June 29, 1965 L. W. NERO 3,192,432

ELECTRON BEAM DEFLECTION YOKE

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FIG. 1

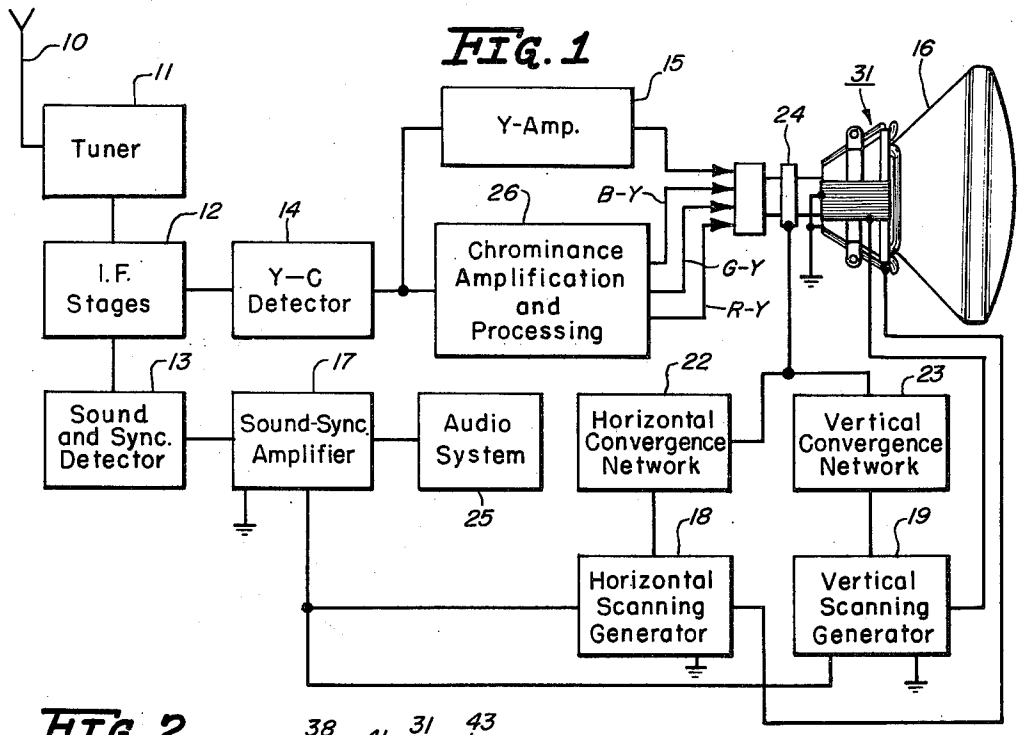
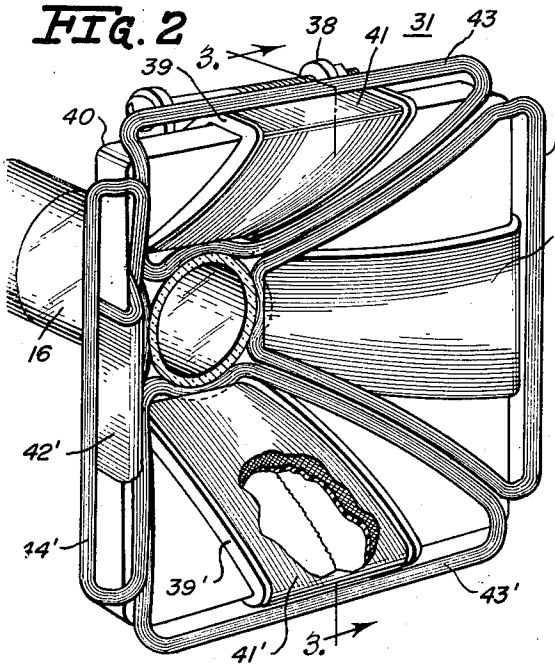



FIG. 2



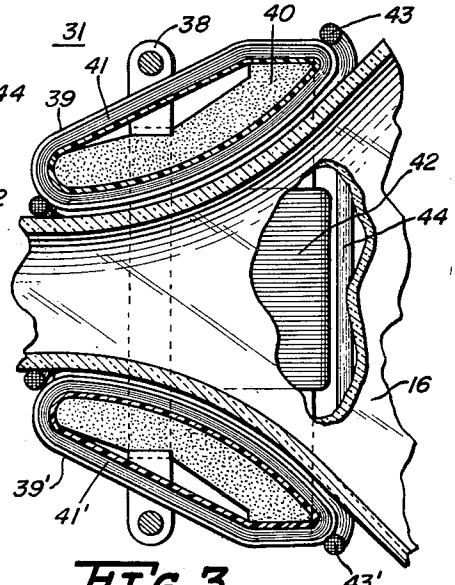




FIG. 3

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ELECTRON BEAM DEFLECTION YOKE

