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(54) **Deflection yoke apparatus with means for reducing leaking magnetic fields.**

(57) A deflection yoke apparatus comprising pairs of horizontal and vertical deflection coils, a coil separator (13) located between both coils, a deflection core forming a magnetic path for a magnetic flux generated from both deflection coils and two auxiliary coil means (16,17) which are arranged at diametrically opposed positions in a vertical deflection direction outside said deflection core. Said auxiliary coil means comprise coils (18, 19) wound on magnetic rods (20,21) of high magnetic permeability. A horizontal deflection current may be supplied to the auxiliary coil means and a magnetic field generated from said auxiliary coil means reduces an intensity of externally leaking magnetic field which radiates outside said deflection core when a horizontal deflection current is supplied to said horizontal deflection coils. The auxiliary coil means are slantly arranged in engaging relationship with the smaller diameter end of the deflection core.

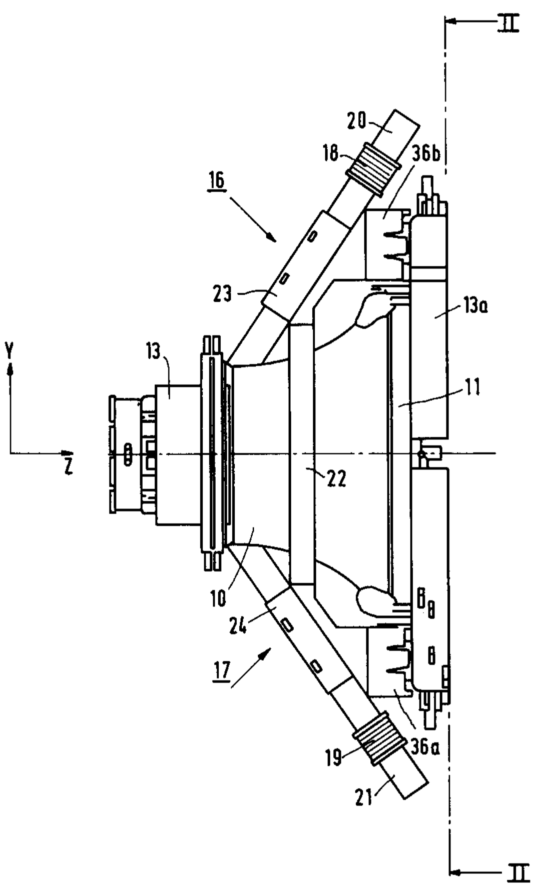

FIG. 1

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The invention relates to a deflection yoke apparatus to be mounted on a neck of cathode-ray tube for projecting rasters on a screen by scanning with at least one electron beam, comprising

(a) a pair of horizontal deflection coils for generating a magnetic field to deflect said electron beam in a horizontal direction,

(b) a pair of vertical deflection coils for generating a magnetic field to deflect said electron beam in a vertical direction,

(c) a coil separator for electrically insulating between said both deflection coils, said coil separator being provided with an expanded part at its front end,

(d) a funnel-shaped deflection core which forms a magnetic path for a magnetic flux generated when a deflection current is supplied to said horizontal and vertical deflection coils and a deflection magnetic field for deflecting said electron beam inside said annular deflection core and an externally leaking magnetic field outside said annular deflection core.

Recently more stringent standards have been introduced for certain types of picture display devices, notably for monitors, with respect to the leaking magnetic fields which they may produce around them. An important source of magnetic interference fields is the pair of horizontal (or line) deflection coils which may be operated at deflection currents with frequencies of 15.75 kHz to 120 kHz. It is impossible to design a satisfactorily operating deflection yoke apparatus which does not produce a leaking field. If the leaking field were to be eliminated by means of a protective shield, such a shield would only be effective if the combination of display tube and deflection unit were also shielded on the display screen side. It is true that the leaking magnetic field of a deflection unit is not very strong; at a distance of 50 cm from the front side of a deflection unit for a 110° monochrome display tube the field strength has already decreased to approximately 1 % of the strength of the earth's magnetic field, but it is the variation of the leaking field with respect to time which is important. Field variations may cause electromagnetic interferences in other electronic apparatus which causes these electronic apparatuses to malfunction. Also research is being done to establish whether human health is affected by these leaking fields. Nowadays the time derivative of the field of the deflection yoke apparatus increases with the increase of the line frequencies and hence with increasingly shorter fly-back periods.

