United States Patent [19]

McGlashan

[11] **3,810,053**

[45] **May 7, 1974**

[54] **DEFLECTION YOKE HAVING RELATIVELY ADJUSTABLE CORE AND COILS**

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[73] Assignee: **Pemcor, Inc.,** Westchester, Ill.

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[52] **U.S. Cl.** **335/212,** 178/7.81

[51] **Int. Cl.** **H01f 1/00**

[58] **Field of Search** 335/210, 212, 213; 178/7.8, 7.81; 313/77

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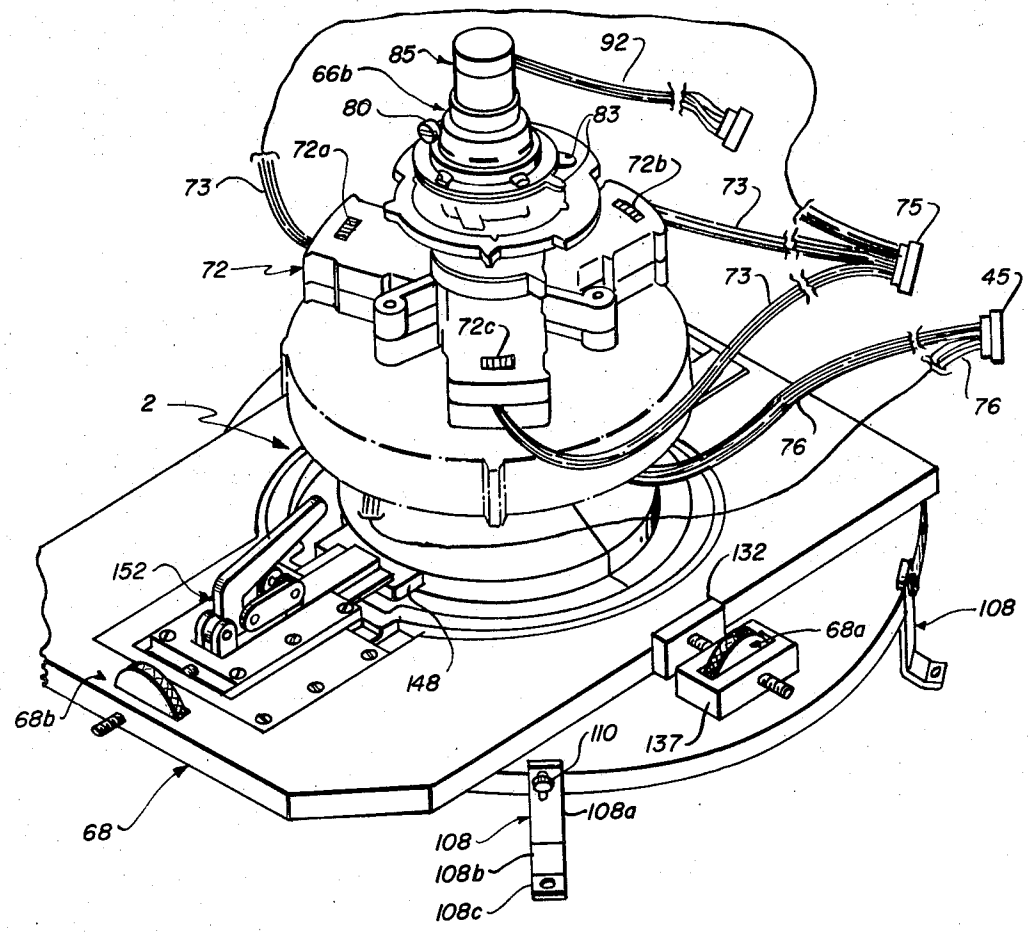
Primary Examiner—George Harris

Attorney, Agent, or Firm—Wallestein, Spangenberg, Hattis & Strampel

[57] **ABSTRACT**

In a deflection yoke assembly for a color television cathode ray tube including a frame adapted to be mounted around the neck of a cathode ray tube, vertical and horizontal deflection coils supported by said frame for respectively producing inside the neck of the cathode ray tube horizontally and vertically extending magnetic fields which respectively effect vertical and horizontal beam deflection in the color television cathode ray tube when vertical and horizontal deflection currents are respectively fed therein, and a core supported by said frame and associated with said horizontal and vertical deflection coils for forming a low reluctance path for said magnetic field outside of the neck of said cathode ray tube, the improvement wherein the position of at least one of said core and horizontal deflection coils are supported for fine adjustment relative to the other of same over a range which significantly varies the relative positions of at least two of the similarly oriented traces appearing on the face of the color television cathode ray tube with which it is to be used when the beams thereof are caused to traverse the face of the tube.

12 Claims, 13 Drawing Figures



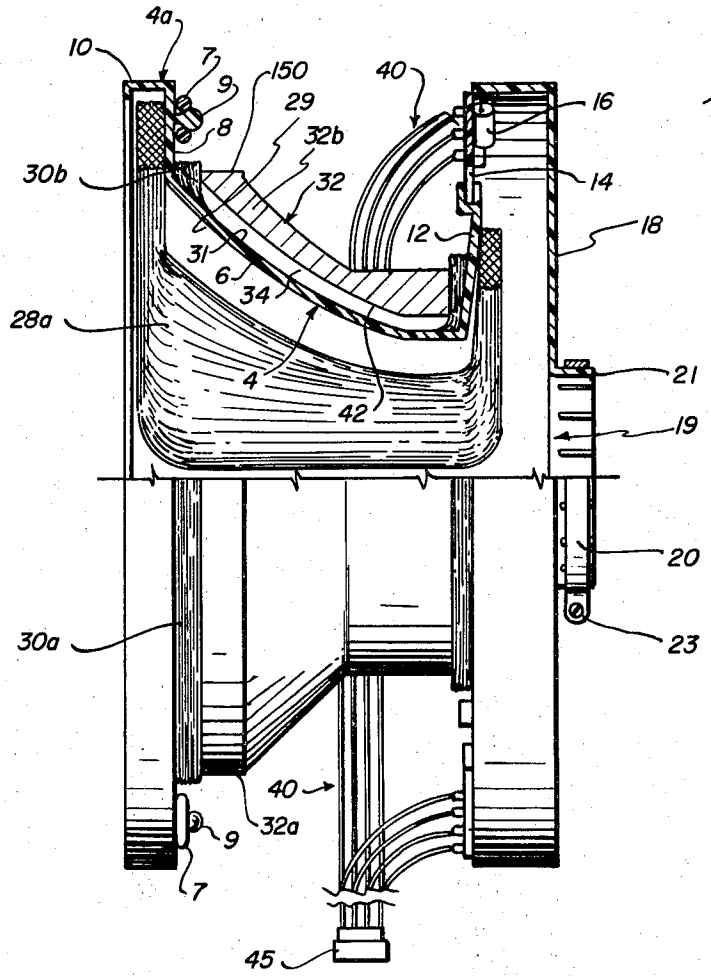

4a
10
7
9
8
150
29
32b
32
40
16
14
12
18
2
30b
31
6
34
28a
4
42
21
19
20
23
30a
40
32a
9
7
45

FIG. 1

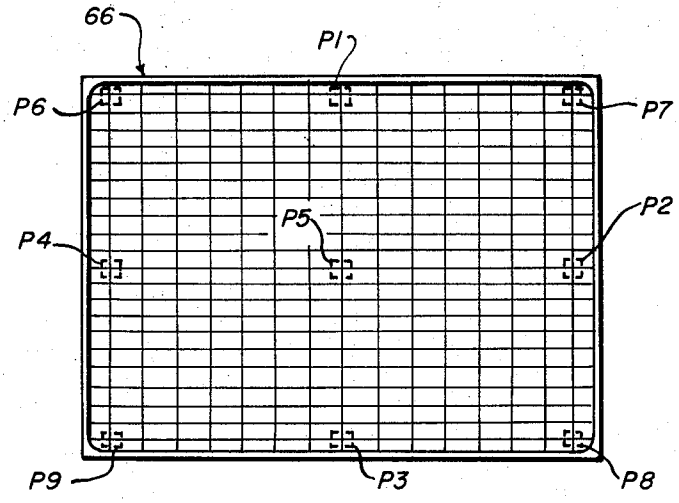
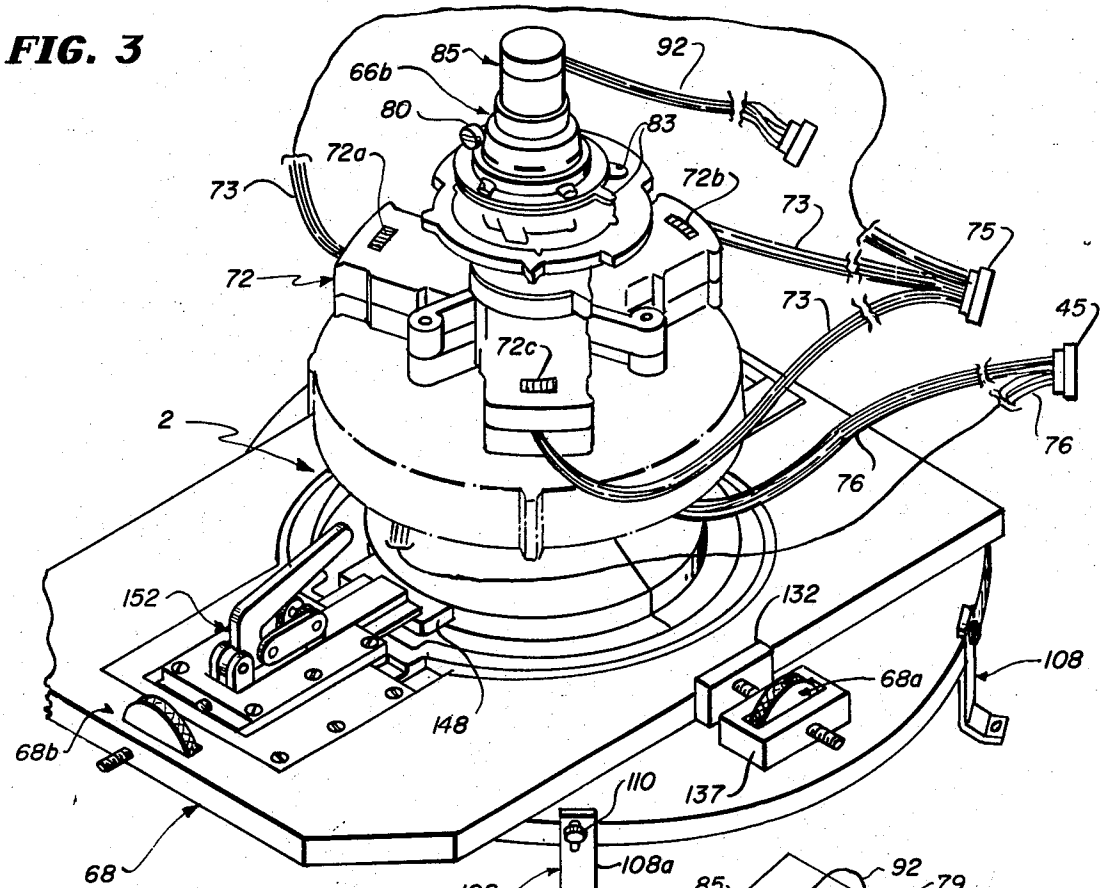