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FIG. 4

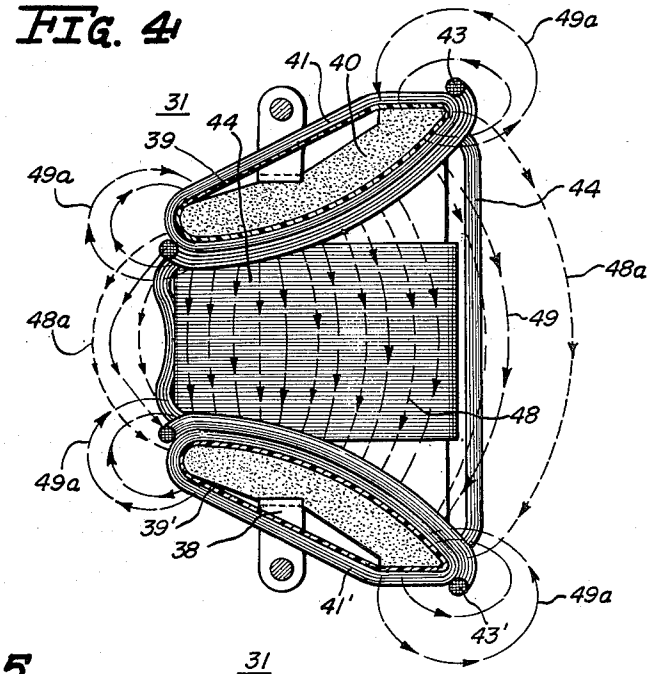



FIG. 5

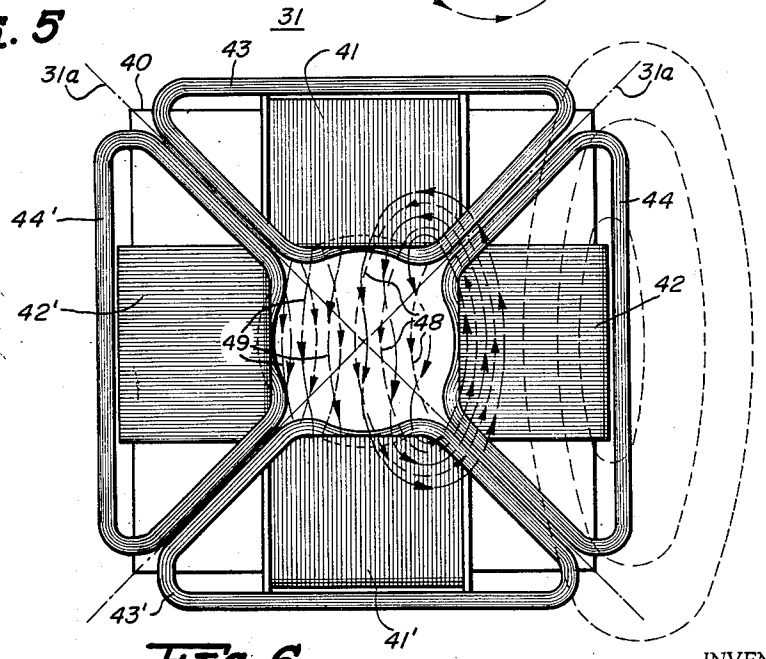
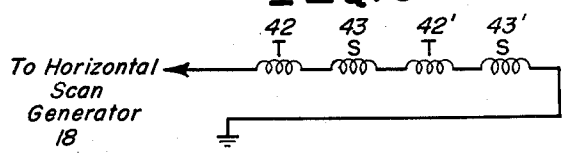



FIG. 6




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FIG. 7

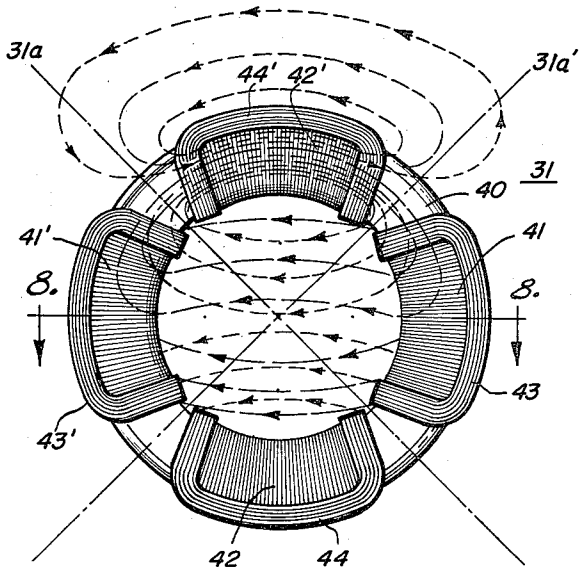
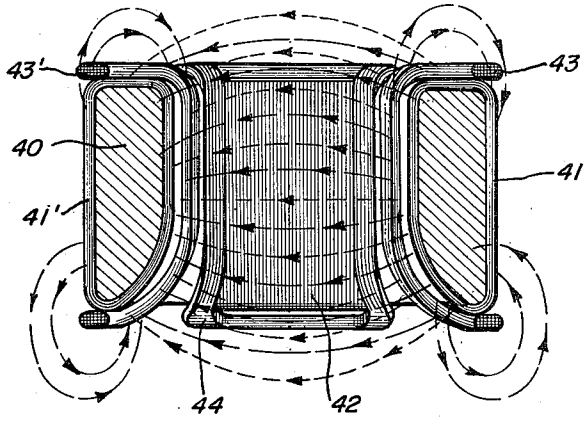