For compensating the leaking field of the pair of horizontal deflection coils the use of a compensation coil means which, when energized, generates a compensating magnetic dipole field has been proposed in EP-A-220 777. This dipole field can be obtained by energizing one auxiliary coil whose turns have been wound around a bobbin in a square form which coil has the correct number of turns, the correct surface area and the correct orientation. Energization may be effected, for example, by arranging the said coil in series with or parallel to the pair of horizontal deflection coils. The compensation field may be obtained alternatively by energizing two of such auxiliary coils which are positioned on either side of the deflection yoke apparatus which auxiliary coils have the correct number of turns, the correct surface area and the correct orientation. Also in this case energization may be effected, for example, by arranging the auxiliary coils in series with or parallel to the pair of horizontal coils.

The auxiliary coils are preferably large so as to reduce their energy content.

However, a problem is that many types of display devices (particularly monitors) lack the space to accommodate large auxiliary coils in their correct position. Consequently, relatively small (too small) auxiliary coils can only be used so that the compensation of the leaking fields consumes much (deflection) energy. Moreover, the sensitivity of the pair of horizontal deflection coils is affected if the known auxiliary coils are arranged in series with them. The induction then increases.

It is an object of the present invention to provide measures enabling a compensation of the leaking magnetic field which costs less energy and less sensitivity than the known measures.

According to the invention this object is solved in that the deflection yoke apparatus of the type described in the opening paragraph has

(e) two auxiliary coil means which are arranged at diametrically opposed positions in said vertical direction outside said deflection core to generate a magnetic field with a direction opposed to the direction of said externally leaking magnetic field when a horizontal deflection current is supplied to said means, wherein each auxiliary coil means has an auxiliary coil and a magnetic rod made of soft magnetic material as a magnetic core for said coil, and

(f) an engaging means for engaging the magnetic rods of said auxiliary coil means in magnetic flux coupling relationship with the smaller diameter end of the deflection core.

The effectiveness of the inventive solution for radiation compensation, which is based on the use of rod-shaped auxiliary core means of a magnetizable material provided with (toroidal) auxiliary coils, is both superior to solutions which are based on the use of coreless, i.e. air-cored auxiliary coils and to solutions which are based on the use of auxiliary coils wound on magnetic rods which are not engaging the smaller diameter end of the deflection core in magnetic flux coupling relationship.

In practice the inventive solution was found to compensate the leaking fields effectively, while there was a reduced loss of deflection sensitivity (in a given case, for example, a reduction by a factor 5 as compared with conventional auxiliary coil means).

As the magnetic rods of the two auxiliary coil means of the inventive solution are arranged in magnetic flux-coupling relationship with the smaller diameter end of the deflection core, the assembly of deflection core and magnetic rods acts, as it were, like one magnetic core of minimum length.

An engaging means is provided for engaging the magnetic rods of the auxiliary coil means in the required magnetic flux-coupling relationship with the deflection core.

A preferred embodiment of the invention is characterized in that said engaging means comprises an annular member through which the deflection core passes, which annular member has two support members which support the magnetic rods in inclined positions towards the smaller diameter end of the deflection core, and connection parts which connect the annular member to the expanded part of the coil separator.

This construction provides a stable and simple support for supporting the magnetic rods of the auxiliary coil means in a desired angled relationship with the smaller diameter end of the deflection core.

The stability may be improved by bonding the end faces of the magnetic rods to the deflection core.

The simplicity may be improved by using connection parts in the form of click-on mounts.

These and other embodiments will be described with reference to the drawings.

Figure 1 is a side view of the deflection yoke apparatus provided with the auxiliary coils in accordance with the present invention,

Figure 2 is a front view of the apparatus in Figure 1.

In Figure 1 an annular ferrite core 10 is supported on a coil separator 13 made of plastic resin material around which vertical deflection coils 11 and 12 are arranged. Inside the coil separator 13 a pair of horizontal deflection coils 14 and 15 is arranged. On the exterior of the deflection core 10, auxiliary coil devices 16 and 17 are slantly arranged in the vertical direction on the drawing and engage the smaller diameter end of the core 10.

Figure 2 shows a front view of the apparatus in Figure 1 and the deflection core 10 is located at the coordinate position where it is divided into four equal portions by X and Y axes. As viewed on this coordinate system, a pair of horizontal deflection coils 14 and 15 are respectively arranged at upper and lower sides in reference to the X axis so that they are arranged symmetrically in reference to the Y axis. The auxiliary coil devices are located at the positons in the Y-axis direction equally away from the X axis and the parallel to the Y-Z plane.

