

PATENT SPECIFICATION

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(54) CORRECTING TELEVISION DISPLAYS

(71) We, N. V. PHILIPS' GLOEILAMPENFABRIEKEN, a limited liability Company, organised and established under the laws of the Kingdom of the Netherlands, of Emmasingel 25, Eindhoven, the Netherlands do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

The invention relates to a colour television display device comprising a display tube of the shadow mask type having a neck portion accommodating an electron gun assembly for generating a plurality of electron beams and a funnel-shaped portion whose widest end is terminated in a display screen; and a system of deflection coils coaxially arranged about the tube at the transition between the neck and funnel-shaped portions which deflection coil system comprises first and second deflection coil units each coil unit having two substantially symmetrical coil halves situated opposite each other, the first deflection coil unit being positioned 90° with respect to the second unit such that the deflection coil units, when energised, deflect the electron beams in first and second orthogonal deflection directions.

It is an object of the invention to provide such a colour television display device where cushion or barrel shaped raster distortion can be corrected by magnet fields.

The invention provides a colour television display device comprising a display tube of the shadow mask type having a neck portion accommodating an electron gun assembly for generating a plurality of electron beams and a funnel-shaped portion whose widest end is terminated in a display screen, a system of deflection coils coaxially arranged about the tube at the transition between the neck and funnel-shaped portions which deflection coil system comprises first and second deflection coil units and each coil unit having two substantially symmetrical

coil halves situated opposite each other, the first deflection coil unit being positioned 90° with respect to the second unit such that the deflection coil units, when energised, deflect the electron beams in first and second orthogonal deflection directions; and means for generating first and second static eight pole magnetic fields the poles of which are situated between the axes of a system of axes which alternatively coincide with and lie diagonally between the said first and second deflection directions, said first eight pole field being generated at or beyond the front end of said deflection coil system which front end faces the display screen whilst the second eight pole field is generated at or beyond the rear end of said deflection coil system which rear end faces the electron gun assembly, correspondingly positioned poles of said first and second eight pole fields being of opposite magnetic polarity.

The means for generating the first and second eight pole fields may comprise first and second arrangements of permanent magnets, each arrangement comprising four or eight permanent magnetics. The arrangements could alternatively be made up of electromagnets.

One of the eight pole fields may be generated by a pair of rings each being magnetised to have eight magnetic poles, the rings being coaxially mounted and adapted to rotate with respect to each other in order that the strength of the eight pole field so produced may be varied.

The invention also provides the combination of a system of deflection coils and means for generating first and second static eight pole magnetic fields for use with a colour television display device as described above. The invention additionally provides a colour television display tube of the shadow mask type and the said combination.

In our Netherlands Patent Application 69210495 laid open to public inspection a system is described with which a convergence correction for the isotropic

astigmatism can be obtained without the landing being noteworthy influenced by it by a dynamic energization of four toroidal windings provided on the core of the deflection coil. For this dynamic energization parabolic or sawtooth voltages are necessary which have to be generated in separate circuits.

As already shown in the above mentioned Patent Application, an n-pole field can be described with

$$\bar{B} = A \bar{v}^{(1/2n-1)} \quad (1)$$

in which $\bar{B}$ is the vector denoting the magnetic field strength B in the complex plane

A is an (integration) constant, and

$\bar{v}$ is a complex auxiliary quantity which can be expressed in the coordinates x and y so that

$$\bar{B} = B_y + i B_x \quad (2)$$

and

$$\bar{v} = y - i x \quad (3)$$

During the deflection the centre of the three electron beams in the n-pole field moves towards the position x_0, y_0 . Description of the field with respect to said new centre yields the relationship:

$$\bar{B} = A (\bar{v}_0 - \bar{v}')^{(1/2n-1)} \quad (4)$$

wherein

$$\bar{v}_0 = y_0 - i x_0 \quad (5)$$

$$\bar{v}' = y' - i x' \quad (6)$$

and x' and y' are the coordinates in the shifted system of coordinates. For the eight-pole used in this invention it follows from (4):

$$\bar{B} = A (\bar{v}_0^3 + 3\bar{v}_0 \bar{v}' + 3\bar{v}_0 \bar{v}'^2 + \bar{v}'^3) \quad (7)$$

