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(54) METHOD OF ADJUSTING A MAGNETIC DEFLECTION UNIT ON A CATHODE RAY TUBE

(71) We, N.V. PHILIPS' GLOEILAMPENFABRIEKEN, a limited liability Company, organised and established under the laws of the Kingdom of the Netherlands, of Emmasingel 29, 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 method of adjusting a magnetic deflection unit on a multibeam cathode ray display tube, the tube having an envelope comprising a neck portion joined to the narrow end of a cone portion whose widest end is closed by a display screen, the neck portion comprising means for generating a plurality of electron beams which beams when undeflected lie in a plane which is substantially perpendicular to the longitudinal axis of the tube. The invention also relates to a multibeam cathode ray display tube having a reference mark or markers provided on its envelope by the method according to the method of the invention and to a deflection unit having a reference mark or markers provided by the said method.

It is known to evaluate the relative positioning between the deflection unit and a colour display tube of the in-line-type with reference to the frame distortion and convergence errors, as described in Philips Product Information 58, 20 AX for 110° Colour Television, dated February 1, 1975. Errors, if any, in the relative positioning can be corrected by passing differential currents through the individual winding sections and/or through extra four-pole windings present in the deflection unit. This evaluation is time-consuming and the correction by means of differential currents is expensive as a result of the extra circuits which are necessary to produce the correct currents.

From the article "A new colour picture tube system for portable T.V. receivers", I.E.E.E. Trans Broadcast Telev. Receivers (N.S.) *18*, 193 – 200 (1972) it is known to adjust the magnetic field of the deflection unit with respect to the beams by moving the deflection unit mechanically horizontally and vertically in a plane at right angles to the tube axis until the axis of the magnetic deflection unit is aligned with the electron beam triplet. The criterion for a good alignment is the convergence pattern as observed on the screen.

It is an object of the invention to produce an alternative method of providing the required alignment in a multibeam cathode ray display tube.

The invention provides a method of adjusting a magnetic deflection unit on a multibeam cathode ray display tube, said tube having an envelope comprising a neck portion joined to the narrow end of a cone portion whose widest end is closed by a display screen, said neck portion comprising means for generating a plurality of electron beams which beams when undeflected lie in a plane which is substantially perpendicular to the longitudinal axis of the tube, said deflection unit being mounted about the junction of said neck and said cone portions, said method comprising the steps of:—

i) rotating the deflection unit about the said longitudinal axis until orthoginal de-

flections of said beam are correctly positioned on said display screen,

ii) centring the end of the deflection unit remote from said display screen substantially about the said longitudinal axis,

iii) generating a dynamic multipole magnetic field with said deflection unit and simultaneously energising an electron beam which substantially coincides with the said longitudinal axis, and

iv) adjusting the position of the end of the deflection unit nearest the display screen until a dot is produced on said display screen.

In order to be able to use the method of the invention successfully, the deflection units should be of a reasonable quality. This means that the halves of the deflection coil when so constructed should be situated substantially symmetrical with respect to a plane which is at right angles to another plane with respect to which the coil halves of the line deflection coil are situated substantially symmetrically. The line of intersection of these two planes then forms the axis of the deflection unit. As long as the electron beam and the axis of the multipole field do not coincide substantially, the beam is deflected by the varying multipole field and a usually curved line is displayed on the display screen.

It is possible to provide the envelope and/or deflection unit with a reference mark or markers which can fix the position of the deflection unit with respect to the envelope unambiguously. As a result of this it is possible to remove the deflection unit from the cathode ray tube and to mount it again afterwards in the same position.

In addition it is possible by means of a calibrated deflection unit to provide in this manner a reference mark or markers on envelopes or on deflection units by means of a calibrated envelope.

