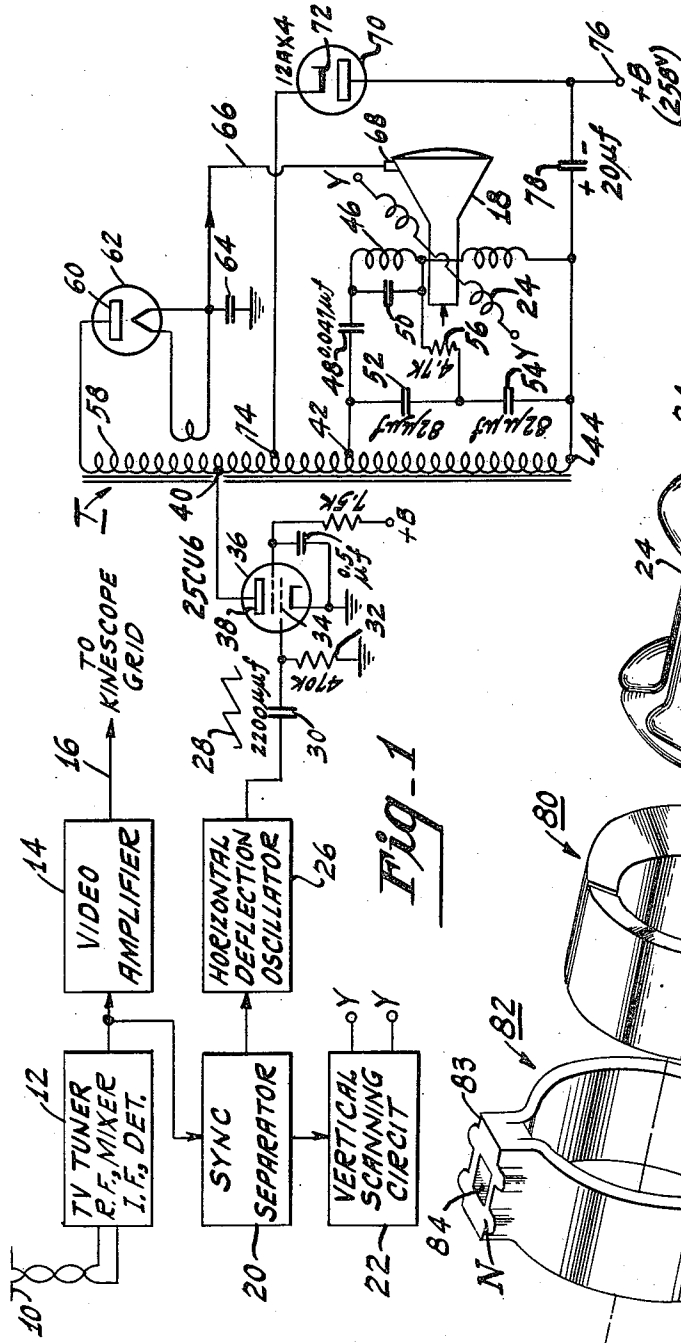
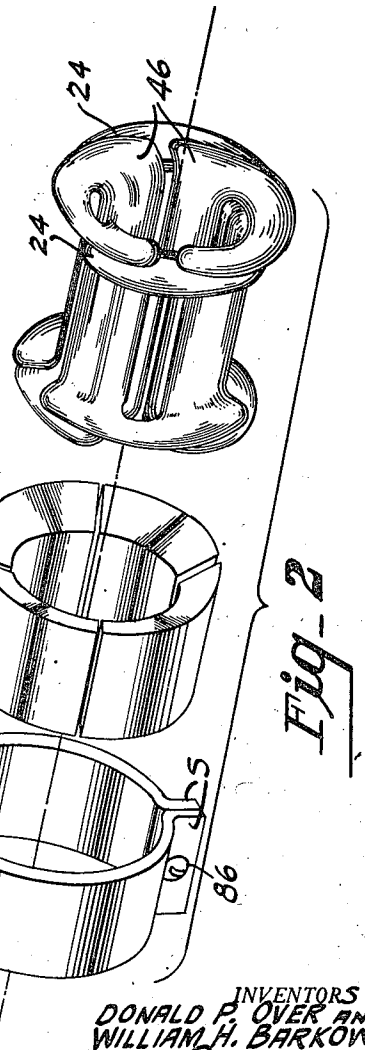
Dec. 24, 1957 D. P. OVER ET AL 2,817,782

