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[54] **PURITY AND BLUE LATERAL ASSEMBLY FOR DELTA BEAM TYPE CATHODE RAY TUBE**

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[52] **U.S. Cl.** **335/212,** 313/77

[51] **Int. Cl.** **H01f**

[58] **Field of Search** 335/210, 212; 313/77

[56] **References Cited**

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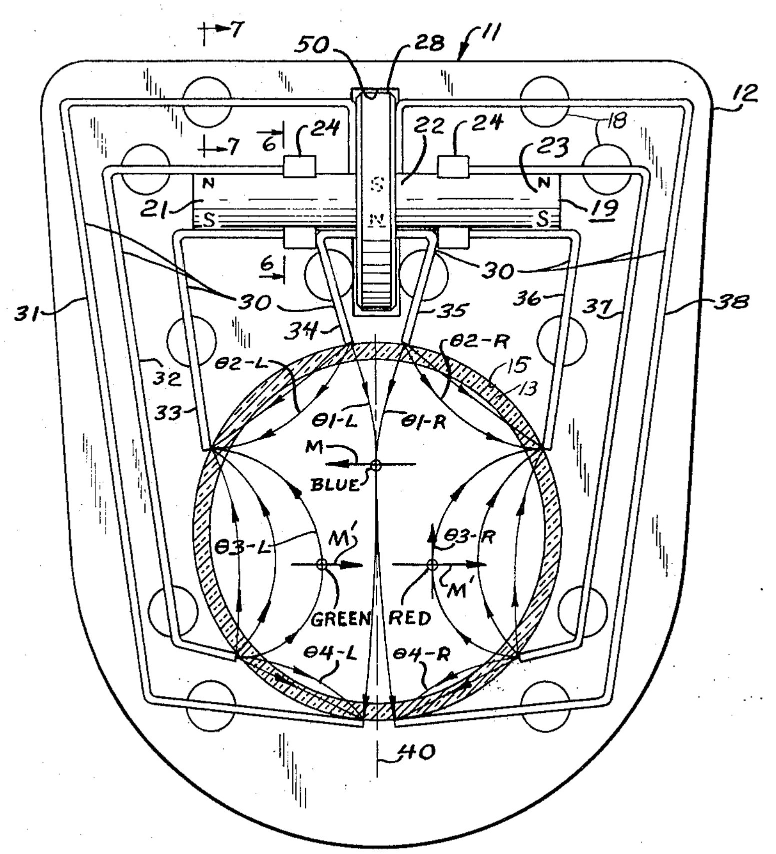
[57] **ABSTRACT**

A static magnetic assembly for delta beam type cathode ray tubes for providing proper convergence adjustment of the electron beams.

