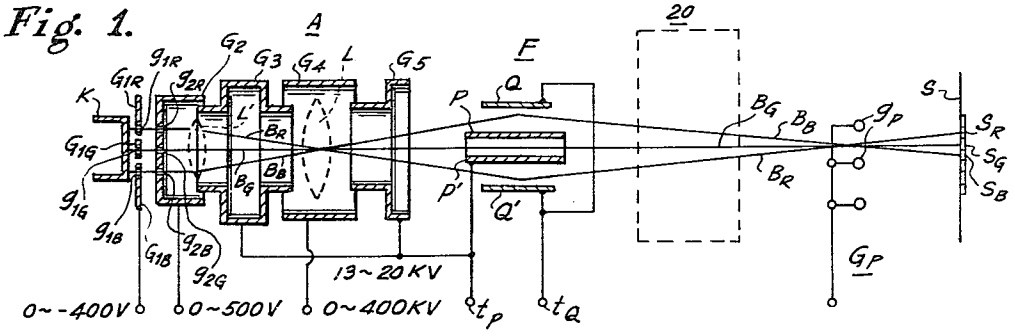
March 10, 1970 MASAHIDE SAWAI 3,500,114

CONVERGENCE SYSTEM FOR A COLOR PICTURE TUBE

Filed Aug. 19, 1968 2 Sheets-Sheet 1

Fig. 1.



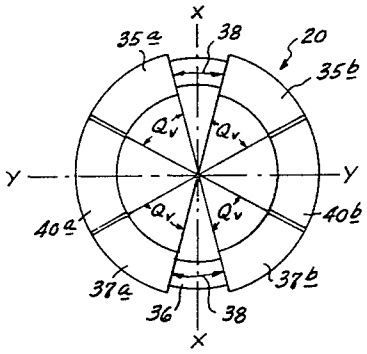


Fig. 2

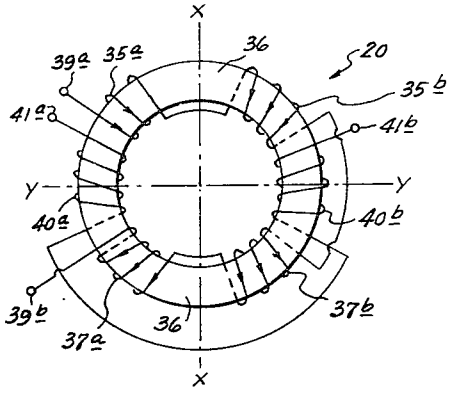
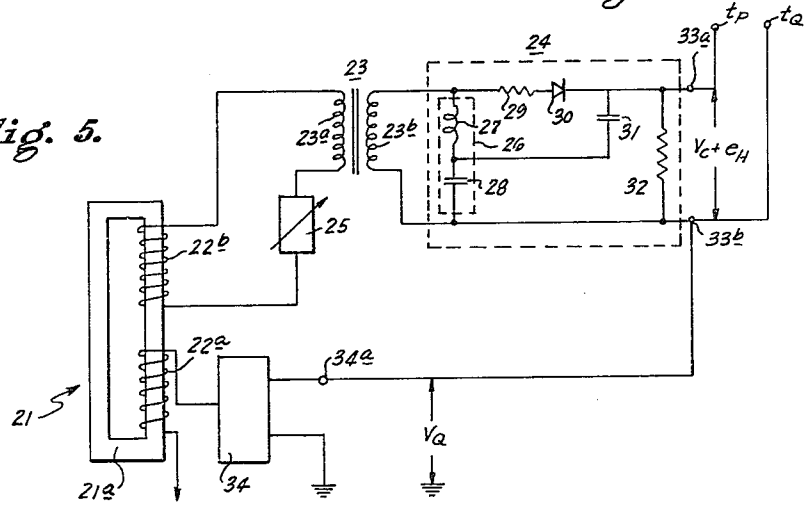


Fig. 3.

Fig. 5.



INVENTOR.
MASAHIDE SAWAI
BY
ATTORNEY.

March 10, 1970 MASAHIDE SAWAI 3,500,114

CONVERGENCE SYSTEM FOR A COLOR PICTURE TUBE

Filed Aug. 19, 1968 2 Sheets-Sheet 2

Fig. 4.