An essential aspect of the invention is the relationship between the deflection core 10 in the interior of which vertical deflection coils 11 and 12 and horizontal deflection coils 14, 15 are disposed and the auxiliary coil devices 16 and 17. Auxiliary coils 18 and 19 are wound on magnetic rods 20 and 21 with high magnetic permeability made of ferrite, permalloy, silicon steel sheet or other material, the lengths of which are almost equal to the length of the deflection core 10 in the axial direction of the core to intensify the magnitude of magnetic field generated when a current is supplied to the auxiliary ciols. Auxiliary coils 18 and 19 may be made up by winding several times 0.4 mm diameter copper wires which are stranded or bound, and these auxiliary coils may be connected in series to horizontal deflection coils 14 and 15. Accordingly, a current as large as the current flowing through the horizontal deflection coils is supplied to auxiliary coils 18 and 19.

In a given embodiment the magnetic rods 20, 21 had a length of 60 mm and a diameter of 5 mm, and they were made of 4C6 ferrite. Rod lengths of, for example, between 5 and 10 cm were found to be suitable in practice. Around the rods 20, 21 auxiliary coils 18, 19 are wound having a limited number of turns (in connection with the induction).

In order to enable the magnetic rods 20, 21 to engage the smaller diameter end of the deflection core 10 in flux-coupling relationship the vertical deflection coils 11, 12 are of the saddle type: they are arranged inside the deflection core 10 and do not extend along the outer surface of the deflection core 10.

For a stable positioning the rods 20,21 preferably are bonded to the core 10 by means of an adhesive.

The rods 20,21 are supported by an annular member 22 which is provided with connecting parts 36a, 36b... which connect the annular member 22 to the front expanded part 13a of the coil separator 13. Preferably the connections are of the click-on type.

The annular member 22, through which the core 10 passes, is provided with support members 23, 24 in which fit the magnetic rods 20, 21.

The use of magnetic rods is determined according to the design of each type of the deflection yoke apparatus. The external sizes of auxiliary coils 18 and 19, number of turns of said coils, diameters of conductors used in these cols, etc. are determined taking into account the impedance of the horizontal deflection coils, magnitude of the externally leaking magnetic field, frequency of the current flowing through said coils 18 and 19, etc.

As described above, the deflection yoke aparaus in accordance with the present invention can reduce the externally leaking magnetic field radiated from the deflection coils, in other words, an unwanted radiation and minimize electromagnetic interference to other electronic equipment. The deflection yoke apparatus of the present invention can be modified in the design in the range of above-mentioned objects.

Claims

1. A deflection yoke apparatus to be mounted on a neck of cathode-ray tube for projecting rasters on a screen by scanning with at least one electron beam, comprising
   (a) a pair of horizontal deflection coils for generating a magnetic field to deflect said electron beam in a horizontal direction,
   (b) a pair of vertical deflection coils for generating a magnetic field to deflect said electron beam in a vertical direction,
   (c) a coil separator for electrically insulating between said both deflection coils, said coil separator being provided with an expanded part at its front end,
   (d) a funnel-shaped deflection core which forms a magnetic path for a magnetic flux generated when a deflection current is supplied to said horizontal and vertical deflection coils and a deflection magnetic field for deflecting said electron beam inside said annular deflection core and an externally leaking magnetic field outside said annular deflection core,
   characterized by:
   (e) two auxiliary coil means which are arranged at diametrically opposed positions in said vertical direction outside said deflection core to generate a magnetic field with a direction opposed to the direction of said externally leaking magnetic field when a horizontal deflection current is supplied to said means, wherein each auxiliary coil means has an auxiliary coil and a magnetic rod made of soft magnetic material as a magnetic core for said coil, and
   (f) an engaging means for engaging the magnetic rods of said auxiliary coil means in magnetic flux-coupling relationship with the smaller diameter end of the deflection core.

2. A deflection yoke apparatus in accordance with Claim 1, wherein said engaging means comprises an annular member through which the deflection core passes, which annular member has two support members which support the magnetic rods in inclined positions towards the smaller diameter end of the deflection core, and connection parts which connect the annular member to the expanded part of the coil separator.

