

[54] MEANS FOR EFFECTING DYNAMIC VERTICAL CONVERGENCE IN AN IN-LINE PLURAL BEAM CATHODE RAY TUBE

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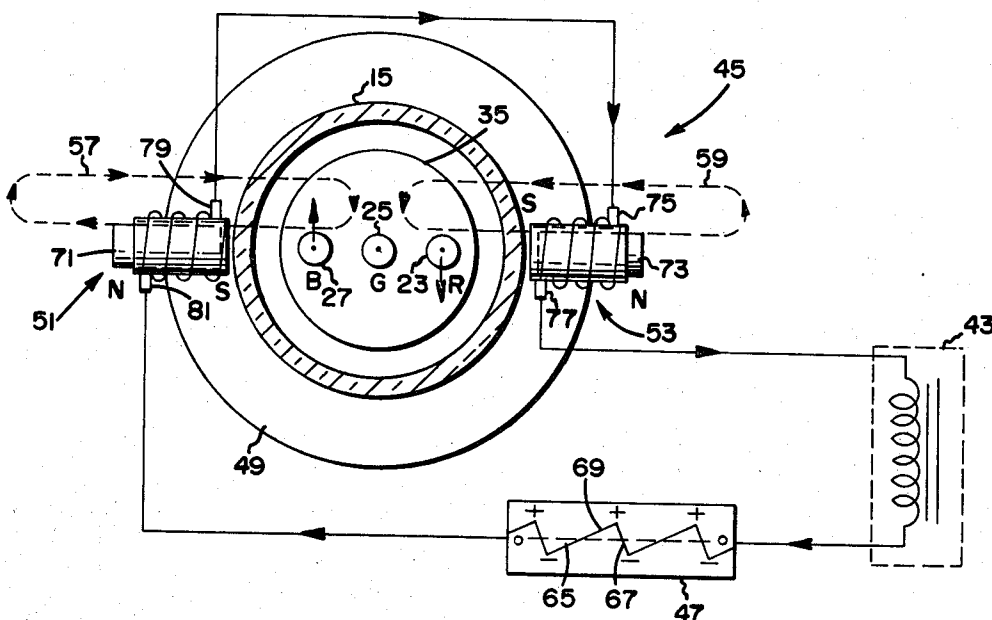
Primary Examiner—G. Harris

