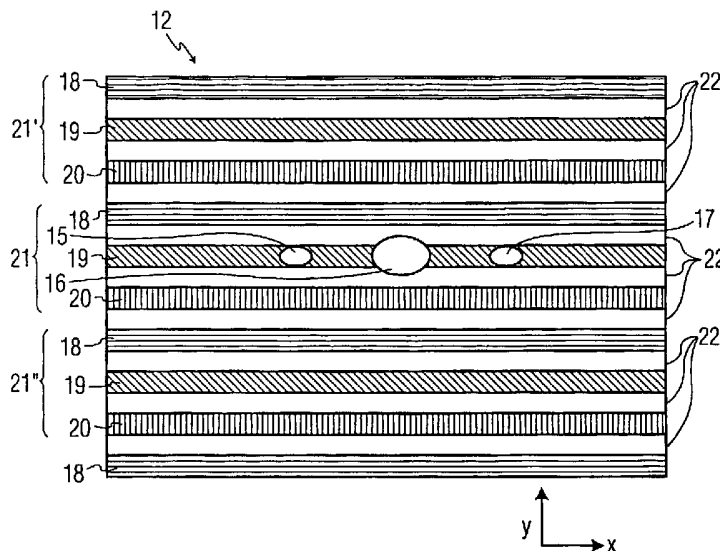
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(54) Title: ENHANCED BRIGHTNESS BEAM INDEX CATHODE RAY TUBE



(57) Abstract: A beam index cathode ray tube comprises a screen, an electron gun assembly, a yoke, and an image processor. The screen includes an alternating pattern of first, second, and third luminescent elements. The first second and third luminescent elements are arranged in triads. Each of the triads has one of each of the first, second, and third luminescent elements. The electron gun assembly directs first, second, and third electron beams toward the screen. The first, second, and third electron beams have an intensity controlled by an image processor. The yoke is arranged between the electron gun assembly and the screen. The yoke deflects the first, second, and third electron beams according to an algorithm generated by the image processor. Each of the first, second, and third electron beams is simultaneously deflected to the first luminescent element of either a single triad or multiple triads.

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Enhanced Brightness Beam Index Cathode Ray Tube

Field of the Invention

The invention generally relates to beam index cathode ray tubes and, more particularly, to a beam index cathode ray tube having an image processor that controls the intensity and deflection of electron beams emitted from an electron gun assembly with an algorithm that derives the control signals from the brightness and color composition of the video input.

Background of the Invention

A conventional beam index cathode ray tube (CRT) comprises a screen with blue, green, and red luminescent elements or phosphor stripes. The blue, green, and red luminescent elements extend in a horizontal direction and are arranged in triads consisting of alternating blue, green, and red luminescent elements. Positioned between each of the blue, green, and red luminescent elements is a black guardband. Blue, green, and red electron beams are simultaneously scanned along the respective blue, green, and red luminescent elements. The blue, green, and red electron beams have an intensity corresponding to an input signal from an image processor, whereby blue, green, and red subimages are formed that together produce a complete color image.

Although the black guardbands separate each of the blue, green, and red luminescent elements, the blue, green, and red luminescent elements are still arranged within close proximity to each other. Thus, when the intensity of any of the blue, green, or red electron beams is too high, adjacent luminescent elements may be excited, which results in a loss of color purity. For example, in a scene only requiring green, the image processor sends a high intensity input signal to the green electron beam. As the intensity of the green electron beam

is increased, the green electron beam increases in size and can overlap into the adjacent blue and red luminescent elements. This overlap results in a loss of color purity, which is aesthetically unpleasing to a viewer. It is therefore desirable to develop a beam index CRT where the intensity of the blue, green, or red subimages may be increased without causing a
5 loss of color purity.

Summary of the Invention

The invention is a beam index cathode ray tube comprising a screen, an electron gun assembly, a yoke, and an image processor. The screen includes an alternating pattern of first,
10 second, and third luminescent elements. The first, second and third luminescent elements are arranged in triads. Each of the triads has one of each of the first, second, and third luminescent elements. The electron gun assembly directs first, second, and third electron beams toward the screen. The first, second, and third electron beams have an intensity controlled by an image processor. The yoke is arranged between the electron gun assembly
15 and the screen. The yoke deflects the first, second, and third electron beams according to an algorithm generated by the image processor. Each of the first, second, and third electron beams is simultaneously deflected to a first luminescent element of either a single triad or multiple triads.