66
P1
P6
P7
P5
P2
P4
P9
P3
P8

FIG. 6

FIG. 3


85
66b
80
92
83
72a
73
72b
73
75
72
73
45
72c
2
76
76
152
132
108
68a
148
68b
137
110
68
108a
108
108b
108c

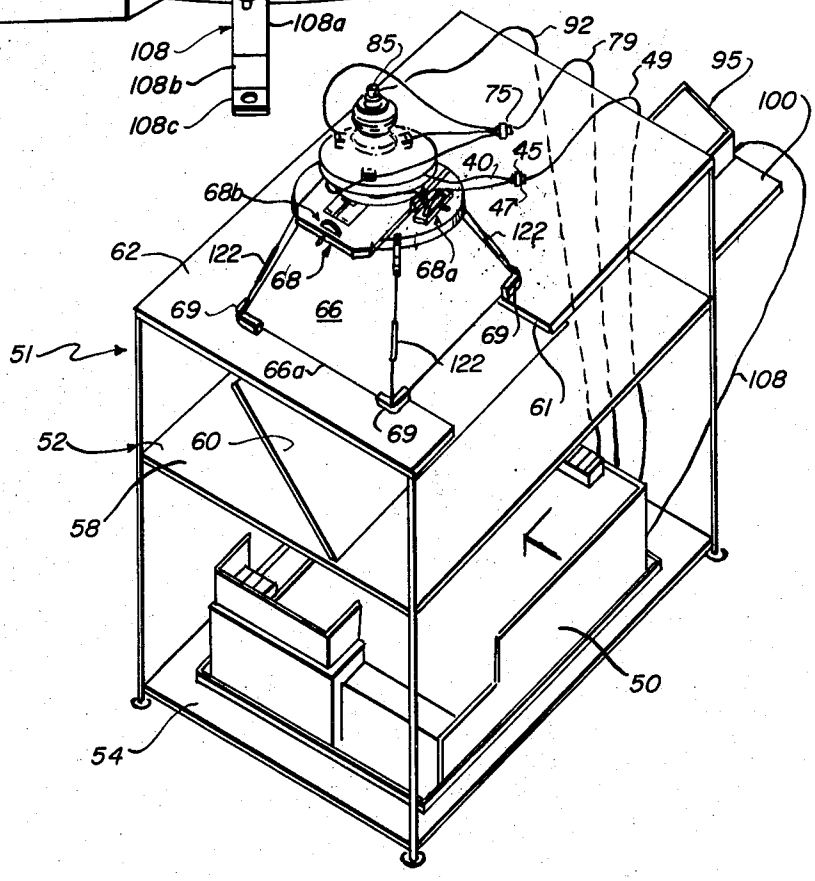
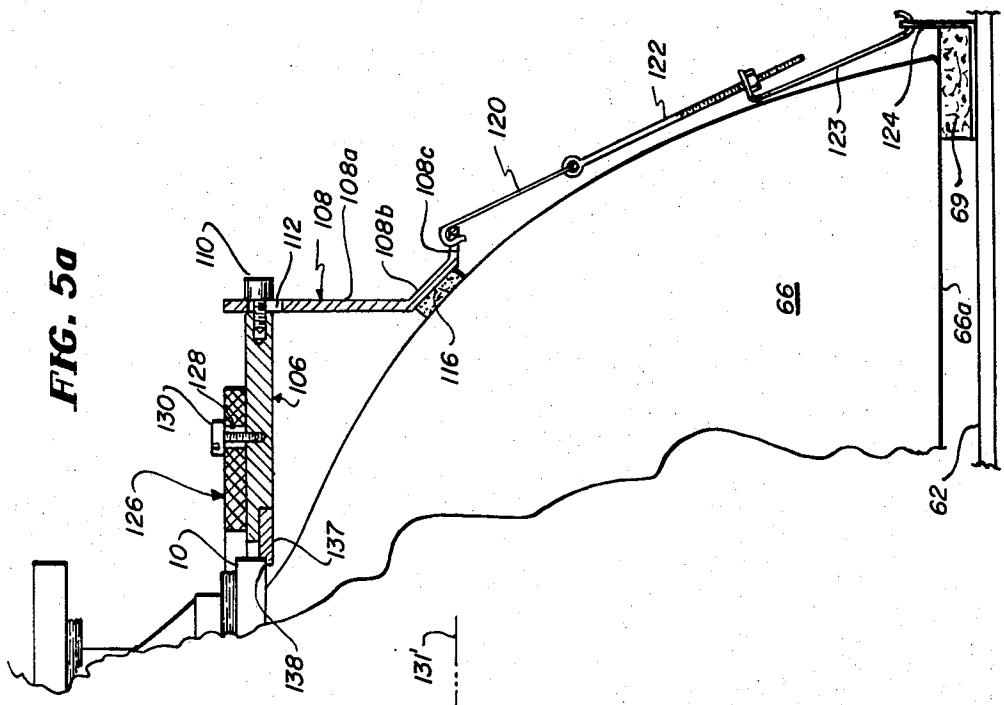

85
92
79
49
95
100
75
45
40
68b
47
122
62
122
68
68a
69
66
69
51
66a
122
108
61
52
60
69
58
50
54

FIG. 2


FIG. 5a
110
112
108
108a
108b
108c
120
122
123
124
69
66
66a
62
116
106
128
130
126
10
137
138

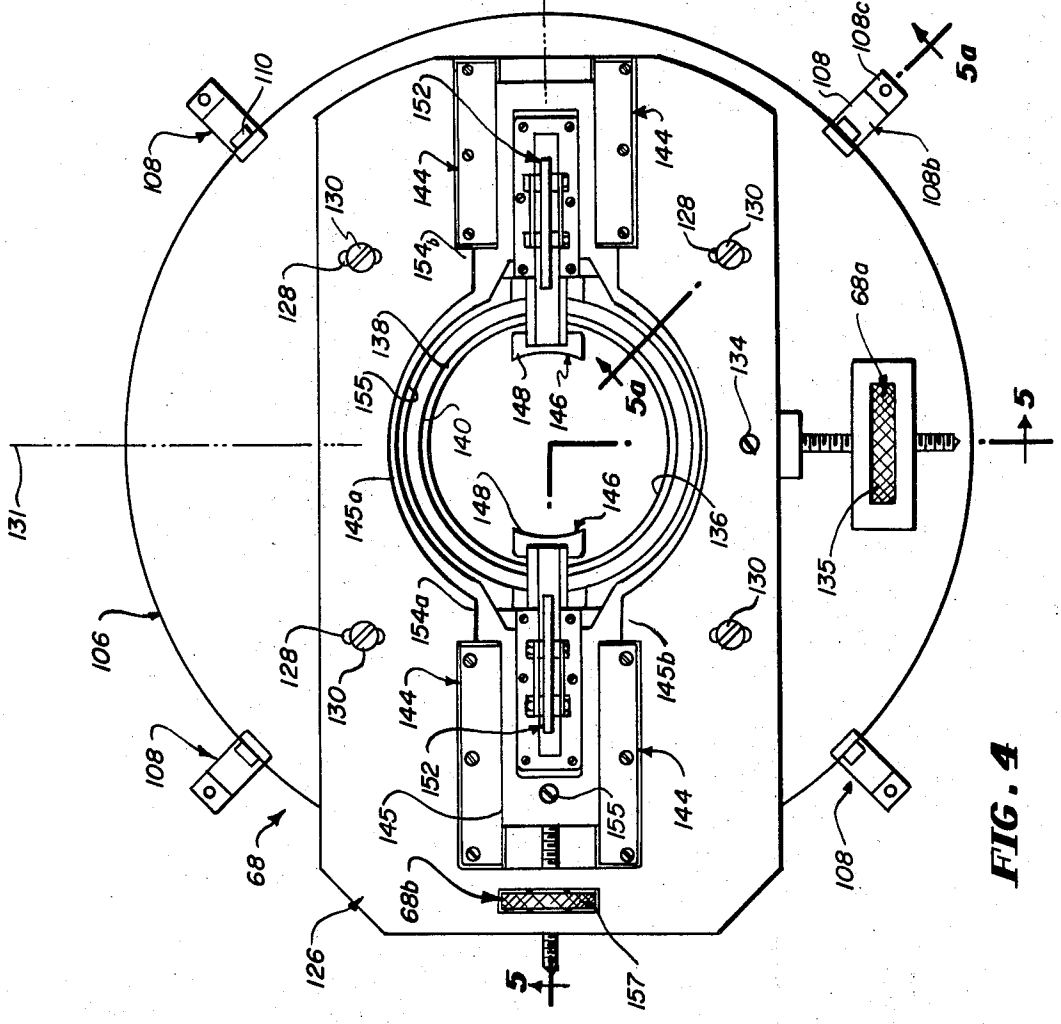

131
131'
110
108
152
144
154
128
130
138
155
140
148
146
5a
134
68a
5
135
136
145a
154a
145b
106
68
68b
126
157
145
155
108c
108b

