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Saruta

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[54] **IN-LINE GUN TYPE COLOR TELEVISION PICTURE TUBE APPARATUS**

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June 23, 1971 Japan 46-45429

[52] **U.S. Cl.** ..... **315/13 CG,** 315/13 C, 315/27 XY, 315/27 GD

[51] **Int. Cl.** **H01j 29/50**

[58] **Field of Search** ..... 315/13 C, 13 CG, 27 XY, 315/27 TD, 27 GD; 335/213; 313/68 A

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Primary Examiner—Leland A. Sebastian
Assistant Examiner—P. A. Nelson
Attorney, Agent, or Firm—Armstrong & Wegner

[57] **ABSTRACT**

An in-line gun type color television picture tube apparatus in which electron beam spots are converged at any point on the screen by a convergence magnetic field in order to symmetrically shift the electron beams from the electron guns at both sides out of three electron guns, which are provided in one line of the in-line electron gun type color cathode-ray tube, in reference to the electron beam from the center electron gun.

17 Claims, 13 Drawing Figures

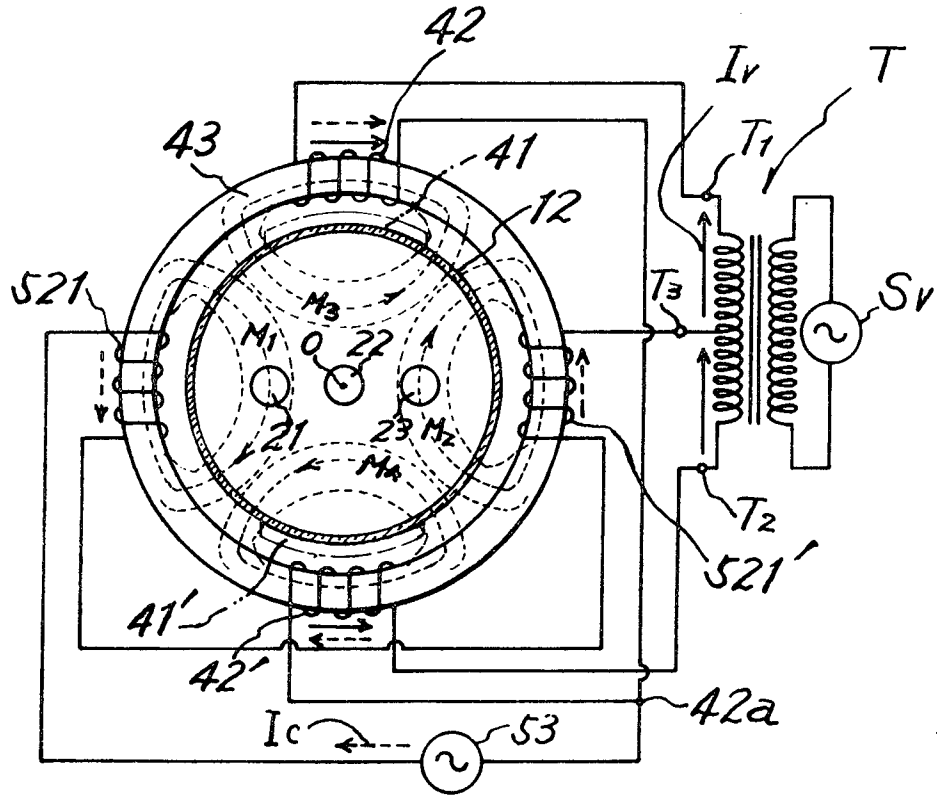


FIG 1

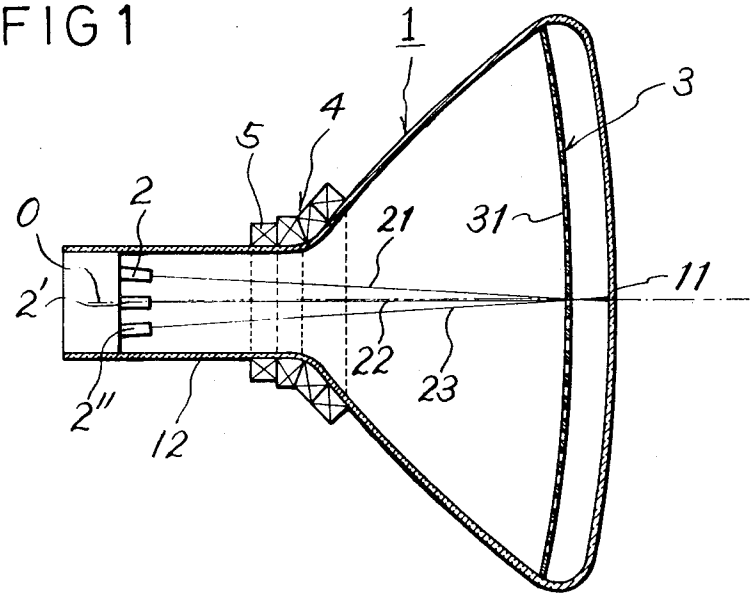


FIG 2

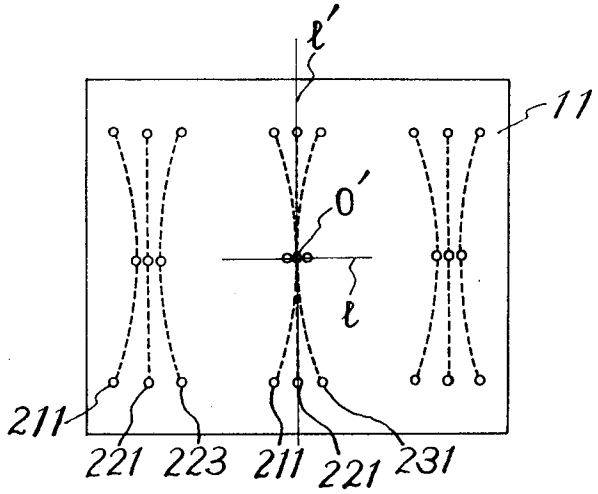


FIG 3

