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Saruta

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[45] **Sept. 25, 1973**

[54] **COLOR TELEVISION PICTURE TUBE APPARATUS**

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[73] Assignee: **Denki Onkyo Co., Ltd.**, Tokyo, Japan

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[30] **Foreign Application Priority Data**

May 17, 1971 Japan 46/33482

[52] **U.S. Cl.** ..... **315/13 C,** 315/13 CG, 315/27 GD, 178/5.4 M

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

[58] **Field of Search** .... 315/13 C, 13 CG, 315/27 GD, 24; 178/5.4 F, 5.4 H, 5.4 M

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Primary Examiner—Carl D. Quarforth
Assistant Examiner—P. A. Nelson
Attorney—James E. Armstrong et al.

[57] **ABSTRACT**

A color television picture tube apparatus which displaces the electron beam dispersing position in the plane of the deflection center of the delta gun shadow mask type color cathode-ray tube in which three electron guns are positioned respectively at the vertices of an equilateral triangle so that the beam spot from each electron gun is incident upon each vertex of the equilateral triangle on the screen of the cathode-ray tube, by supplying the correcting current to be superposed on the deflection current to the deflection coil.

11 Claims, 15 Drawing Figures

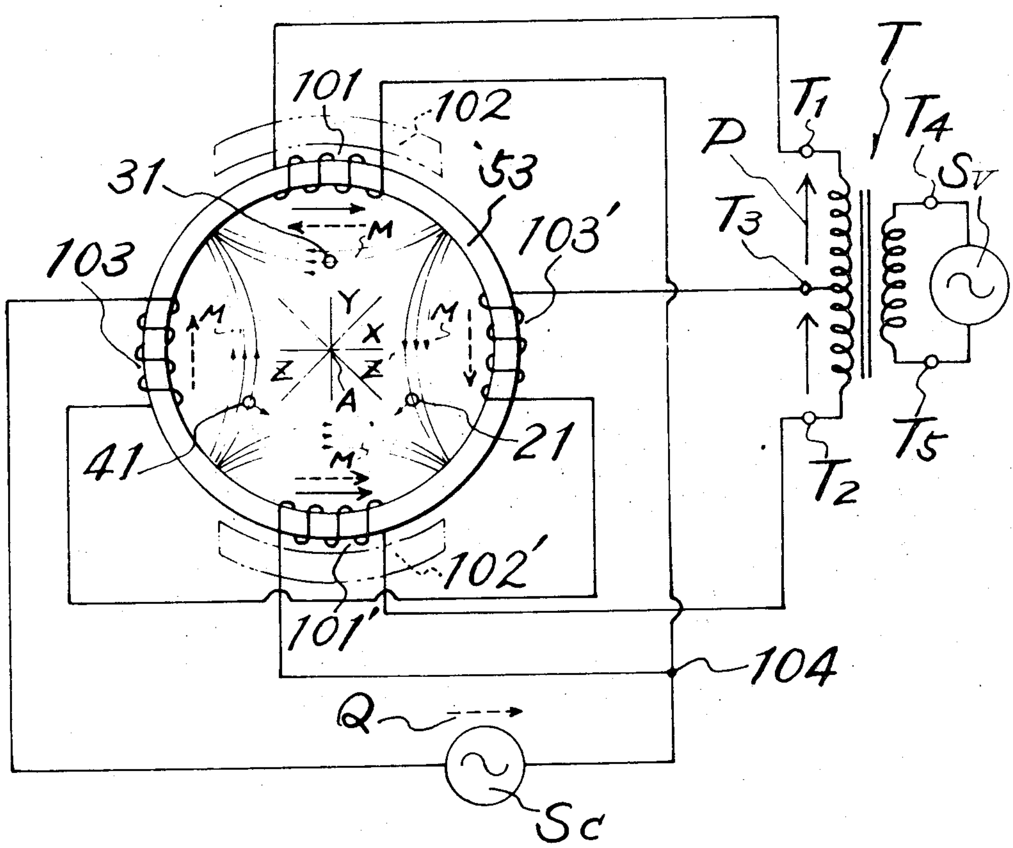


FIG. 1

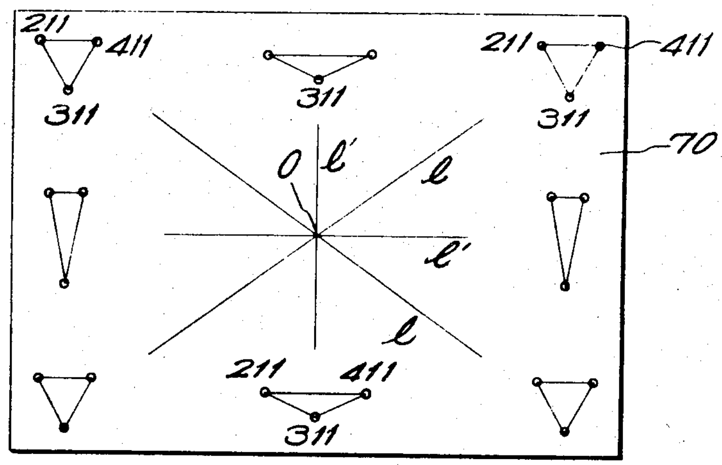


FIG. 2

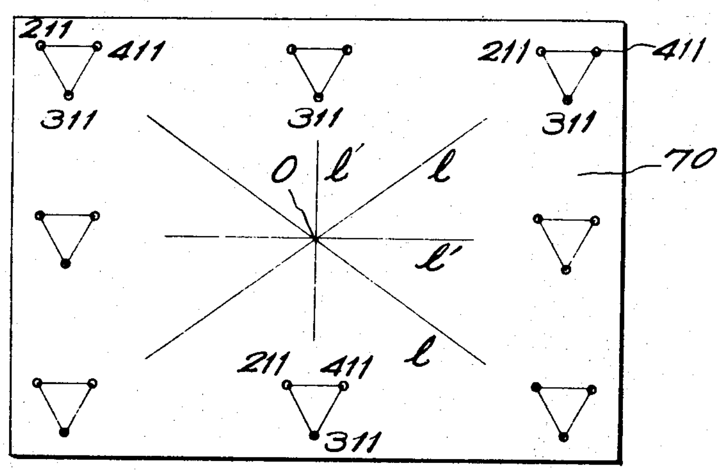


FIG. 3a

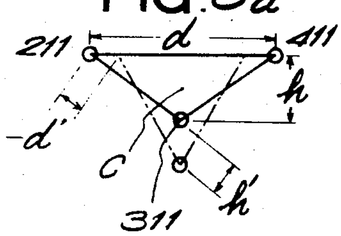


FIG. 3b

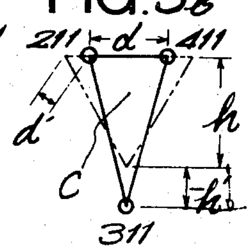


FIG. 3c

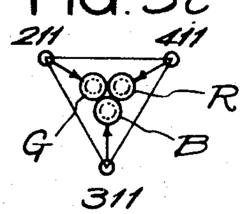


FIG. 4a

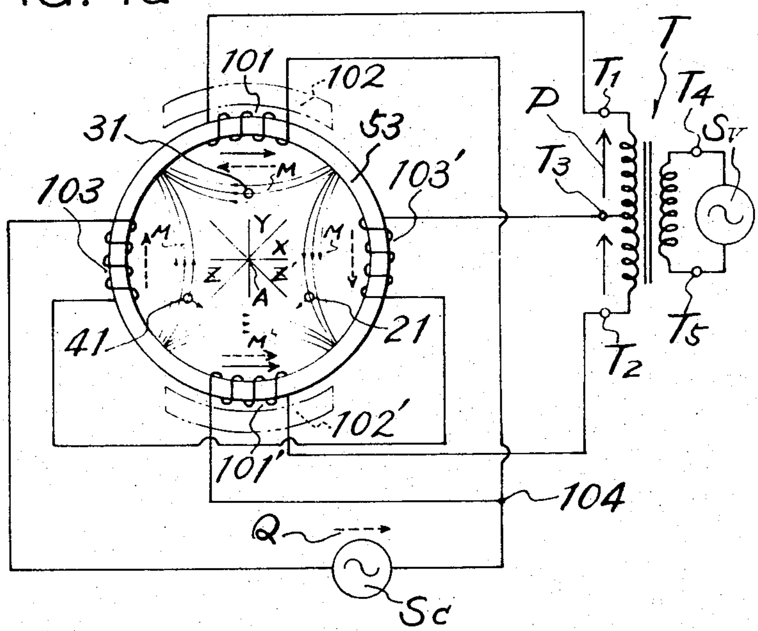

101
102
31
53
103
103'
Y
X
Z
Z
A
M
M
M
M
41
21
102'
101'
104
Q
Sc
T
T_1
T_4
P
T_3
S_V
T_5
T_2

FIG. 4b

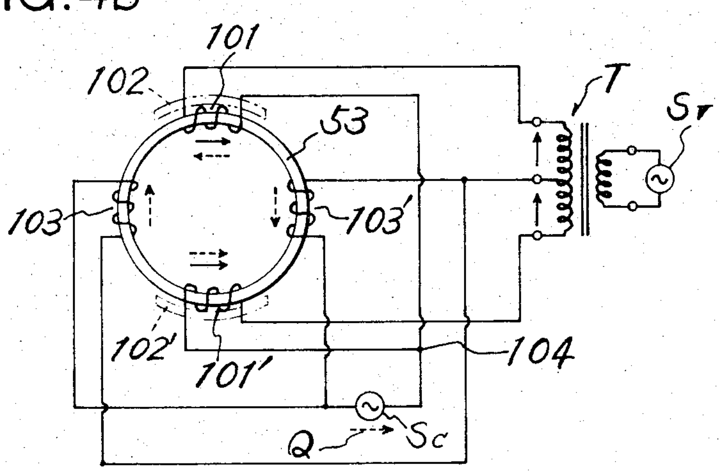

101
102
53
T
S_V
103
103'
102'
101'
104
Sc
Q

FIG.4c

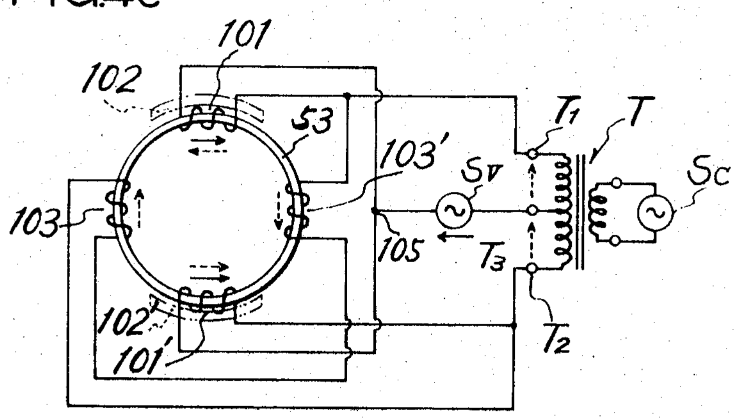

101
102
53
103'
S_V
T_1
T
S_C
103
105
T_3
102
101'
T_2

FIG.4e

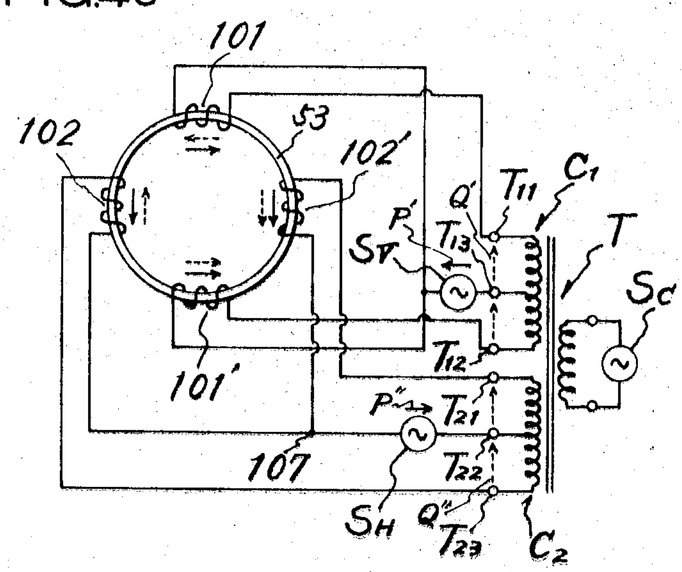

101
102
53
102'
Q'
T_{11}
C_1
P'
T_{13}
S_V
T
S_C
T_{12}
101'
P''
T_{21}
107
T_{22}
S_H
Q''
T_{23}
C_2

FIG.4d

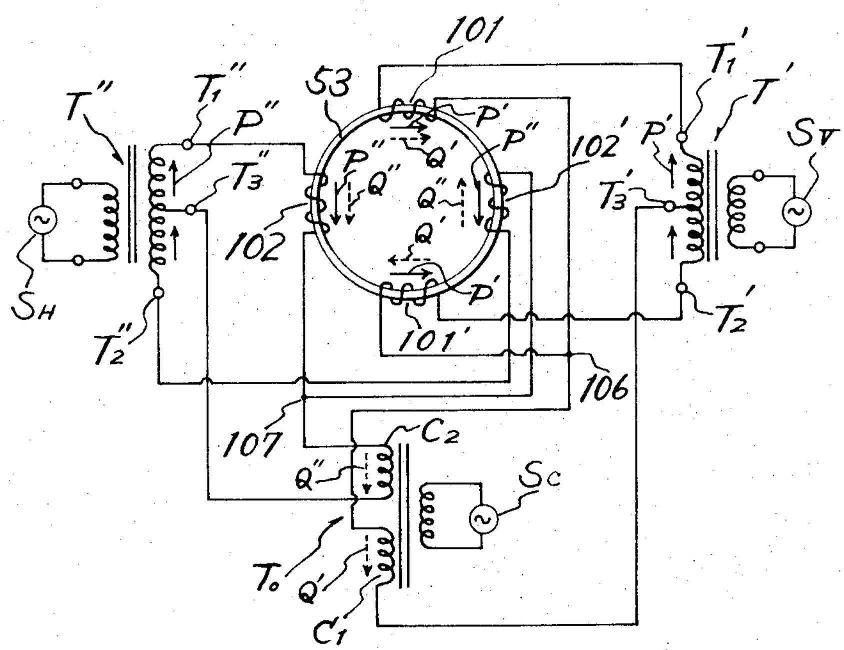

101
53
T''
T1''
P''
P'
P''
Q'
P''
Q''
102'
P'
T1'
T'
SV
T3''
Q''
T3'
102
Q'
SH
P'
T2'
T2''
101'
106
107
C2
Q''
SC
To
Q'
C1