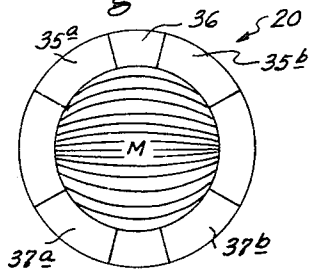


Fig. 6.

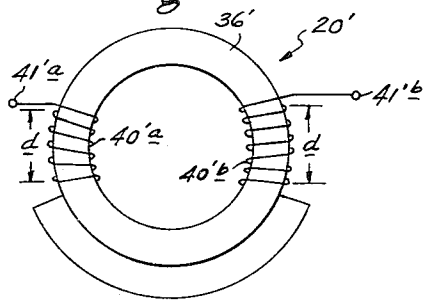
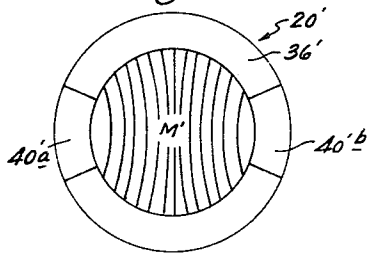


Fig. 7.



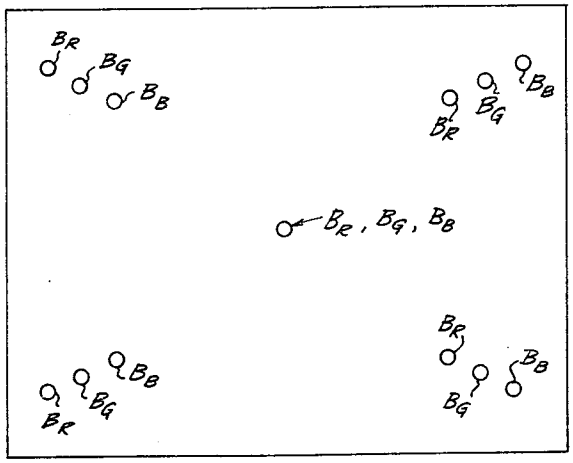


Fig. 8.

INVENTOR.
MASAHIDE SAWAI.

BY Louis H. Eslinger

ATTORNEY.

United States Patent Office 3,500,114 Patented Mar. 10, 1970

3,500,114

CONVERGENCE SYSTEM FOR A COLOR PICTURE TUBE

Masahide Sawai, Tokyo, Japan, assignor to Sony Corporation, Tokyo, Japan, a corporation of Japan

Filed Aug. 19, 1968, Ser. No. 753,694
Claims priority, application Japan, Aug. 24, 1967, 42/53,984
Int. Cl. H01j 29/50
U.S. Cl. 315—13 6 Claims

ABSTRACT OF THE DISCLOSURE

In a color picture tube of the single-gun, plural-beam type in which the beams originate in a common horizontal or vertical plane and are passed through the optical center of an electron lens by which they are focussed on the color phosphor screen, and in which two of the beams emerge from the lens along paths that are divergent with respect to the path of a central beam and are to be converged with the latter by passage between convergence deflecting plates having a voltage difference applied thereto; the misconvergence of the beams at the beam selecting grid or mask that may result from spherical aberration of the deflection yoke provided for causing the beams to scan the screen is corrected by including in the voltage applied to the convergence deflecting plates a dynamic convergence voltage varied with the sweep signal applied to the yoke for deflecting the beams in the direction of the common plane in which the beams originate to eliminate the component of the misconvergence parallel to such plane, and the component of the misconvergence in the direction at right angles to that plane is eliminated by providing the deflection yoke with a suitable non-uniform magnetic field for deflecting the beams in the last mentioned direction.

This invention relates generally to color picture tubes of the single-gun, plural-beam type, and particularly to tubes of that type in which the plural beams are passed through the optical center of a common electron lens by which the beams are focussed on the color phosphor screen.

