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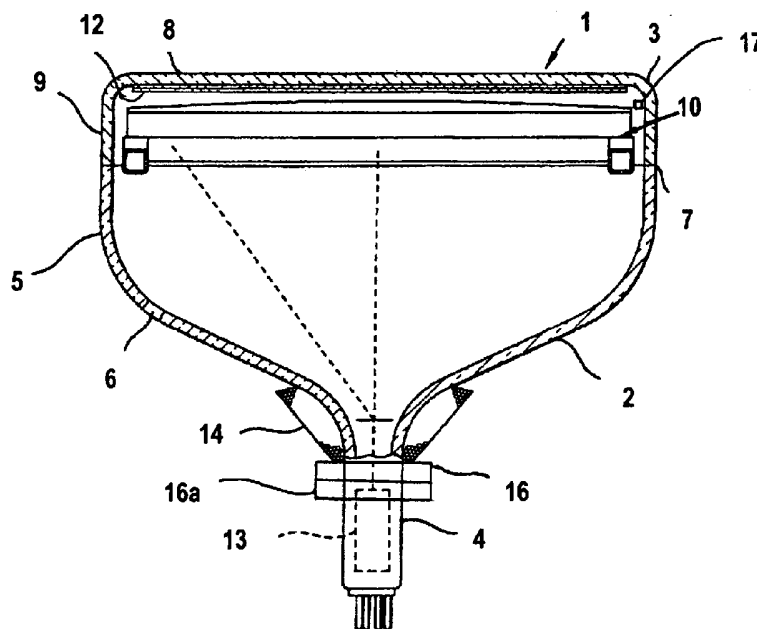
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(54) Title: MAGNETIC FIELD COMPENSATION FOR A CATHODE RAY TUBE



(57) Abstract: A cathode ray tube (CRT) having a glass envelope is disclosed. The glass envelope is formed of a rectangular faceplate panel and a tubular neck connected thereto by a funnel. An electron gun is positioned in the neck for directing electron beams toward the faceplate panel. A yoke is positioned in the neighborhood of the funnel-to-neck junction. The yoke has windings configured to apply a horizontal deflection yoke field and a vertical deflection yoke field to the beams. At least one magnetic field sensor is located near the glass envelope for sensing an ambient magnetic field environment of the CRT. A controller receives a signal from the magnetic field sensor. Register correction coils are mounted in the vicinity of the neck and are dynamically controlled by the controller to shift the beams. A video correction system is employed

to correct misconvergence such as that caused by the register correction coils. The video correction system receives input signal from the magnetic field sensor and processes the input signal to determine appropriate video correction parameters to use to correct for misconvergence. Further, the video correction system can be employed to correct residual raster geometry errors. In another embodiment according to the invention quadrupole coils are applied to the neck and have adjacent poles of alternating polarity such that the resultant magnetic field being dynamically controlled by the controller based on the magnetic field sensor signal moves outer ones of the beams to correct the misconvergence caused by the register correction.



For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

Magnetic Field Compensation for a Cathode Ray Tube

Related Applications

5 This application is a Continuation in Part of pending United States Patent Application PCT/US2004/042457 filed on December 17, 2004, entitled " Magnetic Field Compensation Apparatus for Cathode Ray Tube." This application claims priority to United States Provisional Patent Application Serial No. 60/534,458,
10 entitled "Magnetic Field Compensation Apparatus for Cathode Ray Tube", filed on January 6, 2004, and also claims priority to United States Provisional Patent Application Serial No. 60/649,681, entitled "Magnetic Field Compensation Apparatus for Cathode Ray Tube," filed on February 3, 2005 all of which are hereby incorporated by reference in their entireties.

Field of the Invention

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20 The invention is related to Cathode Ray Tubes (CRT) and more particularly to a magnetic field compensation system and video correction system for use in such CRT.

Background of the Invention

25 The color rendition of a CRT image can be affected by the ambient magnetic field in the vicinity of the CRT. This ambient field is generally caused by the Earth's magnetic field and can be affected by local magnetic fields and magnetic materials in the area. This field can be considered to have a vertical component and a horizontal component. The horizontal component is normally oriented North to South. In a given location the relationship of the vertical component with respect to the path of the CRT electron beams is relatively constant.

However, the effect of the horizontal component on the electron beams changes dramatically as the orientation of the CRT is changed, for example from East to West.

In a conventional CRT with the inline electron guns aligned in a horizontal plane and the phosphor stripes oriented vertically, the vertical component of the Earth's ambient field
5 deflects the beam horizontally affecting the register of the beam to the phosphor stripe, while the horizontal component deflects the beam along the phosphor stripe without significantly affecting the register. Since the vertical fields are relatively constant and not affected by the CRT orientation, and the horizontal field East to West orientation has little effect on register, the magnetic shielding can be designed to minimize the effect of North and South orientation
10 and keep the overall effects of the Earth's magnetic field to within the tolerance of the system. Such magnetic shielding systems are well known in the art.

Recently, the demand for large aspect ratio CRTs has led to the development of CRTs having a vertical electron gun orientation such that the plane in which the undeflected beams are located is parallel to the short axis or in other words on the vertical axis of the display
15 screen. Along with vertical electron gun orientation, phosphor lines on the screen are arranged horizontally. In these CRTs, the vertical component of the ambient magnetic field causes electron beam displacements along the phosphor lines and ideally leaves the registration of the beams with respect to the phosphor pattern intact. Horizontal magnetic fields on the other hand can lead to first order register changes causing color impurities on the
20 screen. Changing the CRT orientation from East to West reverses the direction of the register shift and it becomes significantly more difficult to design adequate shielding for all orientations, North, South, East, and West. Since the relationship between the CRT orientation and the horizontal magnetic field is entirely under the control of the consumer,

who will select it based on personal preference, it is desirable for a CRT having vertically aligned guns to compensate for the register effects of the ambient magnetic field.

Summary of the Invention

5 The invention provides a cathode ray tube (CRT) having a glass envelope. The glass envelope is formed of a rectangular faceplate panel and a tubular neck connected thereto by a funnel. An electron gun is positioned in the neck for directing electron beams toward the faceplate panel. A yoke is positioned in the neighborhood of the funnel-to-neck junction. The yoke has windings configured to apply a horizontal deflection yoke field and a vertical
10 deflection yoke field to the beams. At least one magnetic field sensor is located near the glass envelope for sensing an ambient magnetic field environment of the CRT. A controller receives a signal from the magnetic field sensor. Register correction coils are mounted in the vicinity of the neck and are dynamically controlled by the controller to shift the beams. A video correction system is employed to correct misconvergence such as that caused by the
15 register correction coils. The video correction system receives input signal from the magnetic field sensor and processes the input signal to determine appropriate video correction parameters to use to correct for misconvergence. Further, the video correction system can be employed to correct residual raster geometry errors. In another embodiment according to the invention, quadrupole coils are applied to the neck and have adjacent poles of alternating
20 polarity such that the resultant magnetic field being dynamically controlled by the controller based on the magnetic field sensor signal moves the outer beams to correct the misconvergence caused by the register correction coils.