FIG.4f

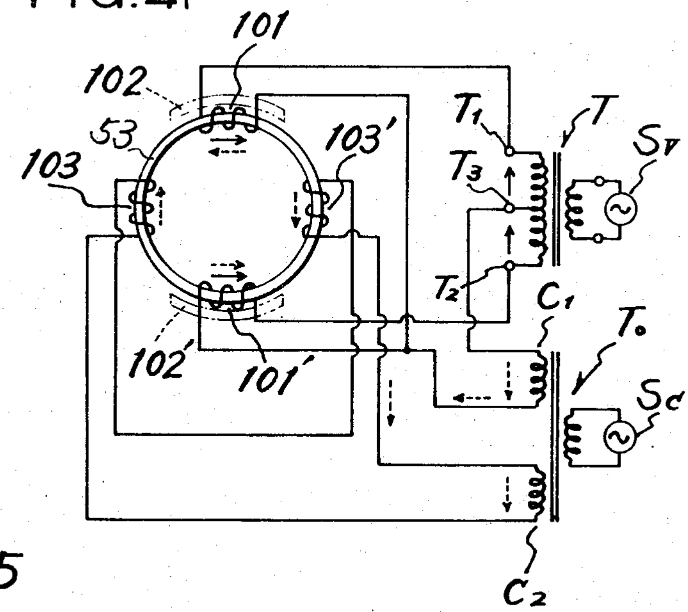


FIG.5

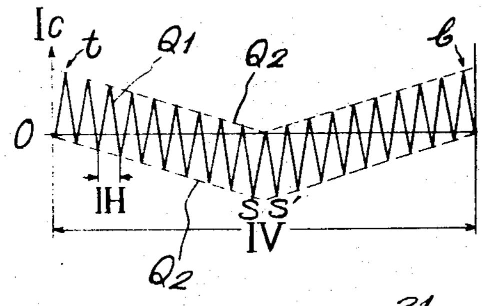


FIG.6

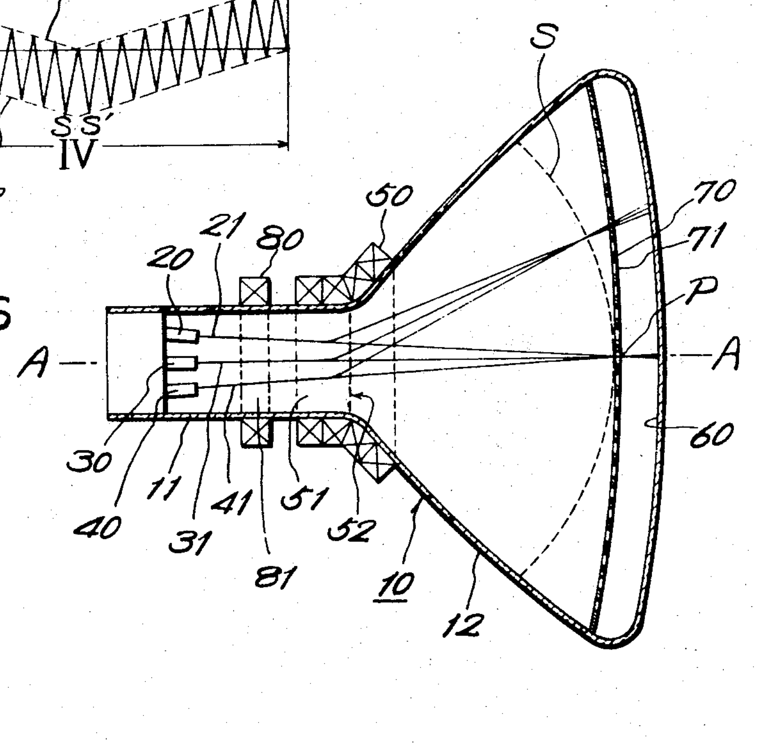


FIG. 7

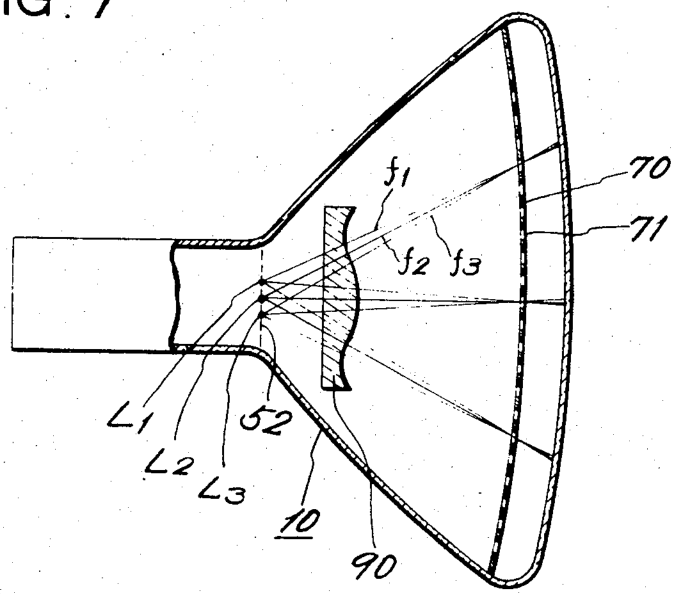
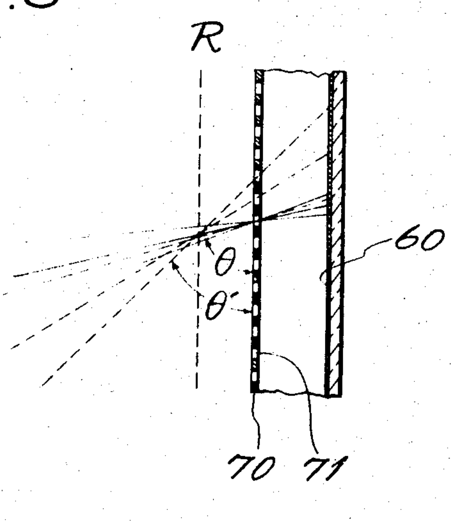


FIG. 8



COLOR TELEVISION PICTURE TUBE APPARATUS

BACKGROUND OF THE INVENTION

The present invention relates to a color television picture tube apparatus employing the so-called delta gun shadow mask type color cathode-ray tube which is provided with three electron guns positioned respectively at the vertices of an equilateral triangle.

To obtain a fine color picture on the screen of the cathode-ray tube of this type, the following requirements should be satisfied that the electron beam is emitted from each electron gun onto the center of each corresponding phosphor dot on the screen of the cathode-ray tube, the purity of colors is high and the electron beams are converged onto a group of phosphor dots.

These requirements can be comparatively easily satisfied in the case of the cathode-ray tube with a spherically formed screen, whereas it is difficult to satisfy the requirements in the case of a narrow-necked, wide-angle deflection cathode-ray tube.

The wide angle deflection cathode-ray tube is advantageous in practical use because the distance between the electron guns and the screen is small and the screen is almost flat with a curvature approximate to that of a flat surface; however, it is necessary to control the electron beams so that the electron beams may be emitted exactly onto the 3-color phosphor dots on the screen because the incident angle and distance of the electron beams which reach the phosphor dots on the screen have the values proper to respective phospher dots.

As known from the above, deviation of color results from the purity of colors and emission of the beam trio onto a group of phosphor dots depends on convergence of electron beams.

The following describes the purity of color and convergence of electron beams in the color television picture tube.

This type of the color television picture tube is comprised, as shown in FIG. **6**, of vacuum tubular body **10** consisting of narrow neck portion **11** and conical portion **12** which is conically expanded from the narrow neck portion, three electron guns **20, 30** and **40** which are arranged in parallel so that the electron guns are positioned at the vertices of a equilateral triangle inside said neck **11** and are slightly slanted so that electron beams **21, 31** and **41** intersect at point P on cathode-ray tube axis A, that is, at a small hole provided in the shadow mask, deflecting means **50**, for example, deflection yoke which deflects vertically and horizontally electron beams **21, 31** and **41** emitted from said three electron guns toward conical portion **12**, screen **60** on the internal surface of which a number of phosphor dots, curved plate **70** called the "mask" which is provided inside said screen and provided with a number of small holes **71**, and convergence yoke **80** which controls intervals between three electron beams.

In the case of the cathode-ray tube, with such construction as above, electron beams **21, 31** and **41** are emitted onto screen **60** with phosphor dots at an incident angle as if the electron beams deflect at deflection center **52** of deflection field **51** in refernece to cathode-ray tube axis A.