10 Claims, 7 Drawing Figures



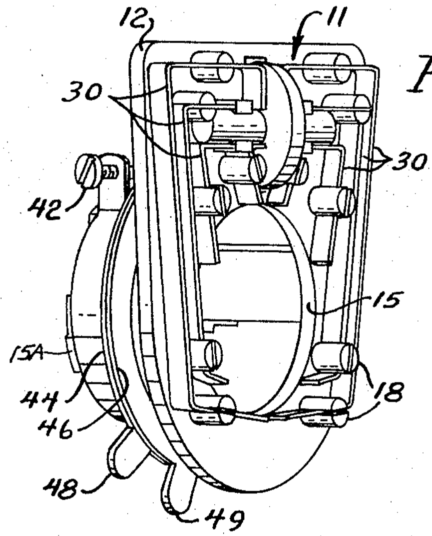


Fig. 1

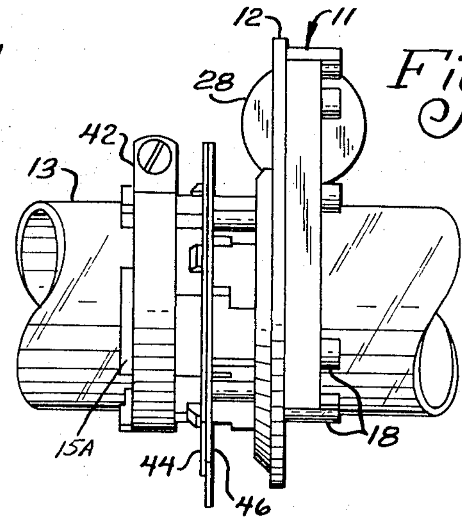


Fig. 2

Fig. 3

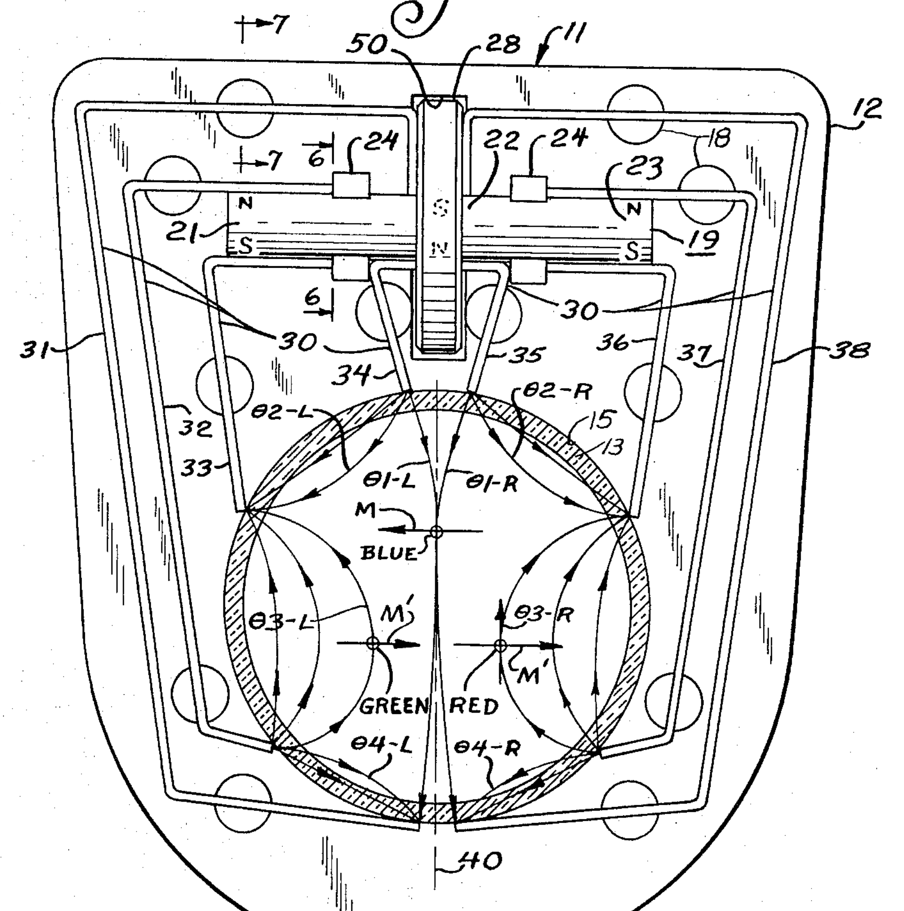
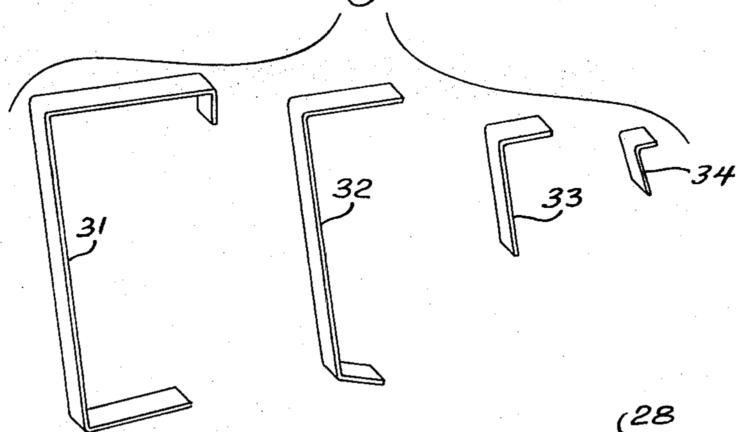


