

## Description

The invention relates to a deflection yoke corrector that provides raster coma error correction.

### Background of Invention

In deflection yokes for cathode ray tubes (CRT) having three horizontal in-line electron beams R, G and B, the red, green and blue beams are required to substantially converge on the CRT display screen. A deflection yoke which does not require dynamic convergence circuitry is referred to as a self-converging yoke. That which requires dynamic convergence circuitry is referred to as a non-self-converging yoke. A self-converging yoke is constructed so that the horizontal deflection coil generates an overall pincushion type deflection magnetic field and the vertical deflection coil generates an overall barrel type deflection magnetic field. A non-self-converging yoke is used for improving, for example, beam focus, trilemma, raster distortion and vertical convergence coma (vcoma).

Vcoma occurs because of a nonuniformity of the vertical deflection field. For example, when a barrel type vertical deflection magnetic field is utilized, the strength of the magnetic field through which the green beam is deflected may be weaker than that through which each of the blue and red beams is deflected. The result is a misconvergence in the vertical direction of the center green beam with respect to the outer red and blue beams. This type of misconvergence is known as vcoma.

An example of a vcoma correction arrangement is described in US-A-4,357,556, entitled TELEVISION DISPLAY SYSTEM EMPLOYING PERMEABLE CORRECTORS FOR A DEFLECTION YOKE, in the name of Burke. There, a correction apparatus for a deflection yoke for use with a color television kinescope includes a plurality of magnetically permeable rods disposed at the rear of the yoke. Each of the rods comprises a short portion disposed parallel to the neck of the kinescope and an elongated portion disposed perpendicular to the neck of the kinescope. The elongated portions of the rods are positioned within the external field of the vertical deflection coils. Flux from the external field is channeled into the rods to form a magnetic field between the short portions of corresponding members on opposite sides of the tube neck to provide vertical coma correction.

Another example of a vcoma correction arrangement is described in US-A-4,357,586, entitled COLOR TV DISPLAY SYSTEM, in the names of Barkow et al., (the Barkow et al., patent) in which an external stray flux is collected from a vertical deflection coil. That flux is channelled by a pair of field formers to the rear of the yoke. That flux forms a localized pincushion-shaped field in the path of the three beams for correcting coma errors that are introduced by the de-

flection field of the deflection coil. Each of the field formers is made of a magnetically permeable material and has a U-shaped form that includes a pair of parallel arms and a cross arm connecting them. Disadvantageously, the cross arm might affect North/South pincushion distortion correction and the stored energy at the horizontal frequency.

US-A-4307363 (RCA) discloses a magnetically permeable assembly for a deflection yoke. The assembly gathers stray vertical deflection fields from the outside of the deflection widening and channels them to the rear of the yoke in a manner to produce a pincushion shaped field, in order to correct coma error. In order to compensate for the addition of a pincushion field, the assembly also forms a barrel field in the vicinity of the exit of the electron gun. Because the assembly uses a crossarm structure, it has the same disadvantages as the arrangement of US-A-4357586. That is, the crossarm might adversely affect north-south pincushion distortion correction and distort energy at the horizontal deflection frequency.

A type of horizontal misconvergence that may require dynamic convergence occurs when a vertical line that is formed by the three beams produces a misconvergence in the horizontal direction of the red and blue beams, at the upper and lower end parts in the Y axis direction of the screen of the CRT.

US-A-4,547,707 entitled DEFLECTION YOKE APPARATUS in the name of Yabase (the Yabase patent) describes a dynamic convergence arrangement. In the Yabase patent, a rectified current having a parabolic waveform is coupled to a pair of correction coils. The correction coils are wound around U-shaped magnetic cores. The magnetic cores form a magnetic quadrupole that provides dynamic convergence.