CATHODE RAY TUBE DEFLECTION APPARATUS

Filed July 9, 1954 2 Sheets-Sheet 1





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CATHODE RAY TUBE DEFLECTION APPARATUS

Filed July 9, 1954 2 Sheets-Sheet 2

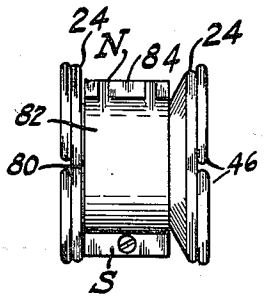


Fig_3

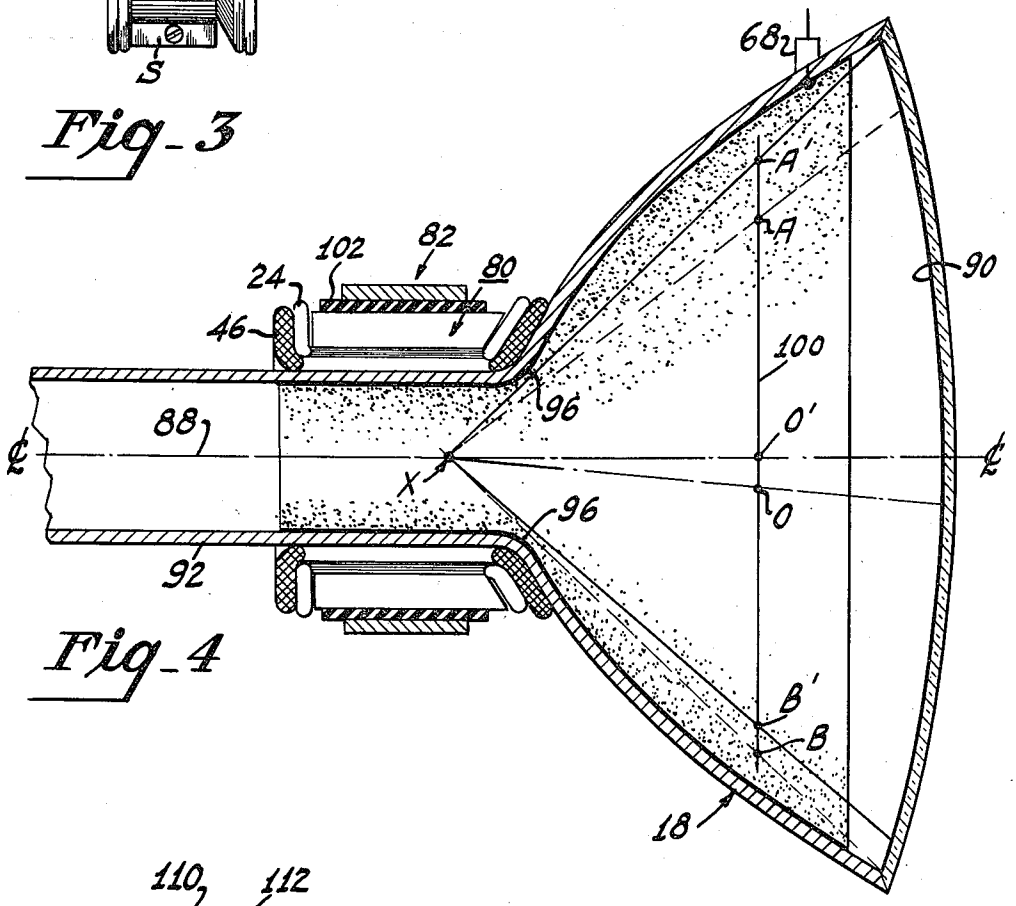


Fig_4

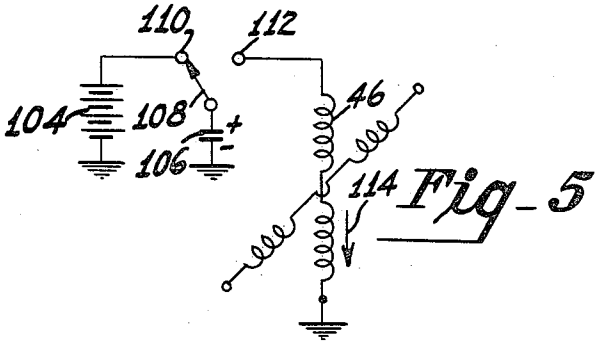


Fig_5

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CATHODE RAY TUBE DEFLECTION APPARATUS

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5 Claims. (Cl. 313—76)

The present invention relates to new and improved cathode ray tube deflection apparatus and, more particularly, to a beam-centering system for use in conjunction with the kinescope of a television receiver.

In the cathode ray tube art, it is well-known to deflect an electron beam in two rectangular coordinates whereby to cause such beam to scan a raster on the luminescent screen of an image-reproducing kinescope. For various reasons including those of compensating for the manufacturing tolerances of the kinescope beam-forming electrodes and the deflection apparatus itself, there has long been present the need for effective beam-centering means. In the case of electromagnetic deflection systems wherein two pairs of electromagnetic coils are furnished with suitable current wave forms of specific vertical and horizontal frequencies, several schemes have been proposed in the past for effecting proper centering of the electron beam. One such scheme is that of supplying a unidirectional current to the deflection coils whereby to afford a fixed magnetic component to the varying magnetic field setup by the currents in the coils. While this proposal, known as D. C. centering, has been found to be quite effective in use, it is a costly system requiring the addition of components to the deflection system which would otherwise be unnecessary.

Another known arrangement for effecting beam centering in a cathode ray tube is that which provides permanently magnetized members associated with the path of the electron beam for providing a fixed magnetic field component. In the case of wide angle kinescopes wherein the beam may be deflected through 90°, for example, it is necessary to maintain the center of deflection as close to the flared portion of the kinescope as is practicable, in order to prevent the beam from striking the neck of the tube in a manner which causes an objectionable "shadow effect."