Brief Description of the Drawings

The invention will now be described by way of example with reference to the accompanying figures of which:

Figure 1 shows a CRT according to the present invention;

5 Figure 2 shows a block diagram according to the present invention;

Figure 3 is a schematic representation showing register correction and related fields;

Figure 4 is a schematic representation of a misconvergence pattern caused by the register correction coils;

10 Figure 5 is a schematic representation of vertical quadrupole coils and related fields correcting the misconvergence pattern of Figure 4;

Figure 6 is a schematic representation of horizontal quadrupole coils and related fields correcting the misconvergence pattern of Figure 4;

Figure 7 schematically depicts a portion of a CRT display screen subject to image distortion;

15 Figure 8 is a block diagram of a video correction system within the CRT display system of Figure 1;

Figure 9 is a characteristic graph of a polyphase filter within the video correction system of Figure 8.

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Detailed Description of the Preferred Embodiments

Figure 1 shows a cathode ray tube (CRT) 1, for example a W76 wide screen tube having a glass envelope 2 comprising a rectangular faceplate panel 3 and a tubular neck 4 connected by a funnel 5. The funnel 5 has an internal conductive coating (not shown) that
25 extends from an anode button 6 toward the faceplate panel 3 and to the neck 4. The faceplate

panel 3 comprises a viewing faceplate 8 and a peripheral flange or sidewall 9, which is sealed to the funnel 5 by a glass frit 7. A three-color phosphor screen 12 having a plurality of alternating phosphor stripes is carried by the inner surface of the faceplate panel 3. The screen 12 is a line screen with the phosphor lines arranged in triads, each of the triads including a phosphor line of each of the three colors. A mask assembly 10 is removably mounted in predetermined spaced relation to the screen 12. An electron gun 13, shown schematically by dashed lines in Figure 1, is centrally mounted within the neck 4 to generate and direct three inline electron beams, a center beam and two side or outer beams, along convergent paths through the tension mask frame assembly 10 to the screen 12.

The electron gun 13 can consist of three guns being vertically oriented, which direct an electron beam for each of three colors, red, green and blue. The red, green and blue guns are arranged in a linear array extending parallel to a minor axis of the screen 12. The phosphor lines of the screen 12 are accordingly arranged in triads extending generally parallel to the major axis of the screen 12. Likewise, the mask of the mask assembly 10 has a multiplicity of elongated slits extending generally parallel to the major axis of the screen 12. It should be understood by those reasonably skilled in the art that various types of tension or shadow mask assemblies which are well known in the art may be utilized. Further the invention also has applicability for electron guns systems where the electron guns are oriented horizontally. This is particularly applicable when the ambient environment has magnetic contributions other than the Earth's where the local magnetic environments causes register shifting analogous to the register shifting experienced in a system with vertically oriented electron guns due to the horizontal field East to West orientation.

The CRT 1 is designed to be used with an external magnetic deflection system having yoke 14 shown in the neighborhood of the funnel-to-neck junction. When activated, the yoke

14 subjects the three beams to magnetic fields which cause the beams to scan vertically and horizontally in a rectangular raster over the screen 12.

A magnetic field sensor 17 is positioned within or near the CRT 1. Although the magnetic field sensor 17 is shown in the embodiment of Figure 1 as being located within the

5 CRT 1 it should be understood that it could be located outside and near the CRT 1. For example, based on ease of manufacturability, the magnetic field sensor 17 may be positioned within a cabinet or enclosure which houses the CRT 1. Magnetic field sensor 17 may be for example a Hall effect sensor which is capable of detecting magnetic fields in a given axis. It

should be understood by those reasonably skilled in the art that the magnetic field sensor 17

10 may be a single sensor capable of detecting magnetic fields in three axes or may alternatively be three separate sensors, one each for detecting magnetic fields along each major axis.

Alternately, the magnetic field sensor 17 may be positioned at various locations within or near the CRT 1 in order to optimize detection of magnetic fields. Alternately, a plurality of magnetic field sensors 17 may be employed at various locations within or near the CRT.

15 These magnetic fields sensor 17 output an electrical signal proportional to the ambient magnetic field incident thereon in a given direction. The magnetic field sensor 17 therefore measures the ambient magnetic field environment of the CRT and it's output changes as the CRT is moved or relocated. When the horizontal component of the ambient magnetic field is changed (particularly East to West), there is a deflection of the beams vertically causing a

20 register shift of the beam landing on the horizontal phosphor stripes. This register shift may degrade color purity.

The output signal of the magnetic field sensor 17 is fed into a controller as shown in Figure 2. The controller dynamically drives a set of register correction coils 16a preferably mounted in the neck region as shown in Figure 1. The controller also drives a video

correction system as shown in Figure 2 and as will be described in greater detail below. It should be understood by those skilled in the art that the register correction coils 16a may also be referred to purity correction coils. The register correction coils 16a apply a relatively uniform field across the three beams, as shown schematically in Figure 3, such that the three beams are uniformly deflected in the direction of the plane of the beams. This deflection moves each beam register normal to the phosphor stripes on the screen 12 so that it can be centered on the respective phosphor stripe. This purity correction, however, causes the beams to shift or become misaligned within the yoke 14 resulting in misconvergence such as depicted in Figure 4. Here it can be seen that the register correction and resultant beam misalignment within the yoke 14 causes an inward shift and an outward shift of the outer beams, specifically in this example, inward shift of the blue beam and outward shift of the red beam.

The yoke 14 and yoke effects will now be described in greater detail with applicability to the system with vertically oriented electron guns. The yoke 14 is positioned in the neighborhood of the funnel-to-neck junction as shown in Figure 1 and, in this embodiment, is wound so as to apply a horizontal deflection yoke field which is substantially barrel shaped and a vertical deflection yoke field which is substantially pincushion shaped. The vertical pincushion shaped yoke field is generated by a first deflection coil system being wound on the yoke. The horizontal barrel shaped yoke field is generated by a second deflection coil system also being wound on the yoke such that it is electrically insulated from the first deflection coil system. Winding of the deflection coil systems is accomplished by known techniques. The yoke fields affect beam convergence and spot shape. These fields are generally adjusted to achieve self-convergence of the beams. Instead of adjusting for self-convergence, in the invention, the horizontal barrel field shape is adjusted, for example

reduced, to give an optimized spot shape at the sides of the screen. The barrel shape of the field is reduced until an optimized nearly round spot shape is achieved at the 3/9 and corner screen locations. This field shape adjustment, resulting in improved spot shape, compromises self convergence causing misconvergence at certain locations on the screen. Specifically, the beams are overconverged at the sides. Overconvergence as used here describes a condition where the red and blue beams have crossed over each other prior to landing on the screen.