FIG. 4

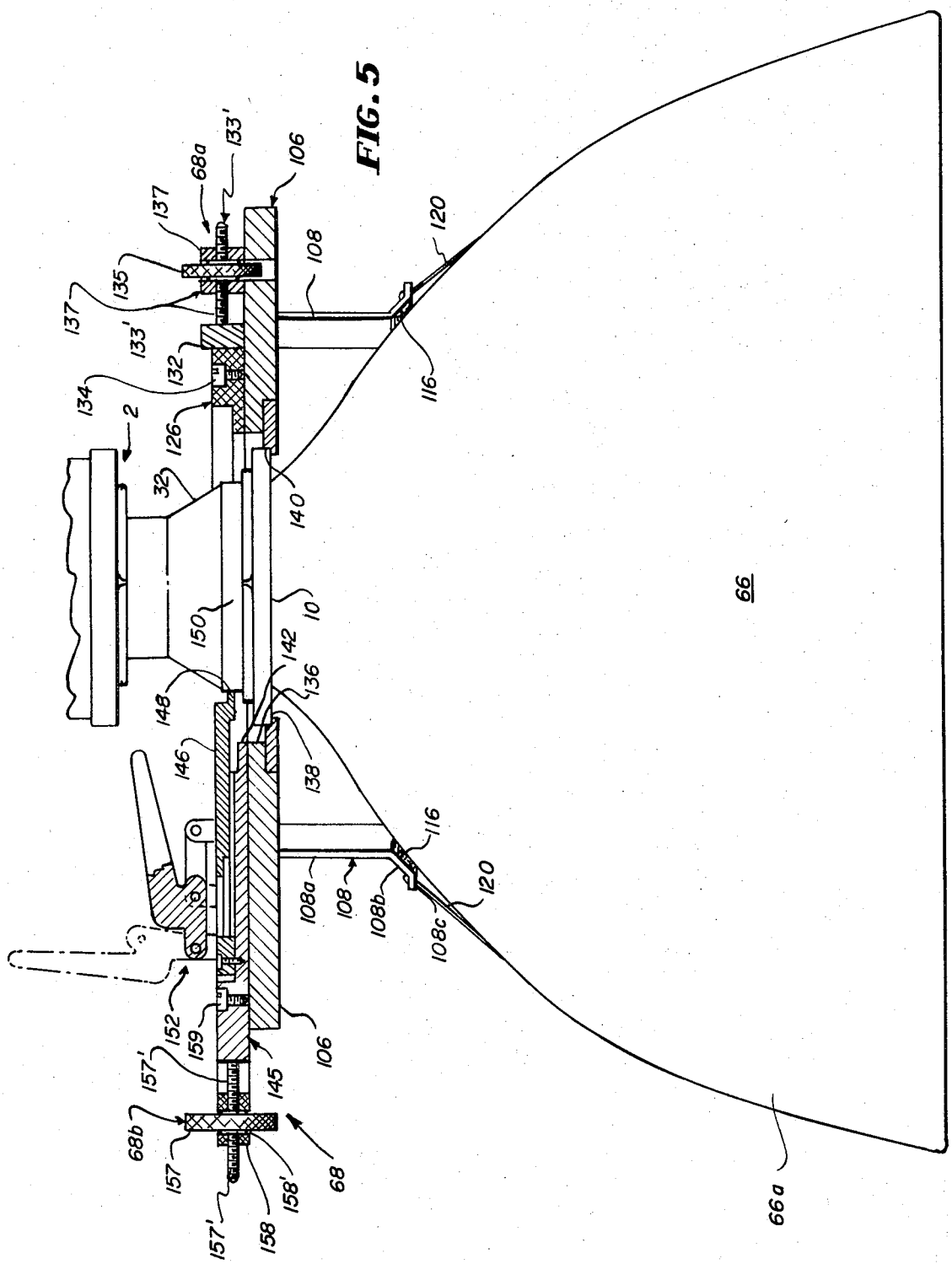
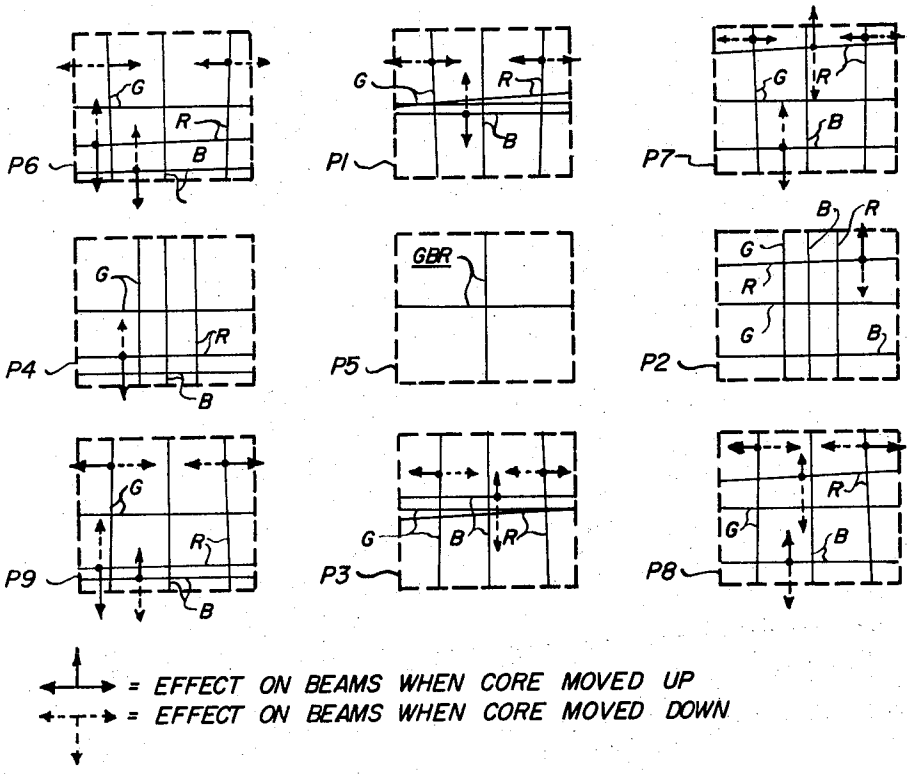

66
66a
68
68a
68b
106
108
108a
108b
108c
116
120
132
133'
134
135
137
138
140
142
145
146
148
150
152
157
157'
158
158'
159
10
126
2
32