Now is, generally, with larger deflection

$$|\bar{v}_0| > |\bar{v}'|,$$

in other words, the displacement in the eight-pole field caused by the deflection then is large with respect to the eccentricity of the beams. As a result of this the terms with $\bar{v}'^2$ and $\bar{v}'^3$ are negligible, so that it holds to an approximation that:

$$\bar{B} = A_3 (\bar{v}_0^3 + 3\bar{v}_0 \bar{v}') \quad (8)$$

The first term $A \bar{v}_0^3$ represents a homogeneous field the strength of which varies with the third power of the deflection and the direction of which depends on the direction of the deflection. This field exerts an identical influence on the three electron beams on the raster shape but not on the convergence. The second term $3A \bar{v}_0 \bar{v}'$ represents a static four-pole field the

strength of which varies with $\bar{v}_0^2$, so with the square of the deflection and thus influences the convergence. In order to be able to use the eight-pole for correction of the raster shape in a colour display tube the influence on the convergence should preferably be minimum. Therefore, the second term of formula (8) should be small with respect to the first term. This can be achieved by causing the eight-pole field to extend preferably not over the whole deflection field but by providing it on the display screen side of the deflection field.

The static eight-pole magnetic field may be constructed in a number of manners. For example, four or eight permanent magnets or electromagnets may be used which may be situated, for example, to form a ring, or radiate from the display tube. The magnets may be incorporated in the housing of the system of deflection coils, be placed substantially against it or by secured at some distance therefrom, for example, against the envelope of the display tube.

As the influence on the convergence may still be too large when a single eight-pole field is used, there is generated at or beyond the other end of the system of deflection coils situated a second static eight-pole field of opposite polarity. The strength of the second eight-pole may then be chosen to be so that the second term of formula (8) is compensated for and hence substantially no influence exists of the convergence any longer. The first term of formula (8) which determines the raster distortion is only little counteracted by the first term of the second eight-pole field. This is because $\bar{v}_0$ in the second eight-pole is much smaller. Just as the first eight-pole, the second eight-pole may be manufactured in a number of manners by means of coils, electromagnets and permanent magnets.

The invention can be used with colour display tubes of *inter alia* the "delta"-type in which the electron beams pass through the corners of an equilateral triangle which is situated in a plane substantially at right angles to the tubes longitudinal axis. However, the invention also proves suitable for colour display tubes for the "in-line" type in which the electron beams are situated substantially in one plane.

As static eight-poles are used, no voltages or currents varying with the deflection are necessary. Thus no extra circuits are necessary to generate these currents or voltages. In the invention, the dynamic character of the required correction is obtained by the deflection of the electron beam itself.

The invention will now be described in greater detail with reference to a drawing, in which

Figure 1 shows a colour display tube of

the "in-line" type according to the invention,

Figure 2 shows an eight-pole field and the forces acting on the electron beam as a result thereof,

Figure 3 shows the effect of the eight-pole on the frame shape, and

Figures 4 to 12 show a number of possibilities for generating an eight-pole field.