Correction of misconvergence that resulted from both the register correction and the yoke effects described above is achieved by addition of quadrupole coils 16 best shown in Figures 1, 5 and 6 and/or the addition of video correction as shown in Figure 2. In short, the quadrupole coils 16 and/or video correction can be used to correct misconvergence caused by register correction coils 16a and other sources. Misconvergence from the yoke effect at locations along the screen 12 can be dynamically corrected by quadrupole coils 16 located on the gun side of the yoke 14. Four or more quadrupole coils 16 are fixed to the yoke 14 or may alternatively be applied to the neck (Fig. 1) and each have four poles oriented at approximately 90° angles relative to each other as is known in the art. The quadrupole coils 16 include a first vertical set of quadrupole coils shown in Figure 5 and a second horizontal set of quadrupole coils shown in Figure 6. In the vertical set of quadrupole coils (Fig. 5), adjacent poles are of alternating polarity and the orientation of the poles is at 45° from the tube axes so that the resultant magnetic field moves the outer (red and blue) beams in a vertical direction as shown by the arrows in Figure 5 to provide correction for the misconvergence. In the horizontal set of quadrupole coils (Fig. 6), adjacent poles are of alternating polarity and are orientated on the tube axes so that the resultant magnetic field moves the outer (red and blue) beams in a horizontal direction as shown by the arrows in Figure 6 to provide correction for the misconvergence. Both sets of quadrupole coils 16 are

located behind the yoke 14 such that they are approximately at or near the dynamic astigmatism point of the guns 13. The quadrupole coils 16 are dynamically controlled to create a correction field for adjusting misconvergence at locations on the screen. The quadrupole coils 16, in this embodiment are driven in synchronism with the horizontal deflection. The magnitude of the quadrupole driving waveform is selected to correct the overconvergence caused by the yoke field described above. In this embodiment the waveform is approximately parabolic in shape. The guns 13 in the embodiments with quadrupole coils have electrostatic dynamic focus (or astigmatism) correction in order to achieve optimum focus in both the horizontal and vertical directions on each of the three beams. This electrostatic dynamic astigmatism correction is done separately on each beam and allows correction of horizontal to vertical focus voltage differences without affecting convergence. Although the quadrupole coils 16 also effect beam focus, their location near the dynamic astigmatism point of the gun allows this effect to be corrected by adjusting the electrostatic dynamic astigmatism voltage of the gun such that the combination does not affect the resultant spot shape. This results in the favorable affect of being able to correct misconvergence at selected locations on the screen without affecting the spot shape. This allows the spot shape to be optimized by the yoke field design and any resultant misconvergence to be corrected by the dynamically driven quadrupole coils 16.

Color purity correction is accomplished by dynamically adjusting register correction coils 16a preferably mounted in the neck region. The register correction coils 16a apply a relatively uniform field across the three beams such that the three beams are uniformly deflected in the direction of the plane of the beams. This deflection moves each beam register normal to the phosphor stripes so that it can be centered on the respective phosphor stripe. Such coils could be integrated with the quadrupole coils 16 or, alternatively,

integrated with the yoke 14 and yet again alternatively, located independently on the neck in the general region between the quadrupole coils 16 and yoke 14. Neck mounted register correction coils 16a cause beam displacements in addition to beam angle changes. The combination of these changes to the beam paths result in simultaneous register and convergence changes as these coils are activated. Therefore, dynamic programming of the quadrupole coils 16 in appropriate synchronization with the register correcting coils 16a is required in order to maintain simultaneously purity and convergence.

As shown in Figure 2, a dynamic waveform generating controller is utilized to generate the required waveforms for convergence and register corrections. The fundamental inputs to the controller are the magnetic field data provided by a magnetic field sensor or sensors and timing signals provided by the horizontal and vertical drive signals. The controller contains appropriate memory and programming functions such that the dynamic waveforms can be set up according to the local magnetic configuration. The controller outputs signals to a video correction system, a register driver, a horizontal convergence driver and a vertical convergence driver. The video correction system is controlled by the controller to apply a distortion to a video source signal which passes to a video output and ultimately to electron gun 13 as will be described below. The register driver receives input from the controller and sends an output to drive register correction coils 16a of Figure 1 accordingly. The horizontal convergence driver likewise receives an input signal from the controller to drive quadrupole coils 16 of Figure 1 which affect horizontal convergence. Likewise, the vertical convergence driver receives input from the controller and sends an output signal to drive quadrupole coils 16 of Figure 1 which affect vertical convergence. Other suitable types of multipole coils could be substituted for the quadrupole coils.

A facet of this invention includes video correction in which digital video signal information is mapped to the appropriate scan location to correct convergence and geometry. This video mapping does not affect the spot shape and is an effective tool for small corrections. Video correction to improve convergence is attractive because it may obviate the need for multipole correction, for example, by quadrupole coils and can also correct residual raster geometry errors. (Raster geometry errors can includes deviations from a desired raster shape.) The elimination of the quadrupole coils is particularly beneficial because it reduces the cost of the novel CRT. Although the controller can be configured by design to drive the coils and/or the video correction system simultaneously, as shown in one embodiment of the invention including the use of both the quadrupole coils and digital video correction to improve convergence, it should be understood that the controller may be configured to drive only the video correction system thus eliminating the need for quadrupole coil correction as described above.

In general, CRT displays exhibit raster distortions. The most common raster distortions pertain to geometric errors and to convergence errors. Both geometric and convergence errors are position errors in the scanned positions of the beams as the raster is drawn on the screen. Convergence errors occur when, in a CRT display, the Red, Green and Blue rasters are imperfectly aligned such that, for example, over some portion of the image the Red sub-image is displaced left with respect to the Green sub-image and the Blue sub-image is displaced to the right of the Green sub-image. Convergence errors of this type can occur in any direction and anywhere in the displayed image. Geometry errors occur when the actual beam locations during the scan deviate from their intended locations and can be detected when one applies an input signal corresponding to a grid designed to have a uniform field of squares is displayed as having non-uniform field of squares. Also, with any practical

embodiment of the known color CRT, both convergence and geometric errors become readily visible even if the center region is perfectly aligned during the original manufacture of the CRT, assuming that the deflection signals applied to the deflection coils are linear ramps.

Utilizing traditional, well known in the art, analog circuit techniques to compensate for such

5 distortions, the deflection signals can be modified from linear ramps to more complex wave shapes. Also, the details of the yoke design can be adjusted such that convergence errors and geometry errors are reduced. As the deflection angle is increased beyond 110° , such

traditional methods of geometry and convergence corrections become more and more

difficult. Furthermore, with the availability of low cost digital signal processing techniques, it

10 is possible and economically feasible to partially replace or supplement the traditional analog correction methods with digital signal processing.

Video correction involves mathematically operating on an input signal and then processing it in a manner of inverse distortion. With reference to the example given above for convergence errors, the inverse distortion to be performed by video correction is to move the

15 Red sub-image right by the same amount with respect to the Green sub-image as the final CRT distortion will move it to the left and similarly move the Blue sub-image to the left.