FIG. 8



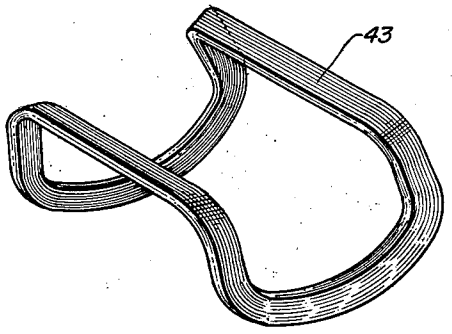




FIG. 9

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3,192,432

# ELECTRON BEAM DEFLECTION YOKE

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Filed Sept. 24, 1962, Ser. No. 225,464
10 Claims. (Cl. 315—27)

The present invention relates to deflection yokes for cathode-ray tubes and while useful in monochrome devices it is particularly advantageous for color cathode-ray tubes and will be described in that environment.

In color as well as monochrome cathode-ray tubes, it is conventional practice to employ a deflection yoke to cause the electron beam or beams to scan a target screen in both horizontal and vertical directions. Because it is desirable to construct short cathode-ray tubes with large angle deflection, errors, commonly referred to as pin cushion pattern errors, may be encountered as the beam deflection radius is not equal to the radius of curvature of the screen.

In conventional monochrome tubes, such pin cushion errors may be compensated by exposing the beam to external magnetic fields commonly produced by permanent magnets placed adjacent the tube envelope. While this correction technique is acceptable for single beam tubes, it does not produce adequate results when employed in multi-beam tubes because the permanent magnets do not vary the beam paths in equal manner.

It is well known that the image reproduced by a cathode-ray tube will reflect the generated flux irregularities and non-linearities if any are present in the beam deflection region of the deflection yoke. Accordingly, it has been the practice to provide a deflection yoke with complicated coil structures for developing a linear field in the beam deflection region. Even the most successful structures have been undesirably complex and sophisticated coil winding techniques and apparatus must be employed to produce their coils.

Furthermore, conservation of deflection power has always been of importance in monochrome receivers and is just as important in the design of deflection yokes and associated circuits for color receivers. When deflection yokes are made more efficient, a corresponding decrease in deflection power is realized resulting in a cost saving in the deflection circuitry.

It is, therefore, an object of this invention to provide a new and improved deflection yoke for a cathode-ray tube.

It is another object of this invention to provide a new and improved deflection yoke for a multi-beam cathode-ray tube.

It is an additional object of this invention to provide a new and improved deflection yoke for a cathode-ray tube which eliminates pin cushion error in reproduced images.

It is a further object of this invention to provide a new and improved deflection yoke for a cathode-ray tube which operates in an efficient manner.

It is still another object of this invention to provide a new and improved deflection yoke for a cathode-ray tube which is simple and economical to construct.

A deflection yoke constructed in accordance with the invention comprises a core member of generally cylindrical configuration enclosing a beam-deflection region and flaring from a small diameter at its leading end to a maximum diameter in the direction of its opposite end. A toroidal coil is wound around one quadrant of the core for excitation at a particular scanning frequency and a saddle coil is wound around a contiguous quadrant of the core for excitation at the same scanning frequency.



Also provided are conductive means for interconnecting the toroidal and the saddle coils.

In one specific aspect of the invention, having to do with color cathode-ray tubes, the toroidal coil is of the uniform density type and, in conjunction with the specific core configuration establishes a pin cushion field, especially at the end of the yoke closer to the image screen. This will be recognized as the appropriate field configuration to compensate pin cushion pattern distortion attributable to the geometry of the screen. The toroidal coil however has an adverse effect on such beam properties as focus and, for the case of a multi-beam tube, convergence but this is compensated by the saddle coil which introduces a field of barrel type configuration. Additionally, at both ends of the yoke the saddle coil has the effect of increasing the apparent reluctance of the magnetic path especially for fringing field effects. This increases the field internally of the yoke and increases the sensitivity of the winding structure.