In single-gun, plural-beam color picture tubes of the described type, for example, as specifically disclosed in the copending U.S. application Ser. No. 697,414, filed Jan. 12, 1968, now Patent No. 3,448,316, and having a common assignee herewith, three laterally spaced electron beams are emitted or originated by a beam generating or cathode assembly and directed in a common substantially horizontal or vertical plane with the central beam coinciding with the optical axis of the single electron lens and the two outer beams being converged to cross the central beam at the optical center of the lens and thus emerge from the latter along paths that are divergent from the optical axis. Arranged along such divergent paths are pairs of convergence deflecting plates having voltages applied thereacross to deflect the divergent beams substantially in the plane of origination thereof for causing all beams to converge at a point on the apertured beam selecting grid or shadow mask associated with the color screen. After passing between the convergence deflecting plates, the beams are acted upon by the magnetic fields resulting from the application of horizontal and vertical sweep signals to the corresponding coils of a deflection yoke, whereby the beams are made to scan the screen in the desired raster. It will be apparent that, when the three beams are deflected by the yoke from a point of convergence at the center of the screen, as during scanning, the distances that such beams travel through the magnetic fields of the deflection yoke are relatively varied and

spherical aberration results, that is, the beams undergo different degrees of deflection resulting in misconvergence of the beams, particularly when the latter are directed at corner portions of the screen.

It is an object of this invention to avoid the above mentioned misconvergence of the beams in color picture tubes of the described type.

More specifically, it is an object of this invention to correct or avoid the misconvergence of the beams in a color picture tube of the described type that results from the magnetic fields of the deflection yoke.

According to an aspect of this invention, a single-gun, plural-beam color picture tube as described has applied to its convergence deflecting plates a static convergence voltage and also a dynamic convergence voltage which is varied in synchronism with the sweep signal applied to the yoke for deflecting the beams in the direction of the plane in which the beams originate whereby to eliminate the component of the misconvergence parallel to such plane, and the component of misconvergence in the direction at right angles to that plane is eliminated by providing the deflection yoke with a suitably non-uniform magnetic field for deflecting the beams in the last mentioned direction.

In the case where the beams originate or are generated in a common horizontal plane, horizontal dynamic convergence is achieved by supplying to the convergence deflecting plates a dynamic convergence voltage synchronized with the horizontal sweep signal, and the vertical deflection coil means of the deflection yoke is given a configuration to provide a so-called "barrel-shaped" magnetic field for eliminating the vertical component of misconvergence.

Conversely, when the beams originate or are generated in a common vertical plane, a dynamic convergence voltage synchronized with the vertical sweep signal is applied to the convergence deflecting plates to eliminate the vertical component of misconvergence, and the horizontal deflection coil means of the deflection yoke is given a configuration to provide a so-called "pincushion-shaped" magnetic field for eliminating the horizontal component of misconvergence.

The above, and other objects, features and advantages of the invention, will be apparent in the following detailed description of illustrative embodiments thereof which is to be read in connection with the accompanying drawings, wherein:

FIG. 1 is a schematic sectional view in a horizontal plane passing through the axis of a single-gun, plural-beam color picture tube of the type to which this invention is applied;

FIG. 2 is a schematic end elevational view of a deflection yoke according to this invention for use in the color picture tube of FIG. 1;

FIG. 3 is a detail, diagrammatic view illustrating the windings provided in the deflection yoke of FIG. 2;

FIG. 4 is a diagrammatic view showing the pattern of the magnetic lines of flux in the magnetic field produced by the vertical deflection coil in the yoke of FIGS. 2 and 3;

FIG. 5 is a circuit diagram of a suitable convergence voltage generating means that may be used in connection with the color picture tube according to this invention;

FIG. 6 is a view similar to that of FIG. 3, but showing the windings provided in the deflection yoke for a color picture tube according to this invention in which the beams originate in a common vertical plane;

FIG. 7 is a view similar to that of FIG. 4, but showing the pattern of the magnetic lines of flux in the magnetic field produced by the horizontal deflection coil in the yoke of FIG. 6; and

FIG. 8 is a diagrammatic view to illustrate the nature of the misconvergence to be corrected or eliminated according to this invention.