It is a primary object of the present invention to provide simplified but effective electron beam centering means of the permanent magnet type.

A further object of the invention is the provision of electron beam centering means, which means does not undesirably shift the deflection center rearwardly of the kinescope neck.

In order to illustrate the utility and efficacy of the present invention it will be described herein in connection with one popular form of commercial television receiver deflection arrangement which is of itself of simple and inexpensive construction. As is well-known to those skilled in the art, presently used electromagnetic deflection arrangements for providing the horizontal scanning energy are mainly of the so-called "reaction scanning" type in

which deflection during a portion of the scanning time is due to the action of a driver tube coupled through a transformer to the horizontal deflection coils, while the remaining portion of the scan is effected by the conduction of a damper tube connected in shunt with the coils. That is to say, the inductance of the coils and transformer forms, together with the inherent capacities of the system, a resonant circuit which furnishes the energy for rapid flyback of the beam to an extreme position on the tube screen. After one-half cycle of the free oscillation, the damper tube is rendered conductive and serves to damp the remaining cycles of the ringing. Normally, and as described and claimed in U. S. Patent No. 2,598,134, granted May 27, 1952, to O. H. Schade for "Power Conservation System," the current through the damper tube is stored in a large "B-boost" capacitor for increasing the available operating potential for the driver tube. Moreover, conventional systems often include a linearity inductance in circuit with the "B-boost" capacitor and damper tube for improving the linearity of the scan, as described and claimed in U. S. Patent No. 2,440,418, granted April 27, 1948 to S. I. Tourshou for "Cathode Ray Beam Deflecting Circuit."