Fig. 4



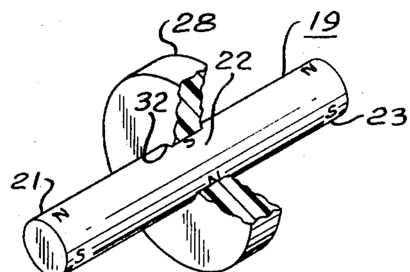


Fig. 5

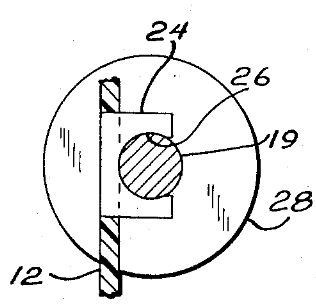


Fig. 6

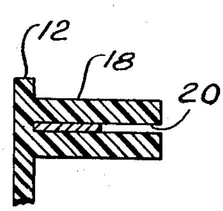


Fig. 7

PURITY AND BLUE LATERAL ASSEMBLY FOR DELTA BEAM TYPE CATHODE RAY TUBE

BACKGROUND OF THE INVENTION

As is known, delta gun, tri-color kinescopes or cathode ray tubes (CRT) used for color television receives include an electron gun assembly having three separate electron guns positioned in a triangular configuration to provide three distinct relatively triangularly disposed beams which impinge on the viewing screen of the CRT or picture tube. The CRT comprises a screen made up of three different color phosphor dots, arranged in the form of triads, each consisting of a blue phosphor dot, a red phosphor dot and a green phosphor dot. The dots are positioned relatively close together, without overlapping or touching each other, and each of the three beams is arranged to respectively strike only those phosphor dots of a particular color.

Again, as is known, when a beam strikes a phosphor dot, that dot will emit light with its respective color; that is, the blue phosphor dot will emit light with a blue color, etc. The characteristics of the human eye are such that the individual light emissions from the three phosphor dots are normally not distinguishable; and, the eye will blend the individual light output of the phosphor dots into a single output. By controlling the light output of the respective phosphor dots, a variety of colors which corresponds to the colors in the visible light spectrum are produced.

The delta gun tri-color tube further includes an aperture or shadow mask, which consists of a thin sheet with a series of small holes. The shadow mask covers the entire viewing screen and includes as many holes as there are phosphor triads on the screen; that is, each hole on the shadow mask corresponds to a dot triad on the viewing screen. As mentioned above, the electron beams from the three guns are arranged to be directed at an angle through each hole such that each beam will energize the same colored dot in each triad throughout the viewing screen. The three electron beams are therefore controlled to converge at the holes of the aperture mask and diverge at the proper angle to impinge upon its respective dot, such that as mentioned, the blue beam impinges only upon a blue phosphor dot, etc.

Since each beam must impinge upon its respective phosphor dot, the beams must be individually controlled to provide a desired color output. The three beams provided by the electron gun assembly are in as close alignment as the state of the art will allow with each other and with the central axis of the tube before they pass through the convergence field. However, because of production tolerances, variations in the gun structure, and differences in the voltage applied thereto, the electron beams may not be in perfect alignment with each other. A common example is that the gun assembly may be rotated slightly relative to the axis of the neck of the tube and hence, will be skewed relative to the viewing screen and, hence, the beams will not impinge at the proper point on the viewing screen. Also, as another example, the three beams may not be properly aligned with respect to the central axis of the tube. Accordingly, should the beams enter the area of deflection at an improper point the blue beam may for instance, tend to impinge, in part, on the red or green color phosphors and the purity of the colors will be impaired.