Brief Description of the Drawings

20 The invention will now be described by way of example with reference to the accompanying drawings, wherein:

Figure 1 is a partial sectional view of a cathode ray tube according to the invention;

Figure 2 is a partial schematic view of a screen having horizontally arranged

25 luminescent elements;

Figure 3 is another partial schematic view of a screen having horizontally arranged luminescent elements;

Figure 4 is a partial schematic view of a screen having vertically arranged luminescent elements;

5 Figure 5 is another partial schematic view of a screen having vertically arranged luminescent elements;

Figure 6 is a chart showing the various possible placement combinations of the individual electron beams within a grouping of phosphor stripes on the screen according to one embodiment of the invention;

10 Figure 7 is a schematic representation of a dipole field arrangement used in the yoke system in one embodiment of the invention;

Figure 8 is a schematic representation of a quadrupole in the yoke system in another embodiment of the invention;

15 Figure 9 is a schematic representation of a quadrupole in the yoke system in another embodiment of the invention; and

Figure 10 is a schematic representation of a six-pole field in the yoke system in another embodiment of the invention

Detailed Description of the Invention

Figure 1 shows a beam index cathode ray tube (CRT) 1 having a glass envelope 2.

20 The glass envelope 2 includes a substantially rectangular faceplate panel 3 and a tubular neck 4 connected by a funnel 5. An internal conductive coating (not shown) extends from an anode button 6 toward the faceplate panel 3 and to the neck 4. The faceplate panel 3 consists of a viewing faceplate 8 and a peripheral flange or sidewall 9, which is sealed to the funnel 5 by a glass frit 7.

A screen 12 is carried by an inner surface of the faceplate panel 3. As shown in Figures 2-3, the screen 12 may be, for example, a line screen with horizontally arranged blue, green, and red luminescent elements 18, 19, 20, respectively, that extend in an x-direction.

The blue, green, and red luminescent elements 18, 19, 20 may be, for example, phosphor stripes. The blue, green, and red luminescent elements 18, 19, 20 may be arranged in first, second, and third triads 21, 21', 21'', respectively, wherein each of the first, second, and third triads 21, 21', 21'' includes alternating blue, green, and red luminescent elements 18, 19, 20.

Although only three triads are shown in the illustrated embodiment for clarity, it will be appreciated by those skilled in the art that the screen 12 may have any number of triads.

Alternatively, the blue, green, and red luminescent elements 18, 19, 20 may be arranged vertically such that the blue, green, and red luminescent elements 18, 19, 20 extend in a y-direction, as shown in Figures 4-5. Typically positioned between each of the blue, green, and red luminescent elements 18, 19, 20 is a black guardband 22. It should be noted that the embodiments according to the invention may employ beam tracking features to ensure proper tracing the electron beams on the screen. For example, beam index stripes can be embedded into the screen in certain locations and work in concert with detection equipment 25, wherein a tracer beam of some sort is made incident on the screen to excite signal from the index marker, such as an index line 27 (as shown in Figure 5) which can be placed at certain intervals on the screen or index ends 28 which can be placed at the ends of one or more of the phosphor stripes. The detection equipment 25 receives the signal and can feed the signal to the processor to appropriately adjust the yoke fields to obtain optimum landing on the actual phosphor stripes. Examples can include some of the structures in U.S. Pat. No. 6,377,003 to Chen et al. Other tracking means include patterned UV phosphor elements on the electron gun side of the screen 12 in combination with an appropriately positioned photodetector. Also,

conductive structures in the screen 12 coupled to some electrical sensing device can be used to perform beam tracking.

An electron gun assembly 13, shown schematically by dashed lines in Figure 1, is centrally mounted within the neck 4. The electron gun assembly 13 consists of blue, green, and red electron guns (not shown). The blue, green, and red electron guns (not shown) are arranged substantially perpendicular to the direction of the blue, green, and red luminescent elements 18, 19, 20. For example, in the beam index CRT 1 having the screen 12 configured as shown in Figures 2-3, the blue, green, and red electron guns (not shown) are arranged in the y-direction. Alternatively, in the beam index CRT 1 having the screen 12 configured as shown in Figures 4-5, the blue, green, and red electron guns (not shown) are arranged in the x-direction. Each of the blue, green, and red electron guns (not shown) of the electron gun assembly 13 can generate and direct a corresponding blue, green, and red electron beam 15, 16, 17, respectively, toward the blue, green, and red luminescent elements 18, 19, 20 of the screen 12.

