ABSTRACT

In a color cathode ray tube having a display screen assembled of a plurality of triplets of green, red and blue strips, the distance between the centers of two adjacent strips belonging to the same triplet is at either side of the red strip at least 5% larger than the distance between the centers of two adjacent strips of which one belongs to the triplet and the other belongs to an adjacent triplet.

3 Claims, 6 Drawing Figures
CATHODE RAY TUBE FOR DISPLAYING COLOURED PICTURES

The invention relates to a cathode ray tube for displaying coloured pictures comprising a display screen having a large number of discrete regions which, upon bombardment with electrons, luminesce in three different colours, a colour selection mask having a large number of apertures, and means to produce three electron beams converging towards the display screen, each luminescent region being present in a path of an electron beam through one of the said apertures, said luminescent regions being arranged according to substantially parallel colour strips, said colour strips being arranged in triplets each containing three colour strips which luminesce green, red, and blue, respectively.

Such a cathode ray tube is known and is usually referred to as a shadow mask tube. However, a tube of the type described in the preamble does not comprise, as the shadow mask tube generally used at the moment, a display screen having a hexagonal pattern of luminescent dots, but comprises a display screen having luminescent strips which during normal operation are vertical, that is to say at right angles to the lines of a television screen. The advantage of such a display screen having luminescent strips is that deviations from the correct place where an electron beam is to impinge upon the display screen (so-called landing errors) which are parallel to the direction of the strips, do not result in colour defects because the electron beam remains impinging upon the strip of the same colour. The colour strips may be formed by continuous strips of one colour or by a series of elongate regions of one colour together constituting a strip. The apertures in the colour selection mask can be formed in the same manner by long slots or by a series of elongate apertures together constituting a slot having reinforcement bridges.

A drawback of such a cathode ray tube, however, is that landing errors at right angles to the colour strips result in much larger colour defects than in the shadow mask tubes having circular phosphor dots. On the one hand, this is because the width of the colour strips must be much smaller than the diameter of the said phosphor dots, since otherwise the line structure of the displayed picture would be visible in an annoying manner. On the other hand, this is caused by the fact that when the phosphor limit of a colour strip is exceeded, the mislanding part of the beam increases linearly rather rapidly, whilst the mislanding part of the beam increases quadratically, and hence initially slowly, when the phosphor limit of a circular dot is exceeded.

It is the object of the invention to provide a display tube in which the colour defects are strongly reduced while retaining a certain distance between the triplets of colour strips.

According to the invention, a cathode ray tube of the type described in the preamble is characterized in that the central colour strip of each triplet luminesces red and that, over at least part of the display screen, the distance between the centers of two adjacent colour strips belonging to the same triplet is at least 5% larger than the distance between the centers of two adjacent colour strips of which one belongs to the said triplet and the other belongs to an adjacent triplet.

The decrease of the colour defects as a result of landing errors of the electron beams as indicated by the invention is based on experiments which have demonstrated that the discoloration which occurs by landing of the red electron beam (by which is briefly meant the beam which transports the red picture signal) on the green or the blue colour strips is experienced to be more serious than landing of the green electron beam on the blue colour strips or landing of the blue electron beam on the green colour strips, while the latter is again experienced to be more serious than landing of the blue or the green electron beam on the red colour strips. Green, red and blue is to be understood to mean herein the set of primary colours which is used in the conventional television systems to realize an optimum colour display. This is used by the invention by choosing the landing tolerance for the red beam to be greatest and the tolerance for the landing of the green and the blue beam on the red colour strips to be smallest. This can be realized by varying the mutual distances and the width, respectively, of the colour strips.

Since an important cause of colour defects is the local expansion of the colour selection mask as a result of heating by the electron beams and the colour defects as a result of this cause increase from the center of the display screen towards the edge, a cathode ray tube according to the invention is characterized in particular in that the said percentage increases from 0% in the center of the display screen to a maximum of 20% at the edge of the display screen.