The colour display tube shown in Figure 1 comprises a glass envelope 1 which has a neck 2 and a funnel or cone shaped part 3. Three electron guns 7, 8 and 9 are provided in the neck 2. The colour display tube is of the "in-line" type so that the axes of the guns 7, 8 and 9 are situated substantially in one plane. The electron beams generated by these electron guns are deflected by the system of deflection coils 11 and impinge upon the display screen 4 through the apertures 6 in the colour selection electrode 5 (the shadow mask). The three electron beams pass through the apertures 6 at a small angle with each other (the so-called colour selection angle) and consequently each impinge only upon phosphor strips of one colour. The system of deflection coils 11 may comprise a number of saddle-shaped coils and/or toroidal coils. An important property of the tube is the convergence. Convergence is the substantial coincidence of the three electron beams 27, 28 and 29 in one point in the apertures 6 of the colour selection electrode 5. The beams must not only converge in one point in the centre of the colour selection electrode but this must remain also during the deflection with the system of deflection coils 11. This is necessary because otherwise the red, green and blue rasters no longer coincide entirely and coloured edges at the transitions are formed in the picture. Good convergence in the centre of the colour selection electrode of a colour display tube can be obtained with simple means. However, it is particularly difficult to maintain good convergence also for the parts of the colour selection electrode in which a large deflection of the electron beams has taken place, the cause of this being the unequal influence of the deflection field on the three electron beams. Another important property is the extent of raster distortion. The raster distortion which is expressed in a cushion-like and/or barrel-like distortion of the picture occurs for the greater part as a result of a non-linear deflection by the system of deflection coils. Such distortion also occurs in deflection coils for black-and-white tubes. Where the design of the deflection coils may be mainly directed to the minimization of the extent of the distortion. However, this necessity is omitted when an eight-pole is used. In

colour display tubes the convergence is most important. The considerable distortion which often occurs in deflection coils providing good convergence has so far been corrected for by passing currents through the individual winding groups of the system of deflection coils. The correction currents must be generated by extra circuits, so that this solution is cumbersome and expensive. The correction in a colour display tube is carried out by means of static magnetic eight-pole fields one of which is situated in or near the front end of the system of deflection coils 11 which faces the display screen 4 and is generated by a number of magnets 12. This eight-pole field can be generated by means of permanent magnets or by means of electromagnets or coils. The coils or magnets may be incorporated in the system of deflection coils 11. It is alternatively possible for them to be assembled at some distance therefrom closer to the display screen, and supported, for example, by means of braces or strips. As the influence of this eight-pole field on the convergence can prove to be too large, a second eight-pole field is generated at the other (rear) end of the deflection coil system which face the electron gun assembly the polarity of which is opposite to that of the first eight-pole field by means of a number of magnets 13 so that said influence is compensated for without considerably influencing the positive influence on the raster distortion.

Figure 2 shows diagrammatically an eight-pole field by means of a number of field lines 14. The axes X and Y coincide with the axes of the deflection directions. The forces F acting on each solution beam are shown in the Figure. The north and south magnetic poles (N and Z) are situated between the axes. The eight-pole field need not be completely symmetrical. By making the eight-pole not quite symmetrical, higher-order multiple fields are obtained in addition (for example a twelve-pole, sixteen-pole) with which higher order errors in the raster can be corrected for.

Figure 3 shows a cushion-like distortion of the raster (solid line). By using the invention, the forces F act on the electron beam(s) in such manner that the raster is corrected (broken line). The raster distortion may also be barrel-shaped. In order to correct for raster distortion, the polarity of the eight-pole must be such that the forces F are directed just in the opposite direction.

Figures 4 to 12 show a number of possibilities for generating an eight-pole.

Figure 4 shows how an eight-pole field can be generated by means of four permanent magnets 15, 16, 17 and 18.

Figure 5 shows how this is possible with a

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permanent magnetic ring 19 having pole pieces.

5 Figures 6 and 7 show the electromagnets 20 and 21 which can replace the permanent magnets of Figures 4 and 5.

10 Figure 8 shows an eight-pole field generated by eight permanent magnets 22. These magnets may be incorporated in the system of deflection coils 11 or be assembled at a small distance therefrom.

Figure 9 shows that it is also possible to generate an eight-pole by means of a number of coils 23.

15 Figure 10 shows the toroidal construction for generating an eight-pole field. A number of coils 25 are provided around a magnetic yoke 24.

20 Figure 11 shows two magnetic rings 26 and 27 constructed to produce an eight-pole field with magnetic regions 42. By rotating these rings relative to each other, the strength of the eight-pole field can be adjusted. Rotating the two rings at the same time may be carried out by means of a rack and pinion transmission which is shown in Fig. 12. Internal teeth 28 are provided on ring 26 and external teeth 29 are provided on ring 27 which are coupled by means of a pinion 30. Such an adjustable eight-pole is preferably used for producing the second eight-pole field.