The features of this invention which are believed to be novel are set forth with particularity in the appended claims. The invention, together with further objects and advantages thereof, may best be understood, however, by reference to the following description taken in conjunction with the accompanying drawings, in the several figures of which like reference numerals identify like elements, and in which:

FIGURE 1 is a block diagram of a color television receiver incorporating the invention;

FIGURE 2 is a perspective view, partly broken away, of a preferred form of deflection yoke embodying the invention positioned about the neck of a cathode-ray tube;

FIGURE 3 is a cross-sectional view, partly broken away, taken along lines 3—3 of FIGURE 2;

FIGURE 4 is a cross-sectional view similar to that of FIGURE 3 but omitting representation of the tube;

FIGURE 5 is an elevational view of the embodiment of FIGURE 2;

FIGURE 6 is a partial electrical schematic of certain flux developing coils of the embodiment of FIGURE 2;

FIGURE 7 is an elevational view of an alternative embodiment of the invention;

FIGURE 8 is a cross-sectional view taken along lines 8—8 of FIGURE 7; and

FIGURE 9 is a perspective view of a saddle winding of the embodiment of FIGURE 7.

In the color television receiver shown in FIGURE 1, composite color signals received by antenna **10** are applied to the input circuit of a tuner **11**. Tuner **11** comprises one or more stages of radio-frequency amplification and a converter or first detector. Intermediate-frequency composite color signals developed by tuner **11** are applied to an intermediate-frequency (IF) amplifier **12** of any desired number of stages. The amplified intermediate-frequency signal from amplifier **12** is concurrently applied to a pair of detectors **13** and **14**, one for deriving the sound signal components and the other for deriving the brightness (Y) and chrominance (C) signal components. The sound detector **13** is also used to derive synchronizing (sync) information as is conventional; however, it is known to utilize either detector for obtaining synchronizing information.

The detected brightness or Y signal is applied from detector **14** to a Y amplifier **15** of any desired number of stages and the amplified brightness signal is impressed upon the cathodes of each of three electron guns of a conventional three-beam tri-color kinescope **16**.

The sound and sync signals from sound detector **13** are amplified in a sound-sync amplifier **17** of one or more stages which includes a synchronizing-signal sep-

arator. The amplified and separated sync signal is then concurrently applied to both horizontal scanning signal generator 18 and vertical scanning signal generator 19. Horizontal scanning generator 18 includes a line-frequency oscillator, a phase detector and a frequency control stage to provide automatic control of the oscillator frequency. Vertical scanning generator 19 employs a field scanning signal developer or driver and one or more stages of amplification. Scanning signal generators 18 and 19 are coupled to respective line-frequency and field-frequency magnetic deflection elements or coils which form a yoke 31 to be discussed in more detail subsequently.

Energy derived from horizontal scanning generator 18 and from vertical scanning generator 19 is fed respectively to a horizontal convergence network 22 and a vertical convergence network 23. Vertical convergence network 23 develops appropriate dynamic convergence signals which are applied to a convergence yoke 24 associated with tri-color kinescope 16. Horizontal convergence network 22 develops similar signals which also are applied to yoke 24.

An automatic gain control potential is developed in the synchronizing-signal separator of the sound-sync amplifier 17 for application to tuner 11 or IF amplifier 12 as is well understood in the art. Intercarrier sound signals developed from the output circuit of the sound-sync amplifier are applied to a conventional audio system 25 which comprises a limiter, a discriminator, an audio amplifier of any desired number of stages and a loudspeaker or other sound reproducing device. Detected video signals from Y-C detector 14 are applied to suitable chrominance amplification and processing circuits 26 which are of entirely conventional construction. As is typical, these circuits include one or more stages of chrominance amplification, a color burst amplifier and separator, a color reference oscillator with an associated automatic frequency control circuit, a color killer and a pair of synchronous demodulators for developing three color difference signals R-Y, G-Y and B-Y corresponding to the chrominance information associated with the three primary colors, red, green and blue. The color difference signals developed by circuits 26 are applied respectively to the control grids of the three electron guns of kinescope 16. If desired, chrominance amplification and processing circuits 26 may also comprise appropriate automatic chrominance control circuits and, of course, appropriate controls for adjusting hue and saturation of the reproduced image.

As thus described, the receiver is entirely conventional so that only a brief description of its operation need be recited here. The received color telecast intercepted by antenna 10 is selected by appropriate adjustment of tuner 11 where it is amplified and converted to an intermediate-frequency signal which is amplified in amplifier 12. The intermediate-frequency signal is then applied to Y-C detector 14 and to sound and sync detector 13. The output signal of detector 14 is applied to Y amplifier 15 to develop a luminance signal which is applied to the cathodes of the electron guns of the picture tube. Furthermore, Y-C detector 14 also presents an output signal to chrominance amplification and processing network 26 which develops the chrominance signal information for concurrent application to the three electron guns of tube 16.

The output signal from sound and sync detector 13 concurrently drives audio system 25 in known fashion to produce the audio program accompanying the telecast and is used to control the vertical and horizontal sweep circuits of generator networks 18 and 19. Accordingly, appropriate synchronizing scanning signals are developed and applied to deflection yoke 31 of picture tube 16 to deflect electron beams issued by the guns across the target electrode of the screen and develop an image raster thereupon.