FIG. 5

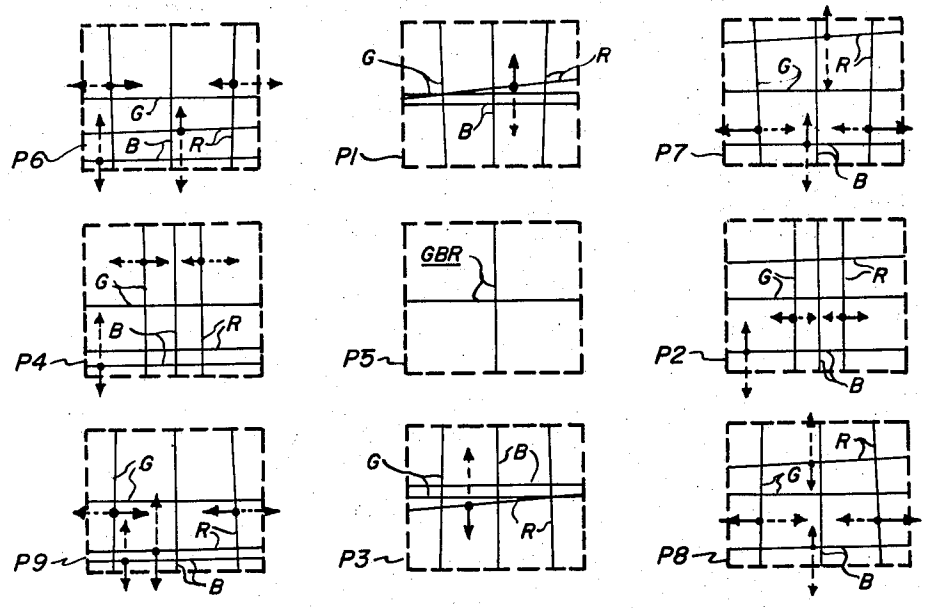
EFFECT ON BEAM TRACES
WHEN CORE MOVED VERT. RELATIVE TO WINDINGS



= EFFECT ON BEAMS WHEN CORE MOVED UP
= EFFECT ON BEAMS WHEN CORE MOVED DOWN

FIG. 7A

EFFECT ON BEAMS TRACES
WHEN CORE MOVED HORIZ. RELATIVE TO WINDINGS



= EFFECT ON BEAMS WHEN CORE MOVED LEFT
= EFFECT ON BEAMS WHEN CORE MOVED RIGHT

FIG. 7B

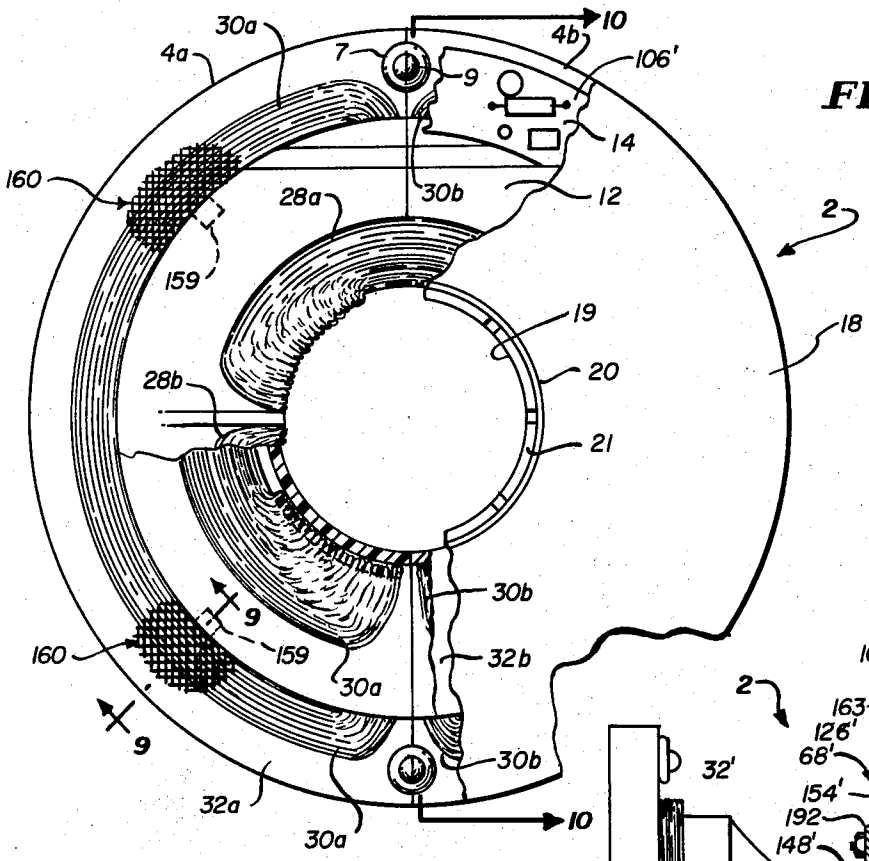


FIG. 8

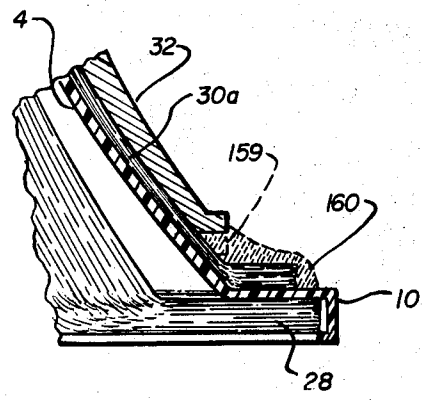


FIG. 9

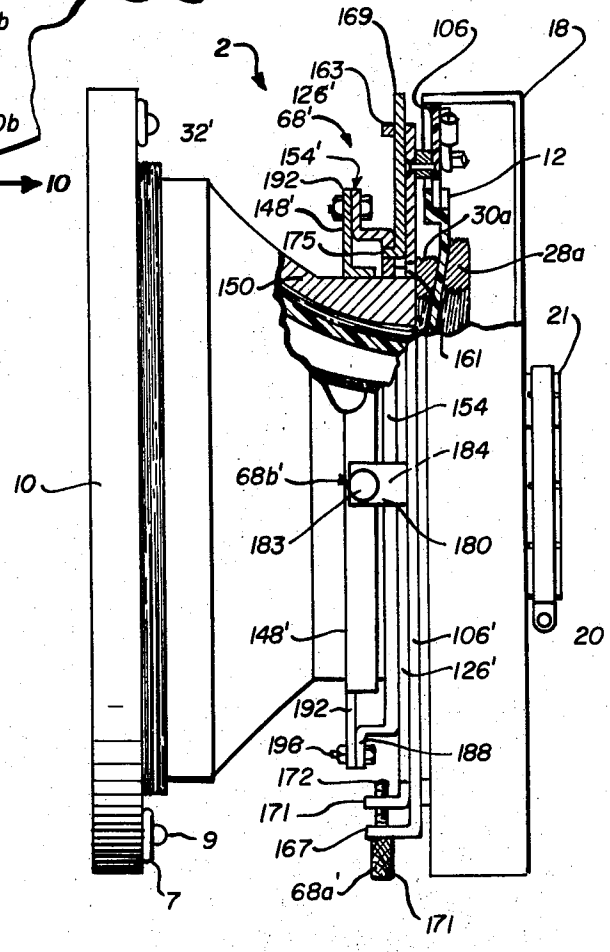
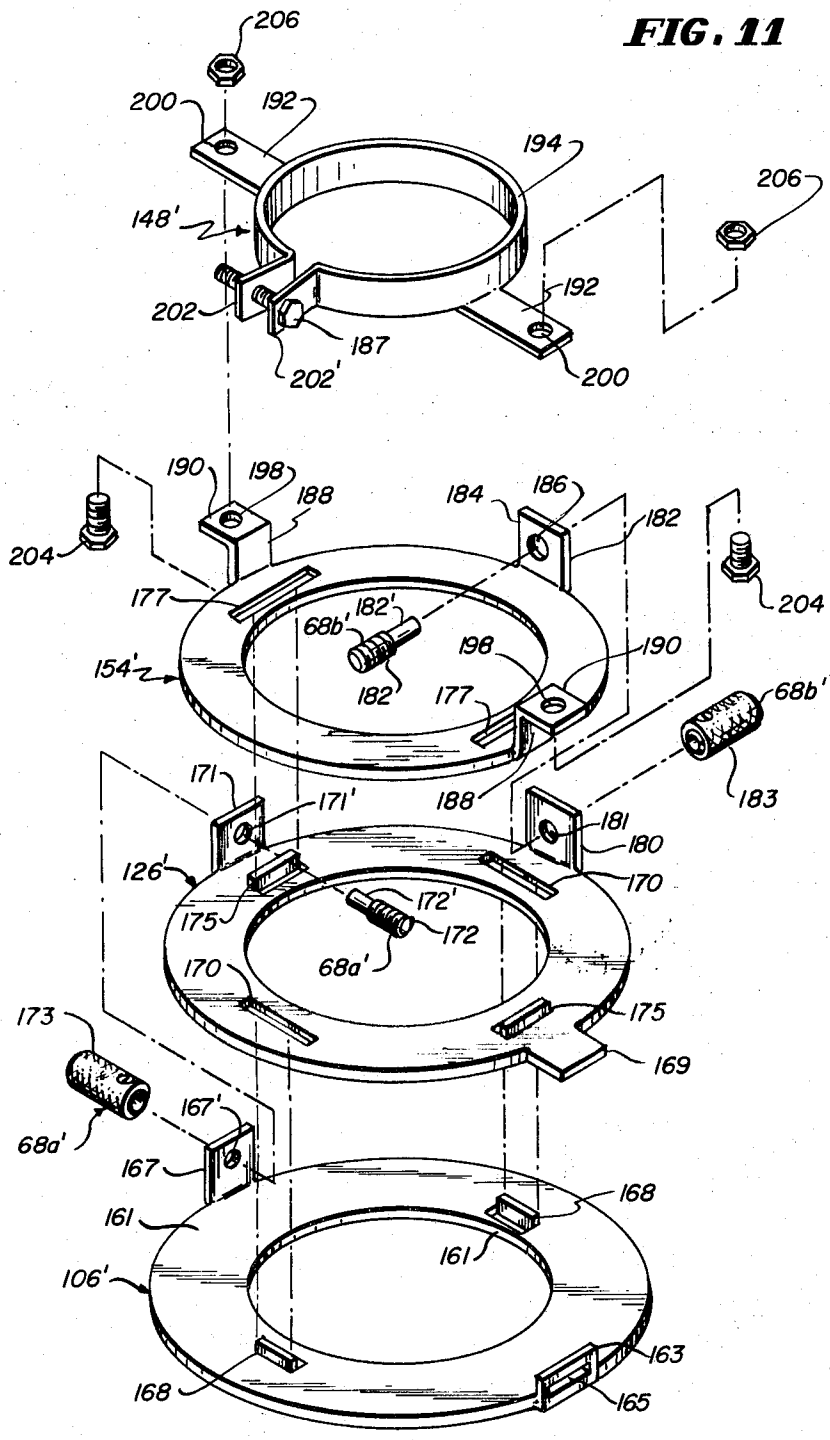


FIG. 10

FIG. 11


206
200
192
194
148'
206
202
187
192
202'
200
190
198
188
184
186
182
204
204
177
182'
68b'
198
190
154'
182
177
68b'
183
171
171'
188
181
180
126'
170
175
172'
172
68a'
170
175
173
169
167'
68a'
167
168
161
161
106'
163
168
165

DEFLECTION YOKE HAVING RELATIVELY ADJUSTABLE CORE AND COILS

This invention relates to deflection yoke assemblies for color television fathode ray tubes.

Color television cathode ray tubes are commonly provided with three juxtaposed electron guns positioned either triangularly or in-line at the base of the narrow neck of the cathode ray tube, so the cathode beams generated by these electron guns assume substantially different positions within the various transverse cross sectional planes of the cathode ray tube until they reach a point at or near the phosphor coated front face of the cathode ray tube. The phosphor coatings on the front face of the cathode ray tube are deposited as triads of phosphor dots, each dot of a triad responding to impingement thereon of a beam intended to produce a different one of the three characteristic colors of red, blue or green. A perforated screen or mask spaced behind the phosphor coated face forms beam screening areas for the various beams approaching the same at different angles so that each beam, which generally encompasses a number of groups of triad dots, passing through the same screen apertures as the other beams will only strike the triad dot which produces the color assigned to the beam involved.

To produce deflection of the beams, a deflection yoke assembly is mounted around the neck of the cathode ray tube. The deflection yoke assembly conventionally used today has deflection coils carrying time varying signals producing electron beam deflecting, vertically and horizontally extending, magnetic fields within the portion of the cathode ray tube transversed by the said electron beams. In one form of deflection yoke assembly, vertically spaced coils on the top and bottom of the tube neck produce a vertically extending magnetic field which effects horizontal deflection of the beams, and horizontally spaced coils on opposite sides of the tube neck produce a horizontally extending magnetic field which effects vertical deflection of the beam. A core snugly envelopes the outermost of these coils to provide a low reluctance path for the magnetic fields outside of the cathode ray tube.

To cause convergence or registration of the beams at or adjacent to the front face of the cathode ray tube, there is commonly provided both electromechanical and electronic means for effecting this result. Thus, a convergence yoke assembly is generally mounted around the neck of the cathode ray tube behind the deflection yoke assembly which convergence yoke assembly is provided with individual manual adjustments which commonly move permanent magnets for varying static magnetic field components respectively in the paths of the red, green and blue producing electron beams, so that the three beams converge into registration at the center of the cathode ray tube. Other magnetic field adjusting units are also mounted on the neck of the cathode ray tube referred to as purity and lateral blue adjusting units, further to insure that each beam strikes its proper phosphor dot.

Contemporary deflection yoke assemblies do not produce linear magnetic fields, that is, the flux lines (and equi-potential lines at right angles thereto) are curved in order to produce pictures without undesirable distortions which would otherwise occur because the front face of the cathode ray tubes is relatively flat and hence not equi-distant at all points from the electron guns referred to. As the electron beams are deflected from the center of the front face of a cathode ray tube, the intensity of the magnetic fields produced by the current flowing through the horizontal or vertical coils of the deflection yoke assembly become greater. In both the possible triangularly and in-line related positioning of the electron guns as manufactured today, the electron guns which generate the red and green producing electron beams occupy the same vertical position but different horizontal positions in the neck of the cathode ray tube. The beams produced by these cathode ray guns will, therefore, occupy different positions horizontally within the curved vertically extending magnetic field of the horizontal deflection coils and are accordingly deflected to different extents thereby both horizontally and vertically because of the curved equi-potential lines referred to, and in degree proportional to the intensity of the magnetic fields involved.

The curved horizontally extending equi-potential lines of the horizontal deflection coils, in the absence of dynamic convergence signals derived from the horizontal deflection current generator circuits and fed to windings forming part of the convergence yoke assembly, produce a progressively greater deflection of the red producing electron beam upwardly with respect to the green producing electron beam as the distance of the beam to the right of center of the face of the cathode ray tube increases, and a progressively greater deflection of the red producing electron beam downwardly with respect to the green producing electron beam as the distance of the beam to the left of the center of the face of the cathode ray tube increases. Thus, assuming the green trace as a reference trace which is approximately horizontal across the face of the cathode ray tube, the red trace crosses over the green trace so it occupies a position rotated counterclockwise of the green trace. A divergence of the green and red traces of only 1/32 inches is readily noticeable. Such crossing divergence between the horizontal red and green traces occuring at the horizontal center line of the cathode ray tube face is referred to as "crossover" and the degree thereof is measured at the 3 and 9 o'clock positions thereon. A similar crossing divergence of the horizontal red and green traces occurs above and below the horizontal center line of the cathode ray tube face for reasons including those responsible for crossover at the horizontal center line of the cathode ray tube face.

