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and

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I, Richard Slade MOORMAN, M.Sc., C.Eng., M.I.E.E.,
translator to Randall Woolcott Services plc of Europa House,
Marsham Way, Gerrards Cross, Buckinghamshire, England, hereby
declare that I am conversant with the French and English
languages and that to the best of my knowledge and belief the
accompanying document is a true translation of the text on which
the European Patent Office intends to grant or has granted
European Patent No. 0,223,670
in the name of VIDEOCOLOR

Signed this 16th day of January 1990.

Richard Moorman

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The invention relates to a colour television tube of the mask type and its method of manufacture. It relates more particularly to a colour television tube in which the three electron guns are aligned, i.e. the axes of these guns are in a common plane.

A colour television tube comprises a front plate on the internal surface of which is deposited the screen which is normally formed from vertical strips of cathodo-luminescent materials (luminophores) emitting, when they are excited by an electron beam produced by an electron gun, a light of red, green or blue colour. The screen thus comprises a succession of sets of three vertical strips, each set having a red strip, a green strip and a blue strip. Each colour is excited by a corresponding electron beam. In a tube, often called a "matrix" tube, two adjacent strips of luminophore are separated by a black graphite strip, which enables an image with improved contrast to be obtained. In a mask tube, for the selection of the colours, i.e. in order that the beam intended for one colour, for example blue, strikes only the luminophore which produces this colour (blue), there is provided in front of the screen a shadow mask whose position and disposition of the openings, which are generally elongated in the vertical direction, provide the said selection of colours.

Given that the position of the mask with respect to the screen must be determined accurately, the mask is used for producing the screen and, for this purpose, it is fixed to the plate of the tube before the screen is formed. Each of the luminescent substances is then deposited as follows: the internal surface of the plate is covered with a solution of this substance in a photosensitive material which hardens when it is illuminated by ultraviolet (UV) radiation, then this solution is illuminated by an optical system which includes a source of UV radiation and a lens simulating the deflector of the tube. The position of the optical system, particularly of the UV lamp, depends on the colour of the luminophore in solution. In this way only the photosensitive material

which is located at the locations provided for the determined colour is illuminated and can therefore harden. The material located at other locations does not harden and does not attach to the glass; it can be
5 cleaned off by washing with water or with another liquid.

As a mask is formed from slits disposed in succession along vertical lines, it is necessary, in order to form continuous vertical lines on the screen, to displace the UV source in the vertical direction
10 during the illumination.

It has been noted that the lines of luminophores or the lines of graphite near the corners of the rectangular screen have an irregular appearance, which affects the quality of the image in these regions.

This fault arises from distortion contributed by
15 the optical system for projecting UV light, these distortions increasing with the distance between each point of the screen and the axis of the tube and with the distance between each of these points and the horizontal
20 median plane. In particular, near a vertical edge of the screen the image of a vertical slit in the mask is, on the horizontal median line, a spot which is also vertical; but near the corners, the image of a vertical slit in the mask is an inclined spot. Furthermore in these
25 corner regions the contour of the image is not an exact replica of the contour of the slit. Thus, after the slight displacement of the UV source with respect to the optical projection system there appears, near the vertical edges of the screen, irregular lines of luminophores
30 or graphite, which are wider near the corners than at the centre.

In order to overcome this fault there is normally provided a cylindrical lens in the optical system for projecting UV light. But such a cylindrical lens is an
35 onerous component and, furthermore, is not entirely satisfactory.

The invention, on the contrary, overcomes this fault in a simple and economic manner.

It relates to a colour television tube provided

with a shadow mask and three aligned electron guns, the disposition of the mask in front of the screen and of its openings being such that each electron beam excites only one predetermined colour, and the openings of the mask being disposed along continuous, straight vertical lines, which is characterized in that the openings of the mask distant from the vertical median and horizontal median axes of the latter have a major axis which is inclined relative to the vertical direction, the inclination of each opening, which increases as the distance from the centre increases, having an orientation such that the end of this opening closer to the horizontal median axis is nearer to the vertical median axis than is the opposite end of this opening.

It is true that in the German patent 2 450 734 there is described a colour television tube in which there are provided openings in the mask which are inclined. But the inclination of the openings in the mask in this prior document is opposite to the inclination of the openings of the mask according to the invention. And it has been noted that with this mask it is not possible to avoid the use of a cylindrical lens or a component similar to the type mentioned above.

In one embodiment the sides of the slits close to the centre are rectilinear while the sides of the slits near the corners are concave.

In order to determine the inclination and the shape of the slits it is possible to proceed in an experimental manner by carrying out tests or using a computing program determining the path of the light rays which, leaving the optical system, form regular vertical images on the screen, these images having a constant width; the shape, position and dimensions of each slit are then determined by the intersection of a light beam with the surface which constitutes the mask.

It has been found that the inclination to be given to each slit in the mask is opposite to the inclination of the image on the screen of a slit in the mask which would be at the same location but not inclined.

Other characteristics and advantages of the invention will appear with the description of certain of its embodiments, this description being given with reference to the appended drawings in which:

5 - Figure 1 is a perspective diagram showing a screen and a mask of a colour television tube during the manufacture of the screen and,

 - Figure 2 is a diagram of a mask according to the invention.

