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(54) **Colour cathode ray tube**

Farbkathodenstrahlröhre

Tube à rayons cathodiques en couleurs

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Description

The invention relates to a colour cathode ray tube comprising an electron gun for generating at least one electron beam, a colour selection electrode having rows of apertures, a display screen and means for deflecting the electron beam across the colour selection electrode in a line deflection direction transverse to the row of apertures.

Such display devices are known from e.g. EP 0 321 202. They are used, *inter alia*, in television receivers.

A disturbing effect which may occur in such display devices is the so-called Moiré effect. This effect causes light and dark lines or lines of a deviating colour in the image.

In operation, lines are written on the display screen in the line deflection direction by the electron beam(s). The number of lines written on the display screen (the so-called number of active lines) is system-dependent. In PAL and SECAM systems approximately 540 lines are written on the display screen, (in these systems the signal comprises 625 lines; approximately 50 of said lines are used for coded information; of the remaining 575 lines approximately 7% is scanned beside the display screen, the so-called "overscan"; thus, the overall number of active lines is approximately $(625 - 50)/1.07 = 537$). In the NTSC system approximately 450 active lines are written (the NTSC signal comprises 525 lines). For so-called HDTV applications of these systems the number of lines is doubled to, respectively, 1250 and 1050 in the signal and approximately 1040 and 900 active lines. In operation, a colour cathode ray tube preferably does not exhibit disturbing Moiré effects for "normal" display or HDTV-display, irrespective of whether such a tube is used in a PAL, SECAM or NTSC system.

It is an object of the invention to provide a colour cathode ray tube which can be used in several systems and in which no disturbing Moiré effect occurs.

To this end, the colour cathode ray tube in accordance with the invention is characterized in that the number of apertures per row ranges between 690 and 780.

Hitherto, "standard" systems customarily have in the order of 500 to 600 apertures per row. In this range (≈ 500 -600) Moiré effects can be avoided for a specific application or system but for other applications or systems such colour cathode ray tubes exhibit very disturbing Moiré effects. The colour cathode ray tube in accordance with the invention does not exhibit such disturbing Moiré effects. By virtue thereof, a substantial saving in costs can be achieved.

Within the range from 690 to 770, there are a number of preferred ranges. These ranges are very suitable for specific combinations of applications or systems. A first preferred range is defined in that the number of apertures ranges between 705 and 750, more particularly between 705 and 730. This range is very suitable for PAL (or SECAM) systems both for normal and HDTV display.

A second preferred range is defined in that the number of apertures ranges between 730 and 750. This range is very suitable for dual PAL-NTSC HDTV applications.

A third preferred range is defined in that the number of apertures ranges between 730 and 780, more particularly between 750 and 780. This range is very suitable for NTSC applications both for normal and HDTV display.

The lines are subjected to interlaced scanning and the ratio between the number of apertures and the number of lines scanned across the apertures is approximately 4/6 or 5/6.

The above-mentioned ratio is equal, within a 0.1% margin, to the so-called s/a_v ratio, where s is the scan pitch for the entire frame and a_v is the mask pitch. Preferably, for a PAL or SECAM display device a ratio of approximately 4/6 is used and for an NTSC display device a ratio of approximately 5/6 is used. A PAL (SECAM), NTSC display device is to be understood to mean within the scope of the invention a display device which is suitable for receiving, respectively, a PAL (SECAM) and an NTSC signal.

These and further aspects of the invention will be explained in greater detail by means of an example and with reference to the accompanying drawing, in which

Fig. 1 is a colour cathode ray tube;

Fig. 2 is a detail of a colour selection electrode.

The Figures are diagrammatic.

In the Figures, like reference numerals refer to like parts.

Fig. 1 is a partly perspective view of a cathode ray tube 1. Said cathode ray tube 1 comprises an evacuated envelope 2 having a display window 3, a cone 4 and a neck 5. In the neck there is provided an electron gun 6 for generating, in this example, three electron beams 7, 8 and 9. On the inside of the display window 3 there is provided a luminescent display screen 10 which, in this example, comprises phosphor elements luminescing in red, green and blue. On their way to the screen 10, said electron beams 7, 8 and 9 are deflected across the screen 10 by means of a deflection unit 11, which is located at the junction between the neck and the cone, and pass through the colour selection electrode, in this example the shadow mask 12 which comprises a thin plate having apertures 13. The electron beams 7, 8 and 9 pass through said apertures 13 at a small angle with respect to each other and each electron beam impinges on phosphor elements of only one colour. Said Figure also diagrammatically shows the drive mechanism 14

of the electron gun and the deflection unit as well as the receiving means 15 for receiving a signal 16.