Since the electron beams are suitably modulated by luminance information from detector 14 and by chrominance information from network 26, the traverse of the screen under the influence of the deflection fields of yoke 31 results in the reproduction of a visual image. The shadow-mask tube 16 is of conventional construction and the reproduction is that of three image fields effectively superposed to yield an image in simulated natural color.

More particular consideration will now be given to the construction of deflection yoke 31 the details of which, both from the standpoint of structure and patterns of magnetic flux, are illustrated in FIGURES 2 to 6, inclusive. This yoke has a core member 40 of generally cylindrical configuration enclosing a beam-deflection region and, of course, having internal dimensions appropriate for the yoke to be applied to the tube by being slid over its neck portion toward the flared or conical section thereof. The expression "cylindrical configuration" is here used to define not only a cylinder of circular cross-section but also structures of elliptical, rectangular, square or other cross-section. Actually, maximum sensitivity for the deflection yoke is attained by shaping the internal cross-section to correspond with that of the cathode-ray tube and this would call for a yoke of annular cross-section but experience has shown that such a yoke introduces winding complications and, therefore, it is preferred that the yoke have a square shape as indicated particularly in FIGURE 5. This not only leads to simplicity of the windings and desirable reproducibility properties but also permits a very advantageous combination of cooperating winding sections presently to be described. Where the yoke is square in cross section, each side may be thought of as constituting a quadrant. As illustrated particularly well in FIGURE 4, the core flares from a minimum internal diameter at one end toward a maximum diameter in the direction of its opposite end. Specifically, the small-diameter end faces the electron gun of the tube and the opposite end is closer to the screen section. The problem of neck shadow is best accommodated by employing a maximum flare for the core but increasing the flare decreases sensitivity and, therefore, the specific flare adopted is a compromise for best sensitivity commensurate with acceptable neck shadow. It has further been found that the property of the yoke, presently to be described, leading to reduced fringe fields or external stray fields shortens the effective length of the yoke and effectively advances the center of deflection toward the screen which further aids in avoiding neck shadows.

To facilitate arranging the coil windings on the core, the core may be formed of four separate pieces or legs each serving as a quadrant as defined by the perpendicular axes 31*a* and 31*a'* in FIGURE 5. Alternatively, the core may be molded as a single piece and then cracked to provide two complementary sections as indicated in FIGURE 2. In any event, the core sections may be joined and held in an assembly by a non-magnetic clamp 38 which circumscribes the core structure and is received in a channel formed on the external surface of the core.

A compound winding is employed in the yoke which basically comprises pairs of coils for developing magnetic fields which aid one another within the deflection regions defined by the core but which oppose one another, at least in part, in the external regions adjacent the ends of the core in order to minimize fringe fields and improve sensitivity. More particularly, there is a pair of uniform density toroidal coils 41, 41' used for vertical deflection and a pair of uniform density toroidal coils 42, 42' which provide the field for horizontal deflection. In other words, these toroidal coils have a uniform dimension in the direction of beam travel; they are not fanned out along the coil section which supports them. Cooperating with coil pairs 41, 41' and 42, 42' are pairs of close wound saddle coils 43, 43' and 44, 44'. Each toroidal coil is wound on one quadrant of the core for excitation at a particular scanning frequency and is associated with a saddle coil wound around a contiguous quadrant of the core for excitation at the same scanning frequency. In

terms of deflection fields, vertical toroidal coils 41, 41' are operatively associated and arranged in series circuit with saddle coils 44, 44' while horizontal toroidal coils 42, 42' are excited in series with saddle coils 43, 43'. Mechanically, coil pair 42, 42' are wound directly on their quadrants of the core while coil pair 41, 41' are wound on bobbins or coil forms 39, 39' which are threaded into position on the appropriate quadrants of the core prior to completion of the core assembly. These coil pairs 41 and 42 enclose the magnetic core.

The saddle coils have sections concentrated in the corner regions of the yoke to follow the flare thereof as depicted in FIGURE 5 by the coil sections which are arranged generally parallel to axes 31*a* and 31*a*'. The return paths of these winding sections may enclose the core or the non-magnetic section inside the yoke; the latter expedient has been shown. It has been adopted to perform a dual function as will be made clear hereafter. Accordingly, the saddle coils are disposed within the core with their flared sections confined to the corners of the supporting core structure. They may be retained in place by glue, tape or by means of any conventional securing device which has no adverse effect on the magnetic field pattern of the yoke.