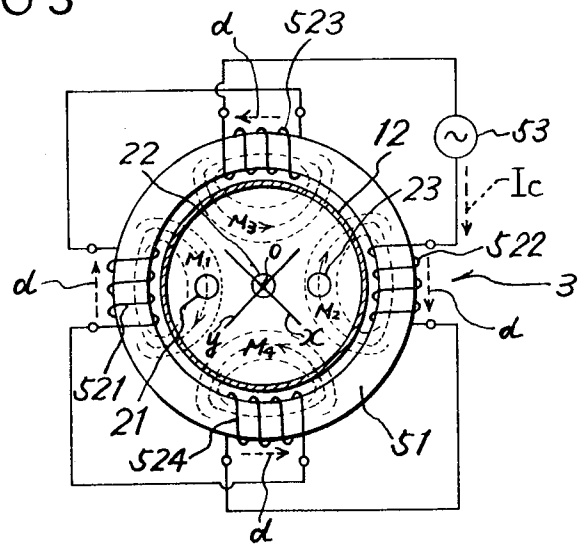


FIG 4

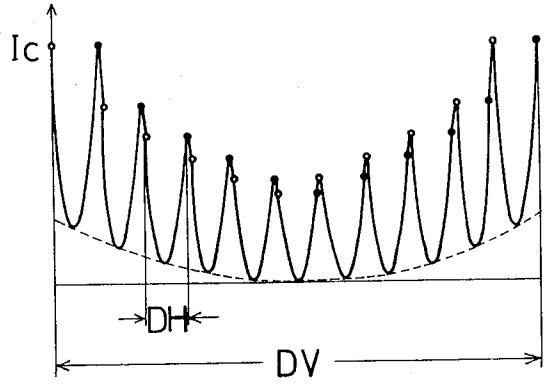


FIG 5a

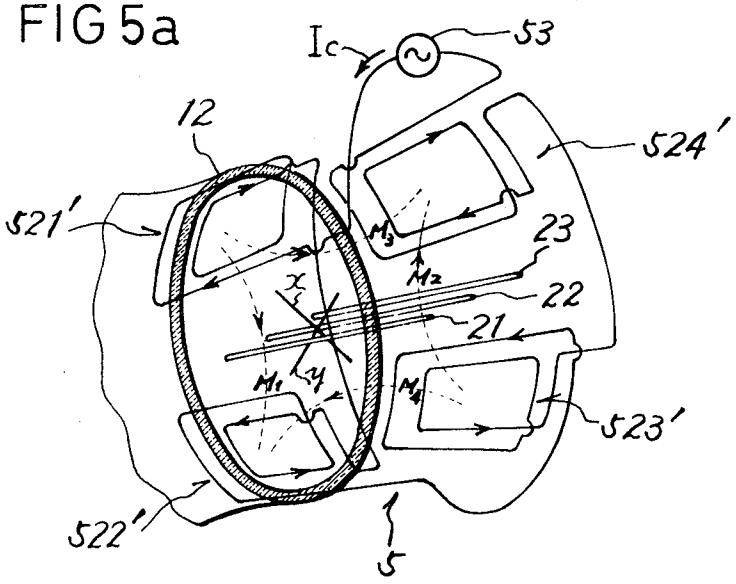


FIG 5b

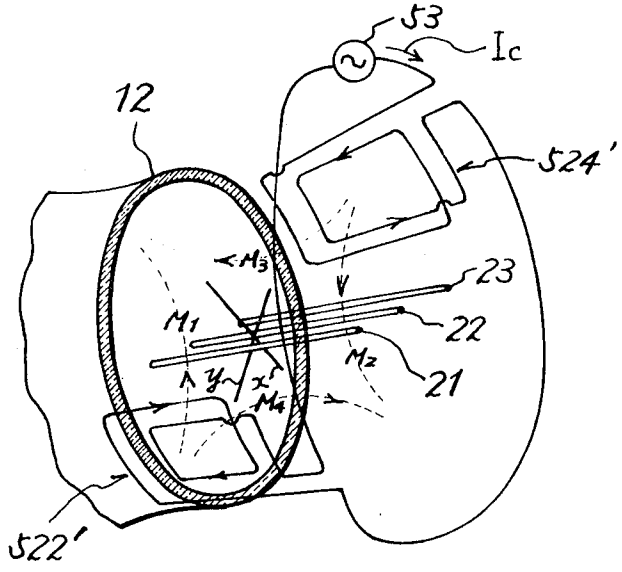


FIG 5c

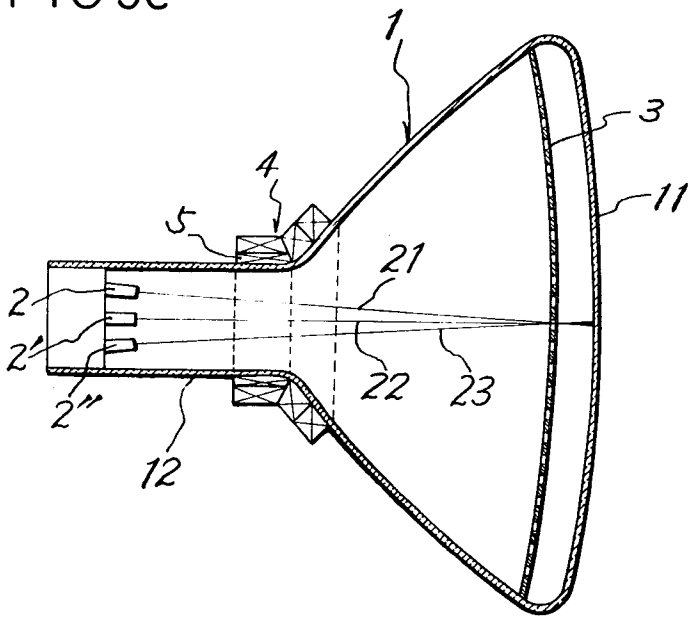

1
3
11
4
5
21
2
2'
2''
22
23
12

FIG 6a

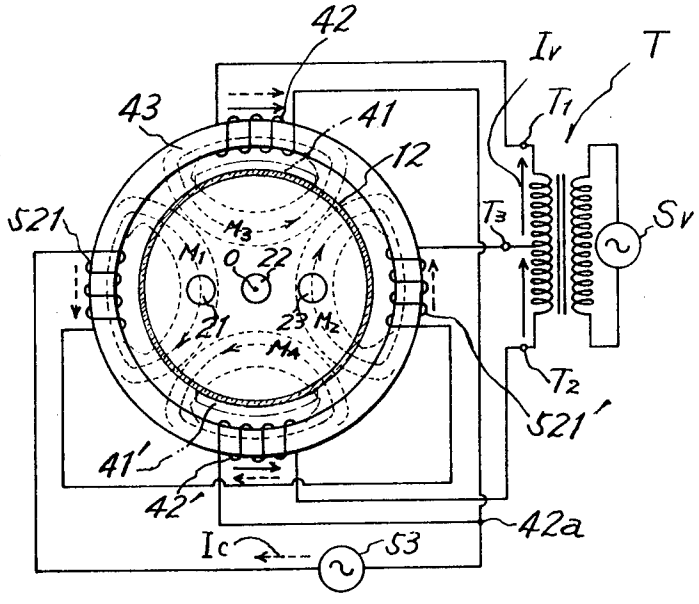

42
Iv
T
T1
43
41
12
S21
T3
Sv
M3
M1
0
22
1
21
23
M2
M4
T2
S21'
41'
42'
42a
Ic
S3

FIG 6b

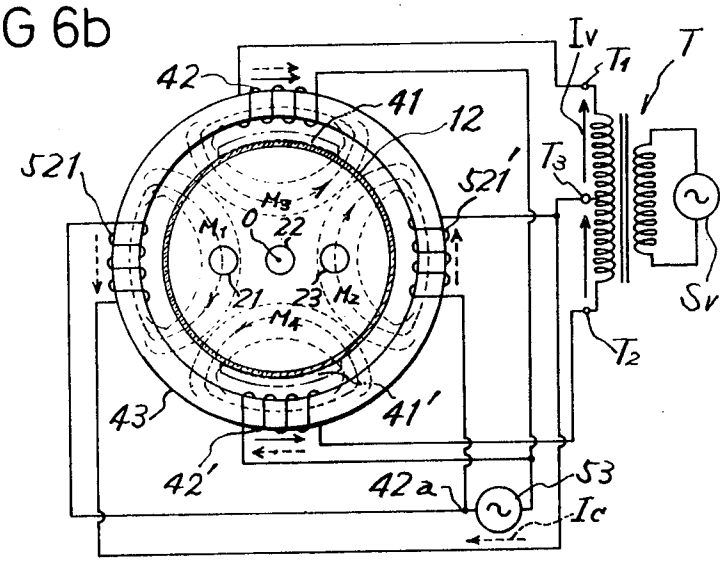

Iv
T1
T
42
41
12
521
521'
T3
M3
M1
0
22
21
23
M2
M4
Sv
T2
43
41'
42'
42a
53
Ic

FIG 6c

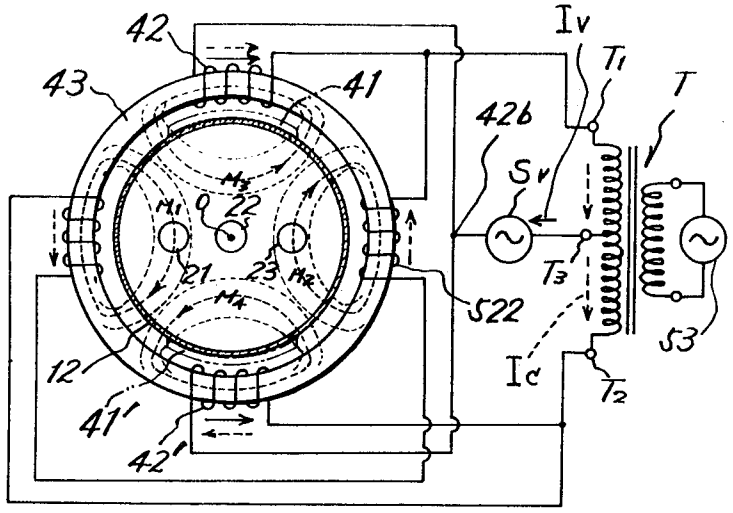
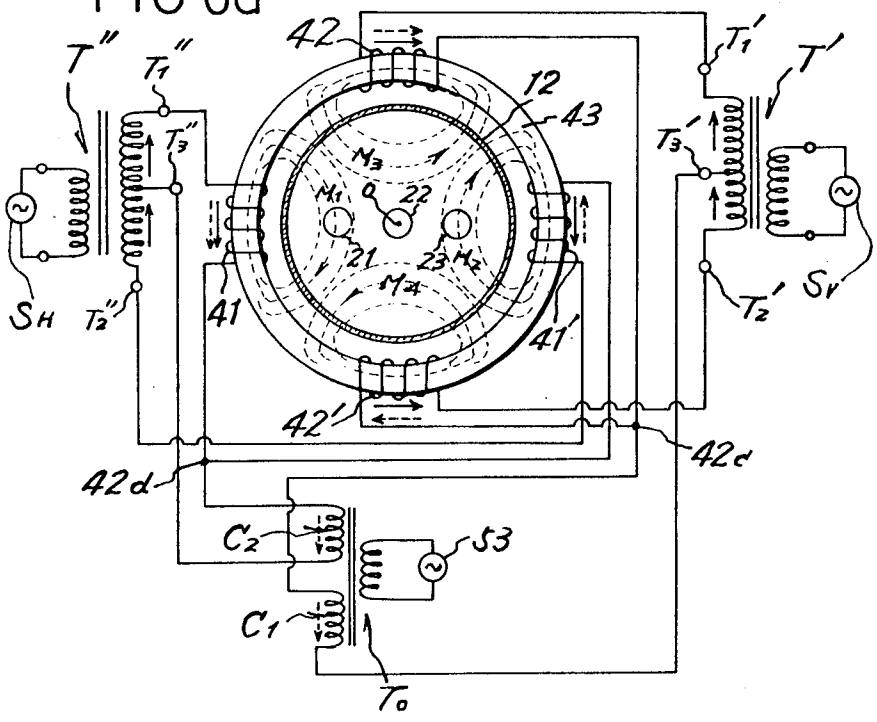