The matter of beam-centering has been found to be particularly acute with low cost television deflection arrangements from which the linearity inductance is omitted in the interest of economy. That is to say, the omission of the linearity inductance has been found to result in the cramping of the righthand portion of the scanned raster, such that the geometric center of the distorted raster is actually not coincident with the physical center of the tube screen. While it would be possible to "decenter" the beam through the use of direct current centering energy applied to the deflection coils, such a solution is inimical to the interests of economy.

Moreover, in the case of wide-angle deflection kinescopes, and as has been mentioned briefly supra, any permanent magnet centering device which is located any appreciable distance from (i. e. nearer the electron gun) the effective deflection center of the yoke is objectionable because of its production of the shadow effect resulting from the beam's striking the tube neck.

Hence it is still another object of the present invention to provide simple and inexpensive, yet extremely effective, permanent magnet beam-centering means, which means is particularly well-adapted for use with low-cost, wide angle deflection yokes.

In general, the present invention may be understood as follows: commercial television deflection yokes comprise a pair of arcuate horizontal coils surrounded by a similar pair of vertical coils disposed at right angles to the horizontal coils. In order to increase the efficiency of the coils, it is also common practice to provide a magnetic core surrounding the longitudinal conductors of the coils in such manner as to afford a low reluctance return path for the electromagnetic deflection flux. Such cores are normally made of a plurality of ferrite sections which together form a cylinder. A strap of steel or similar material surrounds the core sections and holds them securely about the deflection coils, thereby forming a completely self-contained and rigid structure. The present applicants have found that the amount of unidirectional magnetic centering energy necessary for correctly "decentering" the electron beam in a situation as set forth above may be had by permanently magnetizing the steel strap

which, as stated, is included in deflection yokes for securing the multisection magnetic core about the coil. Since the trap is located at substantially the center of deflection of the yoke, it does not deleteriously move the center of deflection rearwardly as is the case with certain known permanent magnet rings, for example, which are normally disposed behind the yoke.

Additional objects and advantages of the present invention will become apparent to persons skilled in the art from a study of the following detailed description of the accompanying drawing, in which:

Fig. 1 illustrates, by way of block and schematic circuit diagram, a television receiver of well-known form in conjunction with which the present invention may be advantageously employed;

Fig. 2 is an exploded, isometric view of an electromagnetic deflection yoke embodying the invention;

Fig. 3 is a side elevational view of the yoke of Fig. 2 in its assembled form;

Fig. 4 is a horizontal sectional view of a television receiver kinescope illustrating certain beam paths useful in explaining the operation of the invention; and

Fig. 5 is a schematic view of one suitable arrangement for producing the apparatus of the invention.

Referring to the drawing, there is illustrated in Fig. 1 a complete television receiver of commercial form and of low cost design, as will become apparent. Radio frequency carrier waves modulated by video intelligence are intercepted by an antenna **10** and applied to a television tuner **12** which may, for example, comprise the usual radio frequency (R. F.), mixer, intermediate frequency (I. F.) and second detector stages. The detected video information is amplified by a stage **14** whose output terminal **16** is designated for connection to the beam-intensity controlling electrode of the image-reproducing kinescope **18**. The detected signals, which normally include synchronizing pulses of field and line rate (e. g. 60 C. P. S. and 15,750 C. P. S.), are also applied to a sync pulse separating circuit **20** which applies the vertical synchronizing pulses to the vertical scanning circuits **22** whose output terminals Y—Y are adapted for connection to the vertical deflection winding **24** associated with the kinescope **18**.