There are provided on the internal surface of screen **60** many phosphor dots each of which contains three fluorescent points which glow respectively in three primary colors, blue, red and green.

The phosphor dots are formed by the method shown below in the course of manufacturing the cathode-ray tubes.

The position of deflection center **52** is predetermined and shadow mask **70** is provided. Then, three light fluxes f_1, f_2 and f_3 from spot light sources L_1, L_2 and L_3 (see FIG. 7) arranged at three positions on deflection center **52** are directed to the screen. These three light fluxes are irradiated onto the screen through small holes **71** of the shadow mask while being deflected by lens **90** which is made to meet deflection tendency of the electron beams due to the field distribution characteristic of the deflection yoke. The fluorescent material photographically developed at every three exposure position to the incident light fluxes through the small holes, thus forming a group of phosphor dots for each small hole.

Accordingly, if three electron beams **21, 31** and **41** are deflected at deflection center **52** and are converged at small holes **71** of the shadow mask to the screen, all electron beams reach the centers of corresponding phosphor dots.

However, a group of electron beams are refracted at deflection center **52** and converged at plane S shown with a dotted line; (FIG. **6**) therefore, if the curvature of focusing plane S is larger than that of shadow mask **70** as in the case of the wide angle deflection cathode-ray tube, a group of electron beams intersect before the small holes of the shadow mask and are inevitably irradiated onto the screen through different small holes (see FIG. **8**).

In this case, the color purity is satisfactory because each electron beams reaches each corresponding phosphor dot but the convergence of electron beams are unsatisfactory.

Therefore, the conventional apparatus is provided with convergence yoke **80** so that a group of electron beams emitted from the electrom guns are converged at the same small hole by displacing the electron beams before deflection field **51**.

Field **81** of this convergence yoke is provided to vary the interval spacings among electron beams in order to concentrate electron beams **21, 31,** and **41** onto a group of phosphor dots on the screen; accordingly, incident angle θ of electron beam to the small hole of the shadow mask in reference to deflection center **52** is different from incident angle θ' of the light which is refracted by lens **90** as illustrated in FIG. **8.**

Since the electron beams from three electron guns pass the small holes of the shadow mask through the incident paths different from those through which the light from the spot light source passes the small holes of the shadow mask, the spot of each electron beam deviates from the center of each of corresponding phosphor dots. In this case, the purity of colors is unsatisfactory even though the convergence of electron beam is satisfactory.

The following describes the relations between said purity and convergence.

If the electron beams are deflected at deflection center **52**, it is duly known, from the fact that the fluorescent screen is made by the photographical technique, that the optimum purity of colors can be obtained at any deflection angle.

This means that each electron beams deviates from the center of each corresponding phosphor dot if the electron beams are deflected in a compensating plane other than the deflection center.