In a television display apparatus embodying the invention, a cathode ray tube is used for producing three in-line electron beams that travel through a neck of said cathode ray tube. A deflection yoke includes a horizontal deflection winding, a vertical deflection winding and a magnetically permeable core encircling a longitudinal axis of the neck. The deflection yoke has a beam entrance region and a beam exit region. The deflection yoke produces a main magnetic flux inside the neck of the cathode ray tube that deflects the electron beams. A magnetically permeable assembly of a plurality of magnetically permeable field formers is disposed around the neck in the vicinity of said beam entrance region. The magnetically permeable assembly is used for collecting stray magnetic field flux produced by the deflection yoke and for producing, from the collected flux, a pincushion-shaped first correction magnetic field inside the neck, in the beam entrance region between corresponding ones of the field formers, that corrects vertical coma convergence error. A correction coil arrangement magnetically coupled to the magnetically permeable

assembly, and responsive to a deflection synchronized current, produces a second correction magnetic field inside the neck, in the beam entrance region between corresponding ones of the field former region, that dynamically corrects horizontal convergence error.

In the Drawing:

FIGURE 1 illustrates a rear view of a deflection yoke that includes a coma tab assembly that is mounted on a neck of a CRT;

FIGURE 2 illustrates the tab assembly of FIGURE 1 without showing the deflection yoke;

FIGURE 3 illustrates a tab assembly, embodying the invention, that can provide dynamic convergence; and

FIGURE 4 illustrates a type of misconvergence that is corrected by the arrangement of FIGURE 3.

#### Detailed Description

FIGURE 1 illustrates a rear view of a deflection yoke 10 that includes a coma tab assembly 110. Yoke 10 is mounted on a neck of a cathode ray tube (CRT) 100 that is received in a cavity 200 in yoke 10. CRT 100 includes three horizontal in-line electron beam guns that produce three electron beams. Yoke 10 includes, for example, a saddle coil 10a that provides horizontal deflection and, for example, a toroidal coil 10b that provides vertical deflection. Toroidal coil 10b is wound on a core 150 having an internal surface of revolution that surrounds the neck of CRT 100 and an external surface of revolution on which a portion of coil 10b, that is visible in FIGURE 1, is wound. Core 150 also surrounds coil 10a. Coil 10b is configured to produce an overall barrel-shaped main magnetic field flux in the neck portion of CRT 100.

A longitudinal axis Z of CRT 100, shown in FIGURE 1, indicates a direction that is orthogonal to a display screen of CRT 100. An axis X indicates a horizontal deflection direction and an axis Y indicates a vertical deflection direction.

FIGURE 2 illustrates a view of tab assembly 110 when it is removed from yoke 10 of FIGURE 1. Tab assembly 110 of FIGURE 2 is shown, by itself, as it is seen from the rear side of CRT 100 of FIGURE 1, when yoke 10 is mounted on CRT 100. For simplification purposes, the other parts of deflection yoke 10 are not shown in FIGURE 2. Similar symbols and numerals in FIGURES 1 and 2 indicate similar items or functions.

Coma tab assembly 110 of FIGURE 1 includes four magnetically separated field formers or tabs 110a, 110b, 110c and 110d. Each of the tabs is made of a magnetically permeable strip or plate of metal such as silicon steel having a thickness of, for example, 0.01 inch (0.3 mm). Each plate is bent to form an angle. Each bent plate that forms the corresponding

tab includes a pole piece and an arm piece that are, for example, perpendicular to each other.

Tab 110a, for example, includes a pole piece 120a and an arm piece 130a that are disposed in perpendicular planes. Pole piece 120a extends, in the direction of its length dimension  $120_{al}$  (Fig. 1), in the direction of axis Z; whereas, arm piece 130a of FIGURE 2 extends, in the direction of its length dimension  $130_{al}$ , in the direction of axis X. Length dimension  $130_{al}$  and a width dimension  $130_{aw}$  of arm piece 130a are located in the X-Y plane defined by axes X and Y. Whereas, length dimension  $120_{al}$ , and width dimension  $120_{aw}$  (Fig. 1) of pole piece 120a are located in a plane that is perpendicular to the X-Y plane and that is inclined by approximately  $45^\circ$  relative to each of the X-Z and Y-Z planes, as shown in FIGURE 2.