Referring to the drawings in detail, and initially to FIG. 1 thereof, it will be seen that a single-gun, plural-beam color picture tube **10** of the type to which this invention is applied may comprise a glass envelope (not shown) having a neck and a cone extending from the neck to a color screen S provided with the usual arrays of color phospors S_R, S_G and S_B and with an apertured beam selecting grid or shadow mask G_P. Disposed within the neck is a single electron gun having cathodes K_R, K_O and K_B, each of which is constituted by a beam-generating source with the respective beam-generating surfaces thereof disposed as shown in a plane which is substantially perpendicular to the axis of the electron gun. In the embodiment shown, the beam-generating surfaces are arranged in a straight line so that the respective beams B_R, B_G and B_B emitted therefrom are directed in a substantially horizontal plane containing the axis of the gun, with the central beam B_G being coincident with such axis. A first grid G_1 is spaced from the beam-generating surfaces of cathodes K_R, K_G and K_B and has apertures g_{1R}, g_{1G} and g_{1B} formed therein in alignment with the respective cathode beam-generating surfaces. A common grid G_2 is spaced from the first grid G_1 and has apertures g_{2R}, g_{2G} and g_{2B} formed therein in alignment with the respective apertures of the first grid G_1. Successively arranged in the axial direction away from the common grid G_2 are open-ended, tubular grids or electrodes G_3, G_4 and G_5, respectively, with cathodes K_R, K_G and K_B, grids G_1 and G_2, and electrodes G_3, G_4 and G_5 being maintained in the depicted assembled positions thereof, by suitable, non-illustrated support means of an insulating material.

For operation of the electron gun of FIG. 1, appropriate voltages are applied to the grids G_1 and G_2 and to the electrodes G_3, G_4 and G_5. Thus, for example, a voltage of 0 to minus 400 v. is applied to the grid G_1, a voltage of 0 to 500 v. is applied to the grid G_2, a voltage of 13 to 20 kv. is applied to the electrodes G_3 and G_5, and a voltage of 0 to 400 v. is applied to the electrode G_4, with all of these voltages being based upon the cathode voltage as a reference. As a result, the voltage distributions between the respective electrodes and cathodes, and the respective lengths and diameters thereof, may be substantially identical with those of a unipotential-single beam type electron gun which is constituted by a single cathode and first and second, single-apertured grids.

With the applied voltage distribution as described hereinabove, an electron lens field will be established between grid G_2 and the electrode G_3 to form an auxiliary lens L' as indicated in dashed lines, and an electron lens field will be established around the axis of the electrode G_4, by the electrodes G_3, G_4 and G_5, to form a main lens L, again as indicated in dashed lines. In a typical use of electron gun A, bias voltages of 100 v., 0 v., 300 v., 20 kv., 200 v. and 20 v. may be applied respectively to the cathodes K_R, K_G and K_B, the first and second grids G_1 and G_2 and the electrodes G_3, G_4 and G_5.

Further included in the electron gun of FIG. 1 are electron beam convergence deflecting means F which comprise shielding plates P and P' disposed in the depicted spaced, relationship at opposite sides of the gun axis, and axially extending, deflector plates Q and Q' which are disposed, as shown, in outwardly spaced, opposed relationship to shielding plates P and P', respectively. Although depicted as substantially straight, it is to be understood that the deflector plates Q and Q' may, alternatively, be somewhat curved or outwardly bowed, as is well known in the art.

The shielding plates P and P' are equally charged and disposed so that the central electron beam B_G will pass substantially undeflected between the shielding plates P and P', while the deflector plates Q and Q' have negative charges with respect to the plates P and P' so that respective electron beams B_B and B_R will be convergently deflected as shown by the respective passages thereof between the plates P and Q and the plates P' and Q'. More specifically, a voltage V_P, which is equal to the voltage applied to the electrode G_5, may be applied to both shielding plates P and P', and a voltage V_Q, which is some 200 to 300 v. lower than the voltage V_P, is applied to the respective deflector plates Q and Q' to result in the respective shielding plates P and P' being at the same potential, and to result in the application of a deflecting voltage difference or convergence deflecting voltages between the respective plates P' and Q' and P and Q and it is, of course, this convergence deflecting voltage V_C which will impart the requisite convergent deflection to the respective electron beams B_B and B_R.

