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54 Cathode ray tube display monitor with stray magnetic field compensation.

57 The stray low frequency magnetic field (S) from an electromagnetic yoke assembly (2) which is produced in front of the CRT (1) screen (3) is compensated with a pair of coils (5 and 6) whose axes are inclined to one another to intersect on the side of the coils remote from the CRT screen. Preferably the coil axes intersect on the axis (4) of the CRT and are equally inclined thereto.

Optionally, the stray magnetic field (S) is sensed by a sensing coils (8 and 9) connected in a feedback loop to control the current in the compensating coils (5 and 6).

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CATHODE RAY TUBE DISPLAY MONITOR WITH STRAY MAGNETIC FIELD COMPENSATION

This invention relates to a cathode ray tube monitor having means for reducing stray magnetic field produced in front of the screen.

Although there is no scientific proof that stray magnetic fields at the front of a cathode ray tube (CRT) monitor are harmful to humans, there is a requirement in certain Countries that the stray fields in the 1 KHZ to 400KHZ frequency range (hereafter referred to as low frequency magnetic fields) are reduced to below a particular value. Accordingly much effort has been expended by the CRT monitor industry over the last year or so to meet this requirement. The most common approach has been to use one or more coils to provide a compensating magnetic field which tends to cancel the undesired stray magnetic field. Examples of this approach are described in Finnish Patent Application 86148, PCT Applications WO87/05437 and WO87/060054, European Patent Applications 220777 and 235863, German Patent Application 3631023 and 3707829 and, US Patents 4634930, 4677344 and 4709220 and IBM Technical Disclosure Bulletin, June 1988 pp119 to 122. A second approach has been to use a magnetic shunt, as described in pending European application No 88105077.7 (IBM Docket KI9-87.005). Although the problem of a stray field has been analysed and is thought to be well understood, it is clear from the number of attempts to solve the problem that the solution is not as simple as it would appear. Furthermore, any solution should not add unduly to the cost of the CRT monitor.

An object of the present invention is to provide a simple but effective solution which will mitigate the effect of the low frequency magnetic field in front of the CRT monitor without requiring more than two compensating coils.

As will be evident from the prior art, the use of one coil is not very effective and hence the suggestions for two or more coils. The problem is that generally more than two coils are believed to be necessary to obtain optimum compensation. We have discovered that by suitable positioning and orientating just two coils, effective compensation can be obtained.

EP-A-0258891 shows deflection yoke apparatus comprising pairs of horizontal and vertical deflection coils and, in addition, auxiliary coils positioned outside of the vertical deflection coils, which are utilised to reduce the intensity of the leakage magnetic field. No significance is given as to the positioning of the auxiliary coils in relation to one another in order to yield the optimum compensating field.

According to the invention, a CRT monitor

comprises a CRT display together with an electromagnetic yoke assembly for causing an electron beam or beams to scan across the screen of the CRT, and a pair of compensating coils mounted so as to oppose the stray magnetic field in front of the CRT screen caused by the electromagnetic yoke assembly, and is characterised in that the pair of compensating coils is located adjacent the electromagnetic yoke assembly with their axes non-parallel but substantially in the same plane, orientated so that the compensating magnetic field is increased on front of the CRT screen and reduced behind the CRT screen. In other words, the two coils are inclined with respect to one another so that their axes intersect at a point behind the CRT screen, preferably on the axis of the CRT and yoke assembly.

Optionally, saving means for sending the stray magnetic field is employed to provide a feedback signal to control the current in the compensating coils. The invention will now be described, by way of example, with reference to the accompanying drawings in which;

Figure 1 is a schematic illustrating the principle underlying the present invention;

Figure 2. is a schematic as in Fig. 1, with additional 'Sensing' coils.

Figure 3. is a simplified circuit schematic.

In Figure 1, CRT 1 is provided with an electromagnetic yoke assembly 2 for sweeping the electron beam over the surface of the phosphor layer on the inner surface of the screen 3. As is now well known, a low frequency magnetic field S will often be found in front of screen 3, caused by stray fields from the yoke assembly 2.

Effectively, the stray field S approximates to that which would be produced by a magnetic dipole D positioned with its axis vertical and intersecting the axis 4 of the CRT.

In theory, a cancellation coil placed in the position of dipole D and energised to produce an equal magnetic dipole of the opposite sense would give effective cancellation of the deflection yoke's stray field S.