The video correction system in this invention works in conjunction with the magnetic field sensor readings of the magnetic field sensor 17. Essentially video correction information based on predetermined magnetic field configurations are stored in a memory. This memory

20 can be created for example during the display system manufacture by simulating a plurality of local earth magnetic field conditions relative to CRT system orientation. For each such simulation condition, optimized video correction parameters are determined. These parameters are stored in local memory. During tube operation, the field sensor 17 measures the local earth magnetic conditions and relays the measurements in the form of an input

signal to the controller, which can include the memory. Based on the information from the field sensor 17, register and convergence are optimized by the corresponding coil systems. Further, based on the measured magnetic field information, the closest match to one of a number of original setup conditions is determined and the appropriate video correction parameters stored in memory are utilized. A further refinement may include interpolation of the prestored values so that instead of a match to exact prestored values, interpolated video correction parameters can be used to better optimize the convergence and residual raster geometry.

The CRT according to the invention can also include the application of beam scan velocity modulation (BSVM) in the fast vertical scan direction. BSVM constitutes a sharpness enhancement method that involves local changes in the scan velocity of the electron beam based on brightness transitions in the video signal inputs. A video correction element or digital enhancement unit could provide a suitable BSVM signal.

Regarding video correction, it could be performed by a gate array element and a video correction element. Video correction can occur by first determining the geometric offset resulting from mis-convergence or raster distortion, and establishing the necessary horizontal and vertical displacement (i.e., Δx and Δy) needed to correct the misconvergence offset or raster distortion. The video then undergoes displacement by Δx and Δy to correct for such misconvergence.

To better understand the process by which such video correction occurs, refer to Figure 7, which depicts an example of image distortion appearing on a CRT screen. Within the encircled area, the image appears distorted by the amounts Δx and Δy (shown as ΔV_x and ΔV_y in the FIG. 7). Note that the distortion over the image is not homogeneous and differs for each color.

Figure 8 provides a general overview of video correction for distortion in accordance with the present principles and adds further detail to the video correction system described above with reference to Figure 2. First, the controller determines the x and y offsets (Δx and Δy) for the measured ambient magnetic field, typically with a grid of 9 x 9 or a 5 x 5 points spaced over the entire image, yielding Δx and Δy offset matrices 400 and 401. The Δx and Δy offset matrices undergo interpolation, via elements 402 and 403 in Figure 8. In practice, the elements 402 and 403 can take the form of a programmed processor, application specific integrated circuit, field programmable gate array or digital signal process as an example. A re-sampling filter 404 re-samples video from an incoming video source, such as the progressive RGB(p) signals and produces a video out signal to yield a video image 405 that is distorted by an amount inverse to the distortion that arises from the geometric raster distortion of each color. It should be understood that the video out signal comprises an inverse distortion of the red sub-image, and inverse distortion of the green sub-image and an inverse distortion of the blue sub-image. Thus, the inverse distortion created by video correction cancels the original distortion, yielding a substantially distortion free-image 406. As discussed, the horizontal Δx and vertical Δy displacements are measured or computed on a 9x9 grid. Interpolation of Δx and Δy samples becomes necessary to know the displacement at each point of the re-sampled image typically by the well known two dimensional cubic interpolation.

The result of the interpolation is a distortion vector comprising integer and non-integer components in both the x and y direction. The re-sampling filter 404 consists of a simple remapping of the pixels for the integer component of the distortion vector and of a polyphase filter for the non-integer component. The remapping is conveniently accomplished

by reading out a video source memory with adjusted addresses, whereas the integer part of the above interpolation, typically cubic interpolation, is used for the address adjustment.

For performing the non-integer component of the re-sampling operation, filter 404 of Figure 8 can take the form of a five tap polyphase filter as described in graph of Figure 9.

5 The graph of Figure 9 shows coefficient values on its y-axis and tap values on its x-axis. The polyphase filter adapts its coefficients to the non-integer shift between the original and the final pixels. The non-integer component of the interpolation can assume values between -0.5 and +0.5, corresponding to interpolated pixel positions ± 0.5 sample spaces from the closest integer value. In Figure 9 the computed five tap-weights are shown for two non-integer
10 interpolated pixels. The non-integer components computed from the interpolation, shown here are +0.05 and -0.4 pixels from the closest integer position, these are referred to as Phase= 0.05 and Phase = -0.4 in Figure 9 respectively. The five element tables associated with each indicated Phase gives the weights for the filter tap summations, indicated in Figure 9 as coefficients. Typically look-up tables are used to store the coefficients for a finite
15 number of non-integer interpolated values. A common approach is to store the coefficients for 64 discrete phases and select the phase closest to the interpolated value.

The foregoing illustrates some of the possibilities for practicing the invention. Many other embodiments are possible within the scope and spirit of the invention. It is, therefore, intended that the foregoing description be regarded as illustrative rather than limiting.

What is claimed is:

1. A cathode ray tube (CRT) comprising:

a glass envelope having a rectangular faceplate panel with a viewing screen
and a tubular neck connected thereto by a funnel;

5 an electron gun positioned in the neck for directing electron beams toward the
faceplate panel, said electron beams emitted from individual cathodes of said electron gun
form individual sub-images of a corresponding particular color when scanned on the screen;

a yoke positioned in the neighborhood of the funnel-to-neck junction;

10 at least one magnetic field sensor located near the glass envelope for sensing
an ambient magnetic field environment of the CRT;

a controller receiving a signal from the magnetic field sensor;

register correction coils being mounted in the vicinity of the neck and being
dynamically controlled by the controller to shift the beams; and,

15 a video correction system receiving input signal from the magnetic field
sensor, the video correction system corrects misconvergence and geometric errors caused by
the register correction coils or other sources by suitably moving at least one of the sub-
images scanned for corresponding said electron beams.

2. The CRT of claim 1 comprising multipole coils applied to the neck and having
20 adjacent poles of alternating polarity such that the resultant magnetic field being dynamically
controlled by the controller based on the magnetic field sensor signal moves outer ones of the
beams to correct the misconvergence caused by the register correction.

3. The CRT of claim 2 wherein the multipole coils are quadrupole coils, the quadrupole coils comprise a set of vertical quadrupole coils being oriented at 45° from the CRT axes such that the resultant magnetic field being dynamically controlled by the controller based on the magnetic field sensor signal moves outer ones of the beams vertically to correct the misconvergence.

4. The CRT of claim 3 wherein the quadrupole coils further comprise a set of horizontal quadrupole coils being oriented on the CRT axes such that the resultant magnetic field being dynamically controlled by the controller based on the magnetic field sensor signal moves outer ones of the beams horizontally to correct the misconvergence.

5. The CRT of claim 4 wherein the yoke has windings configured to apply a horizontal deflection yoke field and a vertical deflection yoke field to the beams, and the horizontal deflection yoke field is substantially barrel shaped and the vertical deflection yoke field is substantially pincushion shaped.

6. The CRT of claim 1 wherein the electron gun has electrostatic astigmatism correction.

7. The CRT of claim 6 wherein the quadrupole coils are located in the vicinity of a dynamic astigmatism point of the electron gun such that adjustment of an electrostatic astigmatism voltage has no affect on spot shape.