An external magnetic deflection yoke 14 is positioned on an exterior surface of the funnel 5 in a neighborhood of the funnel-to-neck junction. An image processor 10 is connected to the electron gun assembly 13 and the yoke 14. When activated, the yoke 14 subjects the blue, green, and red electron beams 15, 16, 17 to magnetic fields that cause the blue, green, and red electron beams 15, 16, 17 to scan horizontally and vertically over the blue, green, and red luminescent elements 18, 19, 20 of the screen 12. For example, in the beam index CRT 1 having the screen 12 configured as in Figures 2-3, the blue, green, and red electron beams 15, 16, 17 scan continuously in the x-direction as the blue, green, and red electron beams 15, 16, 17 move progressively in the y-direction. Whereas the beam index CRT 1 having the screen 12 configured as in Figures 4-5, the blue, green, and red electron

beams 15, 16, 17 scan continuously in the y-direction as the blue, green, and red electron beams 15, 16, 17 move progressively in the x-direction.

The operation of the beam index CRT 1 shown in Figure 1 will now be described in greater detail. A video signal is sent to the image processor 10. The image processor 10

5 processes the video signal and sends an input signal to the yoke 14 and synchronously the blue, green, and red electron guns (not shown) of the electron gun assembly 13. The electron gun assembly 13 emits the blue, green, and red electron beams 15, 16, 17 with an intensity corresponding to the input signal from the image processor 10. As the blue, green, and red electron beams 15, 16, 17 are emitted, the yoke 14 typically subjects the blue, green, and red
10 electron beams 15, 16, 17 to magnetic fields that cause the blue, green, and red electron beams 15, 16, 17 to scan over the blue, green, and red luminescent elements 18, 19, 20 of the screen 12 according to the input signal from the image processor 10. This is for the basic usage of the beam index CRT 1.

For the beam index CRT 1 according to one of the embodiments of the invention,
15 when the video signal sent to the image processor 10 requires a scene comprising a single color, the input signal sent to the yoke 14 by the image processor 10 directs the yoke 14 to position the blue, green, and red electrons beams 15, 16, 17 on the luminescent element(s) having the same color as the desired scene. For example, if the video signal sent to the image processor 10 requires a scene comprising only green, the input signal sent to the yoke 14 by
20 the image processor 10 directs the yoke 14 to position the blue, green, and red electrons beams 15, 16, 17 on the green luminescent element 19 of the first triad 21, as shown in Figures 2 and 5, wherein the image processor 10 sends and ensures a signal for green of appropriate intensity for the beams 15, 16, 17. Although not shown in the illustrated embodiment, the blue, green, and red electrons beams 15, 16, 17 could alternatively be
25 positioned on the green luminescent element 19 of the second or third triads 21', 21''. The

blue and red electron beams 15, 17 are positioned substantially adjacent to or superimposed on the green electron beam 16. The blue and red electron beams 15, 17 have a beam intensity equal to or smaller than the beam intensity of the green electron beam 16. As a result, the blue and red electron beams 15, 17 contribute to the intensity of the green electron beam 16 without having to substantially increase the beam size of the green electron beam 16. As illustrated in Figures 2 and 5, one can have one beam (such as green beam 16) being large enough to yield maximum tolerable intensity of light without crossing over to an adjacent color, but yet one can contribute to greater intensity of light output for that color in the vicinity by permitting one or both of the other beams (blue electron beam 15 and/or red electron beam 17) to further contribute to green light output. The illustrations in the Figures 2 and 5 show the blue electron beams 15 and red electron beam 17 being smaller than the green electron beam 16 to show that these beams contribute to additional light output at varying strengths.

Alternatively, the input signal sent to the yoke 14 by the image processor 10 can direct the yoke 14 to position the blue, green, and red electrons beams 15, 16, 17 on the green luminescent elements 19 of the first, second, and third triads 21, 21', 21'', as shown in Figures 3 and 4. The blue and red electron beams 15, 17 are positioned substantially adjacent to the green electron beam 16. The blue and red electron beams 15, 17 have a beam intensity equal to or smaller than the beam intensity of the green electron beam 16. As a result, the blue and red electron beams 15, 17 contribute to the intensity of the green electron beam 16 without having to substantially increase the beam size of the green electron beam 16. As illustrated in Figures 3 and 4, as well, one can have one beam (such as green beam 16) being large enough to yield maximum tolerable intensity of light without crossing over to an adjacent color, but yet one can contribute to greater intensity of light output for that color in the vicinity by permitting one or both of the other beams (blue electron beam 15 and/or red electron beam

17) to land on the green luminescent elements 19 of the first, second, and third triads 21, 21', 21'' to contribute to the green output. The illustrations in the Figures 3 and 4 show the blue electron beam 15 and red electron beam 17 being smaller than the green electron beam 16 to show that these beams can contribute to additional light output at varying strengths.

5 For clarity of illustration in Fig. 2, beams 15, 16 and 17 are shown as being horizontally disposed with respect to each other. Similarly, on Fig. 5 the corresponding disposition is vertical. It is understood that this is so shown to clarify the graphic description, but in actual practice, direct superposition of the beams can be achieved. If the beams are not directly superimposed, appropriate video processing may be utilized to achieve image content
10 superposition of adjacent beams.