In practice however, and as exemplified by the aforementioned prior art, the glass bulb of the CRT prevents placement of a single cancelling coil. As attempted in the prior art, a pair of cancelling coils one above and one below the CRT bulb might be arranged to approximate to a vertically orientated dipole. However, the conical shape of the CRT bulb prevents placement of the cancelling coils with their axes coincident with one another and with the axis of the equivalent stray field dipole D. Complicated winding arrangements have been suggest-

ed to overcome this difficulty.

However, effective cancellation can be obtained by positioning the pair of coils 5 and 6 further from the screen than the ideal position and arranging the axes of the coils so that they are non-parallel but in the same plane : this increases the magnetic field towards the side of the screens 3 and decreases it away from the screen. The cancelling magnetic field is represented by 7.

Preferably, the coils 5 and 6 are inclined so that their axes intersect on the axis 4 of the CRT.

With the arrangement shown in Figure 1 stray magnetic fields in the 1 KHZ to 400 KHZ frequency range at a distance 0.3m from the CRT screen can be reduced to less than 20mT/S dB/dt and less than 80 nT ΔB .

To provide current to the compensating coils, they can be connected in series with the horizontal deflection coils of the yoke assembly. However, in order to avoid limiting the stray field reduction due to manufacturing tolerances of both the deflection and the compensating coils, a pair of extra 'sensing' coils can be incorporated into the monitor to form "closed loop" feedback systems (Fig. 2.). Each sensing coil (8, 9) is positioned such that it links with any stray fields produced, for example by the horizontal deflection coils, and produces a voltage proportional to the differential of the stray field. These "Sensing coil voltages" are amplified, accoptified, integrated and subsequently used to provide optimum current for the respective compensating coils (5, 6) (Fig. 3), via voltage controlled current sources.

The same technique could be employed to cancel the vertical component of the earth's magnetic field, by adding to the output of the integrator, a voltage proportional to the vertical DC field within the monitor case.

Clearly the size of the compensating coil, the number of turns, their angle of inclination, their positions and the amount of current will depend upon the particular CRT and can be found by simple experimentation but by inclining the coils in accordance with the present invention, optimum cancellation of the stray field can be obtained in a simple manner. The invention avoids the additional expense (and increased energy loss) involved if more than two compensation coils are used.

The invention is suitable for colour and monochrome CRT display monitors.

the cathode ray tube, and a pair (5,6) of compensation coils for producing a magnetic field which tends to cancel a stray low frequency magnetic field (S) produced by the magnetic yoke assembly in front of the screen, characterised in that the coils (5,6) are positioned and inclined with respect to one another in such a way that their axes intersect on the side of the coils remote from the screen.

2. A monitor as claimed in claim 1, in which the axes of the pair of compensations coils intersect at the axis of the cathode ray tube.

3. A monitor as claimed in either preceding claims in which the axes of the coils are equally inclined to the axis of the cathode ray tube.

4. A monitor as claimed in any of the preceding claims further comprising sensing means for detecting said stray low frequency magnetic fields, the output of said sensing means being connected to control the current in the compensating coils.

5. A monitor as claimed in claim 4, in which the sensing means includes a sensing coil (8 or 9) for detecting said stray low frequency magnetic field, the voltage output of the sensing coil being amplified, integrated and output to a voltage controlled current source (11) to provide current to the associated compensating coil (5 or 6).

6. A monitor as claimed in claim 5, wherein a voltage proportional to the vertical D.C field within the monitor case, is added to the output of each integrator to compensate for the effect of the earth's magnetic field.

Claims

1. A cathode ray tube display monitor comprising a cathode ray tube display (1) an electromagnetic yoke assembly (2) for causing an electron beam or beams to scan across the screen (3) of