A cathode ray tube according to the invention may furthermore be provided with a light-absorbing layer between the individual colour strips to reduce the quantity of ambient light reflected by the display screen.

The invention will be described in greater detail with reference to the accompanying drawing, of which FIG. 1 is a cathode ray tube according to the invention.

FIG. 2 shows a part of FIG. 1 on an enlarged scale.
Figs. 3 and 5 show two possibilities for the landing of the electron beams without using the invention, and Figs. 4 and 6 show two possibilities for the landing of the electron beams in a tube according to the invention and as compared with Figs. 3 and 5, respectively.

Fig. 1 shows a colour television display tube having an evacuated envelope comprising an electron gun 2, a colour selection mask 3, a display screen 4 and having deflection coils 5. The electron gun 2 produces three electron beams 6, 7 and 8 which converge towards the display screen 4. The axes of the electron beams 6, 7 and 8 in the non-deflected condition lie in the plane of the drawing. The deflection coils 5 deflect the electron beams 6, 7 and 8 in such manner that the display screen 4 is scanned. Scanning occurs in known manner according to a line frame the lines of which are parallel to the plane of the drawing.

FIG. 2 illustrates the colour selection by means of the colour selection mask 3 and shows the encircled part of FIG. 1 on a larger scale. The colour selection mask 3 has a number of apertures 9 which pass the electron beams 6, 7 and 8 partly. As a result of the angle which the electron beams enclose with each other, the electron beam 6 only impinges upon phosphor strips of the display screen 4 which are denoted by G and which luminesce green. In the same manner, the beam 7 only impinges upon red (R) phosphor strips and the beam 8 only upon blue (B) phosphor strips. The display screen 4 furthermore comprises in known manner a
very thin aluminium layer which is permeable to electrons.
Three phosphor strips belonging to one aperture of the colour selection mask 3 constitute a triplet. The phosphor strips are substantially parallel and extend at right angles to the lines of the already mentioned line frame. The apertures 9 are slot-shaped and are of course parallel to the phosphor dots. In this connection, a slot-shaped aperture is also to be understood to mean a row of apertures parallel to the phosphor strips which together constitute a slot having reinforcement bridges. In connection with the method of manufacturing the tube, said reinforcement bridges may be recognizable in the phosphor strips.
The tube is manufactured by providing a photosensitive layer on a part of the window of the tube and exposing said layer to the light of a source the place of which is related to the deflection point of the electron beams in the deflection coils 5. Thus, for each colour of phosphor strips to be provided, exposure is carried out from a different place. Exposure and development of the photosensitive layer occur in known manner according to a photochemical or an electrophotographic method. By arranging the light successively in places which are more eccentric than the deflection points of the electron beams 6 and 8, the triplet of phosphor strips becomes wider than the triplet of electron spots. The triplet also becomes wider by making the distance between the colour selection mask 3 and the display screen 4 larger. A wider triplet means that the distance between the phosphor strips of the triplet becomes larger but the distance to adjacent triplets becomes smaller. Since, as already stated, red is most sensitive for landing errors, the colour defects are decreased by choosing red for the central phosphor strip of a triplet.
The invention can be carried out in various manners. Two possibilities are explained by means of the FIGS. 4 and 6 and compared with the known possibilities as shown in FIGS. 3 and 5. In these figures, the phosphor strips are shaded and furthermore denoted by G for green, R for red and B for blue. The central three strips in each figure form a triplet. The extreme left and the extreme right strip are of adjacent triplets. The spots of the electron beams are shown diagrammatically by rounded rectangles. The distance between the triplets of phosphor strips in FIG. 3 to FIG. 6 is 0.700 mm measured between the centers of two red phosphor strips.
FIG. 3 shows a configuration in which the invention is not used. In this configuration, the display screen is entirely filled with phosphor. The phosphor strips G, R and B are equally wide, namely each 0.233 mm. The electron spots impinge upon the center of the phosphor strips. The landing freedom is equally large for all three electron beams.