It is understood that when multicolor high brightness images are to be displayed, a spillover of the first beam, say green beam, on the adjacent second phosphor, say blue stripe is acceptable, assuming that the screen color content is blue and green. Video processor 10 is utilized to monitor both the local brightness and the local color content of the
15 scene being displayed and adjust the beam positions and intensities to optimize brightness and color purity. By extension of the foregoing, it can be clearly understood that in bright white scenes, when all three beams are on intensely, spillover of the beams into adjacent phosphor stripes has small or no effect on purity. It is the function of video processor 10 to make logical decisions based on precalibrated beam characteristics in combination with the local brightness
20 and color content of the video signal to adjust the individual beam position and intensities to achieve the desired brightness at optimum color.

The basis of an algorithm for calculating the placement of the electron beams and their intensities is shown in Fig. 6. Fig. 6 is a table of the ten principal 'Combination Cases' for locating the three beams on the three phosphor stripes of any triad. The numbers
25 shown as entries in the table of Fig. 6 indicate how many beams are positioned over a given

stripe. For example, "Combination Case 1" refers to a mode of operation when each beam scans only one corresponding stripe; this case would be utilized for white fields and for any color up to a brightness where color purity would begin deteriorating due to beam spillover into adjacent stripes. Maximum brightness in any single color is achievable with the

5 "Combination Cases 8, 9, 10" where all three beams are positioned into the single stripe that produces the desired single color. Similarly "Combination Case 5" allows up to double beam intensity Blue in combination with single beam intensity Green. A pre-programmed look-up table based on Fig. 6 provides the addressing signals to the yoke for fast repositioning of the beams and for switching the appropriate signals to modulate the intensities of the individual
10 beams with the aid of image processor 10.

For the preceding discussion, here the yoke is understood to be a general beam deflection element that allows not only the continuous raster scanning of the three electron beams synchronously as a group across screen 12, but also the rapid repositioning of the individual beams over distances equal to or less than the center-to-center spacing of adjacent
15 triads, for example 21' and 20, or less. To accomplish the required repositioning of the beams, combinations of magnetic multi-pole fields can be used. Fig. 7 shows schematically a dipole arrangement. Here the arrows indicate a substantially uniform magnetic field extending between magnetic pole pieces N1 and S1. The encircled letters R, G, and B indicate the three electron beams, respectively, propagating perpendicular to the plane of the paper. When the
20 magnetic field is activated, the beams as a group are deflected in the vertical direction, i.e. perpendicular to the field lines, and the beams upon arrival at screen 12 are thus displaced perpendicular to the stripe patterns shown in Figs 3 and 4 by a distance controlled by the magnetic field intensity of the dipole. Similarly, Fig. 8 indicates schematically a quadrupole magnetic field arrangement comprising pole pieces N2, S2, N3, and S3 that, when activated,
5 can be utilized to cause separation of the outer beams, R and B, with respect to the inner

beam, G, as indicated by the vertically oriented short, straight arrows. Fig. 9 shows yet another quadrupole arrangement, comprising magnetic pole pieces N4, S4, N5, and S5. The quadrupole arrangement shown in Fig. 9 can be utilized to move the outer beams, R and B, laterally with respect to the center beam G. A fully symmetric activation of the magnetic poles in Figs 8 and 9, i.e. when all four poles generate equal strength magnetic fields, will result in a symmetric displacement of the outer, R and B, beams and will leave the central G beam without displacement. Asymmetric activation of the quadrupole poles will cause asymmetric displacements of the outer beams and also a displacement of the center beam. Thus, combination of the dipole shown in Fig. 7 and the two quadrupole arrangements shown in Figs 8 and 9 allow programmable repositioning of the individual beams. Yet another multi-pole combination is shown in Fig. 10, where a six-pole system is schematically shown. This six-pole arrangement allows the programmable repositioning of the two outer beams in the same direction, i.e. both up or both down, with respect to center beam. Thus the combination of a six-pole and a dipole allows repositioning of the three beams such that two beams scan over one selected phosphor stripe and two beams scan over another selected phosphor stripe on screen 12. Consequently, when such programmable repositioning is superimposed on the continuous scan any one, or two, or all three of the beams can be locally repositioned to scan over any selected phosphor stripe in the triad. For example, the R and the G beams can be repositioned to join the B beam in scanning the B phosphor stripe. In general, the multi-pole fields can assume any orientation with respect to the line drawn through the three beams in Figs. 7-10, produced by the well known in-line gun arrangement. Furthermore, in general the dipole moves all three beams in the same direction, the quadrupole moves the two outer beams in opposite directions, while the six-pole moves the two outer beams in the same direction with respect to the center beam. Thus, any general repositioning of the three beams can be achieved with appropriate superposition of multi-poles.