Horizontal or line rate sync pulses from the separator circuit **20** are applied to a horizontal deflection oscillator **26** which produces a sawtooth signal **28** of the proper frequency. The sawtooth waveform **28** is applied via a capacitor **30** and resistor **32** to the control electrode **34** of the horizontal output or driver tube **36** of conventional form. The anode **38** of the driver tube **36** is connected to a tap **40** on the horizontal output transformer "T" illustrated herein as an auto-transformer. Connected across that portion of the transformer "T" between its taps **42** and **44** are the horizontal deflection coils **46**, isolated from the transformer direct current-wise by means of the blocking capacitor **48**. A conventional balancing circuit comprising the capacitors **50**, **52** and **54** and the resistor **56** is connected as shown for the purpose of eliminating ringing in the system, all in a well-known manner. A high voltage or "flyback" step-up winding **58** applies flyback voltage pulses to the anode **60** of a high voltage rectifier diode **62** which, in conjunction with the filter capacitor **64**, provides a high, unidirectional accelerating potential for application via the lead **66** to the high voltage anode terminal **68** of the kinescope **18**.

A damper diode **70** has its cathode **72** connected to the transformer "T" at point **74** and its anode connected to the B+ terminal **76**. A B-boost capacitor **78** is connected, as shown, between the terminal **76** and the terminal **44** at the bottom end of the transformer winding.

Since the above-described deflection circuit is well-known and does not per se constitute a part of the present invention, its operation need not be described in detail. Briefly, however, it may be noted that, in accordance with conventional reaction scanning techniques, the driver tube **36** furnishes a sawtooth current through the transformer "T" for a portion of the "go time" of the horizontal line scan. At the end of the scanning the tube **36** is driven to cut-off, thereby producing a flux collapse in the transformer and coils. The inductance of the circuit and its capacities form a resonant circuit which oscillates at a predetermined frequency several times greater than the horizontal scanning rate, which oscillation results in the flyback or retrace of the beam in the kinescope. At the end of one-half cycle of the free oscillation, the damper tube **70** is rendered conductive and serves to damp the remaining cycles of oscillation. Current through the damper tube also provides the energy for the deflection coils for approximately the first half of the succeeding line scan.

As pointed out in the above-cited Schade patent, a portion of the energy in the circuit is stored in the capacitor **78** which is charged as shown, whereby to boost the B+ potential applied to the driver tube. In more expensive horizontal deflection arrangements, a linearity inductance according to the above-cited Tourshou patent is ordinarily connected between the B+ terminal **76** and the junction of the capacitor **78** and damper diode **70**. The function of the linearity inductance is, in general, that of purposely distorting the sawtooth current in the deflection winding by rounding off the sawtooth to compensate for screen flatness of the cathode ray tube and the like. That is, the linearity inductance causes a voltage variable with time to produce this effect in the yoke current. It has been found that omission of the linearity inductance as an economy measure results in an undesirable cramping of the raster produced on the screen of the kinescope **18**, which cramping causes the raster to appear off-center.

In order to compensate for the off-center appearance which results from the omission of a linearity inductance, the present invention provides the novel deflection yoke structure shown in Figs. 2 and 3. In these figures, the horizontal and vertical deflection coils **46** and **24** are illustrated as being conventional arcuate form arranged at right angles to each other and adapted to surround the neck portion of a kinescope. A magnetic yoke **80** made up of a plurality of sections of powdered ferrite or other similar magnetic material is adapted to surround the longitudinal conductors of the coils **24** and **26** in order to furnish a low reluctance return path for the electromagnetic flux produced by the coils, thereby increasing their efficiency. Since the core is, as stated, actually a plurality of separate, arcuate pieces, the usual practice is to provide a strap of steel for holding the core pieces together around the deflection coils. The present invention provides such a strap **82** of generally cylindrical shape having a raised "bridge" **83** which encloses a nut (not shown) adapted to be threadedly engaged by a bolt (not shown) through the slot **84** for the purpose of mounting the yoke on the receiver chassis. The ends of the strap **82** diametrically opposite the bridge **83** are secured to each other as by means of one or more screws **86** which, when tightened, securely hold the sections of the core **80** around the deflection windings.