FIG. 4 shows a configuration which is obtained by applying the invention to the configuration of FIG. 3. The red phosphor strip R is 0.300 mm wide. The green phosphor strip G and the blue phosphor strip B are each 0.200 mm wide. As a result of this, the distance between the centers of G and B is equal to 0.200 mm and between the centers of G and R and R and B, respectively, it is equal to 0.250 mm. The electron spots are equidistant. Comparison of FIG. 4 to FIG. 3 proves that the landing freedom of the red beam is increased. The landing freedom of the blue beam relative to the green phosphor strip and of the green beam relative to the blue phosphor strip has remained the same. The landing freedom of the red and blue beams relative to the red phosphor strip, however, is reduced but provides the least observable colour defects. Said colour defects can be reduced by making the red phosphor strip R narrower while maintaining the stated distances between the centres of G, R and B and while maintaining equidistant electron spots. A space which is not covered with phosphor is then obtained between R and G and B and R, respectively, as a result of which a small landing error of the green or the blue beam causes same to miss the corresponding phosphor strip partly but not yet to impinge upon the red phosphor strip R.
FIG. 5 shows a configuration in which the invention is not used. In this configuration, the phosphor screen is not filled entirely with phosphor. The electron spots overlap the phosphor strips. Such a configuration with so-called negative tolerance is very suitable to fill the space between the phosphor strips with a light-absorbing layer so as to restrict the detrimental reflection of ambient light by the display screen. The phosphor strips G, R and B are each 0.080 mm wide. The distances between the phosphor strips are 0.233 mm. The center of the electron spots coincides with the center of the phosphor strips. The landing freedom is equally large for the three electron beams.
FIG. 6 shows a configuration which is obtained by applying the invention to the configuration of FIG. 5. The phosphor strips G, R and B are also 0.080 mm wide. The distance between the centers of G and R is 0.180 mm and between the centers of G and R and B, respectively, equal to 0.260 mm. The electron spots are not equidistant. The distance between the electron spots of the green and blue beams is larger than between that of the green and the red and the red and the blue beams, respectively. Comparison of FIG. 6 with FIG. 5 proves that the landing freedom of the red beam is increased. The landing freedom of the blue beam relative to the green phosphor strips and of the green beam relative to the blue phosphor strips has remained the same. The landing freedom of the red and the blue beams relative to the red phosphor strip is slightly decreased but this provides the least observable colour defects.
It will be obvious that the number of possibilities within the scope of the present invention is herewith not exhausted. For example, it is possible to place the electron gun which produces the red beam at a slightly larger distance from the electron gun for the blue beam than from the electron gun for the green beam. In that case, the fact is used that contamination of red with blue is experienced to be more serious than contamination of red with green. These, and other refinements within the scope of the present invention are obvious to those skilled in the art in the field of the present invention.
What is claimed is:
1. A cathode ray tube for displaying color pictures comprising a display screen having a plurality of discrete regions which, upon bombardment with electrons, luminesce in three different colours, a colour selection mask having a plurality of apertures, and means to produce three electron beams converging towards the display screen, each luminescent region being present in a path of an electron beam through one of said apertures, said luminescent regions being arranged according to substantially parallel color strips, said color
strips being arranged in triplets each comprising three color strips which luminesce green, red, and blue, respectively, characterized in that the central color strip of each triplet luminesces red and that, over at least a part of the display screen, the distance between the centers of two adjacent color strips belonging to the same triplet is at either side of the red strip at least 5% larger than the distance between the centers of two adjacent color strips of which one belongs to the said triplet and the other belongs to an adjacent triplet.

2. A cathode ray tube as claimed in claim 1, characterized in that the said percentage increases from 0% in the center of the display screen to a maximum of 20% at the edge of the display screen.

3. A cathode ray tube as claimed in claim 1 characterized in that the display screen comprises a light-absorbing layer between the individual color strips.