In operation, the respective electron beams B_R, B_G and B_B which emanate from the beam generating surfaces of the cathodes K_R, K_G and K_B will pass through the respective grid apertures g_{1R}, g_{1G} and g_{1B}, to be intensity modulated with what may be termed the "red," "green" and "blue" intensity modulation signals applied between the said cathodes and the first grid G_1. The respective electron beams will then pass through the common auxiliary lens L' to cross each other at the center of the main lens L and to emerge from the latter with beams B_R and B_B diverging from beam B_G. Thereafter, the central electron beam B_G will pass substantially undeflected between shielding plates P and P' since the latter are at the same potential. Passage of the electron beam B_B between the plates P' and Q' and of the electron beam B_R between the plates P and Q will however, result in the convergent deflections thereof as a result of the convergence deflecting voltage applied therebetween, and the system of FIG. 1 is so arranged that the electron beams B_B, B_G and B_R will desirably converge or cross each other at a common spot centered in an aperture between adjacent grid wires g_p of the beam selecting grid or mask G_P so as to diverge therefrom to strike the respective color phosphors of a corresponding array thereof on screen S. More specifically, it may be noted that the color phosphor screen S is composed of a large plurality of sets or arrays of vertically extending "red," "green" and "blue" phosphor stripes or dots S_R, S_G and S_B with each of the arrays or sets of color phosphors forming a color picture element as in a chromatron type color picture tube. Thus, it will be understood that the common spot of beam convergence corresponds to one of the thusly formed color picture elements.

The voltage V_P may also be applied to the lens electrodes G_3 and G_5 and to the screen S as an anode voltage in conventional manner through a non-illustrated graphite layer which is provided on the inner surface of cone **13** of the tube envelope. The grid wires of screen grid G_P may have a post-focussing voltage ranging, for example, from 6 to 7 kv. applied thereto. Thus, to summarize the operation of the depicted color picture tube of FIG. 1, the respective electron beam B_B, B_G and B_R will be converged at screen grid G_P and will diverge therefrom in such manner that electron beam B_B will strike the "blue" phosphor S_B, electron beam B_G will strike the "green" phosphor S_G and electron beam B_R will strike the "red" phosphor S_R of the array or set corresponding to the grid aperture at which the beams converge. Electron beam scanning of the face of the color phosphor screen is effected by horizontal and vertical deflection yoke means indicated in broken lines at **20** and which receives horizontal and vertical sweep signals whereby a color picture will be provided on the color screen. Since, with this arrangement, the respective electron beams are each passed, for focussing, through the center of the main lens L of the electron gun A, the beam spot formed by impingement of the

beams on the color phosphor screen S will be substantially free from the effects of coma and/or astigmatism of the said main lens, whereby improved color picture resolution will be provided.

It will be apparent that, when beams B_R, B_G and B_B are deflected by yoke means **20** from a point of convergence at the center of grid G_P and screen S, as during scanning of the screen, the distances that such beams travel through the magnetic fields of yoke means **20** are relatively varied and, is such fields are uniform or have uniformly spaced lines of flux, spherical aberration results, that is, the beams undergo different degrees of deflection resulting in misconvergence of the beams, particularly when the latter are directed at corner portions of the screen, as shown in FIG. 8. Such misconvergence of the beams has a vertical component and a horizontal component by reason of the magnetic fields produced by yoke means **20** for deflecting the beams in vertical and horizontal directions.

In the color picture tube according to this invention the horizontal component of the described misconvergence, that is, the component in the direction of the common plane in which the beams are generated and hence in the direction that the beams B_R and B_B are deflected by convergence deflecting means F, is compensated for by means which apply across plates P and Q and plates P′ and Q′ in addition to a static convergence deflection voltage, a dynamic convergence deflection voltage synchronized with the horizontal sweep signal so as to suitably vary the deflections of beams B_R and B_B by convergence deflections means F for compensating or eliminating the horizontal component of misconvergence. A circuit for generating the dynamic convergence deflecting voltage in addition to the static convergence deflecting voltage may be of the kind disclosed in detail in copending U.S. application Ser. No. 739,383, filed June 24, 1968, now Patent No. 3,452,240, and having a common assignee herewith.