In the past, any attempt to magnetize the strap **82** would have been considered highly undesirable, since such magnetization would necessarily have been looked upon as interfering with the action of the deflection windings **24** and **26**. The present applicants, however, have found that by magnetizing the strap **82** permanently, as shown in Figs. 2 and 3 (i. e. transversely or diametrically), certain advantageous results are obtained, which may be better understood from the showing of Fig. 4.

In Fig. 4, which is a sectional view taken along that plane which separates the horizontal deflection coils **46** from each other, the above-described cramping action of the low cost deflection circuit of Fig. 1 is illustrated. The kinescope **18** includes an electron gun (not shown) for forming and directing an electron beam (not shown) along the center line **88** of the kinescope toward its luminescent phosphor screen **90**. The kinescope com-

prises generally a cylindrical neck portion **92** and a flared bulb portion **94**. The deflection coils **24** and **46** surround the neck portion **92** adjacent the bulb **94** and, when respectively energized with vertical and horizontal deflection currents as described, cause the beam to scan a rectangular raster. Disregarding the vertical deflection action, the horizontal coils **46** cause the beam to scan across the screen **90** through the angle defined by the dotted lines AX and BX. As may be seen from the drawing, the cramping of the righthand side of the raster (i. e. the upper part as viewed in the drawing) results in a situation in which the apparent center line of the raster is at line OX which is angularly displaced from the vertical center line O'X of the kinescope **18**. Thus, as will be understood, the resultant raster appears decentered insofar as the physical center of the kinescope is concerned. Such decentering could, of course, be corrected by causing a unidirectional current to flow through the horizontal deflection coils **49** in such direction as to shift the beam by a fixed amount, but would require additional circuitry, thereby undesirably increasing the cost of the apparatus. Also, it would be possible to effect the necessary centering correction by means of a permanent magnet annulus around the kinescope neck **92** behind the yoke, as taught in the prior art. This latter possibility is, however, ruled out because it would necessarily shift the center of deflection of the yoke rearwardly, so that the beam path at its extremes of deflection would strike the neck of the kinescope at the points **96**, thereby causing a shadow to appear in the image on the screen **90**.

The present invention, on the other hand, by reason of its permanently magnetized strap **82**, shifts the beam center so that deflection of the beam, through the combination of the fixed magnetic field from the strap and the sawtooth field from the windings **46**, is defined by the angle A'XB' shown in solid lines. In order further to illustrate the operation of the invention, the reference line **100**, drawn at right angles to the kinescope center line **88**, intersects the lines representative of the extreme deflection paths, from which it may be noted that the distance A'O' is equal to the distance O'B', where O' lies on the physical center line **88** of the kinescope. Hence, it will be appreciated that, without distorting the raster, the permanent magnetic field from the strap **82** brings about that recentering of the electron beam which is necessary to effect coincidence of the raster center with the kinescope center.

Although the permanently magnetized strap **82** surrounds the ferrite core **80** (being separated therefrom by an insulating liner **102**), so that the core **80** represents a magnetic shunt for the strap, enough of the flux from the strap passes through the core to furnish the requisite unidirectional field within the neck **92** of the kinescope. In one practical form of the invention, it has been found that magnetizing the strap **82** so that it has a strength (measured at the location of the screws **86**) of approximately 30 Gauss is sufficient to produce an effective field within the kinescope neck of between 2 and 3 Gauss.