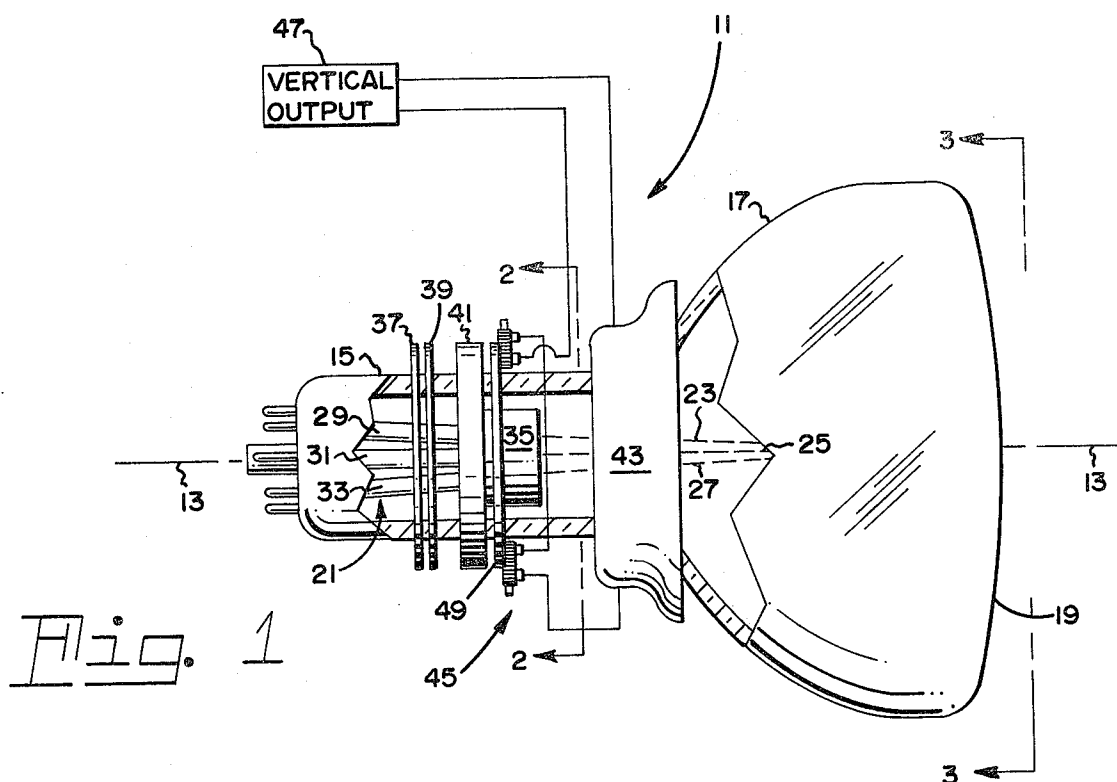
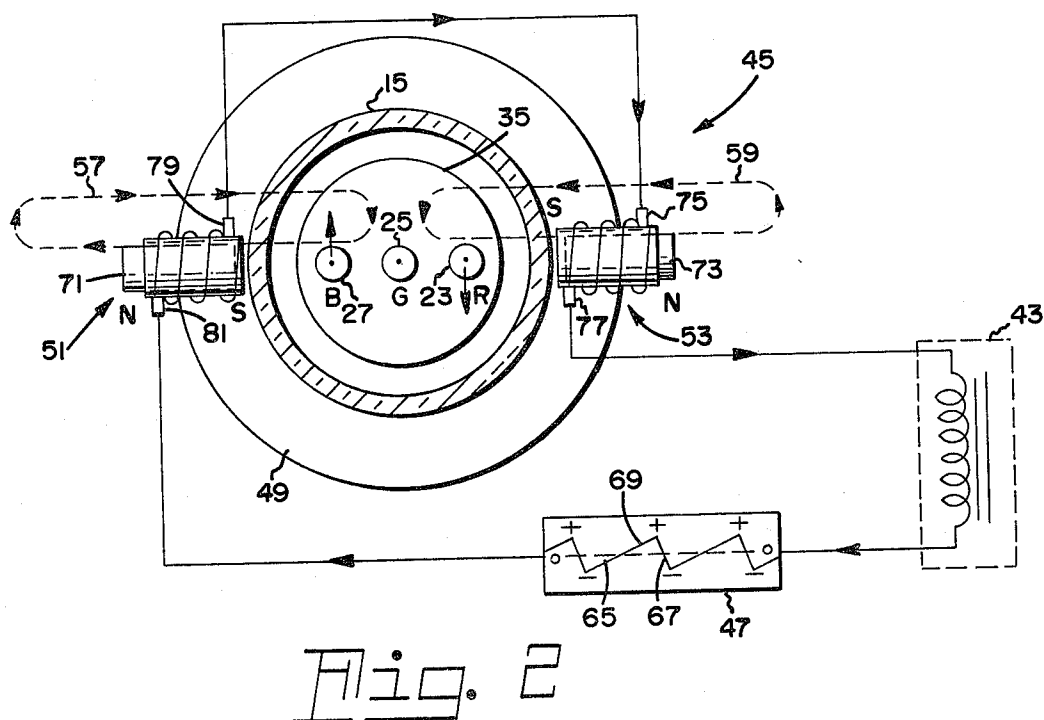
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[57] ABSTRACT

Auxiliary fine-adjustment means are provided for effecting improved dynamic vertical convergence of a plurality of related electron beams at substantially the top and bottom regions of the raster image of an in-line cathode ray tube employing a deflection yoke having vertical windings for accomplishing at least part of the dynamic vertical convergence. The invention comprises a pair of series connected individually adjustable helix-wound coils mounted on a supporting element, and positioned exteriorly of the neck portion on either side of the in-line gun assembly. Movement of the cores provides a fine-adjustable coupling of the magnetic fields as required to provide the desired convergence correction.