The beam index CRT 1 according to the invention can therefore increase the intensity of the blue, green, or red electron beams 15, 16, 17 without increasing beam size or causing a loss of color purity.

Also, while only one electron gun assembly 13 has been described in the
5 embodiments, beam index CRTs 1 according to this invention include those beam index CRTs 1 having multiple electron gun assemblies 13.

The foregoing illustrates some of the possibilities for practicing the invention. Many other embodiments are possible within the scope and spirit of the invention. It is, therefore, intended that the foregoing description be regarded as illustrative rather than limiting, and that
10 the scope of the invention is given by the appended claims together with their full range of equivalents.

What is Claimed is:

1. A beam index cathode ray tube, comprising:

a screen including an alternating pattern of first, second, and third luminescent elements, the first, second, and third luminescent elements being arranged in triads,
5 each of the triads having one of each of the first, second, and third luminescent elements;

an electron gun assembly that directs first, second, and third electron beams toward the screen, the first, second, and third electron beams having an intensity controlled by an image processor;

10 a yoke arranged between the electron gun assembly and the screen that deflects the first, second, and third electron beams according to an algorithm generated by the image processor; and

at least two of the electron beams being simultaneously deflected to at least one of the first luminescent elements.

- 15 2. The beam index cathode ray tube of claim 1, wherein the at least two of the electron beams are simultaneously deflected to the first luminescent element of one of the triads.

3. The beam index cathode ray tube of claim 1, wherein the at least two of the electron
20 beams are simultaneously deflected to the first luminescent elements of different triads.

4. The beam index cathode ray tube of claim 1, wherein the second and third electron beams have an intensity equal to or smaller than the first electron beam which is positioned therebetween.

5. The beam index cathode ray tube of claim 1, wherein the first, second, and third electron beams do not land on adjacent luminescent elements.
6. The beam index cathode ray tube of claim 1, wherein the screen includes blackguard
5 bands positioned between each of the first, second, and third luminescent elements.
7. The beam index cathode ray tube of claim 1, wherein the first, second, and third luminescent elements extend across the screen in a horizontal direction.
- 10 8. The beam index cathode ray tube of claim 1, wherein the first, second, and third luminescent elements extend across the screen in a vertical direction.
9. The beam index cathode ray tube of claim 1, wherein the beam index cathode ray tube includes a plurality of said electron gun assemblies.
- 15 10. The beam index cathode ray tube of claim 1, wherein spillover from at least one electron beam into an adjacent phosphor stripes contributes to local brightness and the local color content of the images.
- 20 11. The beam index cathode ray tube of claim 10, wherein all beams spillover to contribute to enhancing white content.