Accordingly, if the convergence is compensated at a position near the electron guns from the deflection center, the electron beam or beams deviate from the center of phosphor dot or dots. If the amount of correction is large, the electron beams deviate from the phosphor dot center to cause mislanding and the purity will deteriorate.

Deterioration of the purity due to correction of convergence can be prevented by correcting convergence at the center of deflection. Thus, it is said impossible to correct the convergence in the main deflection circuit.

The present invention provides a color television picture tube apparatus capable of effectively preventing deterioration of the purity of colors.

SUMMARY

The present invention provides a color television picture tube apparatus comprising: a delta gun shadow mask type color cathode-ray tube in which three electron guns are arranged respectively at the vertices of an equilateral triangle with 120° angular intervals; a deflection yoke which is comprised of a ring core, a pair of mutually opposing deflection coils being mounted on said ring core, at least one of which is toroidally wound, and a pair of power sources which supply the deflection current to a pair of said deflection coils, thereby the deflection yoke is mounted on said color television picture tube to deflect groups of electron beams horizontally and vertically so that the positions of the spots of three electron beams on the screen, when the electron beams are not converged, conform respectively to the vertices of an equilateral triangle on at least one certain line containing the center of the screen and so that said positions conform to the vertices of the isosceles traingles which are symmetrical in reference to the center of the screen on other lines containing the center of the screen; a correcting field generating means which is comprised of the power source for supplying the correcting current and the mixing means which superposes said correcting current on said deflection current, thereby said correcting current being superposed on said deflection current by said mixing means is supplied to one winding of at least one deflection coil, which is toroidally wound, of a pair of deflection coils in the same direction as the deflection current and to the other winding in the opposite direction to the deflection current and the electron beams are deflected so that the spots of electron beams conform respectively to the vertices of an equilateral triangle on the screen by shifting at least two electron beams in the horizontal direction of three electron beams arranged respectively at the vertices of said isosceles triangle, that is, so that the distances between the center of convergence and spots of electron beams are equal; and a convergence yoke which converges said electron beam trio so that the electron beam trio is converged at each small hole of the shadow mask at the same time, wherein the correcting field generating means is positioned at the position at which the correcting field is generated at the deflection center of said deflection yoke and the correcting field is arranged to deflect the electron beam trio so that the distance between each spot of electron beam trio which is positionally adjusted and the center of convergence is shorter than the longest of the distance between each beam spot and the center of convergence before positional adjustment and is longer than the shortest of said distances.

BRIEF DESCRIPTION OF THE DRAWINGS

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

FIGS. **1** and **2** are the front views of the screen on which the relative positions of the spots of an electron beam trio are shown;

FIGS. **3***a*, **3***b* and **3***c* are the explanatory diagrams for the correcting method of the beam spot trio on the screen;

FIGS.**4***a* to **4***f* are circuit diagrams of the deflection yokes respectively indicating an embodiment of a correcting field generating means;

FIG. **5** shows an example of the correcting current waveform to be supplied to said correcting field generating means;

FIG. **6** is a cross sectional plan view of a cathode-ray tube indicating the construction of a conventional apparatus;

FIG. **7** is a cross sectional plan view of a cathode-ray tube illustrating a method for forming three-color phosphor dots; and

FIG. **8** is a magnified view of the important part of the cathode-ray tube illustrating the incident angle of an electron beam trio into the shadow mask.

DETAILED DESCRIPTION

Referring to FIG. **1**, there is shown the characteristic of the electron beam spot trio appearing on the screen through the deflection yoke of the apparatus according to the present invention.

The beam spot trio is a combination of beam spot **311** directed to a phosphor dot, for example, for blue, beam spot **411** to a phosphor dot, for example, for red and beam spot **211** to a phosphor dot, for example, for green. Each spot is deflected on certain line *l* including center **0** of the screen, for example on the diagonal line on the screen so that the beam spots conform to the vertices of the equilateral triangle and deflected on other line *l'* including the center of the screen, for example, on the vertical line and horizontal line so that the beam spots conform to the vertices of the isosceles triangle.

The shape of the isosceles triangle is such that the perpendicular bisector is small relatively as compared with the base at the top and bottom parts of the screen while the perpendicular bisector is large relatively as compared with the base at the right- and left-side parts of the screen.

Any of said triangles is inverted in direction because three electron beams interesect at a small hole of the shadow mask. Accordingly, in the case of a cathode-ray tube in which three electron guns are arranged at the vertices of an inverted equilateral triangle, the beam spot trio is dispersed so as to conform to the vertices of an equilateral triangle inverse to the shape of the triangle shown.

The triangle formed by the beam spot trio appearing on the screen will be an equilateral triangle at every position on the screen if deflection field **51** is uniform and the screen has a spherical surface. However, the screen of the television picture tube currently used is almost flat, the deflection coil of the existing deflection yoke is short and the deflection coil is formed in a conical shape along the conical part **12** of the cathode-ray tube. It is therefore impossible to obtain a uniform field and it is possible only to disperse the beam spots in the shape of the equilateral triangle on certain line *l* on the screen. On other lines on the screen, dispersion of the beam spot trio only conforms to the isoseles triangle.

Dispersion of the beam spots onto the vertices of an equilateral triangle is not limited to the diagonal line only on the screen and is possible on a vertical or horizontal line including the center of the screen. In this case, it is satisfactory for the electron spot beams to form the isosceles triangle on lines other than the lines on which an equilateral triangle is formed, for example, on the diagonal line. This is possible.

However, it is most desirable to disperse the electron beams in a shape of equilateral traingle at the corners of the screen where the electron beams are deflected to the greatest extent as shown in FIG. **1.**

If the deflection method as described above is employed, a marked aberration occurs at the end of vertical and horizontal lines *l'* as described above and causes the electron beam spots to disperse onto the vertices of an isosceles triangle. Since convergence of electron beams dispersed in the vertical and horizontal directions is possible by supplying a simple correcting current to the convergence yoke, convergence alone is easy.

It is possible to converge the electron beam spots which disperse onto the vertices of an equilateral or isosceles triangle on the screen. If the electron beam spots which are dispersed to conform to the vertices of the isosceles triangle are converged, the amount of movement of one or two of three electron beam spots become large and there is possibility of the beam spots deviating from corresponding phosphor dots on the screen, thus deteriorating the purity of color.

FIG. **2** illustrates the characteristic of a group of electron beam spots which are corrected by the correcting field generating means of the apparatus according to the present invention.