Dependent on the type of deflection unit, multipole fields can be generated in a number of ways by applying an alternating current through the deflection coils. Where the line and field deflection coils each comprise first and second saddle-shaped coil halves, the alternating current may be applied through the line and/or field coil halves in such directions so as to produce a quadripolar magnetic field. Where one deflection coil comprises first and second saddle-shaped coil halves and the other deflection coil comprises first and second toroidal halves, the alternating current may be applied through the saddle-shaped coil halves in such directions so as to produce a quadripolar magnetic field. If both the line and field deflection coils each comprise first and second toroidal coil halves, the alternating current may be applied through the line and field coil halves in such directions so as to produce a quadripolar field. Alternatively in such a construction each of field deflection coil halves may be short ciruited and the current only applied through the line coil halves.

Sometimes, four-pole windings or eight-pole windings are incorporated in a magnetic deflection coil and these might be used to generate the required multipole field. The alternating voltage used may be the field or line deflection voltage used in the display operating condition of the cathode ray tube, so that no extra supply source is necessary for the said method.

The invention will now be described in greater detail by way of example with reference to the accompanying drawings, in which:—

Figure 1 is a sectional view of a multi-beam cathode ray display tube,

Figure 2 shows a display screen of a display tube with an incorrectly positioned deflection unit during the adjustment,

Figure 3 shows a display screen of a display tube with a correctly positioned deflection unit adjusted in accordance with the method of the invention, and

Figures 4 to 8 show ways of producing a multipole magnetic field for use with the invention.

The cathode ray tube shown in section in Figure 1 comprises a glass envelope 1 which has a neck 2 and a conical portion 3. Three electron guns 7, 8 and 9 are provided in the neck. The axis of the central gun 8 coincides substantially with the longitudinal axis of the cathode ray tube. The electron beams generated by the electron guns are deflected by a deflection unit 11 which is centred around the neck 2 by means of its end 10. The deflection unit consists of a housing 15 accommodating coils 16. The electron beams impinge on the display screen 4 through the apertures 6 in the colour selection electrode (shadow mask) 5. The three electron beams pass through the apertures 6 at a small angle to each other and consequently each impinges on stripe-shaped phosphor regions of only one colour. During the adjustment of a cathode ray tube the deflection unit 11 is slid on the neck 2 and rotated in such manner that the field and line deflections take place in the correct directions. However the deflection fields may need to be tilted as the axis 13 of the neck 2 and the gun 8 may not coincide with the axis 14 of the deflection unit 11 to produce frame distortion and convergence errors. Up till now these were corrected by passing differential currents through the coils of the deflection unit so that the axes 13 and 14 substantially coincided. A number of extra circuits were necessary to generate the differential currents. It is also known to tilt and move the deflection unit

during adjustment, with minimum frame distortion as a criterion for good adjustment.

According to the invention, adjustment is made much simpler if a dynamic multipole field is produced by means of the deflection unit with the central electron beam generated by means of the electron gun 8. Before the position of the deflection unit has been adjusted the axis 13 of the electron gun will not substantially coincide with the axis 14 of the deflection unit and a display will be produced on the display screen 4 as shown in Figure 2 in the presence of the multipole field. As a matter of fact, the electron beam is deflected by the dynamic multipole field which in this case is a four-pole field and usually a curved line display is produced. This line has a shape which depends on the position of the beam in the four-pole field. The lines 30, 31, 32 and 33 denote a few individual examples of shapes which such lines might occupy. Because the beam is also incident on the display screen in a small area, the beam current should be chosen to be low so as to avoid burning of the display screen.

Figure 3 shows that, if the axis 14 of the deflection unit and the axis 13 of the electron gun coincide or are made to coincide by tilting the deflection unit a dot 17 becomes visible on the display screen 4. In that case the dynamic four-pole field no longer deflects the electron beam.

When the deflection unit 11 has been adjusted, its position should be fixed on the envelope 1. This may be done, for example, by providing adjusting wedges between the end 12 (see Figure 1) of the deflection unit and the envelope, by gluing or by means of a screw connection.