4 Claims, 3 Drawing Figures





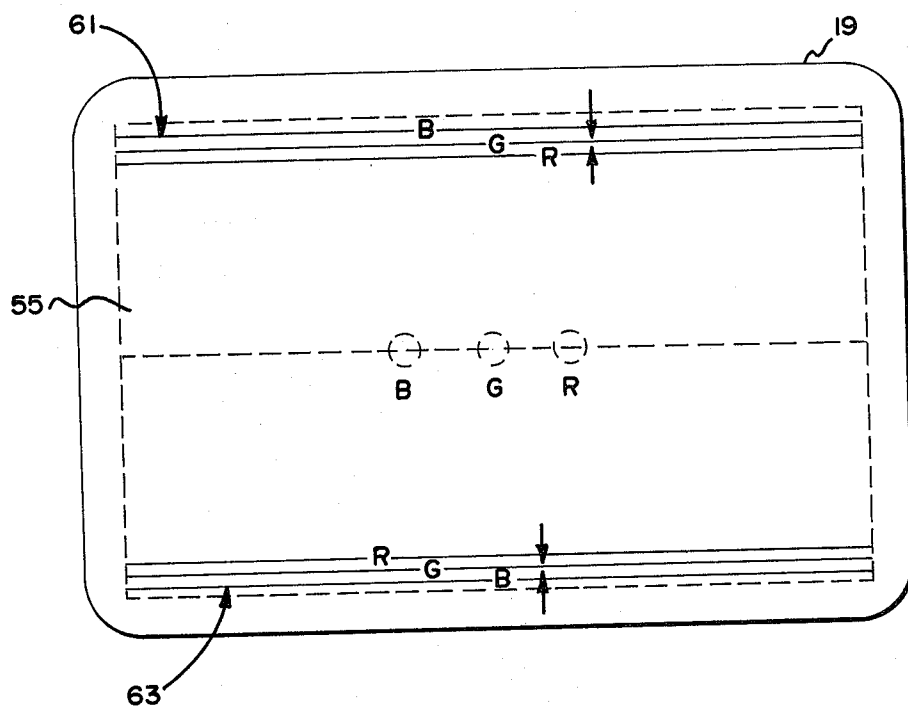


Fig. 3

MEANS FOR EFFECTING DYNAMIC VERTICAL CONVERGENCE IN AN IN-LINE PLURAL BEAM CATHODE RAY TUBE

BACKGROUND OF THE INVENTION

This invention relates to means for effecting convergence of a plurality of electron beams in an in-line beam cathode ray tube and more particularly to an improvement in the means for effecting dynamic vertical convergence of the beams in a three-beam in-line color cathode ray tube.

Color cathode ray tubes, as conventionally utilized in television applications, commonly employ a patterned cathodoluminescent display screen that is disposed relative to the viewing portion of the envelope face panel, such being usually comprised of several electron responsive color-emitting phosphor materials disposed as repetitive groupings of areal defined stripes or dots. In plural beam tubes, the respective color-emitting screen elements are individually excited when selectively impinged by discrete beams emanating from a related electron gun assembly during operation of the tube. A grid or mask member, having a multiplicity of defined openings therein of shapings related to the pattern elements of the screen, is positioned between the screen and the electron gun assembly to assure proper impingement of the respective electron beams on the patterned member. To achieve a screen display of optimized quality, it is imperative that the three electron beams be influenced to converge at the plane of the mask member for all deflection angles. To accomplish this result, a magnetic convergence arrangement is usually positioned on the exterior of the neck portion of the tube envelope, relative to the forward end of the interiorly positioned gun assembly, to provide corrective magnetic convergence influences on the several electron beams passing therethrough. A deflection yoke is conventionally oriented forward of the convergence arrangement in the region whereat the neck portion merges with the funnel portion of the envelope.

