SPECIFICATION

Colour display tube

The invention relates to a colour display tube.

A colour display tube which includes means to generate three electron beams, a display screen having a large number of triplets of parallel phosphor lines luminescing in three different colours, and a shadow mask having apertures which assign each electron beam to phosphor lines of one colour, is disclosed in British Patent Specification No. 1,420,793. As described in Specification No. 1,420,793 the visible effect of landing errors of the electron beams on the phosphor lines can be reduced by choosing the central colour of a triplet to be red and to make the red phosphor lines wider than the green and blue phosphor lines. However, this has been found to be disadvantageous in that red spots are formed in the picture in the case of serious mislanding.

It has now been realised that this mislanding problem may occur because the centre distances of the central electron spot of a triplet to the two outermost electron spot are unequal over large parts of the display screen as a result of the properties of the system of deflection coils. In practice this is taken into account by adapting hereto the centre distances between the central phosphor lines of a triplet and the two outermost phosphor lines. However, this has two disadvantages. First, this makes it substantially impossible during the manufacture of the display screens to perform any control on the correct location of the lines so that faultily illuminated screens are discovered only in a stage which is much too late. Secondly, with increasing mislanding, the electron beams do not impinge all three simultaneously on phosphor lines of the adjacent wrong colour.

According to the invention there is provided a colour display tube comprising means to generate three electron beams, a display screen having a large number of triplets of parallel phosphor lines luminescing in three different colours, and a shadow mask having apertures which assign each electron beam to phosphor lines of one colour, wherein the centre distances between the phosphor lines of a triplet are equal, the widths of the two outermost phosphor lines of a triplet are equal, and the difference in width of the central phosphor line and an outermost phosphor line of the same triplet is equal to the difference of the centre distances between the central electron spot and the two outermost electron spots of the electron beams which cause that triplet to luminesce.

As a result of the equal centre distances between the phosphor lines of a triplet, a simple inspection of the display screens becomes possible. It will furthermore be apparent from the explanation hereinafter that a "white-remains-white" effect is achieved with the indicated difference in width between the central phosphor line and the outermost phosphor lines.

In addition the intermediate spaces between the phosphor lines of a triplet and between a phosphor line of the same triplet and a phosphor of an adjacent triplet may be equal so that the said advantages are obtained to an even greater extent.

The present invention will now be explained and described, by way of example, with reference to the accompanying drawings, in which:—.

Figure 1 shows a longitudinal cross section through a colour television display tube in accordance with the invention,

Figure 2 shows the encircled part referenced II of Figure 1 on an enlarged scale,

Figure 3 explains the pattern of phosphor lines in a known tube, and

Figure 4 explains the pattern of phosphor lines in a tube in accordance with the invention.

Figure 1 shows a colour television display tube having an evacuated envelope 1 comprising an electron gun 2, a colour selection mask 3, a display screen 4 and provided with deflection coils 5. The electron gun 2 generates three electron beams 6, 7 and 8 which converge towards the display screen 4. In the non-deflected condition, the axes of the electron beams 6, 7 and 8 are situated 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. The scanning occurs in known manner according to a line-scanning pattern, the lines of which are parallel to the plane of the drawing.

Figure 2 explains the colour selection by means of the colour selection mask 3 and shows the encircled part II of Figure 1 on an enlarged scale. The colour selection mask 3 has a number of apertures 9 which partly pass the electron beams 6, 7 and 8. As a result of the angle which the electron beams enclose with each other, the electron beam 6 impinges only upon phosphor lines of the display screen 4 denoted by B and luminescing blue. The beam 7 in the same manner only impinges upon green (G) phosphor lines and the beam 8 only on red (R) phosphor lines. The display screen 4 furthermore comprises in known manner a very thin, electron-permeable aluminium layer 10.

Three phosphor lines associated with one aperture of the colour selection mask 3 constitute a triplet. The phosphor lines are substantially parallel and extend perpendicular to the lines of the already mentioned line-scanning pattern. The apertures 9 are slot-shaped and, of course, extend parallel to the phosphorlines. In this connection, a slot-shaped aperture is also to be understood to include a row of apertures parallel to phosphor lines and together constituting a slot having reinforcement bridges. In connection with the method of manufacturing the tube, the reinforcement bridges can be recognizable in the phosphor lines.

The display screen is manufactured by providing a photo-sensitive layer on a window portion of the tube and exposing said layer through the shadow mask by means of a light source the place of which is closely related to the deflection point of the electron beams in the deflection coils 5. So for each colour of phosphor lines there is exposed from another place in which in addition a correction lens is used in known manner. The exposure and

development of the photosensitive layer furthermore occurs in known manner according to a photochemical or an electrophotographical method. By means of the correction lens it is possible to accurately determine the place where a phosphor line is provided. The width of the phosphor lines can be adapted in known manner by controlling the exposure time and by means of filters.