Tabs 110a and 110b are disposed symmetrically relative to axis Y. Tabs 110c and 110d are disposed symmetrically relative to axis Y. Tabs 110a and 110d are disposed symmetrically relative to axis X. Tabs 110b and 110c are disposed symmetrically relative to axis X.

In operation, each of arm pieces 130a-130d, that are disposed outside yoke 10, collects a portion of the external stray magnetic flux generated by vertical deflection coil 10b of yoke 10. Arm pieces 130a-130d channel the corresponding collected stray magnetic flux to the rear of yoke 10 via corresponding pole pieces 120a-120d. Without the external flux channeling operation of arm pieces 130a-130d, the stray magnetic field flux would have formed a closed loop magnetic path that does not include the neck portion of CRT 100. The stray magnetic field flux is produced outside deflection yoke 10 in such a way that core 150 separates the stray magnetic field flux from cavity 200 formed by deflection yoke 10 through which the neck portion of CRT 100 is received. The length dimension  $130_{al}$  of arm 130a, for example, is determined by taking into consideration the amount of flux that is required to be collected to achieve the required vcoma correction.

Each of pole pieces 120a-120d is disposed in the vicinity of the electron beam entrance region of yoke 10. Consequently, a pincushion-shaped magnetic field is produced that includes a magnetic field portion  $P_1$ , between pole pieces 120a and 120b, and a magnetic field portion  $P_2$ , between pole pieces 120d and 120c. Field portions  $P_1$  and  $P_2$  that are shown in dashed lines are produced within the neck of CRT 100.

The pincushion field provides a field nonuniformity suitable for electron beam error correction, such as vcoma correction, since the vertical component of each of field portions  $P_1$  and  $P_2$  is stronger in the vicinity of electron beam G than in the vicinity of each of electron beams R and B. The pincushion field is desirably located at the vcoma sensitive electron beam entrance region of deflection yoke 10, as explained in

detail in the Barkow et al., patent mentioned above.

Each of the four tabs that channels the stray magnetic field flux to the entrance portion of yoke 10 is magnetically separated from each of the other ones. Thus, none of the four tabs 110a-110d is connected to any of the other tabs by a magnetically permeable material. By being so magnetically separated, the tabs do not appreciably disturb, for example, North/South pincushion distortion correction and the energy stored in yoke 10 at the horizontal rate. Thus, such parameters of yoke 10 advantageously remain unaffected. In this way, the design of yoke 10 can be optimized for obtaining the required yoke parameters without being compromised by effects of tab assembly 110.

The width of each plate that forms the corresponding one of pole pieces 120a-120d and arm pieces 130a-130d is substantially larger than its thickness. Such relative dimensions facilitate producing the required pincushion-shaped magnetic field. Such relative dimensions also make tabs 110a-110d easier to attach to CRT 100 and provide mechanical rigidity. Because of the mechanical rigidity of the plates that form tabs 110a-110d, tabs 110a-110d can withstand vibrations and inadvertently applied forces that would otherwise cause deformation in tabs 110a-110b.

FIGURE 3 illustrates a view of a tab assembly 110', embodying the invention. The arrangement of FIGURE 3 is similar to that of FIGURE 2 except for the addition of coil windings 140a, 140b, 140c and 140d that are wound on arm pieces 130a', 130b', 130c' and 130d', respectively. A numeral or symbol that is identical or that differs in FIGURE 3 from that in FIGURE 2 only by the prime symbol (') indicates a similar item or function in both FIGURES 2 and 3.

Coil windings 140a-140d are coupled in series and driven by a source 205 of a deflection synchronized, current  $I_p$ , that is, for example, parabolic at a vertical rate and that provides dynamic convergence. The design of current source 205 is conventional and well-known in the art.