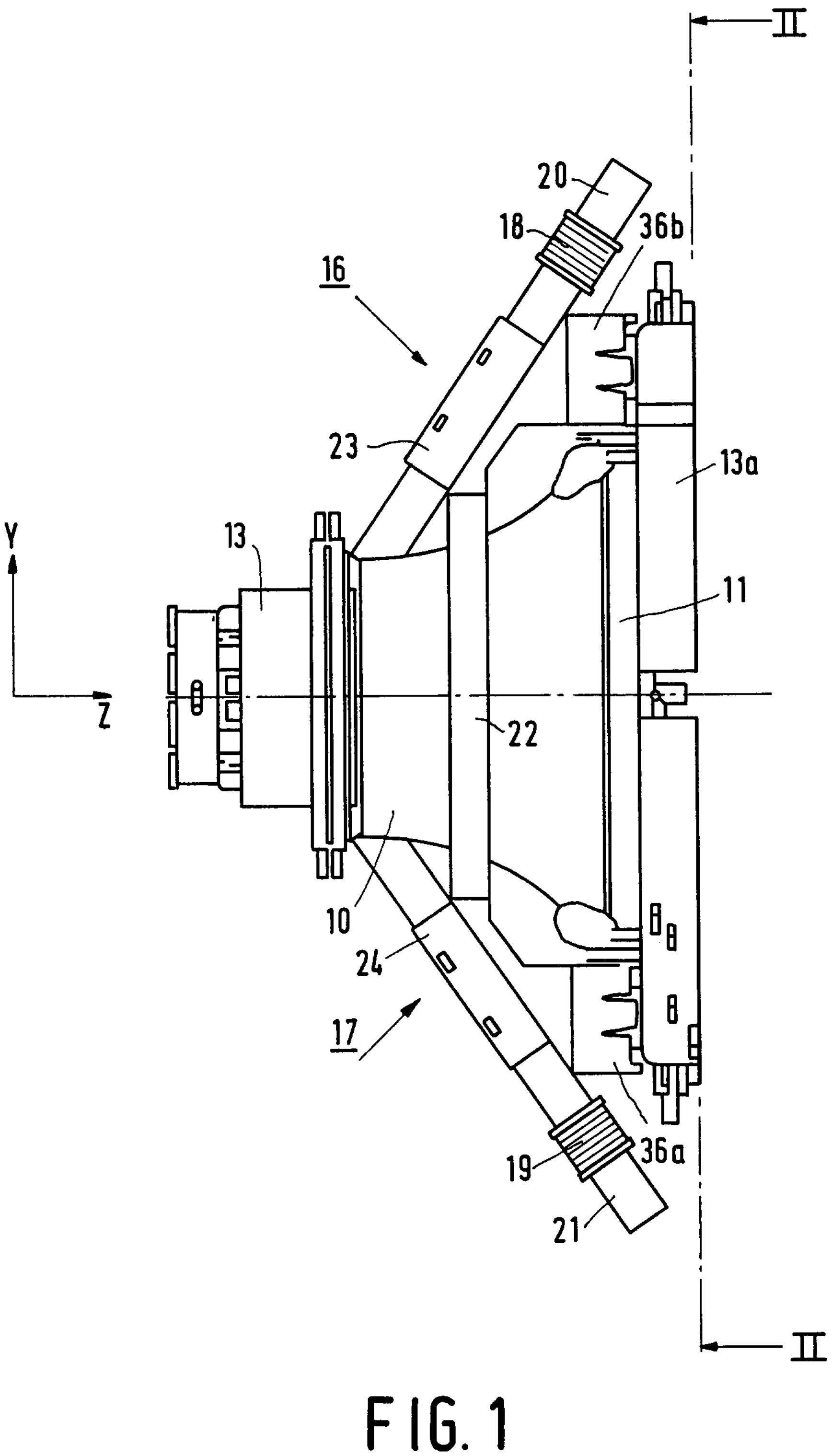

FIG. 1

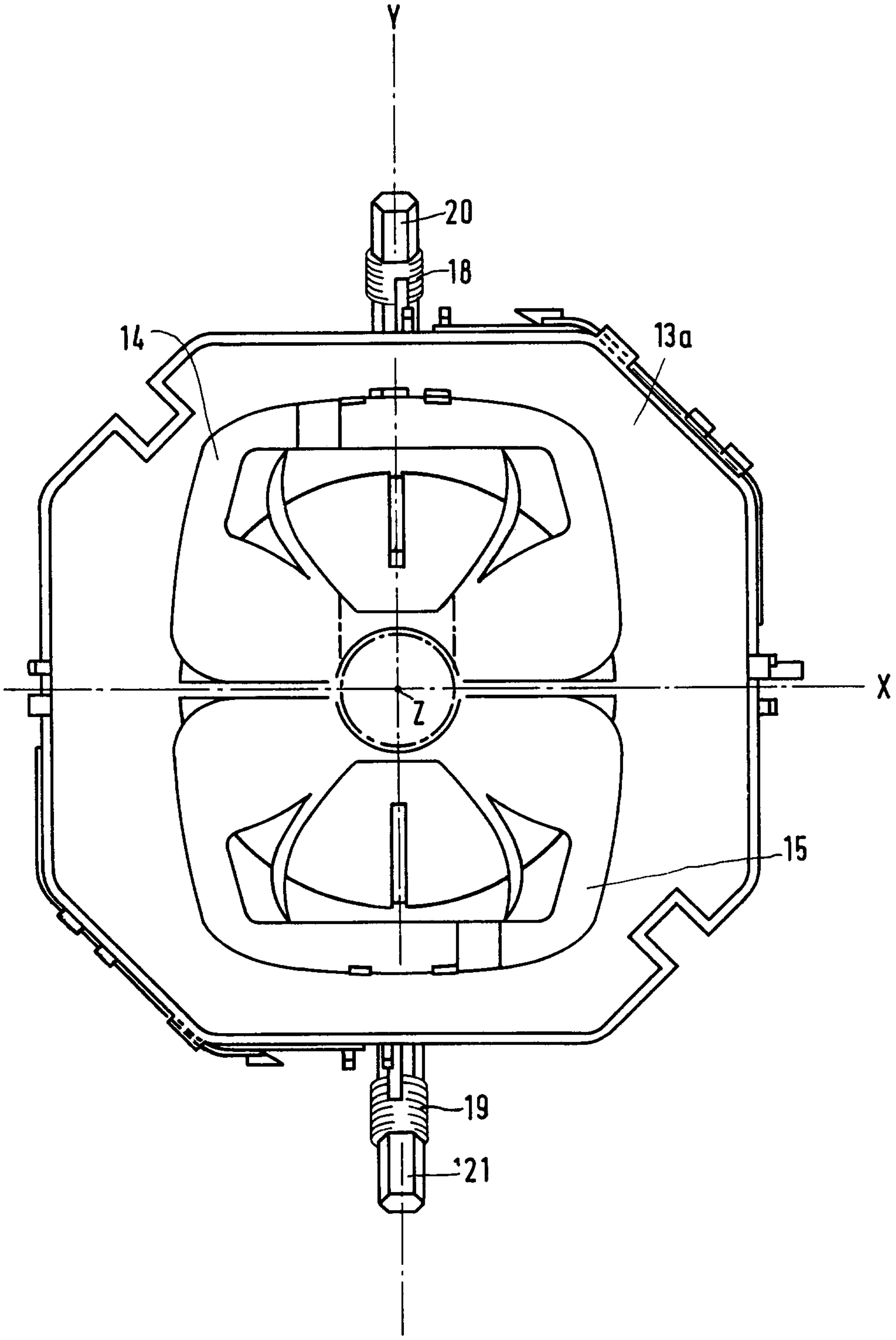

FIG.2

European Patent Office

EUROPEAN SEARCH REPORT

Application Number

EP 92 20 3252

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.5)
A	EP-A-0 435 602 (SAMSUNG ELECTRON DEVICES CO. LTD.) * abstract; figures 3,5-7 * * column 2, line 10 - line 28 * * column 2, line 50 - line 54 * * column 6, line 1 - line 2 * * column 6, line 50 - line 56 * ---	1,2	H01J29/00 H01J29/76
A	EP-A-0 346 972 (NV. PHILIPS' GLOEILAMPENFABRIEKEN) * abstract; figures 6,7 * * column 2, line 36 - line 55 * * column 7, line 14 - line 46 * -----	1,2	
			TECHNICAL FIELDS SEARCHED (Int. Cl.5)
			H01J

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	19 JANUARY 1993	COLVIN G.G.

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
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P : intermediate document

T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
D : document cited in the application
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