It is alternatively possible to provide reference points on the envelope and/or the deflection unit which fix the adjustment of the deflection unit unambiguously. These reference points may be, for example, three studs or a flat portion of the envelope against which the deflection unit is located and may consist of a quantity of plasticized material, for example a thermoplastic material, which is poured between the deflection unit and the envelope or may be a ring or plates of a selected thickness which are adhered to the envelope. In this manner the axial purity adjustment in the direction of the axis of the cathode ray tube in the usual way can be fixed simultaneously.

By positioning the electron guns 7, 8 and 9 accurately about the axis of the neck 2 during sealing them within the envelope, it is not difficult to centre the deflection unit 11 around the neck 2 in the region of the end 10. It has been found that even when the axis 14 of the deflection unit at the region of the end 10 does not coincide entirely with the axis of the gun 8 but is situated at a small distance therefrom, a good adjustment of the deflection unit can nevertheless be obtained in the manner described.

Figure 4 shows diagrammatically a deflection unit having two pairs of saddle-shaped coils and having a core 18 (yoke ring), the coil halves of the line deflection coils being 19 and 20. Deflection in the operating condition of the display tube takes place by energizing the coil halves 19 and 20 with an alternating deflection current which may be sawtooth in shape in the direction indicated by the arrows on the coil connections. This alternating current may have a frequency equal to frequency of the usual deflection current or may be lower e.g. 50 or 60Hz so that the generated magnetic flux 38 due to these two coil halves lies in the same direction.

Figure 5 shows diagrammatically how a dynamic magnetic four-pole field 37 can be obtained with a deflection unit described in relation to Figure 4 the current now flowing in opposite directions in the coil halves 19 and 20 as indicated by the arrows on the coil connections. It will be obvious that such a four-pole field can also be generated by means of the field deflection coil halves 21 and 22, possibly together with the line deflection coils.

It is alternatively possible to obtain a multipole field with the saddle-shaped coil of a hybrid deflection unit consisting of a saddle-shaped coil in combination with a toroidal coil by energizing only the two parts of the saddle-shaped coil of said deflection unit with current flowing in opposite directions.

Figure 6 shows diagrammatically a deflection unit using two pairs of toroidal coils with core 23 (yoke ring). The field deflection coil halves 24 and 25 generate the deflection field 26 in normal operation and a field at right angles thereto can be generated by means of the line deflection coil halves 27 and 28.

Figure 7 shows diagrammatically how a dynamic quadripolar field 39 can be obtained by opposite energization with an alternating deflection current of the line and field deflection coil halves. It is also possible in such a toroidal deflection unit to energize only the line or field deflection coils to obtain the quadripolar field. In such a case the non-energized coil halves should be short-circuited, as is shown in Figure 8.

WHAT WE CLAIM IS:—

1. A method of adjusting a magnetic deflection unit on a multibeam cathode ray display tube, said tube having an envelope comprising a neck portion joined to the narrow end of a cone portion whose widest end is closed by a display screen, said neck

portion comprising means for generating a plurality of electron beams which beams when undeflected lie in a plane which is substantially perpendicular to the longitudinal axis of the tube, said deflection unit being mounted about the junction of said neck and said cone portions, said method comprising the steps of:—

i) rotating the deflection unit about the said longitudinal axis until orthoginal deflections of said beam are correctly positioned on said display screen,

ii) centring the end of the deflection unit remote from said display screen substantially about the said longitudinal axis,

iii) generating a dynamic multipole magnetic field with said deflection unit and simultaneously energising an electron beam which substantially coincides with the said longitudinal axis, and

iv) adjusting the position of the end of the deflection unit nearest the display screen until a dot is produced on said display screen.

2. A method as claimed in claim 1 comprising the additional step of securing the deflection unit to the envelope when a dot is produced on said display screen.

3. A method as claimed in claim 1 comprising the additional step of providing a reference mark or markers on the envelope and/or the deflection unit when a dot is produced on said display screen.