As shown on FIG. 5, such a convergence deflecting voltage generating circuit is connected to therminals t_p and t_q to apply the requisite voltages to plates P and P′ and to plates Q and Q′, respectively, and is also connected to a fly-back transformer **21** which is in turn connected to a conventional horizontal deflection voltage output circuit (not shown). The fly-back transformer **21** (the primary winding of which is not shown) comprises a closed magnetic core **21***a* and a high voltage secondary winding **22***a*. Also wound on the magnetic core **21***a* is a convergence deflecting voltage secondary winding **22***b*. The primary winding **23***a* of an isolating transformer **23** is connected to the winding **22***b* through a convergence adjusting circuit **25** which may comprise a variable impedance element such as a variable resistor, variable inductance, or the like. Series-connected diode **30** and resistors **29** and **32** of the convergence deflecting voltage generating circuit **24** are connected as indicated across the secondary winding **23***b* of transformer **23**, with the diode **30** being connected in what will later be understood to be the forward direction. In addition, series-connected capacitors **31** and **28** are connected in parallel with the resistor **32**, and an inductor **27** is connected as shown between the junction of secondary winding **23***b* and resistor **29**, and the connection point of the respective capacitors **31** and **28**. Circuit terminals **33***a* and **33***b* are connected across the resistor **32**.

In operation, a pulse voltage of the horizontal deflection frequency is induced across winding **22***b*, and imparted to transformer **23** through the adjusting circuit **25**. Thus, pulses of the horizontal deflection or sweep frequency occur at secondary winding **23***b* of transformer **23**. Such pulses developed in winding **23***b* are rectified by the rectifier circuit formed by diode **30**, resistors **29** and **32**, and capacitors **31** and **28**, to provide a static convergence deflecting voltage V_C across resistor **32** and thus between the output terminals **33***a* and **33***b* (terminal **33***a* being at the higher potential).

In addition, the pulses developed across winding **23***b* are converted into a voltage of parabolic wave form by means of inductor **27** and capacitor **28** which, as utilized therein, will function in the nature of a double-integrating circuit **26**. This voltage of parabolic wave form is a horizontal dynamic convergence voltage E_H, which is also available, through capacitor **31**, between the respective circuit terminals **33***a* and **33***b*. As a result, the respective static and dynamic convergence voltages V_C and E_H, are superimposed upon each other to result in a net output voltage (V_C+E_H) between circuit terminals **33***a* and **33***b*. The function of the dynamic convergence voltage E_H is to vary the degree of convergence imposed upon beams B_B and B_R according to the differing requirements of the periodically varying horizontal deflection conditions as the three beams are swept horizontally in the usual manner. Deriving the voltage E_H from fly-back transformer **21** insures synchronism between E_H and the horizontal sweep.

Referring again to fly-back transformer **21** it may be noted that high voltage secondary winding **22***a* thereof is coupled to the anode of a high voltage rectifier circuit **34**, the output side **34***a* of which is connected to terminal **33***b* of circuit **24** to apply the high output voltage V_Q of rectifier **34** to terminal **33***b*. The terminal t_Q provided for the spaced, deflecting plates Q and Q′ is connected as shown to the terminal **33***b* to receive the high voltage V_Q. The terminal t_P, commonly referred to as the "anode button," is tied to each of the electrodes G_3 and G_5, and shielding plates P and P′, and is connected as shown to terminal **33***a* of circuit **24**. The terminal t_P is also connected to the graphite coating on the cathode ray tube cone portion, mentioned previously. As a result, the voltage appearing at the terminal t_P will be applied to each of electrodes G_3 and G_5, shielding plates P and P′, and as an anode voltage to the color phosphor screen S.

With the convergence voltage generating circuit **24** described, the voltage V_Q appearing at the output side of rectifier circuit **34**, and thus at terminal t_Q is applied to the deflecting plates Q and Q′. The anode voltage V_P, which is equal to $V_Q+(V_C+E_H)$, will appear at circuit terminal **33***a*, and thus terminal t_P, and will be applied to electrodes G_3 and G_5, shielding plates P and P′, and the color phosphor screen S. As a result, the convergence deflection voltage, which is equal to (V_C+E_H) is applied between the plates P and Q and between the plates P′ and Q′, the potential at the outer plates Q and Q′ being negative with respect to that at the inner plates P and P′. The magnitude of the static convergence voltage V_C and the amplitude of the dynamic convergence voltage E_H may be adjusted by means of circuit **25**. In practice, the magnitude of voltage V_C is adjusted within a range of 200 to 350 v., and the amplitude of voltage E_H within a range of 30 to 60 v. By means of the circuit described, the adjusted static convergence voltage V_C is applied to the convergence means F of the illustrated single-gun, three-beam type color picture tube so as to provide for proper convergence of the respective electron beams B_B, B_G and B_R at a common spot at the center of the screen grid G_P, which results in proper aiming of the beams toward the respective color phosphor stripes S_R, S_G and S_B. In addition, the adjusted horizontal dynamic convergence deflecting voltage E_H will be simultaneously applied to the deflecting means F so that as the beams are deflected from the central position, the effect of such dynamic convergence deflecting voltage will be to compensate for or eliminate substantially the horizontal component of the misconvergence illustrated on FIG. 8 and which results from the effect of the magnetic field of the horizontal deflecting yoke of yoke means **20**.