Fig. 2 is a top view of a detail of a colour selection electrode. Said colour selection electrode 20 comprises a number of rows of apertures 21. Said rows extend transversely to the line deflection direction x. In successive rows the apertures are offset relative to each other in a direction transverse to the line deflection direction. Scanning lines 22 are also shown. Said lines diagrammatically show where the electron beam(s) is (are) incident on the shadow mask. In the case of the so-called PAL and SECAM system, which is used in Europe, Asia, Africa and parts of South-America, the number of lines which are incident on the shadow mask and which impinges on the display screen after passing through the apertures of the shadow mask is approximately 540 for a "standard" display and twice as many for a HDTV display. The number of active lines of the NTSC system is approximately 450 for "standard" display and 900 for HDTV display. In Fig. 2 the scanning-line pitch s is shown. This is the distance between the scanning lines. The distance between the apertures (mask pitch) a_v is also shown.

Interference of the pattern of apertures in the colour selection electrode with the scanning-line pattern causes Moiré effects. Moiré effects occur in horizontal directions (in which case horizontal bars are visible in the image displayed) and at oblique angles (oblique bars appear in the image). Combinations thereof, which appear for example in the form of a diamond pattern, are also possible. In each of the systems (PAL-SECAM; NTSC) and display variants ("standard" or HDTV) different Moiré effects occur. Table 1 diagrammatically shows the extent to which said Moiré effects as a whole are perceived as disturbing by test persons. The number of apertures in a row (N) is listed in the vertical direction, the systems (PAL; PAL-HDTV; NTSC; NTSC-HDTV) are listed in the horizontal direction. This Table does not distinguish between PAL and SECAM because in said systems use is made of an equal number of scanning lines. The qualifications given have the following meaning:

++ = very good
+ = good
0 = fairly good.

Table 1

Number of apertures per row	PAL	PAL-HDTV	NTSC	NTSC-HDTV
690-770	+	+	o	o
705-730	++	++	+	+
730-750	+	+	+	++
750-780	o	o	++	++

Table 1 shows that if N ranges between approximately 690 and 780 a fairly good display is obtained for each of the systems and display variants. Thus, a colour cathode ray tube comprising a colour selection electrode having such a number of apertures can be used in each system. In PAL systems, the range between 705 and 750, more particularly 705-730, is very suitable. For a dual PAL-NTSC application, the range between 730 and 750 is very suitable and for NTSC applications the range between 730 and 780, in particular 750-780, is suitable.

The invention makes it possible to provide a colour cathode ray tube which can be used in the various existing systems and applications without the occurrence of disturbing Moiré effects. By virtue thereof, a substantial saving in costs can be achieved; in various types of display devices the same colour-cathode ray tube can be used. It is also possible to use the same colour selection electrode for different types of colour cathode ray tubes. The invention also provides a cathode ray tube which does not exhibit disturbing Moiré patterns when it is used for HDTV applications (double line frequencies).

Conventional colour cathode ray tubes for "standard applications" comprise colour selection electrodes the number of apertures of which ranges between approximately 500 and 600. In such colour cathode ray tubes the use of one and the same tube for different systems and applications inevitably leads to disturbing Moiré patterns.

Further it has been found that for the ranges $690 < N < 750$ (preferably $705 < N < 730$) in a PAL-HDTV system and $730 < N < 780$ (preferably $750 < N < 780$) in an NTSC-HDTV system substantially no disturbing Moiré patterns occur. This is remarkable because at first one would expect such a HDTV-system to exhibit the same Moiré effects as a "standard" PAL or NTSC system having half as many apertures, *i.e.* for PAL $345 < N < 375$ and for NTSC $365 < N < 385$. However, this is not the case. "Standard" PAL systems and NTSC systems having the number of apertures indicated in the previous line exhibit clearly visible Moiré patterns.

Table 1 above represents one aspect of the invention, which aspect relates to the number of apertures in one row.

Below, a description is given of a second aspect, which relates to the ratio between the number of apertures and

the number of effectively scanned lines (the s/a_v ratio).

Table 2 below lists the ratios between the number of scanning lines and the number of apertures per row for the different ranges, the number of apertures per row and the different systems. This ratio is equal, within a 0.1 % margin, to the ratio between the distance between the scanning lines (also referred to as scan pitch s) and the distance between the apertures in a row (also referred to as mask pitch a_v). The ratio s/a_v can be calculated from the number of apertures per row and the number of scanning lines. If N_0 is the number of apertures and N_s is the number of effective scanning lines, then s/a_v is defined by $(N_0 - 1)/(N_s - 1)$. Since both N_0 and N_s are very large, s/a_v is substantially equal to N_0/N_s . A few embodiments exhibiting exceptionally few Moiré effects are given in bold print. The s/a_v ratio is an important parameter for the occurrence of Moiré effects.