FIGURE 4 illustrates the effect of an electron beam landing error such as a horizontal misconvergence that can be eliminated by the arrangement of FIGURE 3. As shown in FIGURE 3, a correction magnetic flux 20 generated from magnetic pole piece 120b converges, in the horizontal direction, the red electron beam R onto the green electron beam G. Similarly, a magnetic flux 21 from magnetic pole piece 120a converges the blue electron beam B onto the green electron beam G. Magnetic fluxes 22 and 23 do not appreciably affect the convergence in the horizontal direction of the electron beams.

The misconvergence  $Y_H$  of FIGURE 4 becomes larger toward the upper and lower sides of the screen. Therefore, the magnitude of parabolic current  $I_p$  of FIGURE 3 is made larger at the beginning and at the end of vertical trace than at the center. Correction

current  $I_p$  becomes approximately zero at the center of vertical trace. Thus, the misconvergence  $Y_H$  of FIGURE 4 is corrected over the full range of the screen to obtain a satisfactory convergence. Advantageously, tabs 110a'-110d' provide both vcoma correction and dynamic convergence.

## Claims

1. A television display apparatus, comprising:
  - a cathode ray tube (100) for producing three in-line electron beams that travel through a neck of said cathode ray tube;
  - a deflection yoke (10) including a horizontal deflection winding (10a), a vertical deflection winding (10b) and a magnetically permeable core (150) encircling a longitudinal axis (Z) of said neck, and having a beam entrance region and a beam exit region, said deflection yoke producing a main magnetic flux inside said neck of said cathode ray tube that deflects said electron beams; and
  - a magnetically permeable assembly (110') of a plurality of magnetically permeable field formers (110a'-d') disposed around said neck in the vicinity of said beam entrance region for collecting a stray magnetic field flux produced by said deflection yoke (10) and for producing from said collected flux a pincushion-shaped first correction magnetic field ( $P_1, P_2$ ) inside said neck, in said beam entrance region between corresponding ones of said field formers (110a'-d'), that corrects vertical coma convergence error; and characterized by
    - a correction coil arrangement (140a-d) magnetically coupled to said magnetically permeable assembly (110') and responsive to a deflection synchronized current ( $I_p$ ) for producing a second correction magnetic field (20-23) inside said neck, in said beam entrance region between corresponding ones of said field formers (110a-d) that dynamically corrects horizontal convergence error.
2. An apparatus according to Claim 1 characterized in that at least one of said field formers (110a'-d') includes a pole piece (120a'-d') that form a plate having a longitudinal axis that is in a direction perpendicular to a display screen of said cathode ray tube (100) and an arm piece (130a'-d') forming a corresponding plate that has a longitudinal axis forming an angle with said longitudinal axis of said pole piece (120a-d).
3. An apparatus according to Claim 2 characterized in that said longitudinal axes are substantially perpendicular.



detail in the Barkow et al., patent mentioned above.

Each of the four tabs that channels the stray magnetic field flux to the entrance portion of yoke 10 is magnetically separated from each of the other ones. Thus, none of the four tabs 110a-110d is connected to any of the other tabs by a magnetically permeable material. By being so magnetically separated, the tabs do not appreciably disturb, for example, North/South pincushion distortion correction and the energy stored in yoke 10 at the horizontal rate. Thus, such parameters of yoke 10 advantageously remain unaffected. In this way, the design of yoke 10 can be optimized for obtaining the required yoke parameters without being compromised by effects of tab assembly 110.

The width of each plate that forms the corresponding one of pole pieces 120a-120d and arm pieces 130a-130d is substantially larger than its thickness. Such relative dimensions facilitate producing the required pincushion-shaped magnetic field. Such relative dimensions also make tabs 110a-110d easier to attach to CRT 100 and provide mechanical rigidity. Because of the mechanical rigidity of the plates that form tabs 110a-110d, tabs 110a-110d can withstand vibrations and inadvertently applied forces that would otherwise cause deformation in tabs 110a-110b.