8. The CRT of claim 4 wherein the quadrupole coils and register correction coils are dynamically controlled by the controller to maintain simultaneous purity and convergence.

5 9. The CRT of claim 8 wherein the controller further comprises a register driver, a horizontal convergence driver and a vertical convergence driver.

10. The CRT of claim 9 wherein the register driver is coupled to the register correction coils, the horizontal convergence driver is coupled to the horizontal quadrupole
10 coils and the vertical convergence driver is coupled to the vertical quadrupole coils.

11. The CRT of claim 1 wherein the electron gun comprises three guns being vertically oriented.

15 12. A cathode ray tube (CRT) comprising:
a glass envelope having a rectangular faceplate panel and a tubular neck connected thereto by a funnel;
an electron gun positioned in the neck for directing electron beams toward the faceplate panel;
20 a yoke positioned in the neighborhood of the funnel-to-neck junction, the yoke having windings configured to apply a horizontal barrel shaped field and a vertical pincushion shaped field to the beams, the horizontal barrel field shape being adjusted to give an optimized spot shape at sides of the screen, causing an overconvergence of the beams at the sides of the screen;

at least one magnetic field sensor located near the glass envelope for sensing an ambient magnetic field environment of the CRT;

a controller receiving a signal from the magnetic field sensor;

register correction coils being mounted in the vicinity of the neck and being

5 dynamically controlled by the controller to shift the beams; and

a video correction system receiving input signal from the magnetic field sensor, the video correction system corrects any misconvergence or raster geometry errors caused by the register correction coils or other sources by suitably shaping at least one sub-image scanned of any corresponding said electron beams.

10

13. The CRT of claim 12 comprising quadrupole coils applied to the neck and having adjacent poles of alternating polarity such that the resultant magnetic field being dynamically controlled by the controller based on the magnetic field sensor signal moves outer ones of the beams to correct the misconvergence caused by the register correction
15 coils, the quadrupole coils also being dynamically controlled by the controller to correct overconvergence at the sides of the screen caused by the yoke.

14. The CRT of claim 13 wherein the quadrupole coils comprise a set of vertical quadrupole coils being oriented at 45° from the CRT axes such that the resultant magnetic
20 field being dynamically controlled by the controller moves outer ones of the beams vertically to correct the misconvergence.

15. The CRT of claim 14 wherein the quadrupole coils further comprise a set of horizontal quadrupole coils being oriented on the CRT axes such that the resultant magnetic

field being dynamically controlled by the controller moves outer ones of the beams horizontally to correct the misconvergence.

16. The CRT of claim 13 wherein the electron gun has electrostatic astigmatism
5 correction.

17. The CRT of claim 16 wherein the quadrupole coils are located in the vicinity of a dynamic astigmatism point of the electron gun such that adjustment of an electrostatic astigmatism voltage has no affect on spot shape.

10 18. The CRT of claim 13 wherein the quadrupole coils and register correction coils are dynamically controlled by the controller to maintain simultaneous purity and convergence.

15 19. The CRT of claim 18 wherein the controller further comprises a register driver, a horizontal convergence driver and a vertical convergence driver.

20 20. The CRT of claim 19 wherein the register driver is coupled to the register correction coils, the horizontal convergence driver is coupled to the horizontal quadrupole coils and the vertical convergence driver is coupled to the vertical quadrupole coils.

21. The CRT of claim 12 wherein the electron gun comprises three guns being vertically oriented.

22. A cathode ray tube (CRT) comprising:

a glass envelope having a rectangular faceplate panel with a viewing screen
and a tubular neck connected thereto by a funnel;

an electron gun positioned in the neck for directing electron beams toward the
5 faceplate panel, said electron beams emitted from individual cathodes of said electron gun
form individual sub-images of a corresponding particular color when scanned on the screen;

a yoke positioned in the neighborhood of the funnel-to-neck junction;

at least one magnetic field sensor located near the glass envelope for sensing
an ambient magnetic field environment of the CRT; and,

10 a video correction system receiving an input signal from the magnetic field
sensor and correcting misconvergence and geometric errors by suitably moving at least one
of the sub-images scanned for corresponding said electron beams.

23. The CRT of claim 22 further comprising a controller coupled to received input
15 from the magnetic field sensor.

24. The CRT of claim 23 further comprising register correction coils being
mounted in the vicinity of the neck and being dynamically controlled by the controller to shift
the beams.

20 25. The CRT of claim 24 further comprising multipole coils applied to the neck
and having adjacent poles of alternating polarity such that the resultant magnetic field being
dynamically controlled by the controller based on the magnetic field sensor signal moves
outer ones of the beams to correct the misconvergence caused by the register correction.

26. The CRT of claim 25 wherein the multipole coils are quadrupole coils, the quadrupole coils comprise a set of vertical quadrupole coils being oriented at 45° from the CRT axes such that the resultant magnetic field being dynamically controlled by the controller based on the magnetic field sensor signal moves outer ones of the beams vertically to correct the misconvergence.

27. The CRT of claim 26 wherein the quadrupole coils further comprise a set of horizontal quadrupole coils being oriented on the CRT axes such that the resultant magnetic field being dynamically controlled by the controller based on the magnetic field sensor signal moves outer ones of the beams horizontally to correct the misconvergence.

28. The CRT of claim 27 wherein the yoke has windings configured to apply a horizontal deflection yoke field and a vertical deflection yoke field to the beams, and the horizontal deflection yoke field is substantially barrel shaped and the vertical deflection yoke field is substantially pincushion shaped.

29. The CRT of claim 22 wherein the electron gun has electrostatic astigmatism correction.

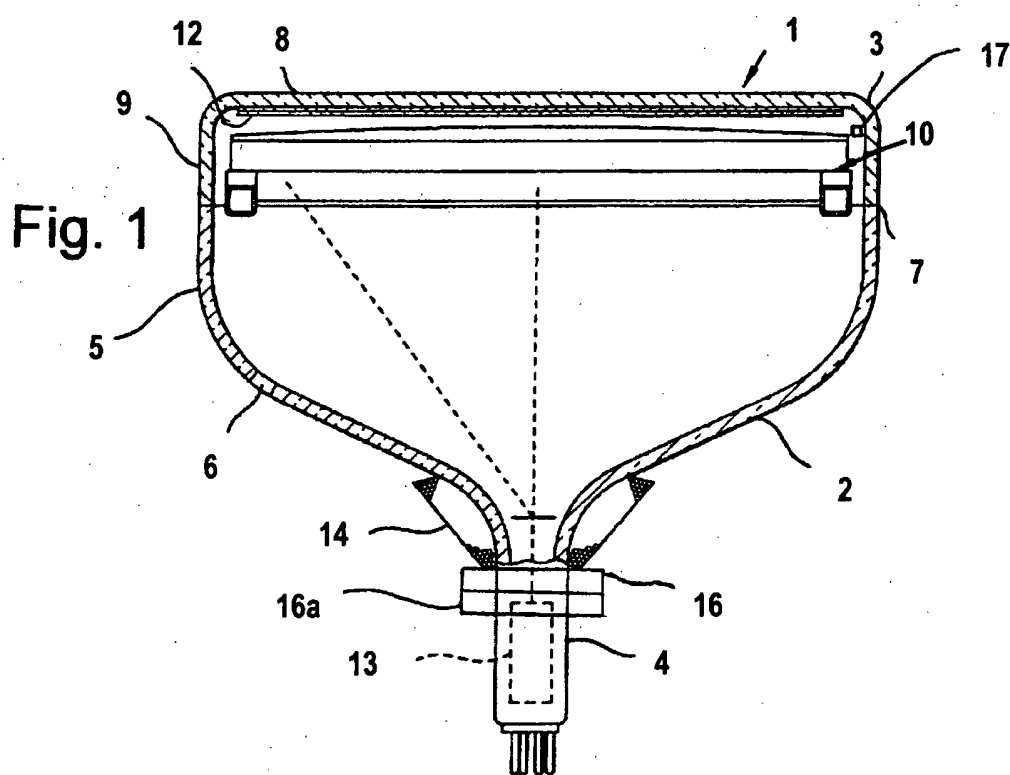
30. The CRT of claim 29 wherein the quadrupole coils are located in the vicinity of a dynamic astigmatism point of the electron gun such that adjustment of an electrostatic astigmatism voltage has no affect on spot shape.