Divergence between the traces also occurs at all points spaced from the center point of the cathode ray tube face, among other reasons, because the focal or convergence points of the different beams occurs at points spaced progressively increasing distances from this face proceeding away from the center point due to the aforesaid varying distances of the electron guns to various points on the cathode ray tube face.

These various divergences between the traces are ultimately reduced to zero or to finite tolerable limits so that an acceptable color picture is achieved. Where the deflection yoke assembly meets certain specifications, this can generally be achieved by the feeding to the aforesaid windings of the convergence yoke assembly signals referred to as horizontal and vertical dynamic convergence signals produced by wave shaping circuits fed with the progressively increasing horizontal and vertical deflection signals of the horizontal and vertical deflection coils to vary the magnetic fields affecting the

electron beams as a function of beam deflection, to converge or register the electron beams which would otherwise be out of registration in progressively increasing degrees as the beams are deflected further from the right or left of or up and down from the center of the cathode ray tube face. To obtain the properly shaped dynamic convergence signals a large number of manual adjustments of different circuit variables are required to provide proper dynamic convergence of the horizontal and red traces over the entire face of the cathode ray tube.

In testing the acceptability of a deflection yoke assembly, it has been heretofore common for the deflection yoke manufacturers to apply a cross-hatch video pattern to a standard test cathode ray tube used with a standard test receiver (both supplied by the television receiver manufacturer involved) to which tube the deflection yoke assembly to be tested is applied. The cross-hatch video pattern comprises groups of horizontal and vertical red, green and blue traces in a grid-like pattern distributed over the face of the cathode ray tube. In the absence of any dynamic convergence signals, a convergence unit also mounted on the cathode ray tube is first adjusted to produce crossing white traces at the center of the cathode ray tube face. Then, in accordance with the practice prior to the present invention, the vertical separation of the horizontal red and blue traces from the horizontal green trace at the 12, 6, 3 and 9 o'clock positions on the cathode ray tube face are measured along with the horizontal separation of the vertical red and blue traces from the vertical green traces thereat. To ensure to the television receiver manufacturer's satisfaction that the dynamic convergence circuit adjustments in the television receivers with which the deflection yoke assemblies are to be ultimately used will be operative to effect a proper final convergence (indicated by crossing white traces at each of the trace crossover points involved), all of these measurements must fall within certain tolerances specified by the television receiver manufacturer involved. If the deflection yoke assembly being tested produces trace divergencies falling within these tolerances, then the vertical separation of the horizontal red traces from the green horizontal traces are often measured in each of the four corners of the cathode ray tube face to determine if they fall within specified tolerances. A deflection yoke assembly which does not produce trace deflections within the limited trace divergencies specified has heretofore been rejected. Although, if a deflection yoke assembly passes the static tests referred to, it will normally pass a test where the traces are finally dynamically converged to produce the crossing white traces at the various test points involved, it is common for the deflection yoke manufacturer to make spot checks of the deflection yoke assemblies which passed the aforesaid static tests to determine whether the dynamic convergence circuit adjustments on the standard test receiver can achieve the proper crossing white traces at these points on the cathode ray tube face and other intermediate points.

Because of the practical limits on the tolerances of the parts making up the deflection yoke assemblies, a significant percentage of the deflection yoke assemblies have often failed to meet specifications resulting in a substantial loss of materials, time and labor. If an assembled deflection yoke assembly was found to be deficient, it was discarded or dis-assembled and the parts thereof combined with other parts in the hope that the new combination would meet specifications.

Tolerances in the manufacture of the cathode ray tube also introduce displacements of the beam traces due, for example, to a slight rotation of the cathode ray guns in the cathode ray tubes from their desired orientations. Thus, strict tolerances are also imposed on the cathode ray tube manufacturers so that with a standard test deflection yoke assembly supplied by the television receiver manufacturers for the purposes of testing the cathode ray tubes, the displacements of the beam traces thereon must fall within prescribed limits to ensure the receiver manufacturers that proper convergence of such traces can be achieved by the dynamic convergence adjustments referred to.

Even with the strict tolerances presently imposed, the accepted degree of variation in the beam trace displacements due to the tolerances in the manufacture of deflection yoke assemblies and cathode ray tubes is such that the person making the large number of adjustments of the dynamic convergence wave shaping circuits at the plant of the television receiver manufacturer can spend a considerable time in making the different adjustments. This adjustment procedure can be simplified and the reject ratio of the deflection yoke assembly and cathode ray tube manufacturers significantly reduced if the deflection yoke assemblies could be made to produce identical or closely similar amounts of beam trace displacements on the standard test cathode ray tube face. This would also make possible the increase of the tolerances permitted in the manufacture of the cathode ray tubes and the parts of the horizontal dynamic convergence wave shaping circuits or a simplification of the latter circuits.

It is one of the objects of the present invention to provide a deflection yoke assembly for a color television cathode ray tube wherein the assembly can be quickly and easily placed in a condition where the beam traces deflected thereby with cross-hatch producing signals applied thereto and the cathode ray tube, can be readily dynamically converged. A further related object of the invention is to provide a deflection yoke assembly for a color tleevision cathode ray tube wherein the assembly can be quickly and easily placed in a condition where the beam traces deflected thereby with cross-hatch producing signals applied thereto and the cathode ray tube are readily positioned to provide a desired degree of crossover at the 3 and 9 o'clock positions of the cathode ray tube face and/or red trace height (i.e., spacing of the horizontal red trace from the horizontal green trace) at the 12 and 6 o'clock positions of the cathode ray tube face.

A further object of the present invention is to provide a deflection yoke assembly with an adjustment which optimizes the deflection producing parameters thereof so that it can readily be adjusted to meet the beam divergence tolerance specification of television set manufacturers.

The various aspects of the present invention results from an unexpected discovery that the relative positions of the beam traces of color cathode ray tubes, particularly the horizontal red and green trace crossover at the 3 and 9 o'clock positions and/or the horizontal red trace height at the 12 and 6 o'clock positions of the cathode ray tube face, can be readily accurately varied between zero and a small finite value in one direction or the other by designing the core and/or the

vertical and/or horizontal deflection coils so that the relative vertical and/or horizontal positions thereof are adjustable, and varying the relative vertical and/or horizontal positions thereof to provide the desired trace positions at these points. (Such adjustments are not possible on conventional deflection yoke assemblies since the cores thereof are designed to be unadjustable with respect to both the horizontal and vertical deflection coils.) It has also been discovered that all of the various aforesaid previously taken divergence measurements need not be made to determine whether the deflection yoke assembly being tested has its optimum deflection producing parameters to ensure that the cross-hatch video pattern can be properly dynamically converged. Thus, it was determined that if the 3 and 9 o'clock red-green trace crossover was adjusted to a correct value (which is generally, but not necessarily in all cases, zero), the downward displacement of the horizontal blue traces from the horizontal green trace at the 3 and 9 o'clock positions and the horizontal spacing between the vertical red and green traces at the 3 and 9 o'clock positions would generally automatically be optimized (i.e., in their best positions to ensure a proper final dynamic convergence), making unnecessary the additional measurement referred to.

This adjustment of the red-green trace crossover at the 3 and 9 o'clock positions of the cathode ray tube is achieved by varying the relative vertical position between the core and the deflection coils, and in most cases could be the only adjustment needed to ensure that a cross-hatch pattern could be properly dynamically converged. However, for best results, another adjustment to be described is preferably carried out to optimize all of the beam deflecting parameters of the deflection yoke assembly. Thus, in accordance with another aspect of the invention, as a secondary, though important, factor in optimizing the deflection producing parameters of the deflection yoke assembly, it was determined that if the spacing of the horizontal red trace from the horizontal green trace (i.e., red trace height) at the 12 and 6 o'clock positions were made ideally zero or at least equal, the horizontal displacement of vertical red traces from the vertical green traces and the vertical displacement of blue horizontal traces from the green horizontal traces at the 12 and 6 o'clock positions are minimized. This red trace height adjustment is achieved by varying the relative horizontal position between the core and deflection coils. The two deflection yoke assembly adjustments are most desirably made by providing the assembly with separate manual controls which respectively move the core relative to the deflection coils along the vertical and horizontal axes thereof.

When the deflection yoke assembly need not be adjusted by the television receiver manufacturer or by the serviceman, (this may be preferred since the adjustment made by the deflection yoke manufacturers can then be permanently fixed by cementing the core and deflection coils together where vibrations and handling cannot disturb the adjustment), the means for adjusting the relative positioning of the core and horizontal deflection coils need not be a permanent attachment to the deflection yoke assembly, to reduce the cost thereof. In such case, it is a means which may be temporarily removably mounted upon each deflection yoke assembly and then removed for further use on another yoke after the relative positions of the core and deflection coils have been fixed as by cementing the same in their relative adjusted positions.

The adjustment of the horizontal spacing of the vertical blue traces from the vertical green traces at the 3 and 9 o'clock positions (referred to as "blue width") has heretofore been effected by adjusting the vertical position of the entire deflection yoke assembly on the neck of a cathode ray tube. However, such vertical adjustment does not perceptably vary the red-green trace crossover. What was not heretofore appreciated is that a variation in the relative position between the core and deflection coils of the deflection yoke assembly produces any useful result, such as a variation in red-green trace crossover. Since the core of a deflection yoke does not itself produce magnetic lines of force but merely effects the magnetic reluctance of a magnetic path outside of the cathode ray tube, the moving of a core relative to the deflection coils would not necessarily be expected to change the relative positions of the red and green traces as above described.

Not only does the aforesaid adjustment of the deflection yoke assembly eliminate the rejection of deflection yoke assemblies by the deflection yoke manufacturers because of excessive trace divergences on the test cross-hatch pattern, but, unlike previous manufacturing techniques where there was a significant but acceptable variation in the red-green trace crossover, it makes possible the manufacture of all deflection yoke assemblies producing near identical trace divergences so that greater tolerances in the angles of the electrode guns of the cathode ray tubes and the parts making up the dynamic convergence circuits can be specified, if desired, and the effort needed to make the final adjustments of the dynamic convergence circuits is significantly reduced.