Of course, there is considerable latitude in the specific configuration adapted for the several windings associated with the core. The specifications for any particular deflection yoke are dictated by the results desired. The illustrative embodiment under consideration is for a tricolor cathode-ray tube of the three beam type and also of the type wherein the geometry of the screen section, unless compensated, introduces pin cushion pattern distortion. The yoke not only compensates for this pattern distortion but at the same time has uniform field properties in the sense that the yoke windings introduce no adverse influence on the focus and convergence of the beams. The consideration of the relevant magnetic fields for horizontal deflection will suffice to explain the effectiveness of the yoke in attaining this desired objective; a generally similar explanation may be made for the coils involved in vertical deflection.

Consider initially the pair of toroidal coils 42, 42' and assume them to be connected with line scanning generator 18 to establish a deflection field causing the electron beams to traverse the image screen in a horizontal direction. The field established by this coil pair is represented by construction lines 48 in FIGURES 4 and 5. The field extends transversely of the beam-deflection region defined by the core and since these coils do not flare or fan out on their supporting core sections, the field which they establish exhibits pin cushion distortion which increases percentagewise in the direction of beam travel, that is to say, increases from the small diameter end of the deflection yoke to the large diameter end. Actually, the variation in pin cushion field may be controlled through shaping of the toroidal winding, assuming a core of fixed dimensions. If the coil is bunched, that is to say, reduced in transverse dimension in the direction of beam travel, a maximum percentage change in pin cushion field results. On the other hand, if the coil is fanned, that is to say, increased in transverse dimension in the direction of beam travel, a minimum percentage change may be effected. As shown, the parameters of the yoke are selected to permit obtaining the required field through the use of a uniform density coil having a constant transverse dimension since this simplifies the yoke fabrication. More particularly, the field obtained compensates the pin cushion pattern distortion attributable to the geometry of the screen which is one of the stated objectives of the deflection system. It may be shown that correction for pin cushion pattern distortion requires that the deflection sensitivity be variable as the beam is displaced from the center to the corners of deflection. As the beam approaches the corner sections of core 40 the field decreases and the deflection sensitivity is reduced, fulfilling this requirement of variation in deflection sensitivity. Manifestly, the deflection distance from the axis of the yoke is small in the section which faces the electron gun and much larger in the other end section which faces the screen and the bulk of pattern correction takes place at the latter portion of the yoke. Therefore, the field resulting from toroidal coils 42, 42' may be characterized predominantly as a pin cushion type of horizontal deflection field at the section of the yoke facing the screen.

Such a field may adversely influence beam focus and convergence but this influence may be compensated by the introduction of a magnetic field exhibiting barrel type distortion particularly in the rear section of the yoke which faces the electron gun. This is the function accomplished principally by the portions of saddle coils 43, 43' disposed internally of the yoke and especially at its leading end. The field of these coils is designated by construction lines 49 in FIGURE 5. The extent of compensation may be adjusted by selection of the number of turns in the saddle coils. In short, this described function of the saddle coils is to develop a magnetic field which, considered by itself, exhibits barrel type distortion in the vertical field. Throughout the region enclosed by the yoke, especially in the leading section thereof, this field aids the field of the toroidal coils to the end that pin cushion pattern distortion is compensated and yet from the standpoint of focus and convergence the deflection yoke may be characterized as exhibiting a uniform field along its length. Of course, since both pairs of coils are to be excited at the same scanning frequency, they are connected in series to the horizontal scanning generator as indicated symbolically in FIGURE 6.

At the ends of the yoke, deflection coils 42, 42' tend to establish fringing fields as indicated by dotted construction line 48*a*. Concurrently, the end portions of saddle coils 43, 43' develop fields shown by construction lines 49*a*. The arrows designate the field directions from which it may be observed that the fields of the saddle coil have a component in opposition to the fringe fields of the toroidal coil. The opposing field components have the effect of increasing the reluctance externally of the yoke at the front and back back ends and reduce the external stray fields that are otherwise developed. As a consequence, the internal field increases and the sensitivity of the deflection yoke is increased correspondingly.

By way of summary, the yoke structure has a first means, including the toroidal coils, for producing a first flux pattern having a disortion or distribution for compensating a pattern distortion of the scanning raster attributable to the geometry of the screen. In particular, the flux exhibits pin cushion distortion as required to compensate pin cushion raster distortion. The deflection yoke has a second flux producing means, specifically the saddle coils, for establishing a second field which aids the first field within the deflection region defined by the core of the deflection assembly. At the external portions of the core the field of the saddle coils partially opposes the external field created by the toroidal coils to increase sensitivity. The effect of the field from the saddle coils internally of the core is to compensate adverse influences that the first field may exert upon such parameters of the electron beams as focus and convergence.

The embodiment of FIGURES 7 and 8 is very similar to that just described, differing principally in the cross-sectional configuration of the core member which, in this case, is circular. It will further be observed that the flare or fanning of the saddle coils, shown in FIGURE 9, is not quite as pronounced in this embodiment as in the first. Also, since the core is annular in cross-section there inherently is a slight fanning of the toroidal coils which is not the case when they are found over linear portions of the core as in the first described structure.

Aside from these differences, the yokes operate in essentially the same way.