31. The CRT of claim 27 wherein the quadrupole coils and register correction coils are dynamically controlled by the controller to maintain simultaneous purity and convergence.

5 32. The CRT of claim 31 wherein the controller further comprises a register driver, a horizontal convergence driver and a vertical convergence driver.

33. The CRT of claim 32 wherein the register driver is coupled to the register correction coils, the horizontal convergence driver is coupled to the horizontal quadrupole
10 coils and the vertical convergence driver is coupled to the vertical quadrupole coils.

34. The CRT of claim 22 wherein the electron gun comprises three guns being vertically oriented.



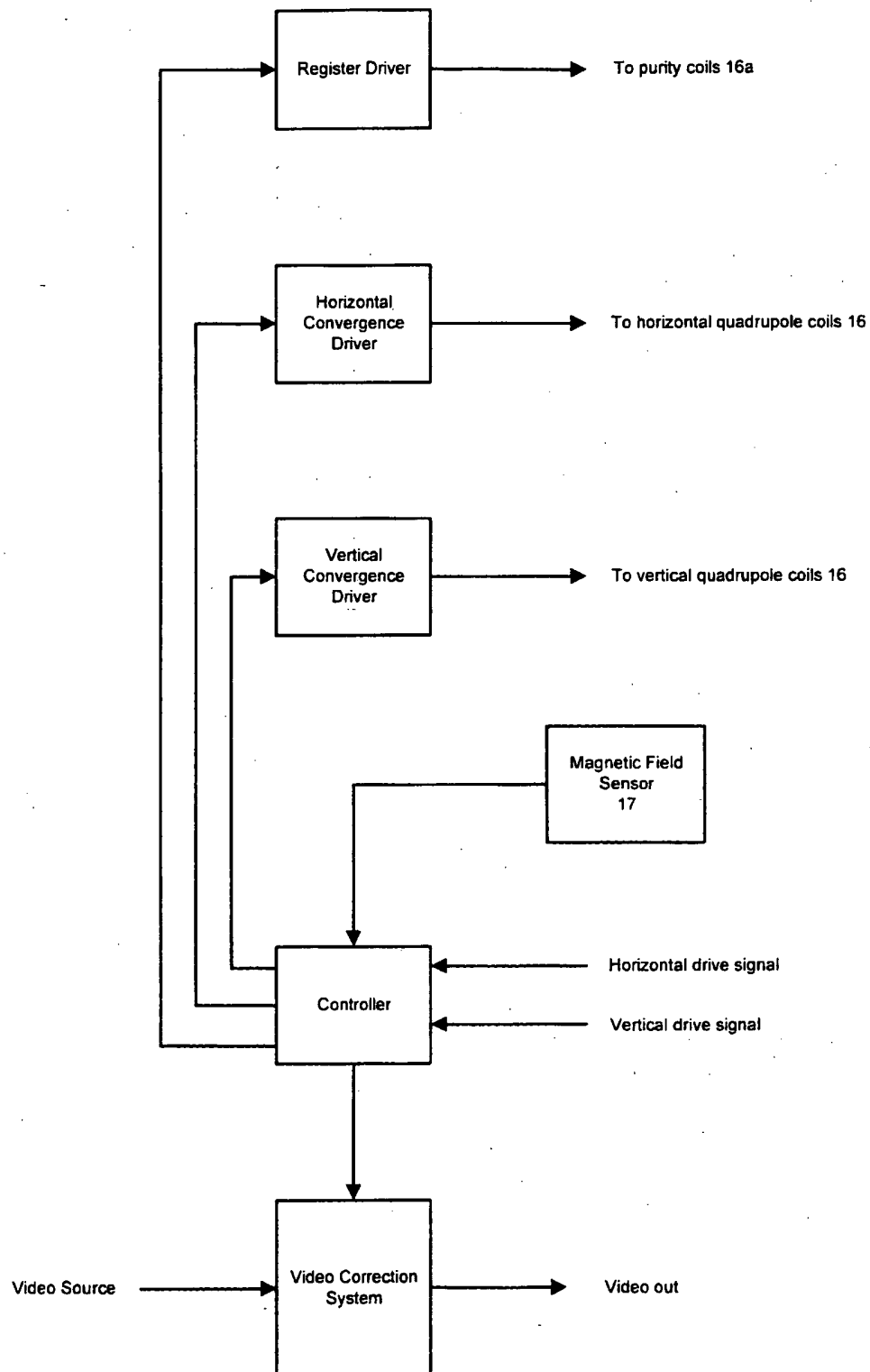