Other aspects of the invention to be described deal, for example, with the manner in which the core and the deflection coils are most advantageously mounted and the construction and arrangement of the means for progressively varying the relative position of the core and deflection coils.

The above and other features, objects and advantages of the invention will become more apparent upon making reference to the specification to follow, the claims and the drawings wherein:

FIG. 1 is a partial sectional and partial elevational view of deflection yoke assembly constructed in accordance with the present invention;

FIG. 2 is a perspective view of a deflection yoke assembly adjusting station where the deflection yoke assembly of FIG. 1 is adjusted to optimize its beam deflection producing parameters in accordance with the present invention;

FIG. 3 is a perspective view of the cathode ray tube and deflection yoke assembly portion of the adjusting station of FIG. 2;

FIG. 4 is a plan view of the deflection yoke assembly adjusting fixture forming one of the elements of the adjusting station shown in FIG. 2;

FIG. 5 is a sectional view through the deflection yoke assembly adjusting fixture shown in FIG. 4, taken along section lines 5—5 thereof, when the adjusting fixture is applied over the neck of a cathode ray tube and temporarily receives a deflection yoke assembly of the adjusting station as shown in FIG. 2;

FIG. 5A is a sectional view through the deflection yoke assembly adjusting fixture shown in FIG. 4, taken

along section line 5A—5A thereof, when the adjusting fixture is applied over the neck of a cathode ray tube and temporarily receives a deflection yoke assembly at the adjusting station as shown in FIG. 2;

FIG. 6 is a view of a cross-hatch video pattern provided on the face of the cathode ray tube at the adjusting station of FIG. 2 during the deflection yoke assembly adjusting operation performed thereat;

FIG. 7A is a greatly enlarged view of those portions of the cathode ray tube face enclosed by dashed lines in FIG. 6, and includes arrows which illustrates the effect on the beam traces of a variation in the position of the core relative to the deflection coils along the vertical axis of the deflection yoke assembly;

FIG. 7B is a view corresponding to FIG. 7A but including arrows which illustrate the effect on the beam traces of a variation in the position of the core relative to the deflection coils along the horizontal axis of the deflection yoke assembly;

FIG. 8 is a fragmentary sectional view through the deflection yoke assembly of FIG. 1 at the adjusting station shown in FIG. 2 after the adjustment thereof has been fixed by adhesively securing the core in its final adjusted position;

FIG. 9 is a fragmentary enlarged sectional view through the deflection yoke assembly of FIG. 8, taken along section line 9—9 thereof;

FIG. 10 is a side elevational view, partly in section, illustrating a modified form of deflection yoke assembly where the core adjusting means is permanently affixed thereto; and

FIG. 11 is an exploded view of the core adjusting means forming a permanent attachment to the deflection yoke assembly shown in FIG. 10.

FIG. 1 illustrates a deflection yoke assembly 2 of the saddle deflection coil type presently used in most color television sets. As thereshown, the assembly includes a frame generally indicated by reference numeral 4 made of a suitable synthetic plastic material. The frame 4, as illustrated, is made of two confronting mirror-image parts 4*a* and 4*b* (FIG. 8) each including a generally forwardly flaring main body portion 6 terminating in its front end in a radially outwardly extending front annular wall or flange 8 joining an outer forwardly projecting annular rim 10. The frame parts 4*a*–4*b* are secured together in any suitable way, such as by securing rings 7—7 made of a flexible resilient material each force-fitted over the enlarged heads of confrontings pairs of pin-forming projections 9—9 respectively extending from the confronting marginal portions of the frame parts 4*a*–4*b*. The main body portion 6 of each frame part 4*a* or 4*b* terminates at the rear thereof in a radially extending rear semi-annular wall 12. The rear walls 12—12 of the confronting frame parts 4*a*–4*b* form a mounting panel upon which various circuit-forming elements like 16 associated with deflection coil circuits are soldered to terminal strips like 14 anchored to the coplanar faces of the walls 12—12. A rear cover member 18 (preferably made of a synthetic plastic material) is suitably releasably secured to the walls 12—12 in any well known manner. The cover member 18 has a central opening 19 defined by an inwardly flexible cathode ray tube engaging neck portion 21 which, as illustrated, is anchored to the neck portion of a cathode ray tube by a clamp 20 enveloping the flexible neck portion 21 and having a tightening screw 23.

The frame 4 has securely anchored to the inner surface 29 of the forwardly flaring main body portion thereof a pair of vertically spaced horizontal deflection coils 28*a*–28*b*. A pair of horizontally spaced vertical deflection coils 30*a*–30*b* are closely but rotatably adjustably mounted around the outer surface 31 of the forwardly flaring main body portion 6 of the frame 4. As is well known, current flow through vertically spaced horizontal deflection coils 28*a*–28*b* generates a vertically extending magnetic field within the scope enveloped thereby which effects horizontal displacement of electron beams, and current flow through the horizontally spaced vertical deflection coils 30*a*–30*b* generates a horizontally extending magnetic field within the spaced envelope thereby which effects vertical displacement of electron beams.

To provide a sufficiently high magnetic field strength for a given current flow in the deflection coils, a low magnetic reluctance path is provided for the magnetic field by a hollow core 32 made of a low magnetic reluctance material, which is generally an iron based material. The core 32, which is generally made of two adhesively secured together mirror image parts 32*a*–32*b* to permit it conveniently to be mounted in place on the deflection yoke assembly, defines an open-ended cavity 34 therein having a generally forwardly flaring configuration like the main body portion 6 of the frame 4 and the outermost deflection coils 30*a*–30*b* which the core envelopes. Unlike the cores used in deflection yoke assemblies heretofore produced wherein the core snugly fit around the outermost deflection coils as previously indicated, the core 32 fits loosely around the latter coils so that it is adjustable relative thereto along at least one axis, most especially the vertical axis, of the deflection yoke assembly, and most advantageously also along the horizontal axis of the deflection yoke assembly. For example, it was found that in most cases sufficient clearance is provided to usefully adjust or optimize the beam deflection parameters of the deflection yoke assembly when the permitted movement of the core 32 relative to the outer deflection coils 30*a*–30*b* is from about .020 to .040 inches.

In the particular deflection coil assembly 2 illustrated in FIG. 1, the adjustment of the core position is effected by a core adjusting fixture to be described into which the deflection yoke assembly 2 is temporarily placed for adjustment. Following such adjustment, the position of the core is fixed by application of a suitable adhesive or the like. (In accordance with another aspect of the invention to be described, the means for adjusting the core is a permanent attachment to the deflection yoke assembly so that the television manufacturer or repairman may make an adjustment thereof, if desired. Also, the feature of making the core adjustable with respect to the deflection coils and providing a means for effecting fine adjustment of the position thereof is applicable to all types of deflection yoke assemblies, such as toroidal core deflection yoke assemblies.)

conductors 40 extend from the various deflection coils and the circuit-forming elements mounted on the terminal strips 14 to a connector 45 adapted to be connected to a complementary connector such as 47 shown in FIG. 2, in turn, connected to a long cable 49 of conductors extending to the various terminals of a standard test television receiver 50 supplied by the television receiver manufacturer to which the deflection

coil assembly is to be sold. FIG. 2 illustrates an exemplary adjusting station 51 used at the plant of the deflection yoke assembly manufacturer. (It should be understood that the construction and arrangement of the various components forming part of the adjusting station 51 may vary widely.) As there shown, an equipment support rack 52 is provided having a bottom shelf 54 upon which rests the standard test receiver 50. Supported on an intermediate shelf 58 of the rack is a mirror 60 inclining upwardly and rearwardly at approximately a 45° angle. The mirror 60 is visible easily by a person sitting in front of the rack 52 viewing the same through an opening 61 extending to the front margin of an upper shelf 62. The opening 61 extends a substantial distance across the width of the shelf 62, and supported above the rear portion of this opening is the color cathode ray tube 66 used with the standard test receiver. The cathode ray tube 66 is mounted with its front side screen-forming end 66*a* facing downwardly so that the beam traces appearing on the cathode ray tube screen will be reflected forwardly by the mirror 60 on the shelf below, so the person making the adjustments to be described can see the beam traces through the front portion of the opening 61 as he glances downwardly and rearwardly upon the mirror 60. The cathode ray tube 66 may be confined in this downwardly facing position in any suitable way. For example, the margins of the front face of the cathode ray tube may be supported upon the defining margins of the shelf opening 61 and confined in a given position thereover by suitable positioning means, which may include cushion elements 69.

There is supported upon the wide front end 66*a* of the cathode ray tube adjacent the neck portion 66*b* (FIG. 3) thereof an adjusting fixture 68 (which will be described later on in the specification) in which is supported the deflection yoke assembly 2. As will be described in more detail, the adjusting fixture 68 has an adjusting member 68*a* for adjusting the position of the core 32 relative to the deflection coils 28*a*–28*b* and 30*a*–30*b* along the normal vertical axis of the deflection yoke assembly, (the normal horizontal or vertical axis being related to the usual horizontally oriented position of the deflection yoke assembly upon the neck of a cathode ray tube), and an adjusting member 68*b* for adjusting the position of the core 32 along the normal horizontal axis thereof. Positioned behind the deflection yoke assembly 2 around the neck 66*b* of the cathode ray tube 66 is a convergence assembly 72 having the usual static convergence adjusting control members 72*a*, 72*b* and 72*c* (FIG. 3). The convergence assembly 72 may have windings (not shown) which receive the dynamic convergence signals previously referred to. These windings are connected through various insulated conductors 73 to a connector 75 which connects with a complimentary connector 77 connected by a cable 79 of conductors to the standard test receiver 50 in a conventional way. Suitable magnet-containing lateral blue width and purity adjusting controls 80 and 83 are also supported around the neck 66*a* of the cathode ray tube behind the convergence assembly 72 in the usual manner. Since these controls are not associated directly with any electrical circuitry, there are no electrical conductors associated therewith. The plug terminals at the end of the neck of the cathode ray tube are connected through a socket connector 85 and conductors in a cable 92 to the standard test receiver 50 in a conventional way.

The adjusting station further includes what is sometimes referred to as a color generator 95 shown mounted on a support shelf 100 extending from one side of the rack 52. The color generator 95 has a cable 108 extending to the standard test receiver 50. The color generator 95 is a well known unit which generates selected voltages fed to the input terminals of the standard test receiver 50 to effect one of a selected number of video patterns on the screen of a color television cathode ray tube. These voltages provide synchronization and intensity control voltages in the usual manner to provide the desired pattern on the screen of the cathode ray tube, such as the cross-hatch pattern shown in FIG. 6 to which reference will be made later on in the specification.