One deflection yoke constructed in accordance with the illustrations of FIGURES 2 to 4 and found acceptable for sweeping a three-beam color tube of 92 degrees deflection angle had the following dimensions and components:

Material of core 40—ferrite
Minimum internal diameter of core 40—1.670 inches
Maximum internal diameter of core 40—3.460 inches
Axial length of core 40—1.843 inches
Coils 41, 41'—270 turns of No. 27 wire
Coils 42, 42'—176 turns of No. 27 wire
Coils 43, 43'—40 turns of No. 26 wire
Coils 44, 44'—60 turns of No. 26 wire
Length of fanned section of the saddle coils; front—3.4 inches; rear—1.6 inches

The described yoke has maximum sensitivity commensurate with the avoiding adverse effects on other parameters and permits the use of a relatively simple winding arrangement. For this reason it lends itself to production techniques because of its reproducibility and relative simplicity of manufacture and accomplishes correction for pin cushion pattern distortion without adversely affecting focus and convergence.

While particular embodiments of the invention have been shown and described, it will be obvious to those skilled in the art that changes and modifications may be made without departing from the invention in its broader aspects, and, therefore, the aim in the appended claims is to cover all such changes and modifications as fall within the true spirit and scope of the invention.

I claim:

1. An electron beam deflection yoke for a cathode-ray tube comprising:
a core member of generally cylindrical configuration enclosing a beam-deflection region and flaring from a small diameter at its leading end to a maximum diameter in the direction of its opposite end;
a toroidal coil wound around one quadrant of said core for excitation at a particular scanning frequency;
a saddle coil wound around a contiguous quadrant of said core for excitation at said scanning frequency; and
conductive means interconnecting said toroidal and said saddle coils.

2. An electron beam deflection yoke for a cathode-ray tube having a screen the geometry of which introduces pin-cushion pattern distortion, said yoke comprising:
a core member of generally cylindrical configuration enclosing a beam-deflection region and flaring from a small diameter at its leading end to a maximum diameter in the direction of its opposite end;
a toroidal coil wound around one quadrant of said core and responsive to excitation at a particular scanning frequency to develop a deflection field having pin cushion distortion in an amount to cancel said pattern distortion, said deflection field further tending to impose undesired focus and convergence effects on the beam of said tube;
a saddle coil wound around a contiguous quadrant of said core and responsive to excitation at said scanning frequency to develop a compensating field having barrel type distortion for compensating said undesired effects of said deflection field; and
conductive means interconnecting said toroidal and said saddle coils.

3. An electron beam deflection yoke for a cathode-ray tube having a screen the geometry of which introduces pin-cushion pattern distortion, said yoke comprising:
a core member of generally cylindrical configuration enclosing a beam-deflection region and flaring from a small diameter at its leading end to a maximum diameter in the direction of its opposite end;
a pair of toroidal coils wound around opposite quadrants of said core and responsive to excitation at a particular scanning frequency to develop a deflection field having pin cushion distortion in an amount to cancel said pattern distortion, said deflection field further tending to impose undesired focus and convergence effects on the beam of said tube;
a pair of saddle coils wound around the remaining quadrants of said core and responsive to excitation at said scanning frequency to develop a compensating field having barrel type distortion for compensating said undesired effects of said deflection field; and
conductive means interconnecting said pairs of toroidal and saddle coils.

4. An electron beam deflection yoke for a cathode-ray tube having a screen the geometry of which introduces pin-cushion pattern distortion, said yoke comprising:
a core member of generally cylindrical configuration enclosing a beam-deflection region and flaring from a small diameter at its leading end to a maximum diameter in the direction of its opposite end;
a pair of uniform density toroidal coils wound around opposite quadrants of said core and responsive to excitation at a particular scanning frequency to develop a deflection field having pin cushion distortion which increases in the direction of said screen to cancel said pattern distortion, said deflection field further tending to impose undesired focus and convergence effects on the beam of said tube;
and a pair of saddle coils wound around the remaining quadrants of said core and responsive to excitation at said scanning frequency to develop a compensating field having barrel type distortion for compensating said undesired effects of said deflection field.

5. An electron beam deflection yoke for a cathode-ray tube having a screen the geometry of which introduces pin-cushion pattern distortion, said yoke comprising:
a core member of generally cylindrical configuration enclosing a beam-deflection region and flaring from a small diameter at its leading end to a maximum diameter in the direction of its opposite end;
a pair of toroidal coils wound around opposite quadrants of said core and responsive to excitation at a particular scanning frequency to develop a deflection field having pin cushion distortion in an amount to cancel said pattern distortion, said deflection field further tending to impose undesired focus and convergence effects on the beam of said tube;
a pair of saddle coils wound around the remaining quadrants of said core and fanned outwardly at said opposite end of said core for excitation at said scanning frequency; and
conductive means interconnecting said pairs of toroidal and saddle coils.