While any suitable means for effecting permanent magnetization of the strap **82** may be employed in producing the yoke of the present invention, one simple but effective arrangement is illustrated schematically in Fig. 5. That is to say, although the strap may be provided with its magnetization by passing it through a strong D. C. magnetic field, a simpler method is that of passing direct current through the horizontal deflection winding **46** in the assembled yoke (Fig. 3), which current results in the permanent magnetization of the strap **82**. The arrangement of Fig. 5 includes a source of direct current of, for example, 400 volts illustrated as a battery **104** and a large capacitor **106**. A switch **108** is adapted for connection to either of the terminals **110** and **112**, as shown. With the switch **108** in contact with terminal **110**, the capacitor **106** will be charged by the battery **104** with the polarity shown. The rotation of the switch **108** into contact with the terminal **112** causes the capacitor **106** to discharge through the horizontal deflection coils **46**, current flow being indicated by the arrow **114**. Once the capacitor **106** has been discharged through the horizontal coils, the strap **82** will be magnetized in such amount as to produce a fixed flux field within the kinescope neck of, for example, approximately 4 to 6 Gauss. The magnetization of the strap is stabilized by operating the yoke with deflection currents of the usual frequency, whereupon flux density is decreased by about 50%, after which it remains stable.

From the foregoing, those skilled in the art will recognize that the present invention requires no additional parts for effecting the beam centering action necessary for proper image reproduction. The apparatus of the present invention is, therefore, capable of low cost production in keeping with commercial aims.

Having thus described our invention, what we claim as new and desire to secure by Letters Patent is:

1. An electromagnetic deflection yoke for use with a cathode ray tube, said yoke comprising: a first pair of deflection coils; a second pair of deflection coils arranged at right angles to said first pair of coils, such that the magnetic fields produced by said first and second pair of coils are substantially normal; magnetic core means comprising a plurality of longitudinal sections adapted to form a generally continuous low reluctance magnetic path around said coils; and a strap surrounding said core sections in such manner as to hold said sections securely around said coils, said strap being permanently magnetized transversely so that its flux lines pass between said longitudinal core sections and lie in planes parallel to the magnetic fields of said coils.

2. An electromagnetic deflection yoke for use in association with a kinescope, said yoke comprising: a first pair of arcuate coils adapted to surround a kinescope neck; a second pair of arcuate coils surrounding said first pair of coils and arranged at right angles thereto; a generally cylindrical magnetic core means comprising a plurality of longitudinal sections of a cylinder surrounding said first and second pairs of coils; and a strap surrounding said core means, said strap being permanently magnetized along a diameter whereby flux lines produced by said strap pass between said longitudinal core sections to provide a unidirectional magnetic field transversely of said yoke.

3. An electromagnetic deflection yoke for use with a cathode ray tube, said yoke comprising: a first pair of deflection coils; a second pair of deflection coils arranged at right angles to said first pair of coils, such that the magnetic fields produced by said first and second pair of coils are substantially normal; magnetic core means comprising a plurality of longitudinal sections adapted to form a generally continuous low reluctance magnetic path around said coils; and a strap tightly surrounding said core sections in such manner as to hold said sections securely around said coils, said strap being permanently magnetized transversely so that its flux lines pass between said longitudinal core sections to lie in planes parallel to the magnetic fields of said coils, whereby to provide a fixed electron beam-centering field.

4. An electromagnetic deflection yoke for use in association with a kinescope, said yoke comprising: a first pair of arcuate coils adapted to surround a kinescope neck; a second pair of arcuate coils surrounding said first pair of coils and arranged at right angles thereto; a generally cylindrical magnetic core means comprising a plurality of longitudinal sections of a cylinder surrounding said first and second pairs of coils; and a strap surrounding said core means for holding said plurality of sections together around said first and second pairs of coils, said strap being permanently magnetized along a diameter whereby flux lines produced by said strap pass between said core sections to provide a unidirectional magnetic field transversely of said yoke.

5. The invention as defined by claim 1 wherein said permanently magnetized strap is disposed rotationally about said core sections so that its lines of flux are substantially parallel to the field lines produced by one of said pairs of coils.

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