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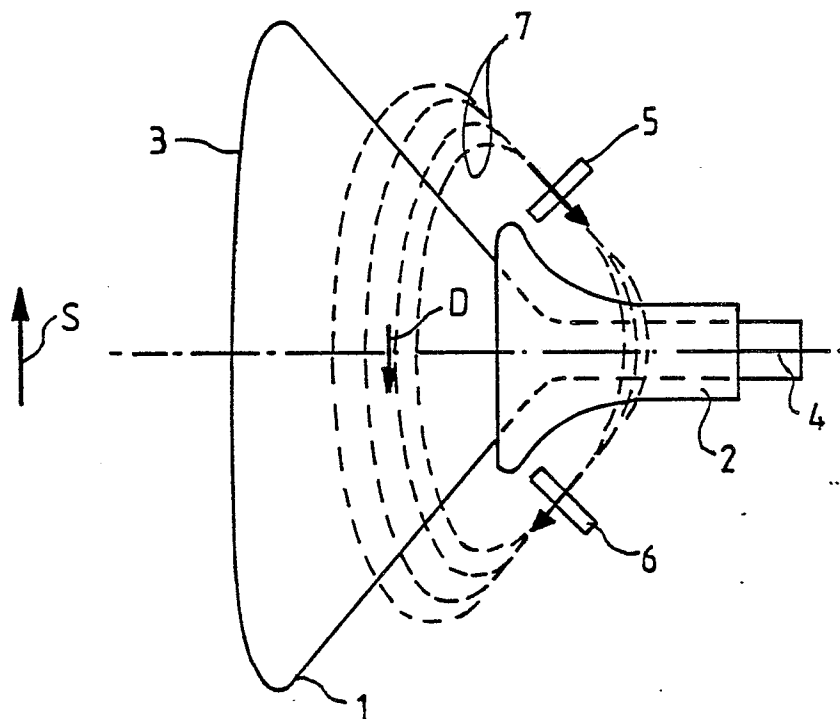
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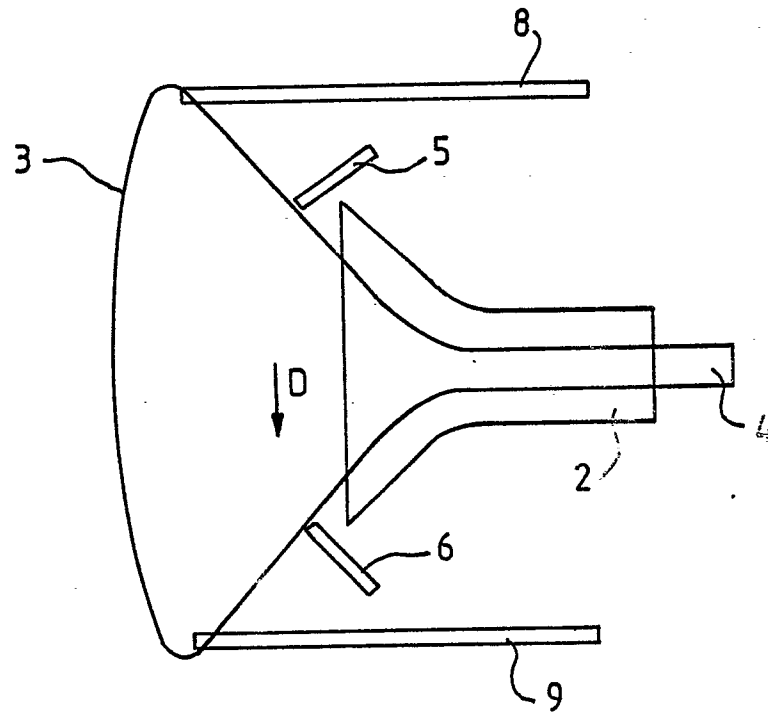
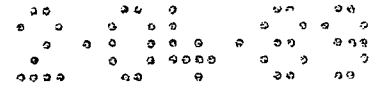


FIG. 2

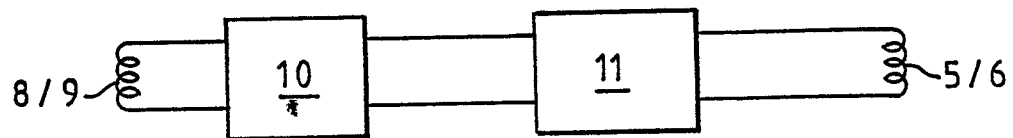


FIG. 3



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)
X	IBM TECHNICAL DISCLOSURE BULLETIN, vol. 30, no. 12, May 1988, pages 9-10, New York, US; "Cancellation of leaked magnetic flux" * Whole article *	1	H 01 J 29/76
D,A	WO-A-8 705 437 (AUTO-VISION) * Page 5, lines 20-25; page 6, line 32 - page 7, line 3; figure 2 *	1-3	
A	EP-A-0 258 891 (DENKI ONKYO) * Column 4, lines 2-8; column 5, lines 27-41; figures 1,6,7 *	1-3	
A	EP-A-0 039 502 (SIEMENS) * Page 2, line 32 - page 3, line 11; figure 2 *		
			TECHNICAL FIELDS SEARCHED (Int. Cl.5)
			H 01 J 29/00 H 05 K 9/00
The present search report has been drawn up for all claims			
Place of search THE HAGUE		Date of completion of the search 03-10-1989	Examiner ROWLES K.E.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 O : non-written disclosure 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 L : document cited for other reasons & : member of the same patent family, corresponding document			