6. An electron beam deflection yoke for a cathode-ray tube having a screen the geometry of which introduces pin-cushion pattern distortion, said yoke comprising:
a core member of generally cylindrical configuration enclosing a beam-deflection region and flaring from a small diameter at its leading end to a maximum diameter in the direction of its opposite end;
a pair of toroidal coils wound around opposite quadrants of said core and responsive to excitation at a particular scanning frequency to develop a deflection field having pin cushion distortion in an amount to cancel said pattern distortion, said deflection field further tending to impose undesired focus and convergence effects on the beam of said tube;
a pair of saddle coils wound around the remaining quadrants of said core and responsive to excitation at said scanning frequency to develop a compensating field having barrel type distortion for compensating said undesired effects of said deflection field, said saddle coils having end sections at said opposite ends of said yoke to at least partially cancel external fringe fields

of said toroidal coils and increase the sensitivity of said yoke at said scanning frequency; and conductive means interconnecting said toroidal and said saddle coils.

7. An electron beam deflection yoke for a cathode-ray tube having a screen the geometry of which introduces pin-cushion pattern distortion, said yoke comprising:

a core member of generally cylindrical configuration enclosing a beam-deflection region and flaring from a small diameter at its leading end to a maximum diameter in the direction of its opposite end;

a pair of toroidal coils wound around opposite quadrants of said core and responsive to excitation at a particular scanning frequency to develop a deflection field having pin cushion distortion in an amount to cancel said pattern distortion, said deflection field further tending to impose undesired focus and convergence effects on the beam of said tube;

a pair of saddle coils wound around the remaining quadrants of said core and responsive to excitation at said scanning frequency, having flared sections disposed within the bore of said core to develop a compensating field having barrel type distortion for compensating said undesired effects of said deflection field, said saddle coils further having end sections at said opposite ends of said yoke to at least partially cancel external fringe fields of said toroidal coils and increase the sensitivity of said yoke at said scanning frequency; and conductive means interconnecting said pairs of toroidal and saddle coils.

conductive means interconnecting said pairs of toroidal and saddle coils.

8. An electron beam deflection yoke for a cathode-ray tube having a screen the geometry of which introduces pin-cushion pattern distortion, said yoke comprising:

a core member of generally cylindrical configuration having essentially a square cross section, enclosing a beam-deflection region and flaring from a small diameter at its leading end to a maximum diameter in the direction of its opposite end;

a pair of toroidal coils wound around opposite quadrants of said core and responsive to excitation at a particular scanning frequency to develop a deflection field having pin cushion distortion in an amount to cancel said pattern distortion, said deflection field further tending to impose undesired focus and convergence effects on the beam of said tube;

and a pair of saddle coils wound around the remaining quadrants and concentrated at the corners of said core and responsive to excitation at said scanning frequency to develop a compensating field having barrel type distortion for compensating said undesired effects of said deflection field.

9. An electron beam deflection yoke for a cathode-ray tube having a screen the geometry of which introduces pin-cushion pattern distortion, said yoke comprising:

a core member of generally cylindrical configuration enclosing a beam-deflection region and flaring from a small diameter at its leading end to a maximum diameter in the direction of its opposite end;

means for producing at said opposite end of said core a deflection field having pin-cushion distortion to cancel said pattern distortion but also tending to impose undesired focus and convergence effects on the beam of said tube;

and means for producing a deflection field having barrel type distortion at said leading end of said core for compensating said undesired effects of said first-mentioned deflection field.

10. An electron beam deflection yoke for a cathode-ray tube having a screen the geometry of which introduces pin-cushion pattern distortion, said yoke comprising:

a core member of square cross-section, enclosing a generally circular beam-deflection region and flaring from a small cross-section at its leading end to a maximum cross-section at its opposite end;

a first pair of toroidal coils wound around a first set of opposite quadrants of said core and responsive to excitation by a horizontal scanning frequency signal to develop a deflection field having pin cushion distortion in an amount to cancel the horizontal components of said pattern distortion, said deflection field further tending to impose undesired focus and convergence effects on the beam of said tube;

a first pair of saddle coils wound around the remaining set of opposite quadrants and concentrated at the corners of said core and responsive to excitation by said horizontal scanning frequency signal to develop a compensating field having barrel type distortion for compensating said undesired effects of said deflection field caused by said first pair of toroidal coils;

a second pair of toroidal coils wound around said remaining set of opposite quadrants and responsive to excitation by a vertical scanning frequency signal to develop a deflection field having pin cushion distortion in an amount to cancel the vertical components of said pattern distortion, said deflection field further tending to impose undesired focus and convergence effects on the beam of said tube;

and a second pair of saddle coils wound around said first set of opposite quadrants and concentrated at the corners of said core and responsive to excitation by said vertical scanning frequency signal to develop a corresponding field having barrel type distortion for compensating said undesired effects of said deflection field caused by said second pair of toroidal coils.

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