42
Iv
T1
43
41
T
426
Sv
M3
M1
0
22
21
23
M2
M4
T3
522
53
12
Ic
T2
41'
42'

FIG 6d


T''
T1''
T3''
T2''
SH
42
12
43
M3
M1
0
22
21
23
M2
M4
41
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T'
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42d
42c
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S3
C1
T0

FIG 6e

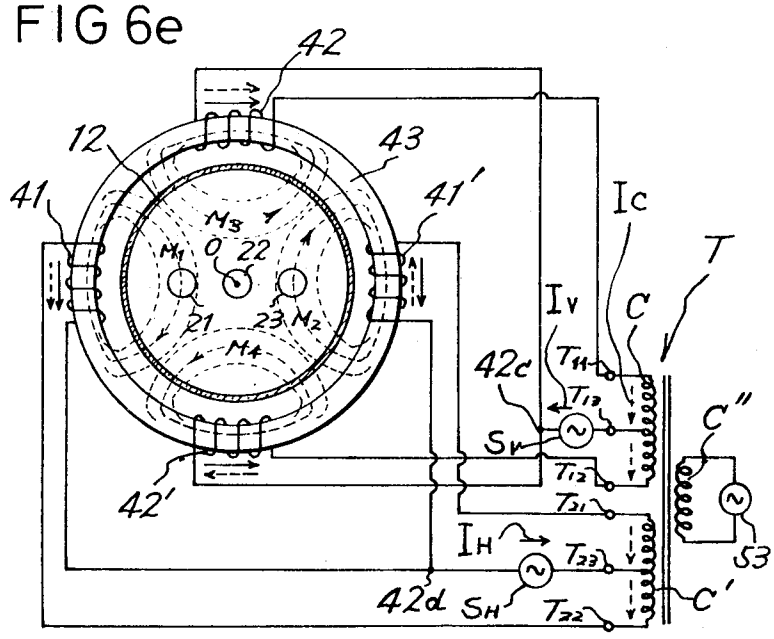
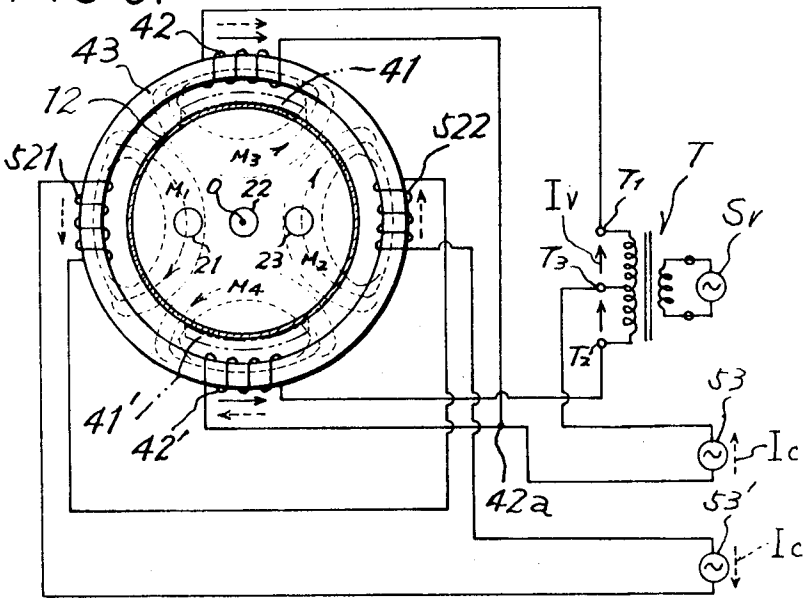

42
12
43
41
41'
M3
M1
0
22
21
23
M2
M4
42'
Ic
T
Iv
C
42c
T11
T13
SV
C''
T12
T31
IH
T33
S3
42d
SH
T22
C'

FIG 6f


42
43
41
12
S22
S21
M3
M1
22
M2
21
23
M4
41'
42'
42a
T
T1
T3
T2
Iv
Sv
53
Ic
53'
Ic

IN-LINE GUN TYPE COLOR TELEVISION PICTURE TUBE APPARATUS

BACKGROUND OF THE INVENTION

The present invention relates to an in-line gun type color television picture tube apparatus in which three electron guns are arranged in one line.

For obtaining high quality image on the screen of this type of the cathode-ray tube, three electron beams are preferred to reach a group of fluorescent materials at any position where electron beams are extemely close each other on the screen when the electron beams hit on three colors of fluorescent materials which are painted in dots or lines. Therefore, an aperture frame having dot-type or slit-type openings such as, for example, a shadow mask or aperture grill is provided between the screen and electron guns and electron beams are preferred to be converged at each opening with specified angles.

In case of a wide angle deflection cathode-ray tube of which the screen is almost flat, the distance between the screen and the electron guns differs with the deflection angle, that is, the greater the deflection angle is, the longer the distance.

Accordingly, even though the electron guns are arranged so that the electron beams are converged at the center of the screen (the electron beams are actually converged at the openings of the aperture frame; however, the aperture frame is positioned close and parallel to the screen and therefore the electron beams are described as being "converged at the screen" for convenience), the electron beams are diverged at a portion where the deflection angle is large, that is, a peripheral portion of the screen. For this reason, the convergence operation to converge electron beams in accordance with the deflection angle, that is, the so-called dynamic convergence operation is performed.