Refer now more particularly to FIGS. 4 and 5 and 5A which shows the constructional details of an exemplary deflection coil assembly adjusting fixture 68. As there shown, the fixture includes a base plate 106 provided with suitable means for supporting the same upon the downwardly facing cathode ray tube 66. As illustrated, this means comprises spaced supporting legs 108 each having a vertically extending shank portion 108*a* secured by a screw 110 passing through a vertically elongated slot 112 in the shank portion 108*a* and threading into the threaded opening in the base plate 106. The position of the base plate 106 with regard to the neck portion of the cathode ray tube 66 can thereby be adjusted over certain limits. The shank portion 108*a* of each leg 108 terminates in an outwardly and downwardly inclining intermediate portion 108*b* which bears upon a cushion pad 116 directly bearing on the outer surface of the forwardly flaring front end 66*a* of the cathode ray tube 66. The intermediate portion 108*b* of each leg terminates in an outwardly extending eyelet-forming portion 108*c* through which extends a securing wire 120 connected to one end of a turnbuckle 122 or the like whose opposite end is connected by a wire 123 to an eyelet 124 secured to one of the corners of a cushion 69.

Adjustably mounted upon the top of the base plate 106 is a slide plate 126 having parallel elongated guide slots 128 into which pass the unthreaded shank portions of guidepins 130 having ends threading into the base plate 106. The guidepins 130 guide the slide plate 126 for movement parallel to a reference axis 131. The slide plate 126 has a block 132 to which the threaded shank portion 133′ of a threaded rod 133 is anchored. The adjusting member 68*a* may include a knurled knob 135 projecting through a narrow slot 137′ in a block 137 secured to the base plate 106 and threaded around the shank of the threaded rod 133 passing through unthreaded holes in the block 137. Rotation of the knob 135 in one direction or the other brings the knob against one of the defining walls of the slot 137 and moves the slide plate 126 in one direction or the other parallel to the axis 131. A screw 134 threaded into the slide plate 126 bears on the surface of the base plate 106 to fix the adjusted position thereof.

The base plate 106 has a relatively large opening 136 whose defining walls are in substantial spaced relationship to the adjacent portion of the cathode ray tube. The defining walls of the opening 136 are provided with a stepped deflection yoke assembly positioning recess defined by an upwardly facing annular support sur-

face **138** upon which the front edge portion of the annular skirt **10** of the frame of the deflection yoke assembly rests, and a radially inwardly extending surface **140** against which the side of the annular skirt **10** is snugly positioned. The deflection yoke assembly is positioned within this recess of the base plate **106** so the normal vertical axis of the deflection yoke assembly, which in the illustrated embodiment of the invention is the separation line between the frame parts **4***a* and **4***b* as best shown in FIG. **8**, is co-extensive with the axis **131** of the adjusting fixture **68**. The deflection yoke assembly positioning recess thus fixes the position of the frame and the deflection coils mounted thereon relative to the cathode ray tube **66**.

The slide plate **126** has a central opening **142** of much greater size than the opening **136** in the base plate **106**. Supported on diametrically opposite sides of the opening **142** of the slide plate **126** in a direction transverse to the aforementioned axis **131** are a pair of guide-forming means **144—144** supporting a slide member **145** carrying core-engaging jaw members **146—146** for movement parallel to an axis **131'** transverse to the aforementioned axis **131**. The jaw members **146—146**, as illustrated, have confronting surfaces **148—148** sized and shaped snugly to engage opposite sides of the core **32** of the deflection yoke assembly. The core **32**, as illustrated, has a front cylindrical outer surface portion **150** which is engaged by the correspondingly sized and shaped surfaces **148—148** of the jaw members **146—146**.

The jaw members **146—146** are supported for movement by respective pivot-forming means **152—152** so that the jaw members can be withdrawn out of the way where the deflection yoke assembly **2** can be freely inserted within the aforementioned positioning recess of the base plate **106**. Such means may take a variety of forms and, as illustrated, is a toggle type linkage carrying the jaw members **146—146** on the ends thereof. This linkage is anchored to and carried by the slide member **145** fitting into an opening in the slide plate **126**. The slide member **145** has a ring-shaped center portion **146***a* with a large center opening **155**. The ring-shaped center portion **145***a* terminates in opposite end portions **145***b—145b* which are slidably mounted within guideways of the guide-forming means **144—144**. The slide member **145** is adjustable along the aforementioned axis **131'** by the aforementioned adjusting member **68***b* which, as illustrated, is similar to adjusting member **68***a* by including a knurled knob **157** projecting through a narrow slot **158'** in a block **158** on the base plate and threaded around the shank **157'** of a threaded rod **157** passing through unthreaded holes in the block **158** and anchored to the slide member **145**. Thus, rotation of the knurled knob **157** in one direction or the other advances the slide member **145** in one direction or the other parallel to the axis **131'**. A screw **159** threaded into the slide member **145** and bearing on the surface of the base plate **106** locks the slide member into its adjusted position. It should be apparent that with the adjusting fixture **68** above described, the core **32** is independently adjustable along two orthogonal axes.

Either after or before the deflection yoke assembly **2** is positioned within the adjusting fixture **68**, the outermost deflection coils **30***a–30b* are adjusted so the cross-coupling therebetween (commonly referred to as "cross talk") is reduced substantially to zero using conventional voltage measuring techniques, and the zero "cross talk" position of the outermost deflection coils is fixed by applying a suitable adhesive between the outermost deflection coils and adjacent exposed portions of the frame **4** in the conventional manner. If it is believed necessary to make a subsequent "cross talk" adjustment after other parameters of the deflection yoke assembly are adjusted in the manner to be described, the adhesive is applied in a manner or is one which remains fairly soft over the period involved, so that the adhesive can be easily removed or broken to make a further adjustment of the outermost deflection coils following which additional adhesive is added to permanently affix the position of the outermost deflection coils.

In accordance with the invention, the deflection yoke assembly is positioned in the adjusting fixture **68** in the manner previously described so that rotation of the adjusting member **68***a* thereof will move the core **32** relative to the deflection coils along the normal vertical axis of the deflection yoke assembly and the rotation of the adjusting member **68***b* will move the core **32** relative to the deflection coils along the normal horizontal axis of the deflection yoke assembly. Before this adjustment is made, the usual purity and static convergence adjustments are made by the controls **72***a*, **72***b*, **72***c*, **80** and **83** (FIG. **3**) with the proper signals applied to and by the standard test receiver **50** in a well known manner (which will not be here described), with no dynamic convergence signals applied to the convergence assembly **72**. (This can be accomplished by using a convergence assembly without the dynamic convergence signal-receiving windings or by eliminating the conductors normally connecting with such windings from the cable **79**.

In accordance with the most preferred procedure for utilizing the adjustable core feature of the present invention, after the above referred to "cross talk", purity and static convergence adjustments are made, the color generator **95** is set (if not previously so set) so that it produces a conventional cross-hatch pattern as shown in FIG. **6**, 7A and 7B. In such a pattern, all of the colored beams are energized to produce a cross grid pattern of adjacent red, green and blue traces respectively identified by the reference characters "R," "G" and "B". FIGS. 7A and 7B show in magnified form the various color traces at the 12, 3, 6, and 9 o'clock positions **P1, P2, P3** and **P4** on the face of the screen of the cathode ray tube, and also at the center and four corner positions **P5, P6, P7, P8** and **P9** thereof. In FIG. 7A, the solid arrows illustrate the direction of movement of the red, green and blue traces when the adjusting member **68***a* is adjusted in a direction which moves the core **32** in a normal upward direction along the normal vertical axis of the deflection yoke assembly and the dashed arrows therein indicate the direction of movement of the various traces when the adjusting member **68***a* is moved in a direction to move the core **32** in a normal downward direction along the normal vertical axis of the deflection yoke assembly. In FIG. 7B, the solid arrows illustrate the direction of movement of the red, green and blue traces R, G and B when the adjusting member **68***b* is adjusted in a direction with moves the core **32** left along the normal horizontal axis of the deflection yoke assembly and the dashed arrows therein indicate the opposite direction of movement of the various beam traces affected thereby when the adjusting

member **68***b* is moved to the right along the normal horizontal axis of the deflection yoke assembly.

It should be noted that in the 3 and 9 o'clock positions P2 and P4 before adjustment, the left hand end of the horizontally extending red trace R is below the horizontally extending green trace G, and the right hand end of the horizontally extending red trace R is above the horizontally extending green trace G. As illustrated, the horizontally extending red trace crosses over the horizontally extending green trace so it is rotated a substantial degree with respect thereto in a counterclockwise direction as seen in the drawings. As previously indicated, in accordance with the invention, the beam deflection parameters of the deflection coil assembly are optimized to a substantial degree by moving the adjusting member **68***a* in a direction which will rotate the horizontally extending red trace closer to, and in most cases preferably in alignment with, the horizontally extending green trace, thereby producing a horizontal yellow line across the center of the screen of the cathode ray tube. The television receiver manufacturer will commonly specify the maximum permissible degree of red trace crossover at the 3 and 9 o'clock positions of the cross-hatch pattern.

While this adjustment in presently manufactured deflection yoke assemblies may be sufficient in most instances to optimize the deflection producing parameters of the deflection yoke assembly, in the most advantageous form of the present invention another adjustment is made with the adjusting member **68***b* which affects the horizontally extending red and green traces R and G at the 12 and 6 o'clock positions P1 and P3 of the crosshatch pattern. It will be noted in FIG. 7A and 7B that at the 12 o'clock position P1, the horizontally extending red trace R crosses the horizontally extending green trace G at a point to the left of the point where the centered vertical blue trace B passes through the green race G, so the red trace is above the green trace at the centered vertical blue trace B. In contrast to this, at the 6 o'clock position P3, the horizontally extending red trace R crosses the horizontally extending green trace G at a point far to the right of the point where the centered vertical blue trace B passes through the green trace G, so the red trace is below the green trace at the centered vertical blue trace B by an amount greater than the spacing of the horizontally extending red trace R from the horizontal green trace G along the vertical blue trace B passing through the green trace G at the 12 o'clock position P1. There is present what is referred to as an unequal "red raster height." In accordance with another aspect of the invention, the beam deflection parameters of the deflection yoke assembly are further optimized by rotating the adjusting member **68***b* so as to move the core along the normal horizontal axis of the deflection yoke assembly to equalize "the red raster height" at the 12 and 6 o'clock positions P1 and P3 of the cross-hatch pattern. This adjustment moves the horizontally extending red traces R at the 12 and 6 o'clock positions in opposite directions relative to horizontally extending green traces G at these points. It is preferable that this equalized position be one wherein the raster height at the point where the horizontally extending red and green traces cross the centered vertical blue traces B at the 12 and 6 o'clock positions to produce a zero "red raster height," but this is frequently not possible. However, an equalization of this red raster height is what is important to effect the best adjustment of the deflection coil assembly.