This correcting field generating means permits shifting of three electron beams **21, 31** and **41,** which are interrelated, at the deflection center of the deflection yoke so that the electron beam spots conforming to the vertices of an isosceles triangle conform to the vertices of an equilateral triangle on screen **70.**

Accordingly, the beam spots are disposed to form an equilateral triangle at each point on the screen as shown; in this case, the equilateral triangles vary in size.

If the dispersing position of the electron beam spots is corrected so that the beam spots conform to the vertices of an equilateral triangle, the distances between center C of convergence and respective beam spots become equal and the electron beam spots are shifted to the center the same distance to direct onto the corresponding phosphor dots by converging the beam trio through field **81** of convergence yoke **80.**

FIGS. **3***a* and **3***c* show the relations between the dispersing of the beam spots and the amount of movement of the beam spots due to convergence. In case of a isosceles triangle with small perpendicular bisector *h* and long base *d*, it is satisfactory to shift beam spot **311** by distance *h'* and, at the same time two beam spots **211** and **411** by distance *−d'* in the direction such that these two beam spots approach each other.

In case of an isosceles triangle with large perpendicular bisector *h* and short base *d* as shown in FIG. **3***b*, it is satisfactory to shift beam spot **311** by distance *−h'* and, at the same time, other beam spots **211** and **411** by *d'* in the direction of dispersion.

The beam spots for which the dispersing position is determined as described above conform to the vertices of an equilateral triangle. If these beam spots are converged, beam spots **211, 311** and **411** move by the same distance and reach corresponding phosphor dots B, R, and G.

Accordingly, the purity of colors is high because no beam spot requires a shift of long distance.

Referring to FIGS. **4***a* to **4***f*, there are shown circuit diagrams for generating correcting field M in the apparatus according to the present invention.

Ring-shaped core **53** is a part of deflection yoke **50.** It is toroidally wound with a pair of vertical deflection coils **101** and **101'** and is wound with a pair of saddle-shaped horizontal deflection coils **102** and **102'.** Furthermore, it is toroidally wound with a pair of correcting coils **103** and **103'.**

Correcting coils **103** and **103'** are oppositely arranged in the direction of horizontal line *x* in reference to cathode-ray tube axis A and both deflection coils are oppositely arranged in the direction of vertical line *y*.

Superposing transformer T is provided with terminals T_1 and T_2 at both ends of the secondary winding and termianl T_3 at the center of the secondary winding. Power source S_V for supplying the vertical deflection current is connected between terminals T_4 and T_5 of the primary winding.

Vertical deflection coils **101** and **101'** are connected in series across terminals T_1 T_2 of the secondary side of said superposing transformer, and correcting coils **103** and **103'** and power source S_C for supplying the correcting current are connected in series across center terminal T_3 and intermediate connecting point **104** of deflection coils **101** and **101'.** Horizontal deflection coils **102** and **102'** are connected to the power source (not shown) for supplying the horizontal deflection current. a

A pair of vertical deflection coils **101** and **101'** are wound around the core in specified directions so that the magnetic force lines in the *x* axis shown in the figure are generated in the same direction and a pair of horizontal deflection coils **102** and **102'** are provided on the core so that the magnetic force lines in the *y* axis shown in the figure are generated in the same direction. In this specification, a pair of vertical deflection coils **101** and **101'** and a pair of correcting coils **103** and **103'** are considered as being wound in the same direction for facilitating the description.

Vertical deflection current I_V flows in the same direction to both vertical deflection coils **101** and **101'** as shown with solid-line arrow P in the figure; however, since the same potential is obtained at intermediate connecting point **104** of said both vertical deflection coils and at center terminal T_3 of superposing transformer T_1, the vertical deflection current does not flow in correcting coils **103** and **103'** which are connected across said intermediate connecting point and center terminal.

Correcting current I_C from source S_C flows oppositely in correcting coils **103** and **103'** and in vertical deflection coils **101** and **101'** as shown with broken-line arrow Q in the figure. In other words, the correcting current flows in direction symmetrical in reference to intersecting axes Z and Z' which are deviated by 45° from said intersecting axes *x* and *y*. Viewing vertical deflection coils **101** and **101'** only, correcting current I_C flows in vertical deflection coil **101'** in the same direction as vertical deflection current I_V and in vertical deflection coil **101** in the opposite direction to said deflection current.

With the above connection, the coils respectively in which correcting current I_C flows generate the magnetic field ranging symmetrical in reference to each axis of intersecting axes Z and Z', thus generating the magnetic force lines as shown which deflect beam **31** in the vertical direction along axis y and two beams **41** and **21** in the horizontal direction to the diagonal direction containing the x-axial component. When beam **31** is shifted upward by this magnetic field, other two beams **21** and **41** are shifted to approach each other at the same time; on the contrary, when beam **31** is shifted downward, other two beams **21** and **41** are shifted to diverge.

In FIG. **4***a*, correcting coils **103** and **103'** are connected in series and can be connected in parallel as shown in FIG. **4***b*.

Superposing transformer T can be employed for power source $S_C$for supplying the correcting current as shown in FIG. **4***c*. In other words, power supply S_C for supplying the correcting current is connected to the primary side of superposing transformter T, correcting coils **103** and **103'** are connected in series across terminals T_1 and T_2 at the secondary side, vertical deflection coils **101** and **101'** are connected in series across terminals T_1 and T_2 and power source S_V for supplying the vertical deflection current is connected across intermediate connecting point **105** of both coils **101** and **101'** and center terminal T_3 at the secondary side of superposing transformer T. With this connection, vertical deflection coils **101** and **101'** are connected in parallel with power source S_V for supplying the vertical deflection current. When power supply S_C is thus connected to the primary side of superposing transformer T, correcting coils **101** and **101'** can be connected in parallel.

In the above embodiments, the apparatus is designed so that the correcting current superposed on the deflection current flows in the vertical deflection coils; however, said current can be supplied to the horizontal deflection coils when the horizontal deflection coils are toroidally wound around the core.

Generally, in most cases, the horizontal deflection coils and vertical deflection coils are arranged so that one of them is toroidally wound and the other is wound in the form of saddle; however both deflection coils are toroidally wound. If both deflection coils are toroidally wound, the horizontal deflection coils are wound in place of correcting coils **103** and **103'** shown in embodiments described above. As known from said emboidments, vertical deflection current I_V and correcting current I_C can be superposed and supplied to toridally wound vertical deflection coils **101** and **101'**. In this case, therfore, the correcting current can be supplied to not only vertical deflection coils **101** and **101'** but also horizontal deflection coils **102** and **102'** and correcting coils **103** and **103'** can be omitted.