Table 2

Number of apertures per row	PAL SECAM	PAL-HDTV SECAM-HDTV	NTSC	NTSC-HDTV
690-770	1,285 -1,434	0,643-0,717	1,524-1,708	0,762-0,854
705-730	1,313-1,359	0,657-0,68	1,557-1,612	0,779-0,806
730-750	1,359-1,397	0,68-0,699	1,612-1,657	0,806-0,829
750-780	1,397-1,434	0,699-0,717	1,657-1,708	0,829-0,854

In this example, the electron gun simultaneously generates three electron beams, each electron beam generating an image in red, green or blue. This is not to be interpreted in a limiting sense, the electron gun may alternatively generate a single electron beam which sequentially generates the three different colour images. In this example each row has an equal number of apertures. Small variations, within the indicated range, in the number of apertures may however occur, for example to improve the edges of the image displayed. Besides, at its periphery, the colour selection electrode may have a small number (fewer than five) of rows having a smaller number of apertures than indicated in the claims.

Claims

1. A colour cathode ray tube comprising an electron gun for generating at least one electron beam, a colour selection electrode having rows of apertures, a display screen and means for deflecting the electron beam(s) across the colour selection electrode in a line deflection direction transverse to the rows of apertures, characterized in that the number of apertures per row ranges between 690 and 780.
2. A colour cathode ray tube as claimed in claim 1, characterized in that the number of apertures ranges between 705 and 750.
3. A colour cathode ray tube as claimed in claim 2, characterized in that the number of apertures ranges between 705 and 730.
4. A colour cathode ray tube as claimed in claim 2, characterized in that the number of apertures ranges between 730 and 750.
5. A colour cathode ray tube as claimed in claim 1, characterized in that the number of apertures ranges between 730 and 780.
6. A colour cathode ray tube as claimed in claim 5, characterized in that the number apertures ranges between 750 and 780.

Patentansprüche

1. Farbelektronenstrahlröhre mit einem Elektronenstrahlerzeugungssystem zum Erzeugen wenigstens eines Elektronenstrahls, mit einer Farbselektionselektrode mit Reihen von Öffnungen, mit einem Wiedergabeschirm und mit Mitteln zum Ablenken des Elektronenstrahls (der Elektronenstrahlen) über die Farbselektionselektrode in einer Zeilenablenkrichtung quer zu den Reihen von Öffnungen, dadurch gekennzeichnet, daß die Anzahl Öffnungen je

Reihe zwischen 690 und 780 liegt.

2. Farbelektronenstrahlröhre nach Anspruch 1, dadurch gekennzeichnet, daß die Anzahl Öffnungen zwischen 705 und 750 liegt.
3. Farbelektronenstrahlröhre nach Anspruch 2, dadurch gekennzeichnet, daß die Anzahl Öffnungen zwischen 705 und 730 liegt.
4. Farbelektronenstrahlröhre nach Anspruch 2, dadurch gekennzeichnet, daß die Anzahl Öffnungen zwischen 730 und 750 liegt.
5. Farbelektronenstrahlröhre nach Anspruch 1, dadurch gekennzeichnet, daß die Anzahl Öffnungen zwischen 730 und 780 liegt.
6. Farbelektronenstrahlröhre nach Anspruch 5, dadurch gekennzeichnet, daß die Anzahl Öffnungen zwischen 750 und 780 liegt.

Revendications

1. Tube à rayons cathodiques en couleurs comprenant un canon à électrons afin de générer au moins un faisceau électronique, une électrode de sélection des couleurs présentant des rangées d'ouvertures, un écran d'affichage et un moyen de déviation du (des) faisceau(x) électronique(s) en travers de l'électrode de sélection des couleurs dans une direction de déviation de balayage transversale aux rangées d'ouvertures, caractérisé en ce que le nombre d'ouvertures par rangée est compris entre 690 et 780.
2. Tube à rayons cathodiques en couleurs suivant la revendication 1, caractérisé en ce que le nombre d'ouvertures est compris entre 705 et 750.
3. Tube à rayons cathodiques en couleurs suivant la revendication 2, caractérisé en ce que le nombre d'ouvertures est compris entre 705 et 730.
4. Tube à rayons cathodiques en couleurs suivant la revendication 2, caractérisé en ce que le nombre d'ouvertures est compris entre 730 et 750.
5. Tube à rayons cathodiques en couleurs suivant la revendication 1, caractérisé en ce que le nombre d'ouvertures est compris entre 730 et 780.
6. Tube à rayons cathodiques en couleurs suivant la revendication 5, caractérisé en ce que le nombre d'ouvertures est compris entre 750 et 780.