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  - a magnetically permeable assembly (110') of a plurality of magnetically permeable field formers (110a'-d') disposed around said neck in the vicinity of said beam entrance region for collecting a stray magnetic field flux produced by said deflection yoke (10) and for producing from said collected flux a pincushion-shaped first correction magnetic field ( $P_1, P_2$ ) inside said neck, in said beam entrance region between corresponding ones of said field formers (110a'-d'), that corrects vertical coma convergence error; and characterized by
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3. An apparatus according to Claim 2 characterized in that said longitudinal axes are substantially perpendicular.



4. An apparatus according to Claim 1 characterized in that said plurality of field formers (110a'-d') form four magnetic field poles.
5. An apparatus according to Claim 1 characterized in that each of said field formers (110a'-d') is magnetically separated from each of the other field formers.
6. An apparatus according to Claim 1 characterized in that said correction coil (140a-d) is wound on said field formers (120a'-d').
7. An apparatus according to Claim 1 characterized in that said deflection synchronized current ( $I_p$ ) comprises a vertical rate parabolic current.

2. Gerät nach Anspruch 1, dadurch gekennzeichnet, daß wenigstens einer der Feldformer (110a' bis d') einen Polteil (120a' bis d'), der eine Platte mit einer Längsachse bildet, die senkrecht zum Anzeigeschirm der Kathodenstrahlröhre (100) verläuft, und einen Armteil (130a' bis d') enthält, der eine entsprechende Platte bildet, deren Längsachse einen Winkel mit der Längsachse des Polteils (120a bis d) bildet.
3. Gerät nach Anspruch 2, dadurch gekennzeichnet, daß die Längsachsen im wesentlichen senkrecht zueinander verlaufen.
4. Gerät nach Anspruch 1, dadurch gekennzeichnet, daß die Mehrzahl von Feldformern (110a' bis d') vier Magnetfeld-Pole bilden.

### Patentansprüche

#### 1. Fernsehzeigegerät umfassend:

eine Kathodenstrahlröhre (100) zur Erzeugung von drei in Reihe liegenden Elektronenstrahlen, die durch den Hals der Kathodenstrahlröhre verlaufen;

ein Ablenkjoch (10), das eine Horizontal-Ablenkwicklung (10a), eine Vertikal-Ablenkwicklung (10b) und einen die Längsachse (Z) des Halses umgebenden magnetisch permeablen Kern (150) aufweist, das einen Strahl-Eingangsbereich und einen Strahl-Ausgangsbereich hat, und das innerhalb des Halses der Kathodenstrahlröhre einen magnetischen Haupt-Fluß erzeugt, der die Elektronenstrahlen ablenkt, und

eine magnetisch permeable Anordnung (110') aus einer Mehrzahl von magnetisch permeablen Feldformern (110a' bis d'), die um den Hals in der Nähe des Strahl-Eingangsbereiches angeordnet sind, um einen magnetischen Streufeldfluß zu sammeln, der von dem Ablenkjoch (10) erzeugt wird, und um aus dem gesammelten Fluß ein kissenförmiges erstes Korrektur-Magnetfeld ( $P_1$ ,  $P_2$ ) innerhalb des Halses in dem Strahl-Eingangsbereich zwischen entsprechenden Feldformern (110a' bis d') zu erzeugen, das den vertikalen Koma-Konvergenzfehler korrigiert; gekennzeichnet durch

eine Korrektur-Spulenordnung (140a bis d), die magnetisch mit der magnetisch permeablen Anordnung (110') gekoppelt ist, und die auf einen mit der Ablenkung synchronisierten Strom ( $I_p$ ) anspricht, um innerhalb des Halses in dem Strahl-Eingangsbereich zwischen entsprechenden Feldformern (110a bis d) ein zweites Korrektur-Magnetfeld (20 bis 23) zu erzeugen, das dynamisch den horizontalen Konvergenzfehler korrigiert.