Fig. 2

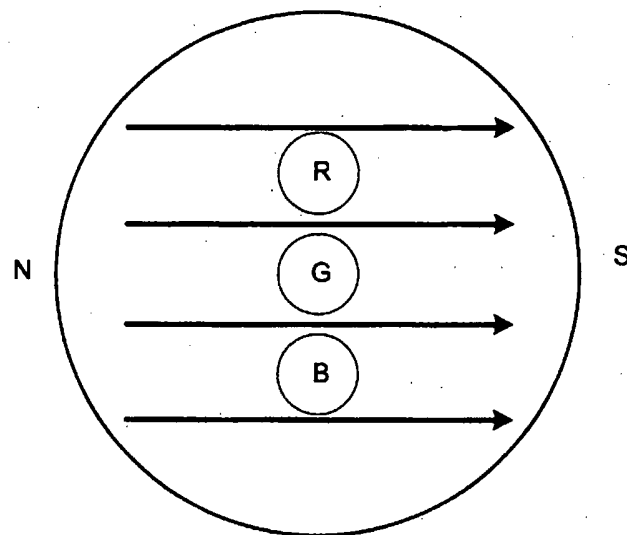


Fig. 3

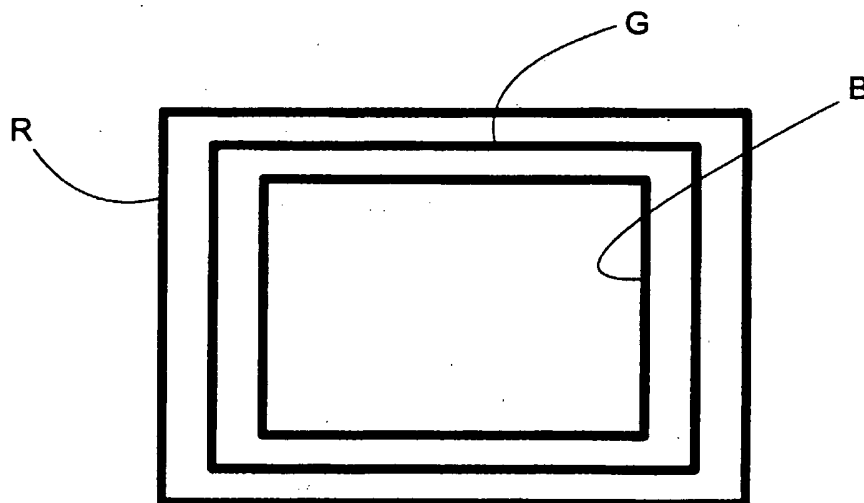


Fig. 4

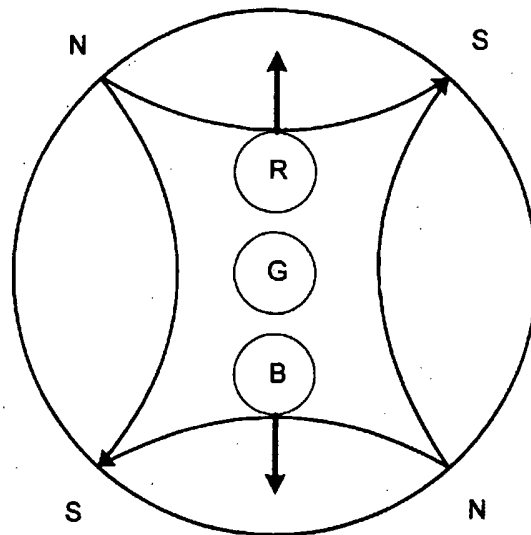


Fig. 5

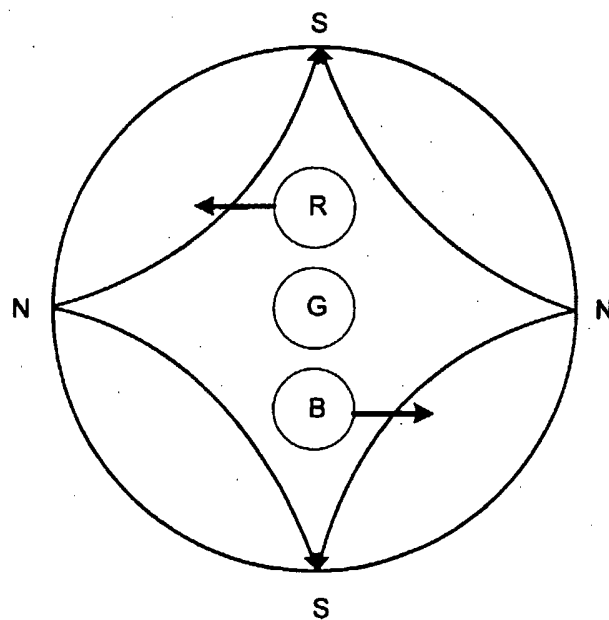


Fig. 6

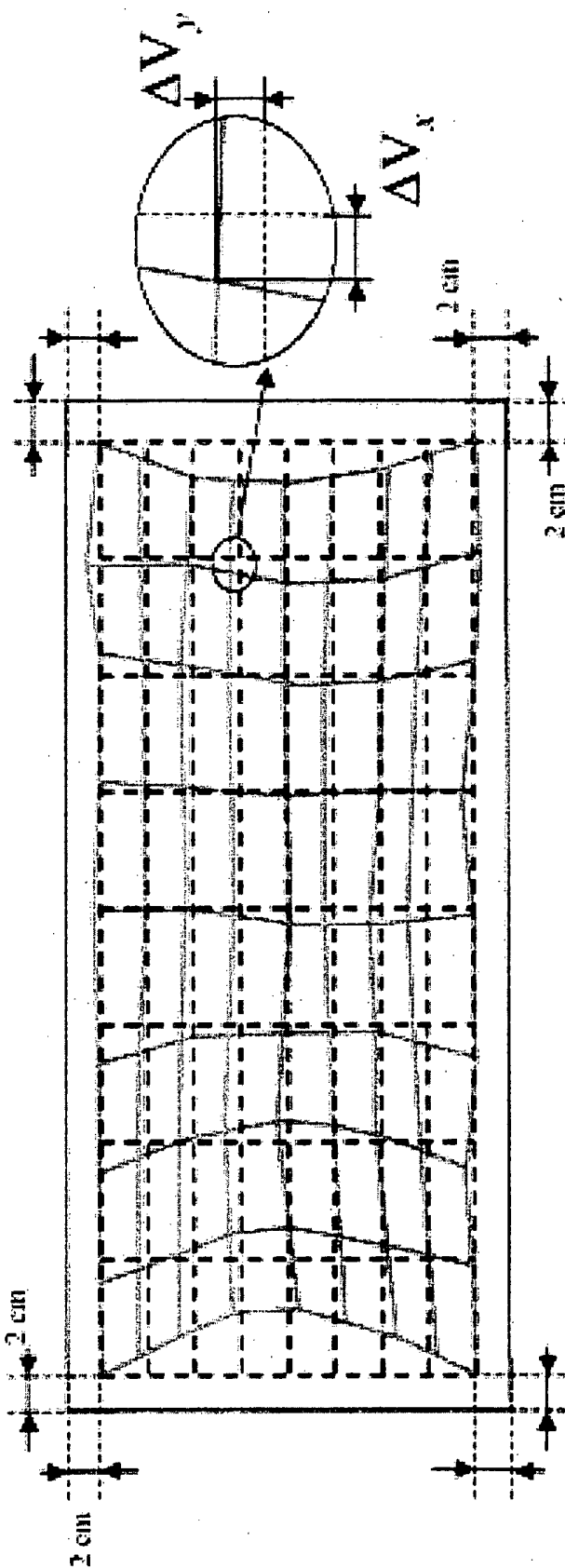


Fig. 7

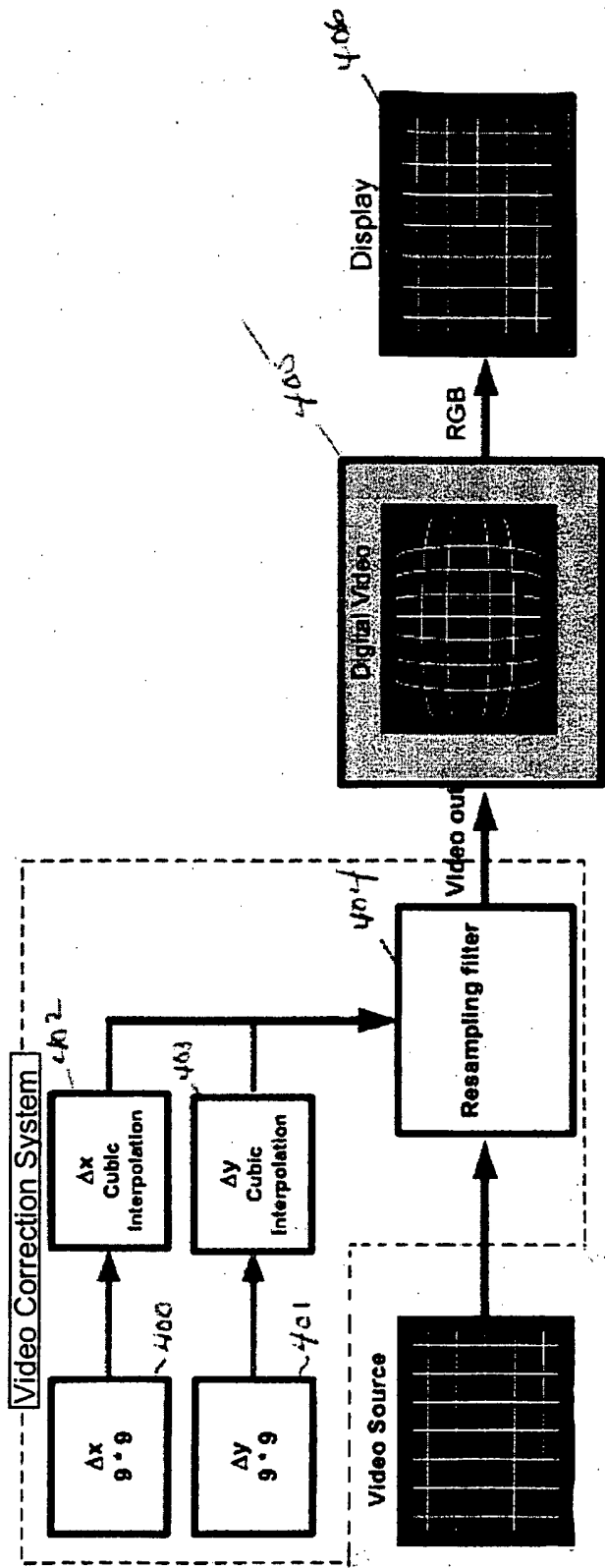


Fig. 8

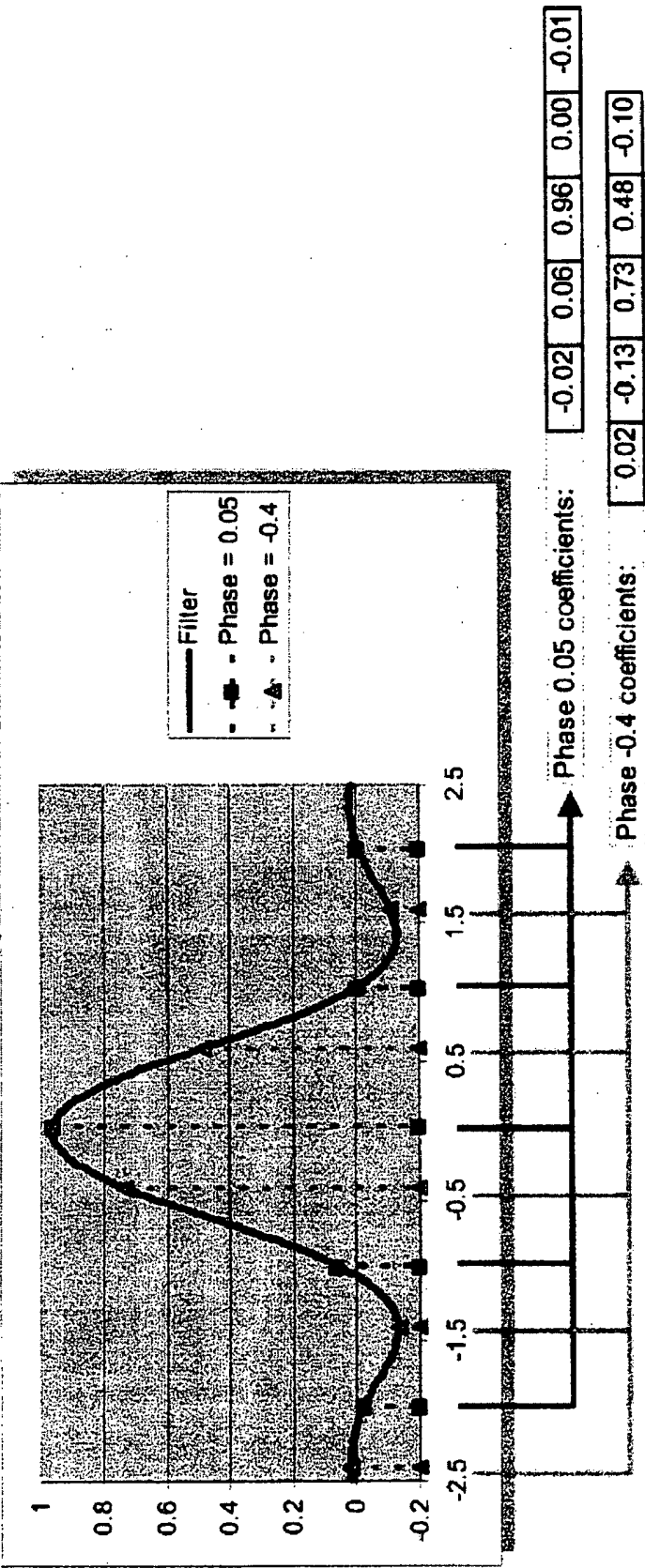


Fig. 9

INTERNATIONAL SEARCH REPORT

Intern~~ation~~al Application No

PCT/US2005/014755

A. CLASSIFICATION OF SUBJECT MATTER

IPC 7 H01J29/00 H04N9/29 H01J29/70

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 7 H01J H04N

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

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X	GB 2 344 984 A (* MITSUBISHI DENKI KABUSHIKI KAISHA) 21 June 2000 (2000-06-21) abstract page 2, line 21 - page 4, line 6 page 8, line 20 - page 10, line 9 page 17, lines 11-20 page 18, line 6 - page 27, line 19	1, 2, 11, 22-25, 34
A	----- -/--	3-5, 7-10, 12-20, 26-28, 30-33



Further documents are listed in the continuation of box C.



Patent family members are listed in annex.

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Date of the actual completion of the international search

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Date of mailing of the international search report

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PCT/US2005/014755

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