Conventionally, convergence has been performed in such the manner that electrodes are provided in the cathode-ray tube, a converging device is provided outside the cathode-ray tube corresponding to the electrodes and relative angles of the electron beams are controlled at the position before the electron beams are deflected. Accordingly, the conventional type cathode-ray tube is disadvantageous because it has been complicated in its construction and the convergence device has employed a complex-shaped yoke corresponding to the electrodes in the cathode-ray tube.

The present invention provides a cathode-ray tube which requires no electrode for convergence in the cathode-ray tube and is capable of specifically converging the electron beams through an extremely simple construction.

SUMMARY

An in-line gun type color television picture tube apparatus comprising an in-line gun type color cathode-ray tube in which the spots on the screen of electron beams from free electron guns provided in one line are aligned on the same line and are converged at the center of the screen, a deflection yoke which deflects and scans the electron beams so that both side spots appear on the screen with equal distance symmetrically at both sides of the center spot when three electron beams are not converged, and a convergence magnetic field generating means which forms a convergence magnetic field having a field distribution linear-symmetrical in reference to two axes, as the reference line, which are biased respectively by 45° from the direction of three electron guns aligned in one line and the direction intersecting at a right angle to said direction of the electron guns in reference to the axis of the cathode-ray tube by, for example, providing the windings at specified positions on the core of said deflection yoke and supplying the convergence current to said windings, wherein both side electron beams are symmetrically shifted in reference to the center electron beam in accordance with the deflection angle, in order to complete convergence of the beam spot trio through said convergence magnetic field.

BRIEF DESCRIPTION OF THE DRAWINGS

The present invention is illustrated in detail at the accompanying drawings whereon:

FIG. **1** is a cross sectional plan view illustrating an embodiment of a convergence magnetic field generating means of the apparatus according to the present invention,

FIG. **2** is a front view of a screen illustrating the position of the beam spot trio,

FIG. **3** is a longitudinal sectional view of a cathode-ray tube illustrating an embodiment of a convergence magnetic field generating means of the apparatus according to the present invention,

FIG. **4** is an example of the convergence current supplied to said convergence magnetic field generating means,

FIGS. **5***a*, **5***b* and **5***c* are respectively an embodiment of the convergence magnetic field generating means; FIGS. **5***a* and **5***b* are an isometric view of a partially magnified convergence winding, and FIG. **5***c* is a cross sectional plan view of the cathode-ray tube, and

FIGS. **6***a* to **6***f* are respectively a circuit diagram illustrating an embodiment of the convergence magnetic field generating means.

DETAILED DESCRIPTION

Referring to FIG. **1**, there is shown a rough construction of the apparatus according to the present invention.

Three electron guns **2**, **2'** and **2''** are arranged on one line in the rear end plane of neck **12** of cathode-ray tube **1** and aperture frame **3** such as, for example, a shadow mask or an aperture grill, having a plurality of openings **31** such as through holes or slits is provided near the screen between screen **11** and the electron beams.

Electron guns **2**, **2'** and **2''** are slanted so that electron beams **21**, **22** and **23** radiated from the electron guns intersect at one point in the opening through which center axis **0** of selection frame **3** passes.

Deflection yoke **4** is mounted at neck **12** of cathode-ray tube **1** and convergence coil **5** is provided at the rear end of the deflection coil which induces the convergence magnetic field.

In the above arrangement, cathode-ray tube **1** and electron guns **2**, **2'** and **2''** are known as the in-line type cathode-ray tube and therefore can be designed as desired as in case of conventionally known in-line type color television picture tubes.

In deflection yoke **4**, the electron beams are deflected in the electron gun aligning direction such as, for example, a horizontal direction and a direction at a right angle to said direction such as, for example, a

vertical direction. In this case, deflection in the horizontal direction is performed in a far shorter cycle than that in the vertical direction to form a raster on the screen of the picture tube.

As described in Background of the Invention, the electron beams diverge depending on the deflection angle even though the electron beams are forced to concentrate at center **0'** on screen **11**. In the embodiment of the present invention, it can be understood that the electron beams are diverged on the screen in a relatively simple pattern depending on the deflection field of the deflection yoke and the curvature of the screen.

Referring to FIG. **2**, there is shown the characteristic of the electron beam spot trio appearing on screen **11** through the deflection yoke of the apparatus according to the present invention.

The beam spot trio is an assembly of spot **211** formed by electron beam **21** radiated onto, for example, a red fluorescent material, spot **221** formed by electron beam **22** radiated onto, for example, a blue fluorescent material and spot **231** formed by electron beam **23** radiated onto, for example, a green fluorescent material. In a special line containing center **0'** of the screen, that is, the special line such as, for example, horizontal line l which coincides with the direction in which electron beams **21, 22** and **23** are arranged, the electron beams are deflected so that the distance between the spots increases as the spots depart from a line intersecting at a right angle to said special line at center **0'** such as, for example, vertical line l'. In a direction parallel with vertical line l', the electron beams are deflected so that the distance between the spots increases as the spots depart from vertical line l'.

In other words, the electron beams are deflected in the deflection field so that the electron beams are symmetrically diverged in reference to horizontal line l and vertical line l'. Such the deflection field characteristic can be easily realized.

The convergence magnetic field which is the most important feature of the apparatus according to the present invention converges the electron beams which are diverged as described above.

Referring to FIG. **3**, there is shown an embodiment of convergence coil **5** of the apparatus according to the present invention.

Three electron beams **21, 22** and **23** are aligned on one line in neck **12** of cathode-ray tube **1** and core **51** consisting of a circular highly magnetic material is mounted on the periphery of neck **12**.

A pair of windings **521** and **522** are toroidally wound on core **51** at symmetrical positions in the same direction as said electron guns are aligned, and a pair of windings **523** and **524** are toroidally wound at symmetrical positions in the direction intersecting at a right angle to the same direction as the electron guns are aligned.

The windings are series-connected to power supply **53** which supplies convergence current I_C to said windings so that the magnetic fluxes from adjacent windings flow in opposite directions in the core. If the windings are wound on core **51** in the same direction, the windings are connected so that directions *d* of the currents in adjacent windings are opposite each other, and magnetic field M_1 from winding **521** shown in the figure, magnetic field M_2 from winding **522**, magnetic field M_3 from winding **523** and magnetic field M_4 from winding **524** are induced respectively.