10 The mask 10 (Figure 1) of a colour television tube (not shown completely) known in the prior art comprises elongated slits 11 disposed in rows along lines 12 which, during the normal use of a television receiver, constitute vertical lines. The major axes of the slits of
15 a same row are merged with the corresponding line 12. These slits of the known masks also all have the same width with rectilinear vertical edges.

 For the formation of the screen on the front plate 13 of the glass bulb forming the tube, before the
20 assembly of this glass plate with the rest of the bulb, the mask 10 is fixed to this plate 13 whose internal surface is previously covered with a photosensitive material which can be hardened under ultraviolet radiation and contains one of the luminophores. This assembly
25 is then associated with an optical system 14 comprising an ultraviolet source 15 and a projection device 16, simulating the deflector of the tube which will be finally manufactured, in such a way that the UV light rays have the direction of the electron beams which will
30 be produced by the gun associated with the colour of the luminophore in solution on the screen.

 It is noted that images 17 on the screen 13 of the slits 11 of the mask are not exact replicas of these slits; in particular the images 17c near the corners 18
35 have a major axis inclined by an angle α with respect to the corresponding vertical line 12' and, furthermore, their edges are slightly concave. The amplitude of this defect reduces on approaching the horizontal median axis 19 of the screen and the centre 20 of the screen. It

should also be noted that this defect reduces when the radius of curvature of the screen increases, i.e. the defect is less pronounced for a flat screen.

5 In order to obtain an illumination along continuous lines on the screen 13 the source 15 is displaced parallel to the lines 12. But because of the variable inclination of the images of the slits 11 on the screen, despite this displacement of the source 15, the lines
10 obtained on the screen are not of constant thickness, they are thicker near the corners than at the centre.

According to the invention in order to eliminate this defect the slits 11 of the mask 10 have an orientation and a shape such that they project themselves on the screen 13 in such a way as to form regular alignments
15 of vertical axes and constant thickness over the entire area of the screen. Thus, unlike the mask of colour television tubes known up to the present time, the slits 11 do not all have the same orientation. For example (Figure 2) the slit 11c which is near a corner 25 is
20 inclined, with respect to the vertical line 12, by an angle α' in the opposite direction to the angle α (Figure 1). On the other hand on the same vertical line 12 the central slit 11a, on the median horizontal line 26, has a major axis along the line 12. On the same line 12, the
25 slit 11d near the bottom right corner 27 has a major axis whose inclination with respect to line 12 is practically equal in absolute value to the angle α' but in the opposite direction, the line 26 constituting an axis of symmetry for the mask. The longitudinal edges 28 and 29
30 of the slit 11a are rectilinear. On the other hand the corresponding edges of the slits 11c and 11d have a slight convex curvature.

It should be noted that the mask 10 has a vertical axis of symmetry 31 passing through the centre 30.

35 In order to determine the inclination and the shape of the slits 11 of the mask 10 it is possible to proceed in an empirical manner, i.e. by carrying out tests with various inclinations of slits and various curvatures of their edges. This determination can also

be carried out by computing using a program in which the various paths of the light emerging from the optical system 14 are stored and determining the intersection with the mask 10 of the light rays which supply light spots on the screen 13 whose major axes are always on the vertical 12 and which are of the same thickness (dimension along the horizontal axis) over the entire height of the screen. In order to establish such a program it suffices to call upon the well-known laws of optics applied to the optical system 14; the computation is simplified by the fact that the light source 15 is generally unidimensional, i.e. formed by a straight segment. In this case it is considered, for example, that the source is formed by a limited number of points and there is determined, for each of these points and for each direction of rays emitted by the latter, the direction of the ray emerging from the system 14. This computation is carried out, for each value of azimuth for increments of elevation, the value of the increment being chosen as a function of the desired accuracy, the various values of azimuth are also separated by an incremental value chosen as a function of the desired accuracy.

It will be appreciated that the consistency of the thickness of the lines of luminophore or graphite on the screen 13 is obtained without complicating the production of the optical system 14. On the contrary, the optical system 14 is simplified with respect to the prior embodiments in which a cylindrical lens used to be provided whereas with the invention it is possible to dispense with such a lens.

The invention applies in particular to a colour television tube in which the three electron guns are in line, i.e. having axes in a common plane.

CLAIMS

1. Colour television tube provided with a shadow mask (10) and three aligned electron guns, the disposition of the mask (10) in front of the screen (13) and of its openings (11) being such that each electron beam excites only one predetermined colour, and the openings (11) of the mask being disposed along continuous, straight vertical lines (12), characterized in that the openings (11c, 11d) of the mask (10) distant from the vertical (31) median and horizontal (26) median axes of the latter have a major axis which is inclined relative to the vertical direction (12), the inclination (α') of each opening, which increases as the distance from the centre (30) increases, having an orientation such that the end of this opening closer to the horizontal median axis (26) is nearer to the vertical median axis (31) than is the opposite end of this opening.

2. Tube according to Claim 1, characterized in that the openings (11a) located near to the horizontal median line (26) of the mask (10) have a substantially vertical major axis.

3. Tube according to either of Claims 1 or 2, characterized in that the openings close to the centre (30) and to the horizontal median line (26) have rectilinear vertical edges, whereas the openings of the mask (10) located near the corners (25, 27) have edges which have a slightly convex curvature.