5. Gerät nach Anspruch 1, dadurch gekennzeichnet, daß jeder Feldformer (110a' bis d') magnetisch von allen anderen Feldformern getrennt ist.
6. Gerät nach Anspruch 1, dadurch gekennzeichnet, daß die Korrektur-Spule (140a bis d) auf die Feldformer (120a' bis d') gewickelt ist.
7. Gerät nach Anspruch 1, dadurch gekennzeichnet, daß der mit der Ablenkung synchronisierte Strom ( $I_p$ ) ein vertikalfrequenter parabolischer Strom ist.

### Revendications

1. Dispositif d'affichage de télévision, comprenant :  
un tube à rayons cathodiques (100) destiné à produire trois faisceaux d'électrons en ligne qui se propagent à travers un col dudit tube à rayons cathodiques;

un collier de déviation (10) comprenant un enroulement de déviation horizontale (10a), un enroulement de déviation verticale (10b) et un noyau magnétiquement perméable (150) entourant un axe longitudinal (Z) dudit col et possédant une région d'entrée de faisceaux et une région de sortie de faisceaux, ledit collier de déviation produisant un flux magnétique principal à l'intérieur dudit col dudit tube à rayons cathodiques qui dévie lesdits faisceaux d'électrons ; et

un ensemble magnétiquement perméable (110') d'une pluralité de générateurs de champs magnétiquement perméables (110a'-d') disposés autour dudit col au voisinage de ladite région d'entrée de faisceaux pour collecter un flux de champ magnétique parasite produit par ledit collier de déviation (10) et pour produire à partir dudit flux collecté un premier champ magnétique de correction en forme de coussin ( $P_1$ ,  $P_2$ ) à l'inté-



rieur dudit col, dans ladite région d'entrée de faisceaux entre les générateurs correspondants parmi lesdits générateurs de champs (110a'-d') qui corrigent une erreur de convergence de coma vertical ; et

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caractérisé par

un agencement de bobines de correction (140a-d) couplées magnétiquement audit ensemble magnétiquement perméable (110') et sensible à un courant synchronisé de déviation ( $I_p$ ) pour produire un second champ magnétique de correction (20-23) à l'intérieur dudit col, dans ladite région d'entrée de faisceaux entre les générateurs correspondants parmi lesdits générateurs de champs (110a-d), qui corrige de façon dynamique une erreur de convergence horizontale.

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2. Dispositif selon la revendication 1, caractérisé en ce qu' au moins l'un desdits générateurs de champs (110a'-d') comprend une pièce polaire (120a'-d') qui forme une plaque ayant un axe longitudinal qui est dans une direction perpendiculaire à l'écran d'affichage dudit tube à rayons cathodiques 100 et une partie de bras (130a'-d') formant une plaque correspondante qui possède un axe longitudinal formant un angle avec ledit axe longitudinal de ladite pièce polaire (120a-d). 20
3. Dispositif selon la revendication 2, caractérisé en ce que lesdits axes longitudinaux sont sensiblement perpendiculaires . 25
4. Dispositif selon la revendication 1, caractérisé en ce que ladite pluralité de générateurs de champs (110a'-d') forme quatre pôles de champ magnétique. 30
5. Dispositif selon la revendication 1, caractérisé en ce que chacun desdits générateurs de champs (110a'-d') est séparé magnétiquement de chacun des autres générateurs de champs. 35
6. Dispositif selon la revendication 1, caractérisé en ce que ladite bobine de correction (140a-d) est enroulée sur lesdits générateurs de champs (120a'-d'). 40
7. Dispositif selon la revendication 1, caractérisé en ce que ledit courant synchronisé de déviation ( $I_p$ ) comprend un courant parabolique de fréquence verticale. 45

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