4. A method as claimed in claim 1, 2 or 3, in which said multipole magnetic field is generated by applying an alternating current through the line deflection coil and/or the field deflection coil of said deflection unit.

5. A method as claimed in claim 4, in which the line and field deflection coils each comprise first and second saddle-shaped coil halves, said alternating current being applied through said line and/or field coil halves in such directions so as to produce a quadripolar magnetic field.

6. A method as claimed in claim 4, in which one deflection coil comprises first and second saddle-shaped coil halves whilst the other deflection coil comprises first and second toroidal halves, said alternating current being applied through the saddle-shaped coil halves in such directions so as to produce a quadripolar magnetic field.

7. A method as claimed in claim 4, in which the line and field deflection coils each comprise first and second toroidal coil halves, said alternating current being applied through the line and field coil halves in such directions so as to produce a quadripolar field.

8. A modification of the method as claimed in claim 7, in which each of field deflection coil halves is short circuited.

9. A method as claimed in claim 1, 2 or 3, in which said deflection unit is provided with line and field deflection coils and multipolar windings, said multipole magnetic field being generated by means of said multipolar windings.

10. A method of adjusting a magnetic deflection unit on a multibeam cathode ray tube, substantially as herein described with reference to the accompanying drawings.

11. A multibeam cathode ray display tube having a reference marker or markers provided on its envelope by the method according to claim 3.

12. A magnetic deflection unit having a reference mark or markers provided thereon by the method according to claim 3.

13. The combination of a magnetic deflection unit and a multibeam cathode ray display tube in which the deflection unit is adjusted by the method as claimed in any of the preceding claims 1 to 10.

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3 SHEETS This drawing is a reproduction of the Original on a reduced scale
Sheet 1