In color cathode ray tubes utilizing an in-line electron gun assembly, dynamic vertical convergence of the beams is often accomplished by utilizing a yoke of the self-converging type, for example, one embodying toroidal quadrupole windings. When employing yokes of this type, it is difficult to correct any misconvergence of the beams which may occur at the top and bottom of the scanning raster on the screen. Only a limited amount of top and bottom dynamic vertical convergence correction can be accomplished by adjustment in the conventional circuitry. Usually, the normal assembly procedure involves the interchanging of yokes and tubes, but such a practice is not only time consuming but also results in a compromising convergence effect that is less than optimum desideratum.

OBJECTS AND SUMMARY OF THE INVENTION

It is an object of the invention to reduce and obviate the aforementioned disadvantages evidenced in the prior art. Another object of the invention is to provide an improvement in the means for effecting dynamic vertical convergence of a plurality of related electron beams in a three beam in-line color cathode ray tube employing a deflection yoke wherein at least part of the dynamic vertical convergence of the beams is accomplished.

These and other objects and advantages are achieved in one aspect of the invention wherein an auxiliary fine-adjustment convergence means is utilized in conjunction with the dynamic vertical convergence influences supplied by the yoke and vertical output portions of the operational circuitry. The auxiliary adjustment means consists of a pair of series-connected individually adjustable helix wound coils that are mounted on a non-magnetic supporting element formed for positioning on the exterior of the neck portion of the tube forward of a static convergence assembly. The coils are mounted in the plane of the in-line beams in a manner that a coil is substantially adjacent each of the outside beams of the in-line arrangement. Each coil has a movable core element to provide individual adjustable coupling of the magnetic fields induced in the respective coil thereby effecting improved convergence of the beams at substantially the top and bottom regions in the raster of the screen display.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a plan view of a plural in-line beam type of color cathode ray tube showing the auxiliary beam convergence means exteriorly oriented thereon;

FIG. 2 is a view taken along the line 2—2 of FIG. 1 and incorporates diagrammatic circuitry utilized in the invention; and

FIG. 3 is a plan view taken along the line 3—3 of FIG. 1 portraying the dynamic vertical convergence corrections evidenced in the raster as accomplished by use of the invention.

DESCRIPTION OF THE PREFERRED EMBODIMENT

For a better understanding of the present invention, together with other and further objects, advantages and capabilities thereof, reference is made to the following specification and appended claims in connection with the aforescribed drawings.

With particular reference to FIG. 1, there is shown a plan view of a plural beam in-line color cathode ray tube 11 having a longitudinal axis 13 therethrough and an envelope comprised of an integration of neck 15, funnel 17, and face panel 19 portions. An in-line electron gun assembly 21 is positioned within the neck portion 15 of the envelope in a manner to direct a plurality of three in-line electron beams 23, 25 and 27 toward a patterned cathodoluminescent screen disposed on the interior surface of the viewing panel 19. Although not shown, a multi-apertured grid or mask is positioned adjacent to the screen and spaced therefrom whereat the aforementioned plural beams are converged. The in-line electron gun assembly 21 is partially detailed to delineate three related electron guns 29, 31 and 33 which are aligned in a common plane with the axis of the side guns, 29 and 33 respectively, angled slightly toward the forward end of the center gun 31 and the longitudinal axis 13. A common convergence electrode 35, comprised of a metallic shell of non-magnetic material, is terminally integrated to the forward portions of the three gun assembly 21 in a manner that the emitted electron beams 23, 25 and 27 are directed therethrough toward the patterned screen. While any electron gun in the assembly 21 may be denoted to excite a particular color-emitting phosphor component of the patterned screen, for purposes of illustration, the side-oriented gun 29 is designated as the red electron gun

which emits and directs a beam 23 (R) to excite the red phosphor components of the screen pattern. The center gun 31 in the structure is denoted as the green gun from which beam 25 (G) is directed to impinge the green phosphor screen components, while the remaining oppositely-disposed side gun 33 is denoted as the blue gun producing beam 27 (B) for exciting the blue color-emitting phosphor of the cathodoluminescent screen pattern.