Since the magnetic fields show a linear symmetrical distribution of the magnetic field in reference to two axes *x* and *y* shifted by 45 degrees from the electron gun aligning direction and the direction intersecting, at center axis **0** of cathode-ray tube **1**, at a right angle to the same direction as the electron guns are aligned, magnetic fields M_3 and M_4 do not affect the electron beams and magnetic fields M_1 and M_2 do not affect electron beam **23** at center axis **0** of cathode-ray tube **1**. Accordingly, the magnetic force affecting electron beams comes from only magnetic field M_1 affecting electron beam **21** and magnetic field M_2 affecting electron beam **23**. This magnetic force causes said electron beams to be symmetrically shifted in reference to center electron beam **22**.

As described in the foregoing, divergence of the electron beams appears markedly in the vertical direction and is symmetrical in reference to horizontal line containing center **0'** of the screen. Electron beams **21** and **23** at both sides of center electron beam **22** diverge in the horizontal direction and are symmetrical in vertical line l'. Accordingly, three beam spots **211, 221** and **231** can be converged at all positions on the screen by varying the magnetic fields in accordance with the deflection angles.

As shown in FIG. **4**, convergence current I_C superposed on a parabola type current of horizontal deflection cycle D_H and a parabola type current of vertical deflection cycle D_V can be supplied from power supply **53**. In FIG. **4**, a white round mark indicates the current value in the beginning of the horizontal deflection cycle and a black round mark indicates the current value at the end of the horizontal deflection cycle. The time between these timings is the flyback time. Convergence current I_C as shown in FIG. **4** has been applied to conventional televison picture tubes and therefore it can be employed as is.

It is known generally that the deviation of relative angles is minimum at the points which the electron beams reach when convergence is performed at the deflecting point for scanning electron beams.

Accordingly, the so-called "mislanding" that electron beams do not arrive properly at the centers of corresponding fluorescent materials even though convergence of the electron beams is satisfactorily performed is prone to occur when the deflection scanning positions of electron beams are different from the convergence positions.

If the coils of the deflection yoke are toroidally wound, a highly magnetic core is employed and therefore core **51** of the convergence coil and the core of the deflection yoke can be employed commonly. In other words, the windings of the convergence coil can be mounted on the core of the deflection yoke. Accordingly, the deflection center of the deflection yoke can be matched with the convergence position and thus mislanding can be minimized.

If one set of deflection coils, for example, the horizontal deflection coils are wound toroidally and the other set of deflection coils, for example, the vertical deflection coils are wound in the frame shape, a convergence coil is wound, around the core of the vertical deflection coil.

The windings of said convergence coil need not be toroidally wound and if they are wound in the frame

shape, the magnetic field as described above can be generated.

Referring to FIG. 5, there is shown an embodiment of the apparatus according to the present invention where the windings of the convergence coil are wound in the frame shape.

Four sets of frame-shaped windings 521', 522', 523' and 524' are provided at symmetrical positions in the direction at 45° to the direction in which electron guns 2, 2' and 2'' are aligned on the periphery of neck 12 of cathode-ray tube 1. And the cathode-ray tube is constructed so that magnetic field M_1 is induced between windings 521' and 522', magnetic field M_4 between windings 522' and 523', magnetic field M_2 between windings 523' and 524' and magnetic field M_3 between windings 524' and 521'. Magnetic fields in the cathode-ray tube is distributed so that the magnetic fields at mutually opposing positions has symmetricity as in the case of the embodiment shown in FIG. 3.

When the frame-shaped winding is employed, two pairs of windings need not be provided. For example, as shown in FIG. 5*b*, a pair of frame-shaped windings 522' and 524' can be arranged only at the position of axis y which deflects 45° in one direction from the direction from which electron beams 21, 22 and 23 are originated. The magnetic fields having a similar distribution to that in case that two pairs of windings are arranged because magnetic fluxes induced by both windings 522' and 524' repulse each other.

When convergence coil 5 is thus comprised of the frame-shaped winding, it can be provided inside deflection yoke 4, that is, between deflection yoke 4 and neck 12 of cathode-ray tube 1 as shown in FIG. 5*c*. In this arrangement, convergence can be performed at the deflection center of the deflection yoke.

At the position where the magnitude of deflection is large, electron beams 21, 22 and 23 may be affected by other convergence magnetic fields, not by the intrinsically corresponding magnetic field; for example, center electron beam 22 may deviate from center axis 0 and may be affected by either magnetic field M_1 or M_2. For this reason, it is desirable to provide convergence coil 5 at a position near the electron guns in deflection yoke 74 as shown so that the magnetic field does not exist at a position near screen 11 in deflection yoke 4.

If at least one of the horizontal deflection coil and vertical deflection coil is toroidally wound, the position of the toroidally wound deflection coil corresponds to the toroidal winding of the convergence coil. Accordingly, the convergence coil need not be provided additionally and convergence current I_C superposed on the deflection current can be supplied.

For example, as shown in FIG. 6*a*, if a pair of windings 41 and 41' of the horizontal deflection coil are wound in the frame shape at opposing positions and a pair of windings 42 and 42' of the vertical deflection coil are toroidally wound at opposing positions, a pair of windings 521 and 522 are toroidally wound on core 43 of the windings of the vertical deflection coil at the position at 90° to vertical deflection windings 42 and 42', that is, at symmetrical positions in the direction from which electron beams 21, 22 and 23 are originated, in reference to axis 0 of cathode-ray tube 1. Vertical deflection current I_V and convergence current I_C are supplied to vertical deflection windings 42 and 42' through distribution transformer T so that both currents do not interfere each other and, at the same time, convergence current I_C is supplied to windings 521 and 522 exclusively used for convergence.