WHAT WE CLAIM IS:—

35 1. A colour television display device comprising a display tube of the shadow mask type having a neck portion accommodating an electron gun assembly for generating a plurality of electron beams and a funnel-shaped portion whose widest end is terminated in a display screen; a system of deflection coils coaxially arranged about the tube at the transition between the neck and funnel-shaped portions which deflection coil system comprises first and second deflection coil units each coil unit having two substantially symmetrical coil halves situated opposite each other, the first deflection coil unit being positioned 90° with respect to the second unit such that the deflection coil units, when energised, 45 deflect the electron beams in first and second orthogonal deflection directions; and means for generating first and second static eight pole magnetic fields the poles of which

are situated between the axes of a system of axes which alternately coincide with and lie diagonally between the said first and second deflection directions, said first eight pole field being generated at or beyond the front end of said deflection coil system which front end faces the display screen whilst the second eight pole field is generated at or beyond the rear end of said deflection coil system which rear end faces the electron gun assembly, correspondingly positioned poles of said first and second eight pole fields being of opposite magnetic polarity. 55 60 65

2. A display device as claimed in Claim 1, in which said means comprises first and second arrangements of permanent magnets for respectively generating said first and second eight pole fields, each arrangement comprising either four or eight permanent magnets. 70

3. A display device as claimed in Claim 1, in which said means comprises first and second arrangements for electromagnets for respectively generating said first and second eight pole fields. 75

4. A display device as claimed in Claim 1, in which one of said eight pole fields is generated by a pair of rings each being magnetised to have eight magnetic poles, said rings being coaxially mounted and adapted to rotate with respect to each other in order that the strength of the eight pole field so produced may be varied. 80 85

5. A colour television display device substantially as herein described with reference to the accompanying drawings.

6. The combination of a system of deflection coils and means for generating first and second static eight pole magnetic fields for use with a colour television display device as claimed in Claims 1, 2, 3 or 4. 90

7. A colour television display tube of the shadow mask type and the combination of the system of deflection coils and the means for generating the said eight pole fields as claimed in Claim 6. 95

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Figure 10 shows the toroidal construction for generating an eight-pole field. A number of coils 25 are provided around a magnetic yoke 24.

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1. A colour television display device comprising a display tube of the shadow mask type having a neck portion accommodating an electron gun assembly for generating a plurality of electron beams and a funnel-shaped portion whose widest end is terminated in a display screen; a system of deflection coils coaxially arranged about the tube at the transition between the neck and funnel-shaped portions which deflection coil system comprises first and second deflection coil units each coil unit having two substantially symmetrical coil halves situated opposite each other, the first deflection coil unit being positioned 90° with respect to the second unit such that the deflection coil units, when energised, deflect the electron beams in first and second orthogonal deflection directions; and means for generating first and second static eight pole magnetic fields the poles of which

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2. A display device as claimed in Claim 1, in which said means comprises first and second arrangements of permanent magnets for respectively generating said first and second eight pole fields, each arrangement comprising either four or eight permanent magnets.

3. A display device as claimed in Claim 1, in which said means comprises first and second arrangements for electromagnets for respectively generating said first and second eight pole fields.

4. A display device as claimed in Claim 1, in which one of said eight pole fields is generated by a pair of rings each being magnetised to have eight magnetic poles, said rings being coaxially mounted and adapted to rotate with respect to each other in order that the strength of the eight pole field so produced may be varied.

5. A colour television display device substantially as herein described with reference to the accompanying drawings.

6. The combination of a system of deflection coils and means for generating first and second static eight pole magnetic fields for use with a colour television display device as claimed in Claims 1, 2, 3 or 4.

7. A colour television display tube of the shadow mask type and the combination of the system of deflection coils and the means for generating the said eight pole fields as claimed in Claim 6.

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