In accordance with this invention the vertical component of the misconvergence shown on FIG. 8 is eliminated, that, is vertical dynamic convergence is effected, by providing the vertical deflecting yoke of yoke means **20** with a configuration that results in a non-uniform field, more particularly a so-called "barrel-shaped" field, when the vertical sweep signal is applied thereto.

As shown on Fig. 2, the deflecting yoke means **20** according to this invention comprises a vertical deflecting yoke constituted by separately wound upper vertical deflection coils **35***a* and **35***b* arranged on an annular or doughnut-shaped magnetic core **36** and by separately wound lower vertical deflection coils **37***a* and **37***b* also arranged on core **36**. As shown, the coils **35***a* and **37***a* are respectively arranged above and below the horizontal plane Y—Y which extends through the center of core **36** at one side of the vertical plane X—X extending through such center, and coils **35***b* and **37***b* are similarly arranged above and below plane Y—Y at the opposite side of plane X—X.

The coils **35***a* and **35***b* are wound in the same direction with a gap **38** therebetween and coils **37***a* and **37***b* have a similar gap **38** therebetween and, as shown on FIGS. 3, are wound in the same direction which is opposed to the direction of winding of coils **35***a* and **35***b*. Further, the coils **35***a* and **35***b* and the oppositely wound coils **37***a* and **37***b* are connected in series, as shown, to terminals **39***a* and **39***b*, as shown on FIG. 3, to which there is applied the vertical sweep signal for providing, by the resulting current flows through the series connected coils, the desired barrel-shaped magnetic field M (FIG. 4).

The angular extents Q_V of coils **35***a* and **35***b* and of coils **37***a* and **37***b*, and the size of the gaps **38** determine the shape of field M and such dimensions are selected so that the resulting barrel-shape of the field will afford vertical dynamic convergence, that is, will compensate for or eliminate the vertical component of misconvergence that would result from the passage of beams B_R, B_G and B_B through the magnetic field of the vertical deflection yoke if such field was uniform.

As shown on FIGS. 2 and 3, the yoke means **20** according to this invention may further comprise the usual horizontal deflection yoke constituted by coils **40***a* and **40***b* which are oppositely wound and connected in series to terminals **41***a* and **41***b* which receives the horizontal sweep signal. As previously described, in this embodiment of the invention, the horizontal component of misconvergence that results from passage of the beams through the magnetic field established by coils **40***a* and **40***b* of the horizontal deflection yoke is compensated for, or eliminated by the application to convergence deflecting means F of the horizontal dynamic convergence deflecting voltage E_H. Thus, proper convergence of beams B_R, B_G and B_B is maintained at all portions of screen grid G_P to provide a substantially distortion-free color picture which is virtually free of misconvergence.

If the beams B_R, B_G and B_B originates in a common vertical plane, rather than in a common horizontal plane as in the embodiment of FIG. 1, in which case the electron beam convergence deflecting means corresponding to the means F are effective to convergently deflect the beams B_R and B_B in a vertical plane to converge with beam B_G at a common spot on the screen grid or mask, the vertical component of misconvergence that results from passage of the beams through the magnetic field of the vertical deflection yoke is eliminated by applying a vertical dynamic convergence deflecting voltage across the plates of the convergence deflecting means in synchronism with the vertical sweep signal, for example, as by a circuit similar to that of FIG. 5, and the horizontal component of the misconvergence is eliminated, that is, horizontal dynamic convergence is effected, by providing the horizontal deflecting yoke with a configuration that results in a non-uniform magnetic field, more particularly in a co-called "pincushion shaped" field, when the horizontal sweep signal is applied thereto.