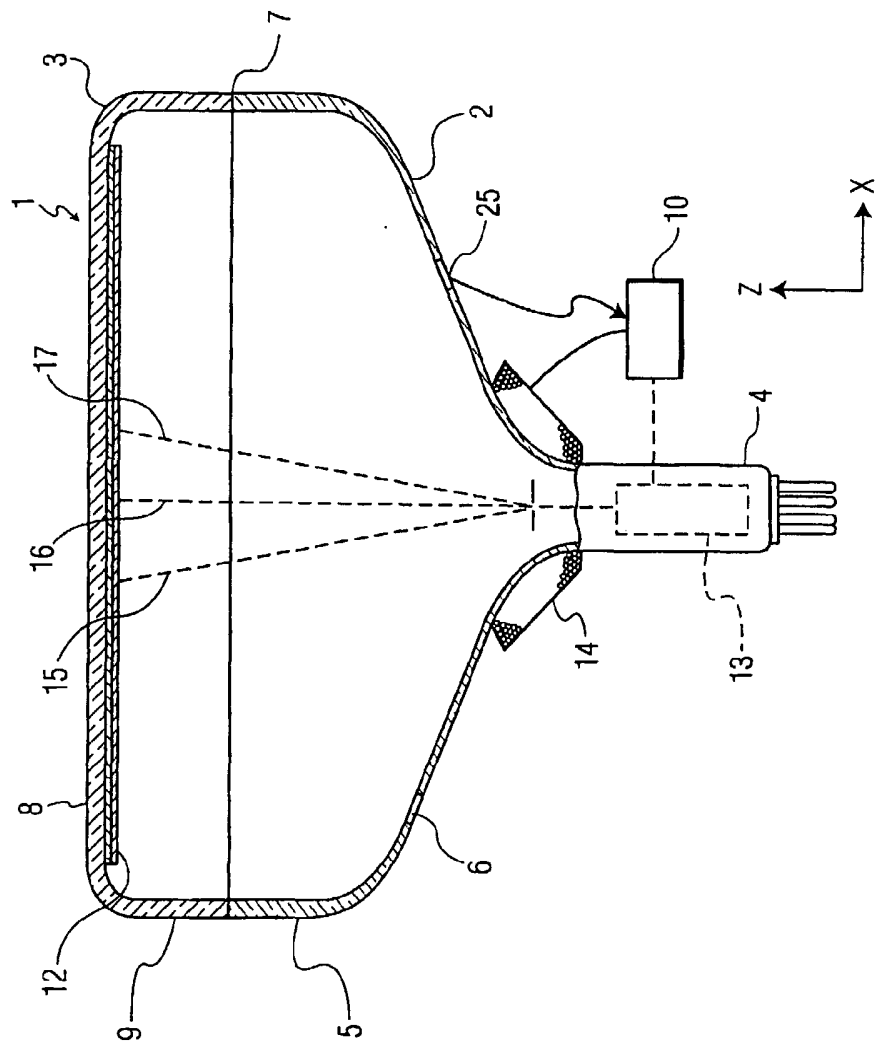
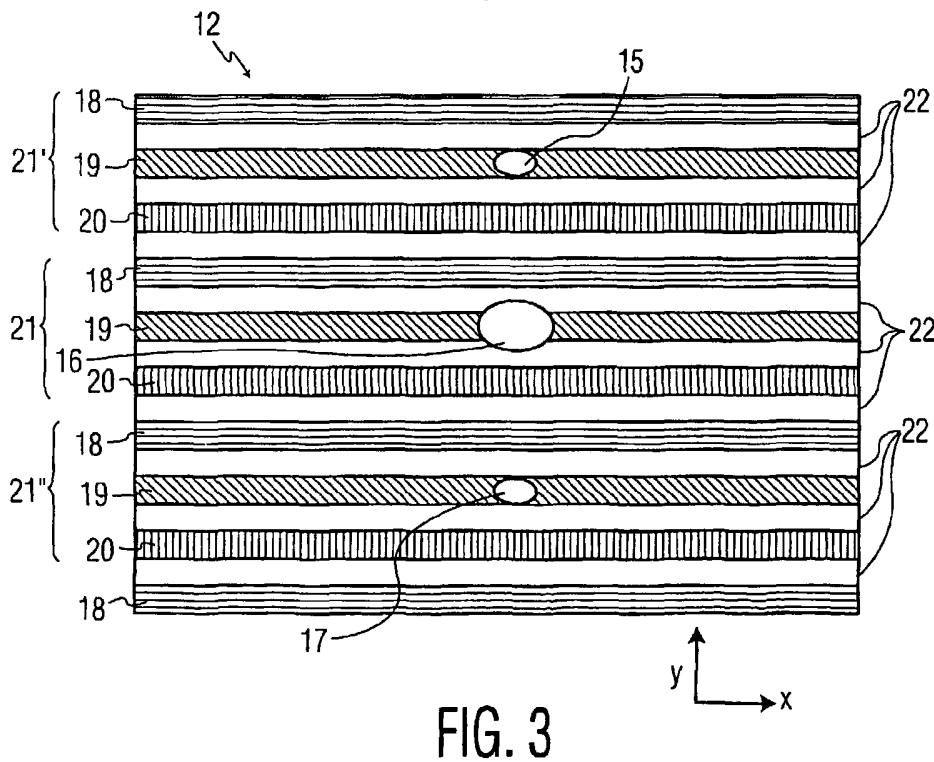
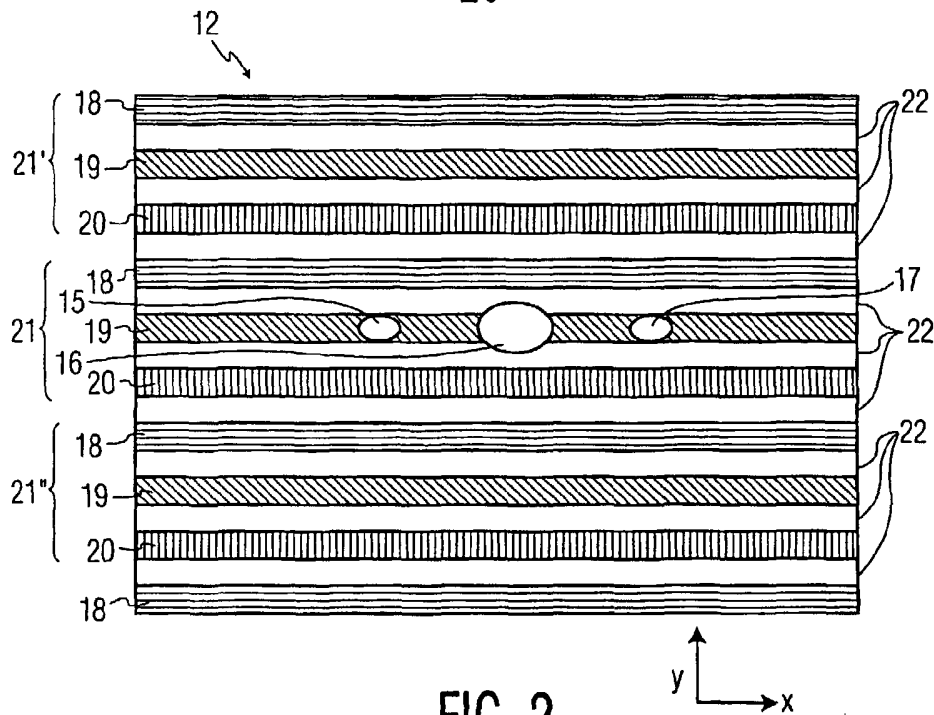