Mounted on the exterior of the tube neck portion 15, adjacent to the gun assembly 21 encompassed therein, is a purity ring device comprised of two magnetized rings 37 and 39 which are formed to be rotatable about the neck of the tube. Selective rotation of the purity rings orients a magnetic field to exert a force in any desired transverse direction to move all three beams 23, 25 and 27 transversely of the tube axis 13 to thereby align them with the mask or grid apertures and the respective associated phosphor patterns of the screen therebeyond.

Forward of the purity ring device are conventional static convergence means 41 which are not detailed in the drawings. These means 41, which effect horizontal and vertical convergence of the beams at the center portion of the apertured mask, are magnetic structures known in the art; such as, for example, an adjustable assembly of four rotatable ring-like members each having a plurality of magnetic elements discretely oriented therein.

Dynamic vertical and horizontal convergence of the scanning beams, as they sweep the raster area of the screen, is effected by separate windings in the deflection yoke 43 of self-converging construction, in conjunction with the respective output signals of the operational circuitry for the tube. The invention is concerned with an improvement in the means for effecting dynamic vertical convergence, and is in the form of an auxiliary fine-adjustment device 45 which is oriented on the neck portion 15 of the tube ahead of the static horizontal and vertical convergence means 41 and connected in series with the vertical output portion 47 of the circuitry and the vertical deflection windings in the yoke 43.

To describe the constructional and operational aspects of the invention in greater detail, reference is directed to FIGS. 1, 2, and 3, wherein the auxiliary dynamic vertical convergence means 45 is shown positioned on the exterior of the neck portion of the tube ahead of the static convergence means 41. A nonmagnetic supporting element 49, fashioned to encompass the tube neck portion, has a pair of series connected individually adjustable helix wound coils 51 and 53 mounted thereon in the plane of the in-line beams 23, 25, and 27 in a manner that one of the coils is substantially adjacent each of the outside beams 23 and 27 of the in-line arrangement. As shown, the tube coils are series connected in a manner to provide magnetic influences for each of the outer beams. The corrective magnetic force (F) exerted upon each of these respective beams is perpendicular to both the direction of the influencing lines of flux (B) and the velocity (v) of the charged particles (q) comprising the moving beam; the force vector being determined by the cross-product of the two: $\vec{F} = q \vec{v} \times \vec{B}$. In describing the dynamic vertical convergence correction at the top and bottom of the defined raster image 55 as provided by the invention, reference is directed to FIG. 2 wherein the respective

electron beams 23, 25 and 27 are shown as emerging from the plane of the drawing. The flow of the current induces a magnetic field for each coil. For purposes of clarity, only one exemplary force line, 57 and 59 respectively, is shown to indicate the momentary direction of the magnetic field in each coil. Accordingly, by facing in the direction of the lines of flux emanating from each of the respective coils, a directional shift of the associated beam is to the right, which in this instance, is slightly up or down from the plane of the beams. As previously mentioned, the auxiliary convergence device 45 of the invention is series connected through the operational vertical output 47 of the circuit and the vertical windings of the self-converging deflection yoke 43 thereby providing an improved fine-adjustment coupling of the magnetic fields to effect an improved convergence of the beams of the screen display that is not normally possible to obtain from the yoke windings alone.