Vertical deflection power supply S_V is connected to the primary winding of distribution transformer T, both windings 42 and 42' of the vertical deflection coil are series-connected across terminals T_1 and T_2 at both ends of the secondary winding, and convergence windings 521 and 522 and convergence power supply 53 are series-connected between the intermediate connecting point 42*a* of both windings and center terminal T_3 of the secondary winding.

If convergence current I_C is supplied as shown with a broken line and arrow in the figure so that the current flows in opposite directions along the circumferential direction in adjacent windings which are all wound in the same direction, for example, in the counterclockwise direction, magnetic fields M_1, M_2, M_3 and M_4 which are symmetrical in reference to tube axis 0 are induced. Under this condition, vertical deflection current I_V flows in vertical deflection coils 42 and 42' but does not flow in convergence windings 521 and 522 because the potential at intermediate connecting point 42*a* between both vertical deflection coils 42 and 42' is equal to that at center terminal T_3 of the secondary winding of the distribution transformer.

Both convergence windings 521 and 522 can be parallel-connected as shown in FIG. 6*b*.

Distribution transformer T can be employed for convergence power supply 53. For example, as shown in FIG. 6c, the primary winding of distribution transformer T can be connected to convergence power supply 53, convergence windings 521 and 522 and both vertical deflection windings 42 and 42' can be respectively series-connected between terminals T_1 and T_2 of the secondary winding, and vertical deflection power supply S_V can be connected between intermediate connecting point 42*b* of vertical deflection windings 42 and 42' and center terminal T_3 of the secondary winding of distribution transformer T.

If both the vertical deflection coil and the horizontal deflection coil are toroidally wound, convergence current I_C superposed on horizontal deflection current I_H or vertical deflection current I_V can be supplied to said both deflection coils. For example, as shown in FIG. 6d, vertical deflection power supply S_V is connected to the primary winding of one distribution transformer T' of two distribution transformers T' and T'', windings 42 and 42' of the vertical deflection coil are series-connected between terminals T_1' and T_2' of the secondary winding, horizontal deflection power supply S_H is connected to the primary winding of other distribution transformer T'', and windings 41 and 41' of the horizontal deflection coil are series-connected between terminals T_1'' and T_2'' of the secondary winding.

Convergence power supply 53 is connected to the primary winding of dividing transformer T_0 having a pair of independent secondary windings C_1 and C_2, one secondary winding C_1 of dividing transformer T_0 is connected between center terminal T_3' of the secondary winding of distribution transformer T' for vertical deflection and intermediate connecting point 42c of vertical deflection windings 42 and 42', and the other secondary winding C_2 is connected between center terminal T_3'' of the secondary winding of distribution transformer T'' for horizontal deflection and intermediate connecting point 42*d* of horizontal deflection windings 41 and 41'.

When convergence current I_c is supplied to both the vertical deflection coil and horizontal deflection coil as described above, the distribution transformer can be employed for the convergence power supply as shown in FIG. 4*e*.

The distribution transformer is comprised of a pair of independent secondary windings C and C′ respectively provided with three terminals. Transformer T is formed so that center terminal T_{13} of one secondary winding C is positioned at the electrical center between terminals T_{11} and T_{12} at both ends and center terminal T_{23} of other secondary winding C′ is positioned at the electrical center between terminals T_{21} and T_{22} at both ends. Primary winding C″ is connected to convergence power supply **53** and vertical deflection windings **42** and **42′** are series-connected between terminals T_{11} and T_{12} of one secondary winding C, vertical deflection power supply S_V is connected between intermediate connecting point **42***c* of vertical deflection windings **42** and **42′** and center terminal T_{13}, horizontal deflection windings **41** and **41′** are series-connected between terminals T_{21} and T_{22} of other secondary winding C′, and horizontal deflection power supply S_H is connected between intermediate connecting point **42***d* of horizontal deflection windings **41** and **41′**.

As shown in FIG. 4*a*, if the convergence current superposed, on the deflection current is supplied to one pair of deflection windings **42** and **42′** and the convergence current alone is supplied to windings **521** and **522**, the convergence current can be supplied from separate convergence power supply **53′** to windings **521** and **522** exclusively employed as shown in FIG. 4*f*.

Thus, if the toroidally wound deflection coils are employed, convergence can be easily performed without providing a separate convergence coil and is performed at the deflection and scanning position.

As described above, when both side electron beams are diverged symmetrically in reference to the center electron beam, the convergence of electron beams can be easily performed at any position on the screen by supplying the convergence current, of which the amplitude varies in accordance with divergence, to the convergence coil. Accordingly, the apparatus of the present invention is advantageous because the convergence electrodes need not be provided in the cathode-ray tube and a deflection yoke in a complicated shape corresponding to said electrodes need not be provided. In particular, the apparatus is advantageous because the electron beams can be shifted for convergence at the center of deflection to effectively prevent mislanding and the convergence current superposed on the deflection current can be supplied to the toroidally wound deflection coil, thus simplifying the construction of the apparatus.

What is claimed is:

1. An in-line gun type color television picture tube apparatus comprising:

a. an in-line gun type color cathode-ray tube in which three electron guns are arranged in a line along a first axis and the spots of electron beams from these electron guns appear along the first axis on the screen of the cathode-ray tube and are converged at the center of the screen,

b. a deflection yoke which deflects and scans the electron beams so that both side spots of the three electron beams appear on the screen at an equal distance on both sides of the center spot when the three electron beams are not converged,

c. a convergence magnetic field generating means, said convergence magnetic field generating means consisting essentially of at least one pair of convergence windings which are respectively provided externally on the neck of said cathode-ray tube and are opposite from each other in reference to the axis of the cathode-ray tube and a convergence power supply which supplies the convergence current to said windings which forms said convergence magnetic field generating means forming a convergence magnetic field having which shifts only said side electron beams and has a field distribution which is symetrical and linear in reference to a second and third axis, said second and third axes being positioned 90° with respect to each other and 45° with respect to said first axis, the plane formed by said second and third axes being perpendicular to the axis of the cathode-ray tube, wherein both side electron beams are symmetrically shifted in reference to the center electron beam, as a function of the deflection angle, in order to complete convergence of the beam spot trio through said convergence magnetic field.