FIG. 1

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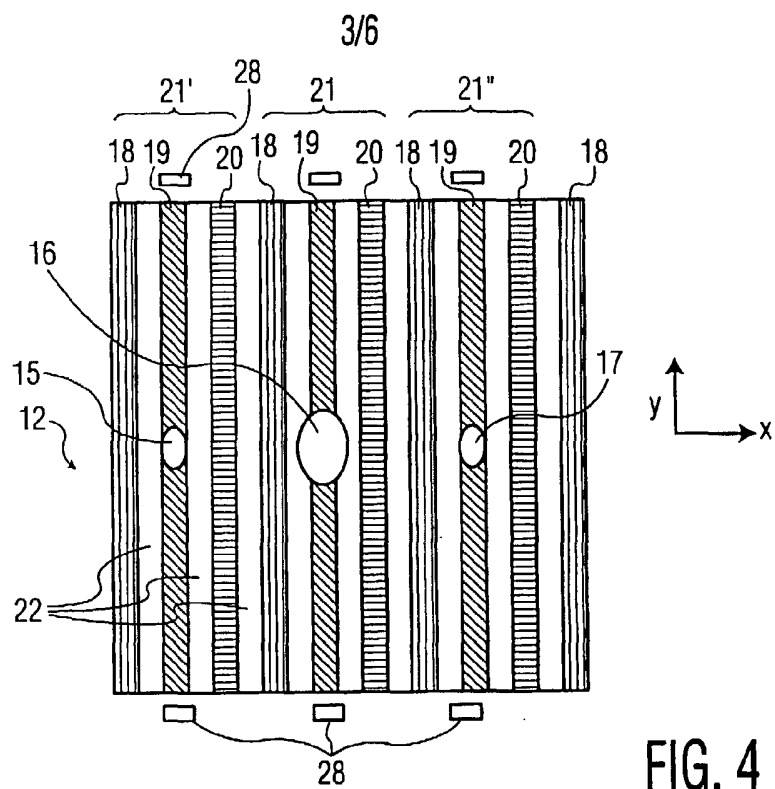