The core **32** is most advantageously provided with a number of widely spaced apertures **159** (see FIGS. 8 and 9) at points overlying the outermost deflection coils **30***a* and **30***b*, and these apertures are filled with a hot-melted adhesive **160** so as to fix the adjusted position of the core **32** with regard to the deflection coils. As the hot melt cools, which may take from about 30 seconds to one minute, the effect of the various adjustments at the 12, 3, 6 and 9 o'clock positions P1, P2, P3 and P4 of the cross-hatch pattern are checked to be sure that these adjustments are maintained.

Following the aforementioned adjustment, measurements are made of the horizontal separation of the vertical blue traces B from the vertical green traces G at the 3 and 9 o'clock positions P2 and P4 (referred to as "blue width") to see if they meet specifications and, if not, the deflection yoke assembly is sent to the repair section for a coil change. Similarly, what is referred to as the "reverse trap" (dealing with the relative overall height of the vertical red and green traces R and G at the left and right sides of the cross-hatch pattern) is checked along with the spacing of the colored beams at the corners P6, P7, P8 and P9 of the cross-hatch pattern to determine whether the various beam spacing specifications set by the television receiver manufacturer are met and, if not, the deflection yoke assembly is similarly sent to the repair section for coil replacement.

Refer now to FIGS. **10** and **11** which illustrate a modified form of deflection yoke assembly **2'** wherein the deflection yoke assembly includes as a permanent attachment thereof a deflection yoke assembly adjusting structure **68'** permitting adjustment by the television receiver manufacturer or television repairman. (Many of the parts of the structure **68'** correspond in function to portions of the deflection coil assembly adjusting fixture **68** previously described, and the corresponding elements therein have been similarly numbered, with a prime (') used on the parts of the structure **68'**). The structure **68'** includes an inner stationary annular plate **106'** secured in any suitable way to the wall **12'** of the insulating frame **4'** of the deflection coil assembly **2'**. The inner annular plate **106'** has a central opening **161** which fits loosely around the narrow cylindrical inner end **150'** of the core **32'** so the position of the core is radially adjustable with respect to the annular plate **106'**. The inner annular plate **106'** has an outwardly axially extending ear **163** having a slot **165** extending therethrough. At a point on the periphery of the inner annular plate **106'** diametrically opposite the ear **163** there is provided an outwardly axially extending lug **167** having a circular hole **167'** therein. Projecting axially outwardly from the inner annular plate **106'** at diametrically opposite points on the annular inner plate **106'** and transversely to the spacing of the ear **163** and lug **167** are a pair of guide tongues **168—168.**

Supported adjacent the outer face of the inner annular plate **106'** is an annular slide plate **126'** which is slidably mounted with respect to the inner annular plate **106'** along an axis extending between the aforementioned ear **163** and the lug **167.** To this end, the annular slide plate **126'** has a tongue **169** extending radially therefrom which is slidably disposed within the slot **165** in the ear **163** on the inner annular plate **106'**. The annular slide plate **126'** is also provided with a pair of

diametrically oppositely disposed elongated guide slots **170—170** which slidably receive the aforementioned guide tongues **168—168.** The guide tongues **168—168** guide the annular slide plate **126'** for movement in the direction of the length of the slots. The annular slide plate **126'** has an ear **171** positioned adjacent to the inner side of the aforementioned lug **167,** the ear **171** having a hole **171'** in slignment with the aforesaid lug hole **167'.** An adjusting member **68***a'* is provided including a hollow hub portion **173** forming a knurled knob in which is anchored the reduced unthreaded portion **172'** of a screw **172** threading within the hole **171'.** The unthreaded portion **172'** of the adjusting member **68***a'* is rotatable within the hole **167'** of the lug **167,** the defining walls of which form a bearing for the screw **172.** When the screw is rotated in one direction or the other the annular slide plate **126'** is moved along the face of the annular inner plate **106'** which it confronts in a direction parallel to the elongated guide slots **170—170** in the annular slide plate **126'.**

Adjustably mounted upon the slide plate **126'** is a core mounted annular plate **154'** which has a pair of diametrically oppositely disposed elongated guide slots **177—177** which fit over relatively narrow guide tongues **175—175** projecting axially outwardly from the other face of the slide plate **126'.** The guide tongues **175—175** have a thickness approximately equal to the width of the slots **177—177** and a length much less than the length thereof, so that the guide tonges **175—175** guide the core connected annular plate **154'** for movement in the direction of the length of the slots **177—177,** which is transverse to the direction in which the slide plate **126'** is slidable relative to the inner annular plate **106'.**

The slide plate **126'** is provided with an outwardly axially extending lug **180** which has a hole **181** for rotatably supporting the reduced unthreaded portion **182'** of a screw **182** forming part of an adjusting means **68***b'.* The screw **182** extends into and is anchored to a hollow hub **183** forming a knurled knob. The core connected annular plate **154'** has an outwardly axially extending lug **186** positioned in confronting spaced relationship to the inner side of the lug **180** on the slide plate **126'.** The lug **184** has a threaded opening **186** in which the screw **182** is threaded. It is thus apparent that upon rotation of the knurled hub **183** from which the screw **182** extends, the core connected annular plate **154'** will move along the slide plate **126'** which it confronts in a direction parallel to the length of the guide slots **177—177** therein.

The core connected annular plate **154'** anchored to the core **32'** of the deflection coil assembly **2'** by means of a clamping member **148'** which is a split sleeve-like structure firmly secured around the cylindrical inner end **150'** of the core by a clamping screw **187.**

The clamping member **148'** is secured to the core connected annular member **154'** by means including axially extending legs **188—188** terminating in radially outwardly extending flanges **190—190** abutting a pair of radial wings **192—192** extending from the clamping member **184'.** The flanges **190—190** have holes **198—198** aligned with holes **200—200** on the wings **192—192.** Bolts **204—204** passing through the aligned pairs of holes **198-200** and nuts **206—206** threading around the bolts **204—204** interconnect the flanges **190—190** and the wings **192—192.**

It is apparent that the modified deflection coil assembly **2'** with the integral adjusting structure **68'** may be adjusted in the same manner previously described in connection with the adjustment of the deflection coil assembly **2,** to provide the proper relationship between the beam deflection parameters of the deflection coil assembly **2'.** An adjusting station similar to that shown in FIG. **2** may be provided for this purpose and the identical procedure carried out as previously described.

It should be understood that numerous modifications may be made in the various forms of the invention described above without deviating from the broader aspects of the invention.

I claim:

1. In a deflection yoke assembly or a color television cathode ray tube, said assembly including a frame adapted to be mounted around the neck of a cathode ray tube, vertical and horizontal deflection coils supported by said frame for respectively producing inside the neck of the cathode ray tube horizontally and vertically extending magnetic fields which respectively effect vertical and horizontal beam deflection in the color television cathode ray tube when vertical and horizontal deflection currents are respectively fed therein, and a core supported by said frame and associated with said horizontal and vertical deflection coils for forming a low reluctance path for said magnetic field outside of the neck of said cathode ray tube, the improvement wherein the position of at least one of said core and horizontal deflection coils are supported for fine adjustment relative to the other of same over a range which significantly varies the relative positions of at least two of the similarly oriented traces appearing on the face of the color television cathode ray tube with which it is to be used when the beams thereof are caused to traverse the face of the tube.

2. The deflection yoke assembly of claim **1** wherein the adjustable one of said core and deflection coils are mounted for relative fine adjustment in a direction parallel to the vertical axis of the assembly.

3. The deflection yoke assembly of claim **1** wherein said adjustable one of said core and deflection coils are mounted for relative fine adjustment in a direction parallel to the horizontal axis of the assembly.

4. The deflection yoke assembly of claim **1** wherein the adjustable one of said core and deflection coils are mounted for independent adjustment respectively along the horizontal and vertical axes of the deflection yoke assembly.

5. The deflection yoke assembly of claim **4** wherein there is provided adjusting means for independently progressively adjusting the relative positions between said core and deflection coils along said horizontal and vertical axes.

6. The deflection yoke assembly of claim **1** wherein there is provided temporarily mounted adjusting means for progressively adjusting the relative positions between said core and deflection coils along at least one of said horizontal and vertical axes.

7. The deflection yoke assembly of claim **1** wherein there is provided on said frame permanently mounted adjusting means for finely progressively adjusting the relative positions between said core and deflection coils along at least one of said horizontal and vertical axes.

8. The deflection yoke assembly of claim 1 wherein the horizontal and vertical deflection coils are radially immovably mounted relative to said frame, and said adjusting means adjusts the relative position of one of said vertical and horizontal deflection coils and the frame, on the one hand, and the core, on the other hand.

9. The deflection yoke assembly of claim 1 wherein the core is mounted for movement relative to said deflection coils, and said adjusting means adjusts the position of the core relative to the deflection coils.

10. The deflection yoke assembly of claim 4 in combination with a single manually adjustable means for independently adjusting the relative position between said core and deflection coils along said horizontal axis and a single manually adjustable means for independently adjusting the relative position between said core and deflection coils along said vertical axis.

11. The deflection yoke assembly of claim 6 wherein said adjusting means comprises a base plate adapted to receive the frame of said deflection coil assembly and holding the same immovable with respect to said axes, a slide member supported for progressive movement on said base plate along one of said axis, means for progressively adjusting the position of said first slide member on said base member, a pair of opposed jaw members adapted to engage opposite diametrical sides of said core, said jaw members being supported on said slide member for progressive movement relative thereto in a direction parallel to the other of said axes, and means for progressively adjusting the position of said jaw members relative to said slide member along said latter axis.

12. The deflection coil assembly of claim 7 wherein said core is positioned around said horizontal and vertical deflection coil, said adjusting means includes an inner annular member surrounding said core immovably secured to said frame and surrounding one end of said core, an annular slide member surrounding said one end of the core and mounted on said inner annular member for movement in a direction parallel to one of said axes, manually adjustable means for progressively moving said slide member in one direction or the other along said one axis, a core connected annular member mounted in juxtaposed relationship to said slide member and surrounding said core, said core connected annular member being mounted upon said annular slide member wherein it is movable with respect thereto along the other axis, a single manually adjustable means for progressively moving said core connected annular member in one direction or the other along said other axis, and means for anchoring said core connected annular member to said core of the deflection yoke assembly.

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