As shown in FIG. 3, misconvergence is noted in the representative scan lines 61 and 63 at substantially the top and bottom of the raster image 55. At the top, the scan of the blue beam (B) needs to be lowered and the scan of the red beam (R) raised to coincide with the scan of the green or center beam (G). Conversely, at the bottom of the raster the scan of the red beam (R) needs to be lowered and the scan of the blue beam (B) needs to be raised to coincide with the scan of the center green beam (G). Defined correctional adjustment of the top and bottom misconverged regions is provided by the invention. In the center of the raster, the three electron beams (B), (G) and (R) are shown in phantom to indicate the orientation of the beams as they emerge from the gun assembly 21. The signal supplied by the vertical output circuitry 47 is a sawtooth current illustrated in FIG. 2 as having a repetitive trace 65 and re-trace 67 shaping. With each scan of the raster, the signal moves through one sawtooth waveform. As the signal progresses up the ramp of the trace 65, from negative to positive, it passes through an intermediate zero region whereat the direction of the current in the circuit is reversed. FIG. 2 depicts the operational conditions when the signal is most positive or at substantially the apex of the trace as denoted by 69. At this instant, the misconvergence of the scan at the bottom of the raster is being corrected by effecting a slight upward movement of the blue beam (B) and slight downward movement of the red beam (R). This correctional movement of the respective outer beams 23 and 27 is effected by the magnetic flux fields emanating from the respective coils. The movable cores 71 and 73, which are formed of a high permeable material such as ferrite, are selectively adjusted to provide the necessary degrees of coupling to accomplish the required correction. Thence, the signal passes through retrace in the sawtooth waveform to the negative value at the beginning of a new ramp, whereupon the misconvergence at the top of the raster 55 is corrected by current momentarily moving in the reverse direction in the circuit.

The device of the invention has versatility, for example, if the misconvergence at the top and bottom of the raster requires movement of both outer beams in the same direction, such can be accomplished by reversing the terminal connections on one or other of the coils. For example, in FIG. 2, if it is found necessary to move both the blue (B) and red (R) beams upward, the connections 75 and 77 on coil 53 would be reversed. In like

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manner, the connections 79 and 81 on coil 51 may be reversed in accordance with the corrective conditions required. Therefore, it has been found advantageous to incorporate quick connect-disconnect terminals on the coils.

It has been found expedient to utilize threaded cylindrical high permeable cores 71 and 73 for individually adjusting the magnetic coupling in the coils, as such can be accurately positioned and retained within the forms of the respective coils 51 and 53.

Thus, there is provided an auxiliary fine-adjustment dynamic vertical convergence means that is formed to provide corrective magnetic influence to the side-oriented beams in a plural beam in-line cathode ray tube. This auxiliary device is expeditiously utilized in conjunction with the dynamic vertical convergence influences supplied by the vertical deflection windings in the yoke and the vertical output portions of the operational circuitry thereby effecting improved convergence of the beams as they scan the top and bottom of the display raster.

While there has been shown and described what is at present considered the preferred embodiment of the invention, it will be obvious to those skilled in the art that various changes and modifications may be made therein without departing from the scope of the invention as defined by the appended claims.

What is claimed is:

1. An improvement in the means for effecting dynamic vertical convergence of a plurality of related electron beams as operationally manifest in the raster of the screen display of a three in-line beam color cathode ray tube employing a deflection yoke having vertical and horizontal deflection windings wherein at least

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part of the dynamic convergence of said beams is accomplished by the utilization of said yoke, said improvement being an auxiliary fine-adjustment convergence means comprising:

5 a non-magnetic supporting element formed for positioning on the exterior of the neck portion of said tube; and

10 a pair of series connected individually adjustable helix-wound coils mounted on said supporting element in the plane of said in-line beams in a manner that one of said coils is substantially adjacent each of the outside beams of said in-line arrangement, said coils being series connected to the operational vertical output circuit and the vertical windings of said yoke to provide adjustable coupling of the magnetic fields for effecting improved convergence of the beams as they scan substantially the top and bottom regions of the raster image.

2. The improvement in dynamic vertical convergence means according to claim 1 wherein positioning of said means is accomplished by orienting said means intermediate said yoke and a static convergence assembly also mounted on the neck of said tube.

3. The improvement in dynamic vertical convergence means according to claim 1 wherein the adjustable feature of each coil is in the form of an individual core accommodated within the helix of the coil and adapted for movable positioning and retention therein.

4. The improvement in dynamic vertical convergence means according to claim 1 wherein each of said coils has interchangeable connection means to facilitate a directional change of current flow therethrough to provide a reverse polarity of the coil.

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