Referring to FIG. **4***d*, there is shown an embodiment of the wiring connection when both vertical deflection coils **101** and **101'** and horizontal deflection coils **102** and **102'** are toroidally wound.

Vertical deflection coils **101** and **101'** are connected in series across terminals T_1' and T_2' at both ends of the secondary winding of superposing transofrmer T' for vertical deflection coils. Power supply S_V for supplying the vertical deflection current is connected to the primary winding of said superposing transformer T'.

Horizontal deflection coils **102** and **102'** are connected in series across terminals T_1'' and T_2'' at both ends of the secondary winding of the superposing transformer T'' for horizontal deflection coils and power supply S_H for supplying the horizontal deflection current is connected to the primary winding of superposing transformer T''.

Power supply S_C for supplying the correcting current is connected to the primary winding of dividing transformer T_0 having two secondary windings as a pair of coils. One end of one secondary winding C_1 is connected to intermediate connecting point **106** between vertical deflection coils **101** and **101'** and the other end of the secondary coil is connected to center terminal T_3' of the primary windinpg of superposing transformer T'. One end of the other secondary winding C_2 is connected to intermediate connecting point **107** of horizontal deflection coils **102** and **102'** and the other end is connected to center terminal T_3'' of the secondary winding of superposing transformer T''.

Vertical deflection current I_V flows in the same direction to both vertical deflection coils **101** and **101'** as shown with solid-line arrow P' in the figure to generate the magnetic field in the direction of axis *x* and horizontal deflection current flows in the same direction to both horizontal deflection coils **102** and **102'** as shown with solid-line arrow P'' in the figure to generate the magnetic field in the direction of axis *y*.

Correcting current I_C flows symmetrically in reference to intersecting axes Z and Z' as shown with broken-line arrows Q' and Q'' in the figure, from one secondary winding C_1 of dividing transformer T_O to vertical deflection coils **101** and **101'** and from other secondary winding C_2 to horizontal deflection coils **102** and **102'**, thus generating the magnetic field in a distribution symmetrical in reference to said intersecting axes Z and Z'. Since the potential at intermediate connecting point **106** of vertical deflection coils **101** and **101'** is the same as that at center terminal T_3' of the secondary winding of superposing transformer T', vertical deflection current I_V does not flow in secondary coil C_1 and since the potential at intermediate connecting point **107** of horizontal deflection coils **102** and **102'** is the same as that at center terminal T_3'' of the secondary winding of superposing transformer T'', horizontal deflection current I_H does not flows in secondary coil C_2.

When both deflection coils are toroidally wound as described above, power supply S_C for supplying the correcting current can be connected to the primary winding of superposing transformer T as shown in FIG. **4***e*. In this case, said superposing transformer serves as said dividing transformer T_0. Power supply S_V for supplying the vertical deflection current is connected across center terminal T_{13} between both terminals T_{11} and T_{12} of one winding C_1 of divided secondary windings C_1 and C_2 and intermediate connecting point **106** of vertical deflection coils **101** and **101'** and power supply S_H for supplying the horizontal deflection current is connected across center terminal T_{23} between both terminals T_{21} and T_{22} of other winding C_2 and intermediate connecting point **107** of horizontal deflection coils **102** and **102'**.

In the embodiment shown in FIG. **4***a*, the correcting current to be supplied to correcting coils **103** and **103'** need not to be supplied from power supply S_C for supplying the correcting current to vertical deflection coils **101** and **101'** and another power supply can be provided. For example, as shown in FIG. **4f**, one secondary winding of dividing transformer T_O employed in FIG. **4d** can be connected to correcting coils **103** and **103'**.

FIG. **5** shows a waveform of the correcting current. The current flow shown in FIG. **5** is to change dispersion of the beam spot trio as shown in FIG. **1** into dispersion shown in FIG. **2**.

The magnitude of correcting current I_C to be supplied determines the extent of correction; accordingly, the condition that the current value is 0 indicates that no correction is required, the beam spots are dispersed onto the vertices of the equilaterial triangle and the beam spots are converted onto the center of the screen.

The point where the value of correcting current is large coincides with the point where the beam spots are deflected to the center of the top and bottom of the screen and of the right- and left-side parts.

The correcting current waveform becomes maximum as shown in waveform t when the beam spots reach the center of the top of the screen. At this time, the direction of the magnetic flux of the correcting field is as shown in FIG. **4**; therefore beam **31** in a vertical direction is shifted far from center A on axis *y* and other two beams **21** and **41** are shifted to approach each other.

Since it is necessary to shift similarly the electron beams even when the beam spots are deflected to the center of the bottom of the screen, the correcting increases again as waveform *b* at the end of vertical deflection I_V.

On the contrary, the direction of the correction current flow is reversed at the central part of the vertical deflection cycle and becomes the maximum.

When such the correction current is supplied, the magnitic flux of correcting field M flows in the direction reverse to that shown in FIG. **4**; accordingly, electron beam **31** is deflected to approach the central point and other two electron beams **21** and **41** are deflected in the direction of dispersion. Therefore, the electron beams which are dispersed to form an isosceles triangle with large perpendicular bisecotr *h* at the centers of the right and left sides on the screen are deflected to the dispersing position where an equilateral triangle is formed in the correcting field generated with waveforms S and S' of the correcting current.

The waveform of the correcting current should be able to correct dispersion of electron beams in the form of the isosceles triangle on the scanning line into dispersion in the form of the equilateral triangle.

Dispersion of the electron beams shows a proper distribution due to the characteristic of the specified cathode-ray tube and the deflection coil provided thereon; accordingly, it is difficult to determine the general correcting current waveform. If the dispersion of the electron beam spots is distributed as shown in FIG. **1**, triangular wave Q_1 of horizontal deflection cycle I_H is coupled to vertical deflection cycle I_V with envelop Q_2 of the triangular wave.

Actually, in most cases, the waveform of triangular wave Q_2 shows a bent side. Furthermore, the sine wave and parabolic wave can be substituted for triangular wave Q.

According to the present invention, the electron beam trio is positionally corrected at the deflection center so that the electron beam trio which is disposed to conform to the vertices of the isosceles triangle conform to the vertices of the equilateral triangle. In this case, it is necessary there is relationship between the equilateral triangle and the original isosceles triangle.

The direction where the beam spots are converged is fixed at the times and the center of convergence coincides with the center of the equilateral triangle. Accordingly, the distance between the center of convergence and each beam spot, that is, the convergence distance is equal in case of the equilateral triangle.