2. An apparatus according to claim **1**, wherein a deflection yoke deflects and scans the electron beams so that the distances between side spots and center spots appearing at two symmetrical positions in reference to the center of the screen are equal when three electron beams are not converged.

3. An apparatus according to claim **1**, wherein said convergence magnetic field generating means is positioned such that the convergence magnetic field is induced at the deflecting position of the deflection yoke to shift symmetrically both side electron beams in reference to the center electron beam at the center of deflection.

4. An apparatus according to claim **1**, wherein said at least one pair of convergence windings comprises two sets of said convergence windings arranged at positions at 90° from each other around the axis of said cathode-ray tube.

5. An apparatus according to claim **5**, wherein said convergence windings are toroidally wound on a core made of a ring-shaped highly magnetic material which surrounds the neck of said cathode-ray tube about the axis of said cathode-ray tube.

6. An apparatus according to claim **5**, wherein said deflection yoke is comprised of a ring-shaped yoke core surrounding the neck of the cathode-ray tube and a pair of coils which are opposed to each other and mounted on said yoke core, and wherein said yoke core is employed as the core for said convergence windings.

7. An apparatus according to claim **4**, wherein said convergence windings are formed with frame-shaped windings which are provided at the positions around the neck of said cathode-ray tube in two axial directions 45° from the first axis and the direction intersecting said first axis at a right angle.

8. An apparatus according to claim **7**, wherein said convergence windings are provided inside said deflection yoke.

9. An apparatus according to claim **1**, wherein a set of convergence windings are wound in the form of frame at the positions around said cathode-ray tube in

the axial direction and 45° at one side from said first axis.

10. An apparatus according to claim **9**, wherein said convergence windings are arranged inside said deflection yoke.

11. An in-line gun type color television picture tube apparatus comprising:

a. an in-line gun type color cathode-ray tube in which three electron guns are arranged in a line along a first axis and the spots of electron beams from these electron guns appear along the first axis on the screen of the cathode-ray tube and are converged at the center of the screen,

b. a deflection yoke which deflects and scans the electron beams so that both side spots of the three electron beams appear on the screen at an equal distance on both sides of the center spot when the three electron beams are not converged,

c. a convergence magnetic field generating means which forms a convergence magnetic field having a field distribution which is symmetrical and linear in reference to a second and third axis, said second and third axes being positioned 90° with respect to each other and 45° with respect to said first axis, the plane formed by said second and third axes being perpendicular to the axis of the cathode-ray tube, wherein both side electron beams are symmetrically shifted in reference to the center electron beam, as a function of the deflection angle, in order to complete convergence of the beam spot trio through said convergence magnetic field, and wherein,

d. said deflection yoke is comprised of a ring-shaped yoke core, a deflection coil having two pairs of windings opposing each other and mounted on said ring-shaped yoke core wherein at least one pair of said windings are toroidally wound and a power supply which supplies the deflection current to said deflection coil, and wherein said convergence magnetic field generating means is further comprised of a convergence power supply which supplies the convergence current and a current superposing means which superposes said convergence current on said deflection current, whereby said convergence current superposed on said deflection current is supplied, from said current superposing means in the direction opposite said deflection current, to one winding of at least one pair of toroidally wound deflection coils and, in the same direction as said magnetic current, to the other winding for generating said convergence magnetic field.

12. An apparatus according to claim **11**, wherein said current superposing means is comprised of a transformer which has a secondary winding provided with three terminals and the center terminal is positioned at an electrical center between the terminals at both ends, windings of the deflection coil which supply the convergence current are series-connected between the terminals at both ends of the secondary winding of said transformer, and one of said deflection current power supply and convergence current power supply is connected to the primary winding of said transformer and the other is connected between the intermediate connecting point and the center terminal of the secondary winding.

13. An apparatus according to claim **11**, wherein one pair of windings in said deflection coil are toroidally wound and the other is wound in the form of frame, a pair of convergence windings opposing each other are toroidally wound at the positions 90° from a pair of said toroidally wound windings of deflection coil in reference to the axis of said cathode-ray tube, wherein said current superposing means is comprised of a transformer having a secondary winding provided with three terminals and the center terminal is positioned at the electrical center of the terminals wherein a pair of said toroidally wound windings of said deflection coil are series-connected between both terminals of the secondary winding of said transformer, and one of said deflection current power supply and said convergence current power supply is connected to the primary winding of said transformer and the other is connected between the intermediate connecting point of a pair of said toroidally wound windings of said deflection coil and the center terminal at the secondary side of said transformer.

14. An apparatus according to claim **13**, wherein a pair of said convergence windings are series-connected to a power supply which supplies the convergence current to said toroidally wound windings of said deflection coil.

15. An apparatus according to claim **13**, wherein a pair of said convergence windings are parallel-connected to a power supply which supplies the convergence current to said toroidally wound windings of said deflection coil.

16. An apparatus according to claim **13**, wherein the convergence current to be supplied to a pair of convergence windings is supplied from a separate power supply independent of the power supply which supplies the convergence current to said toroidally wound windings of said deflection coil.

17. An apparatus according to claim **11**, wherein said two pairs of windings of said deflection coil are toroidally wound respectively on said yoke core and the convergence current superposed on said deflection current is supplied to said pairs of windings of said deflection coil respectively.

* * * * *

UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,806,757 Dated April 23, 1974

Inventor(s) SADAYOSHI SARUTA

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

In Claim 5, line 1, change "5" to --4--.

Signed and Sealed this

first Day of June 1976

[SEAL]

Attest:

RUTH C. MASON
Attesting Officer

C. MARSHALL DANN
Commissioner of Patents and Trademarks

Notice of Adverse Decision in Interference

In Interference No. 99,381, involving Patent No. 3,806,757, S. Saruta, IN-LINE GUN TYPE COLOR TELEVISION PICTURE TUBE APPARATUS, final judgment adverse to the patentee was rendered Feb. 16, 1977, as to claims 1–6.

[*Official Gazette July 5, 1977.*]

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