FIG. 4

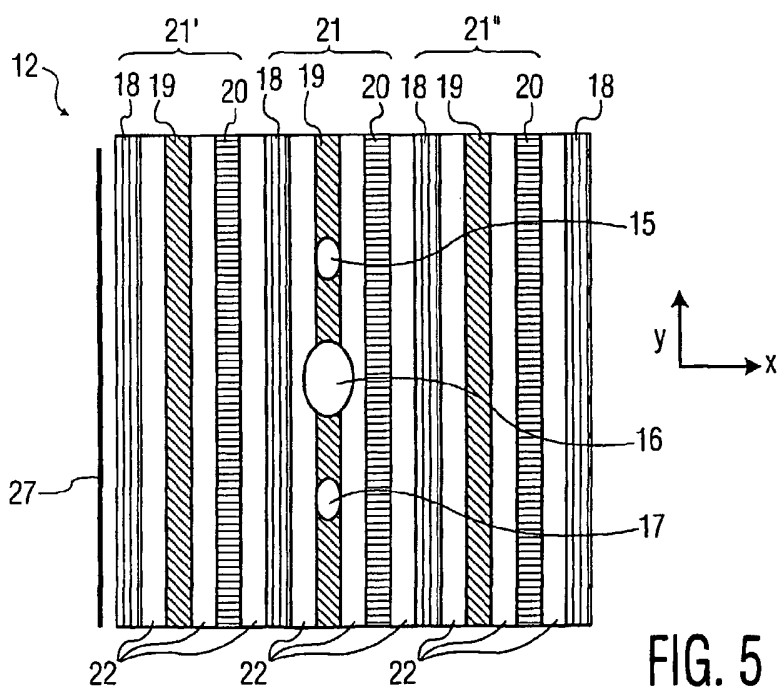


FIG. 5

PHOSPHOR STRIPE	BEAMS ON COMBINATION CASES									
	1	2	3	4	5	6	7	8	9	10
R	1	1	1	2	-	2	-	3	-	-
G	1	2	-	1	1	-	2	-	3	-
B	1	-	2	-	2	1	1	-	-	3

FIG. 6

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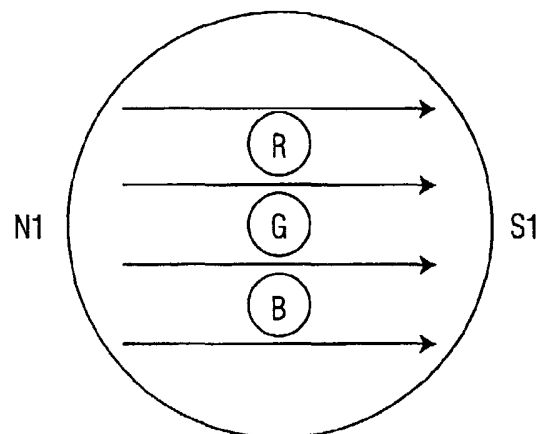


FIG. 7

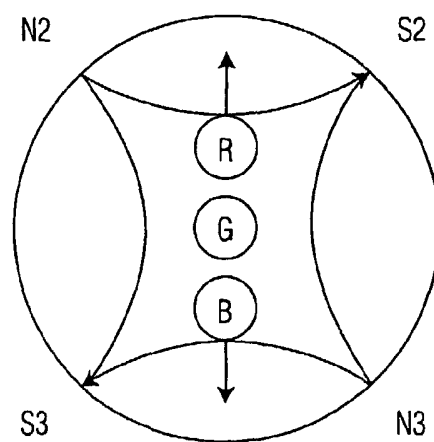


FIG. 8

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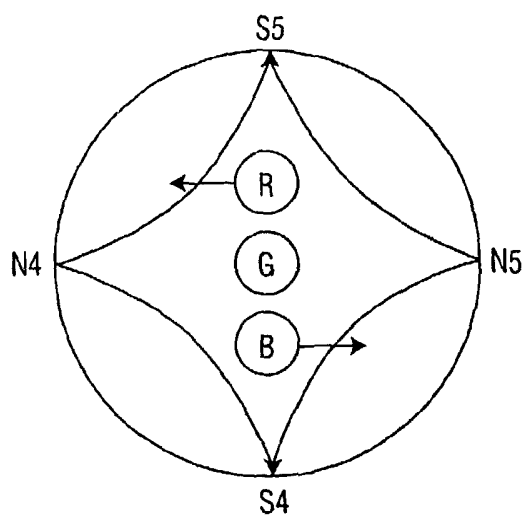


FIG. 9

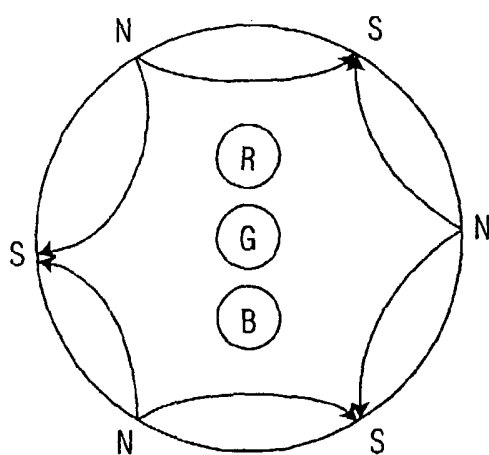


FIG. 10

INTERNATIONAL SEARCH REPORT

International Application No

PCT/US2005/011458

A. CLASSIFICATION OF SUBJECT MATTER
H04N9/24

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

H04N

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 2002/125825 A1 (VAN DEN BRINK HENDRIKUS BERNARDUS ET AL) 12 September 2002 (2002-09-12)	1-11
A	paragraphs '0038! - '0043! -----	
A	GB 2 227 911 A (* FERRANTI INTERNATIONAL SIGNAL PLC) 8 August 1990 (1990-08-08) abstract; figure 1 -----	1-11

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Date of the actual completion of the international search

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