On the other hand, if perpendicular bisector *h* of the isosceles triangle is long, the convergence distance of beam spot **311** in a vertical direction is also long and the convergence distance of other spots become short. If perpendicular bisector *h* is small, the convergence distance of beam spot **311** is short and that of other two spots is long.

The convergence distance of the equilateral triangle resulting from correction should be shorter than the longest convergence distance of the isosceles triangle and longer than the shorter convergence distance of the isosceles triangle.

Only one equilateral triangle which satisfies the above condition is obtained from each isosceles triangle if the ratio of variation of the perpendicular bisector to variation of the base of the isosceles triangle is fixed, and therefore it is possible to fix the ratio of decrease of the long convergence distance of the similar isosceles triangle to the increase of the short convergence distance at all time. This provides an advantage to easily determine the waveform of the correcting current.

As known from the above, beam **31** in the vertical direction vertically moves along axis *y* to vary the convergence distance. This vertical movement of beam **31** can be obtained by shifting two beams **21** and **41** arranged in the horizontal direction including the amount of vertical movement of beam **31**.

These two beams should be shifted slantly downward so as to approach each other and slantly upward so as to disperse.

In this case, the position of beam **31** in the vertical direction is the reference position. Accordingly, the base of the equilateral triangle obtained through correction on the screen is deviated vertically from the base of the original isosceles triangle. The size of the equilateral triangle obtained from this method can be determined to be the same as that obtained when three electron beams are shifted at the same time.

Thus, correction will be easy because the correcting field need not act on electron beam **31**.

It is known from the above that deterioration of the purity of colors can be minimized and the electron beam trio can be converged.

What is claimed is:

1. A color television picture tube apparatus comprising:

a. a delta gun shadow mask type color cathode-ray tube means which is arranged so that three electron guns adapted to collectively emit an electron beam trio are respectively positioned at vertices of an equilateral triangle.

b. a deflection yoke means comprised of a ring-shaped core, a pair of deflection coils, at least one of which is toroidally wound which are mounted on said core together with a pair of opposed windings and a pair of power sources which supply the deflection current respectively to a pair of said deflection coils, wherein the deflection yoke is mounted on said color television cathode-ray tube to horizontally and vertically deflect groups of electron beams so that the positions of the spots of three electron beams on the screen, when the electron beams are not converged, conform respectively to the vertices of an equilateral triangle on at least one certain line containing the center of the screen and said positions conform respectively to the vertices of the isosceles triangles which are symmetrical in reference to the center of the screen on other lines containing the center of the screen,

c. a correcting field generating means which is comprised of a power source supplying a correcting current and means for superposing said correcting current with said deflection current and means for supplying said correcting current from said means for superposing to one winding of at least one deflection coil, which is toroidally wound, of a pair of deflection coils in the same direction as the deflection current and to the other winding in the opposite direction to the deflection current whereby the convergence distance of the electron beam trio can be made shorter than the longest convergence distance of the former isosceles triangle and longer than the shortest convergence distance of the former isosceles triangle by shifting at least two electron beams in the horizontal direction at the deflection center of said deflecting yoke so that the spots of electron beams conforming to the vertices of each isosceles triangle come to conform to the vertices of the equilateral triangle, and

d. a convergence yoke which converges said groups of electron beams onto small holes of the shadow mask of the cathode-ray tube.

2. An apparatus according to claim **1**, wherein the deflection yoke means is adapted to deflect the electron beams so that the electron beam spots on the screen conform respectively to the vertices of an equilateral triangle on diagonal lines on the screen, to the vertices of an isosceles triangle with a long base and a short perpendicular bisector on the line including the centers of the top and bottom.

3. An apparatus according to claim **1**, wherein said correcting field generating means is adapted to generate a correcting field, which causes one electron beam positioned at a vertex of a triangle to shift along a vertical line including the center of the deflection field and other two beams to shift in a horizontal direction and, when the electron beam in the vertical direction is shifted upwardly, causes the other two electron beams to be shifted to approach each other and when the electron beam in the vertical direction is shifted downwardly, causes the other two beams to be shifted to diverge.

4. An apparatus according to claim **1**, wherein said correcting field generating means is adapted to generate a correcting field, which does not affect one electron beam in the vertical direction conforming to one vertex of a triangle and shifts obliquely the other two beams to appraoch each other and to depart from the electron beam positioned in the vertical direction and also shifts obliquely the other two beams to depart from each other and to approach the electron beam positioned in the vertical direction.

5. An apparatus according to cliam **1**, wherein said mixing means is devised so that it has at least one transformer provided with three terminals at the secondary winding and the intermediate terminal positioned at the center between said both terminals, both windings of the deflection coils for supplying the correcting current, of said deflection coils are connected in series across the terminals at both ends, and one of said power sources for supplying the deflection current and the correcting is connected to the primary side of said transformer and the other is connected across said center terminal and the intermediate connecting point between said both windings.

6. An apparatus according to claim **1**, wherein one of said deflection coils is toroidally wound and the other is wound in the former of saddle, a pair of opposed correcting coils are toroidally wound at the position 90° away from a pair of windings of said toroidally-wound deflection coils, said correcting current is supplied to said correcting coils and said mixing means is devised so taht it has at least one transformer provided with three terminals at the secondary winding and the intermediate terminal positioned at the center between said both terminals, both windings of the deflection coil for supplying the correcting current, of said deflection coils are connected in series across the terminals at both ends, and one of said power sources for supplying the deflection current and the correcting current is connected to the primary side of said transformer and the other is connected across said center terminal and the intermediate connecting point between said both windings.

7. An apparatus according to claim **6**, wherein the correcting current flowing in said correcting coils is supplied from a power source other than the power source which supplies said correcting current to said toroidally-wound deflection coils.

8. An apparatus according to claim **6**, wherein a pair of said correcting coils are connected in series to the power source which supplies said correcting current to said toroidally-wound deflection coils and are connected in parallel each other.

9. An apparatus according to claim **6**, wherein a pair of said correcting coils are connected in series to the power source which supplies the correcting current to said toroidally-wound deflection coils.

10. An apparatus according to claim **1**, wherein said both deflection coils are toroidally-wound respectively on said core and said means for supplying correcting current supplies said current respectively to said both deflection coils.

11. An apparatus according to claim **1**, wherein the deflection yoke means is adapted to deflect the electron beams so that the electron beam spots on the screen conform respectively to the vertices of an equilateral triangle on the line including the centers of the right and left sides of the screen and to the vertices of an isosceles triangle with the short base and a long perpendicular bisector on the rest of the lines.

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