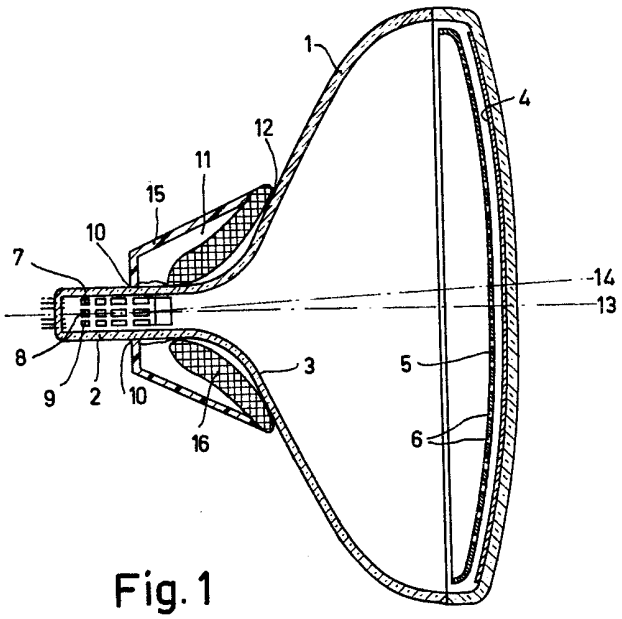

Fig. 1

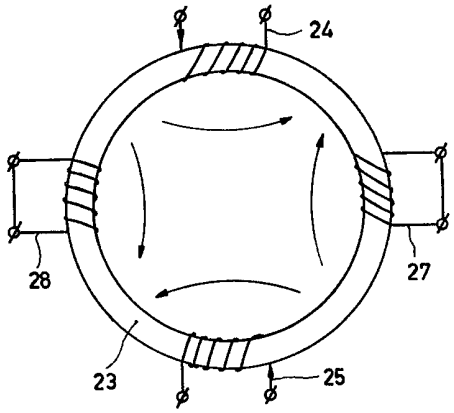

Fig. 8

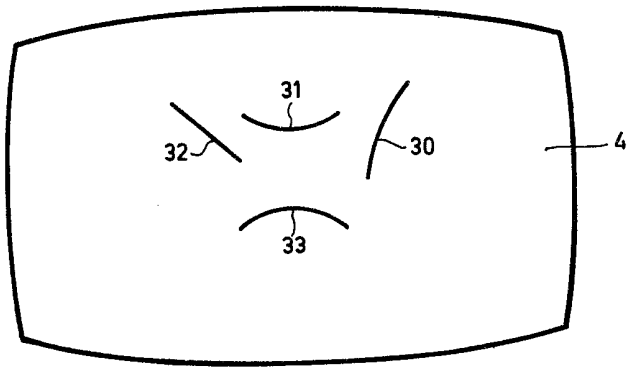

Fig. 2

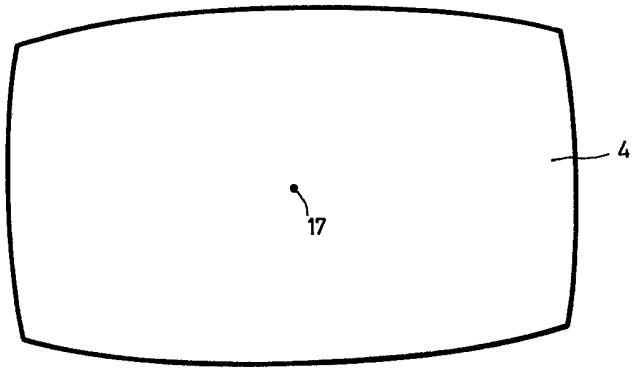

Fig. 3

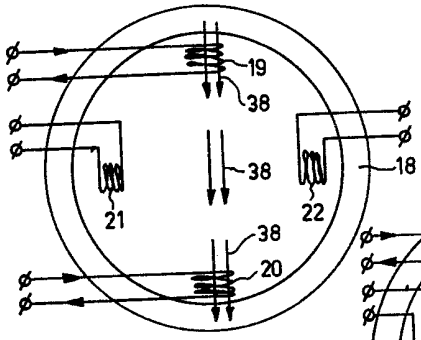

Fig. 4

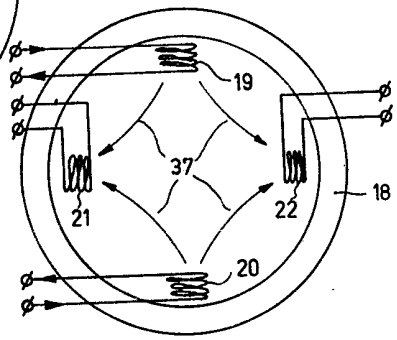

Fig. 5

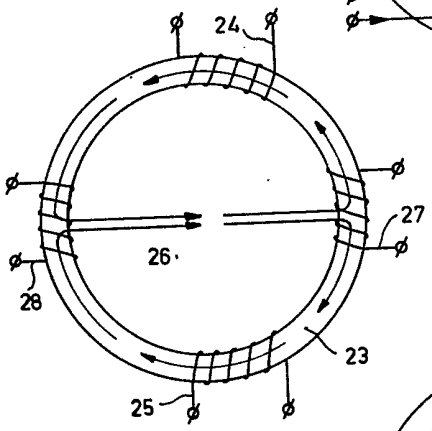

Fig. 6

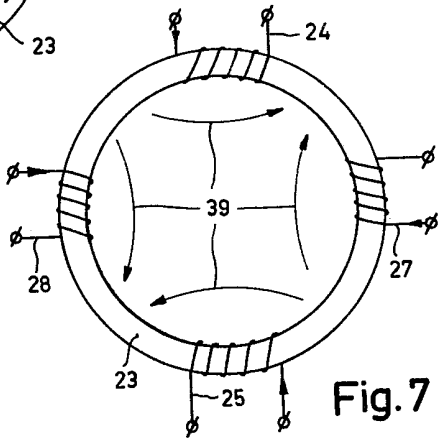

Fig. 7