As shown on FIG. 6, the horizontal deflecting yoke of yoke means **20'** according to this invention for a color picture tube in which the beams originate in a common vertical plane may be constituted by oppositely wound coils **40'***a* and **40'***b* on diametrically opposed portions of an annular magnetic core **36'**, with such oppositely wound horizontal deflecting coils being connected in series to terminals **41'***a* and **41***b* which receive the horizontal sweep signal. The lengths *d* of coils **40'***a* and **40'***b* are sufficiently limited so that the magnetic field M' produced by the current flows therethrough in response to the horizontal sweep signal is of a suitable pin-cushion shape, as shown on FIG. 7, to eliminate the horizontal component of misconvergence.

Although illustrative embodiments of the invention have been described in detail herein with reference to the accompanying drawings, it is to be understood that the invention is not limited to those precise embodiments, and that various changes and modifications may be effected therein by one skilled in the art without departing from the scope or spirit of the invention as defined in the appended claims.

What is claimed is:

1. A single-gun, plural-beam color picture tube comprising a color screen having arrays of color phosphors and beam selecting means provided with apertures corresponding to said arrays, beam generating means for directing a plurality of electron beams in a common plane toward said screen for impingement on respective phosphors of each array through the corresponding aperture, lens means for focusing said electron beams on said screen and having an optical center through which said beams are all passed with at least two of said beams emerging from said lens means along paths lying in said plane and which are divergent to the optical axis of the lens means, electron beam convergence deflecting means located between said lens means and said screen and being operative, upon the application of a convergence deflecting voltage thereto, to deflect said beams emerging along said divergent paths for convergence of said beams at an aperture of said beam selecting means, and deflection yoke means having sweep signals applied thereto to deflect said beams in directions respectively parallel, and at right angles to said plane for causing said beams to scan said screen; and in which misconvergence of said beams at said beam selecting means as a result of spherical aberration of said yoke means is corrected by the combination of means generating said convergence deflecting voltage so as to include in the latter a static convergence voltage and a dynamic convergence voltage which is varied in synchronism with said sweep signals applied to said yoke means for deflection of said beams in said direction parallel to said plane, whereby to eliminate the component of said misconvergence in said direction parallel to said plane, and coil means in said deflection yoke means receiving said sweep signals for deflection of the beams in said direction at right angles to said plane and being arranged to provide a resulting magnetic field which is non-uniform so as to eliminate the component of said misconvergence in said direction at right angles to said plane.

2. A color picture tube according to claim **1**, in which said common plane of the electron beams is substantially horizontal, and said magnetic field provided by said coil means is barrel-shaped.

3. A color picture tube according to claim **2**, in which said deflection yoke means has an annular magnetic core, and said coil means includes a first pair of coils which are wound in the same direction and arranged on said core above a horizontal plane passing through the center of said core and which are spaced apart at opposite sides of a vertical plane passing through said center, and a second pair of coils arranged on said core below said horizontal plane and being spaced apart at opposite sides

of said vertical plane, said coils of the second pair being wound in the direction opposed to said direction of winding of said first pair of coils and being connected in series with the latter to receive the vertical sweep signal.

4. A color picture tube according to claim 3, in which the angular extent of each of said first and second pairs of coils on said core is selected to provide the barrel-shape of said magnetic field requisite for the elimination of the vertical component of said misconvergence.

5. A color picture tube according to claim 1, in which said common plane of the electron beams is substantially vertical, and said magnetic field provided by said coil means is of pin-cushion shape.

6. A color picture tube according to claim 5, in which said deflection yoke means has an annular magnetic core, and said coil means includes oppositely wound coils arranged on said core at diametrically opposed side portions of the latter, said coils being series connected to receive the horizontal sweep signal and having the height thereof on said core selected to provide the pin-cushion shape of said magnetic field requisite for the elimination of the horizontal component of said miconvergence.

References Cited

UNITED STATES PATENTS

2,690,517	9/1954	Nicoll et al.	313—82 X
2,907,915	10/1959	Gleichauf	315—13
2,925,542	2/1960	Gethmann	335—213
2,991,392	7/1961	Kratochvil et al.	315—27
3,325,675	6/1967	Sanford	315—13
3,430,099	2/1969	Ahley	315—27

RODNEY D. BENNETT, JR., Primary Examiner

MALCOLM F. HUBLER, Assistant Examiner

U.S. Cl. X.R.

314—27; 335—213