Figure 3 explains the pattern of phosphor lines and the landing of the electron beams in a known tube. The diagrammatically shown screen portion is situated in the left-hand top corner of the display screen with the symbolically denoted screen edge 11. The phosphor lines of one triplet are denoted by R, G and B and the electron spots on the phosphor stripes are denoted by 8, 7 and 6. As a result of the properties of the deflection coils, the centre distances between the electron spots 6 and 7 and 7 and 8, respectively, are unequal over large parts of the display screen. In the known tube this has been taken into account by adapting hereto the centre distances between the phosphor stripes B and G and G and R, respectively. When the mislanding is not too large the electron spots 6, 7 and 8 reach the edge of the phosphor lines B, G and R simultaneously. This situation is shown in Figure 3.

It is to be noted that the primary cause of mislanding is a bulging of the shadow mask as a result of thermal effects. Such bulging causes that the three electron spots 6, 7 and 8 to be moved collectively in the direction of the centre of the display screen with respect to the phosphor lines B, G and R. So in Figure 3 said movement is oblique towards the lower right. It also appears from this figure that in the case of serious mislanding the electron spots 6 and 7 land on an adjacent phosphor line sooner than the electron spot 8 so that a "white-remains-white" effect is not obtained. It will furthermore be obvious that as a result of the unequal intermediate spaces between the phosphor lines their correct mutual location is difficult to control with reference to the display screen alone.

Figure 4 explains the pattern of phosphor lines and the landing of the electron beams in a tube in accordance with the invention. The centre distance between the electron spots 6 and 7 is denoted by q and that between the electron spots 7 and 8 is denoted by p. The intermediate spaces between the phosphor lines are equal and are denoted by d. The width of the phosphor lines is denoted by b, g and r (where $b = r$) and the centre distances between the phosphor lines of a triplet are equal and are denoted by s. In Figure 4, as in Figure 3, the mislanding is such that the electron spots have just reached the edge of the phosphor lines.

From Figure 4 it appears that $p = g + d$ and $q = b + d$, from which it follows that $p - q = g - b$, which means that the difference in width of the central phosphor line and the outermost phosphor lines of a triplet is equal to the difference of the centre distances between the central electron spot and the two outermost electron spots. It will furthermore be obvious from Figure 4 that in the case of larger mislanding (towards the right in the figure) the electron spots 6, 7 and 8 will land simultaneously on an adjacent phosphor line. This has for its result that when the colour white is displayed, which means that the electron beams have substantially the same current strength, the ratio between the currents which impinge upon the phosphor lines is not varied. As a result of this it is achieved that in the case of mislanding white does not change colour. In practice it has been found that this so-called "white-remains-white" effect makes mislanding far less noticeable to the view of the displayed picture.

In a practical example of a tube in accordance with the invention having a display screen diagonal of 66 cm the properties of the system of deflection coils are such that at approximately 2/3 of the distance from the centre of the display screen to the left-hand top corner $p = 273$ microns and $q = 263$ microns. Therefore $g - b$ must be equal to 10 microns. In the tube in question $g = 255$ microns, $b = r = 245$ microns, $d = 18$ microns and $s = 268$ microns. The centre distance between two triplets is 799 microns. The values of p and q for a given combination of tube-deflection coils are known for each place on the display screen. So herefrom the desired pattern of phosphor lines can be computed, from which the design of the correction lenses to be used during the exposure is derived in the usual manner.

It is to be noted that the properties of the usual system of deflection coils are such that the central electron spot of a triplet with respect to the centre between the two outermost electron spots is moved in the direction of the centre of the display screen. In principle it is possible for said movement to take place in the reverse direction, that is to say that q is larger than p in Figure 4. Accordingly the central phosphor line then becomes narrower (instead of wider as in the above-mentioned example) than the two outermost phosphor lines according to $q - p = b - g$.

CLAIMS

1. A colour display tube comprising means to generate three electron beams, a display screen having a large number of triplets of parallel phosphor lines luminescing in three different colours, and a shadow mask having apertures which assign each electron beam to phosphor lines of one colour, wherein the centre distances between the phosphor lines of a triplet are equal, the widths of the two outermost phosphor lines of a triplet are equal and the difference in width of the central phosphor line and an outermost phosphor line of the same triplet is equal to the difference of the centre distances between the central electron spot and the two outermost electron spots of the electron beams which cause that triplet to luminesce.

2. A display tube as claimed in Claim 1, wherein the intermediate spaces between the phosphor lines of a triplet and between a phosphor line of the same triplet and a phosphor line of the adjacent triplet are equal.

3. A colour display tube substantially as hereinbefore described with reference to or as

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shown in Figures 1, 2 and 4 of the accompanying drawings.

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