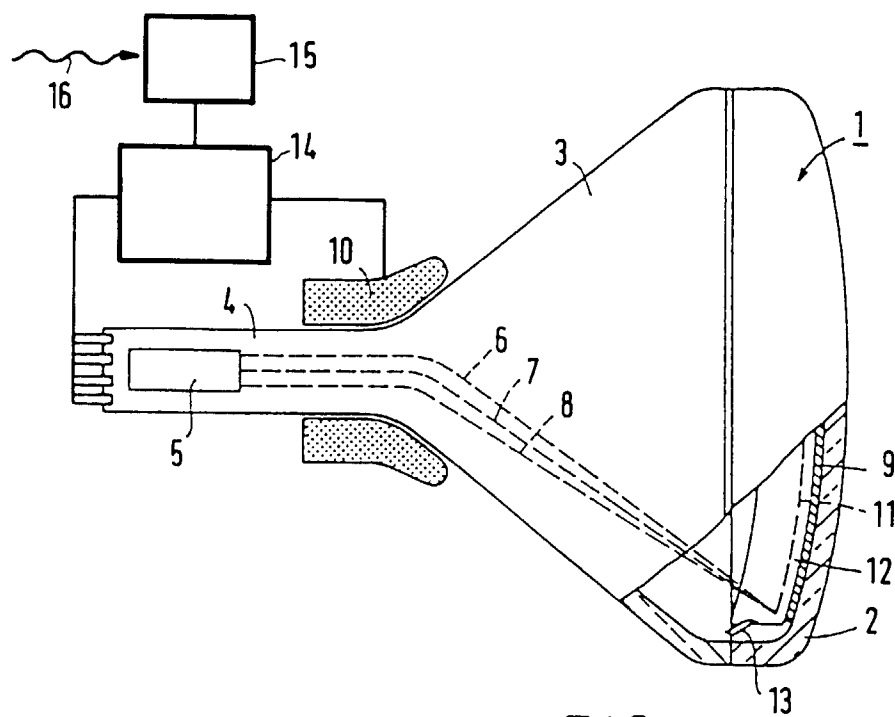


FIG. 1

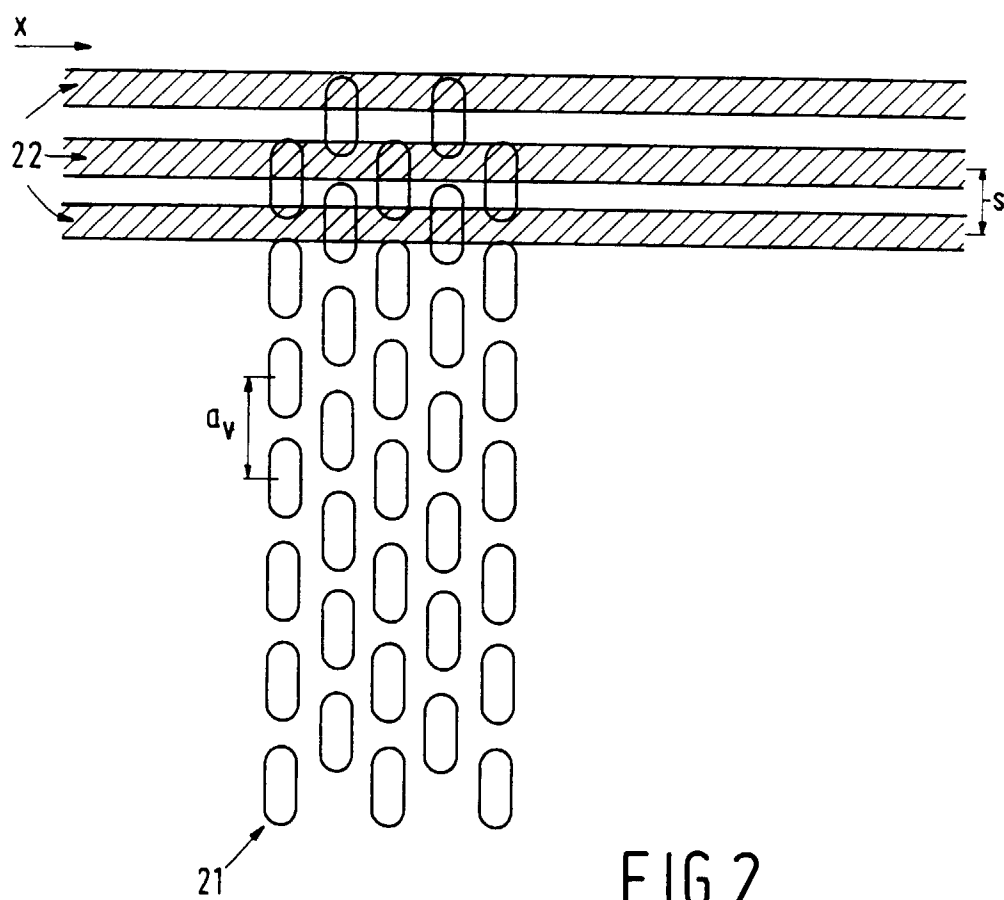


FIG. 2