Thus, it will be appreciated that both static convergence devices and dynamic control devices must be provided to the beams to properly direct, position and deflect the beams vertically and horizontally to cover the entire viewing screen.

The present invention is particularly directed to a purity and blue lateral control static magnetic convergence assembly. More specifically, in the type of CRT mentioned, it is necessary to adjust the position of the beam with respect to the aperture mask in the viewing screen by using auxiliary components such as blue lateral correction assemblies and purity magnets. While the prior art discloses various types of blue lateral connection assemblies and purity magnets, such prior art devices have for one reason or another, not been entirely satisfactory.

Accordingly, it is a principal object of the present invention to provide an improved purity and blue lateral assembly for delta beam cathode ray tubes.

It is another object of the present invention to provide a static magnetic assembly which provides a more precise and accurate adjustment and control of the three beams of a delta gun cathode ray tube.

It is known in the art, and can be verified geometrically, that any two of the three beams, say the red and green beams can be converged in a straight line directly toward the center axis of the neck of the tube; and, the beams cannot all be directly converged. Therefore, a specific magnetic field is provided by the so-called blue lateral correction magnet, to move the blue beam in a horizontal direction to converge the blue beam with respect to the red and green beams.

The foregoing and other objects, features and advantages of the invention will be apparent from the following more particular description of embodiments of the invention, as illustrated in the accompanying drawings wherein:

DESCRIPTION OF THE DRAWINGS

FIG. 1 is an isometric view showing the inventive purity and blue lateral assembly in accordance with the invention;

FIG. 2 is a side view of the inventive assembly shown mounted on the neck of an associated cathode ray tube;

FIG. 3 is a front view of the inventive assembly shown mounted on the neck of the associated cathode ray tube; and, FIG. 3 includes a showing of the lines of force of the magnetic fields developed by the inventive assembly;

FIG. 4 is an exploded view showing some of the pole pieces or pole piece extenders utilized in the present invention;

FIG. 5 shows the ferrite rod used in the present invention; and shows three permanent magnets formed thereon;

FIG. 6 is a side view showing mounting means for the rod; and,

FIG. 7 is a view partly in section showing a mounting of the pole piece extenders on an associated stud.

DESCRIPTION OF THE INVENTION

Refer now to the Figures. The overall physical construction of the inventive purity and blue lateral assembly **11** is clearly shown in FIGS. **1–3.**

Before describing the structure of FIGS. **1–3,** note that the inventive purity and blue lateral assembly functions to adjustably cause the position of the blue beam to cause the red and green beams to adjustably and correspondingly move in an equal and opposite direction relative to the blue beam.

The purity and blue lateral assembly **11** of the invention comprises a plastic or nonmagnetic carrier or base **12** formed in a planar surface which includes a central clamping flange **15A** and a central aperture **15** to permit the mounting of the blue lateral assembly **11** on the neck **13** of the associated CRT as by a suitable clamp **42.** In the FIG., the blue and green beams are shown in their approximate operating position.

Blue lateral assembly **11** includes ferrite rod **19** mounted in a horizontal orientation on base **12,** see also FIGS. **5** and **6.** The ferrite rod **19** includes a first or central magnet portion **22** polarized across a diameter of the rod in a first orientation relative to the principal axis of the tube to provide a magnetic field component transverse to the path of the blue beam, as will be explained. Rod **19** further includes a pair of additional magnet portions **21** and **23** which are disposed adjacent to, but on opposite sides of magnet portion **22.** Magnets **21** and **23** are also polarized across a diameter of the rod but at a 180° angle relative to the orientation to magnet **22.** Magnets **21** and **23** provide magnetic field components transverse to the paths of the red and green beams as will also be explained.

In one embodiment, magnets **21** and **23** have substantially equal field strengths and magnet **22** has a field strength less than magnets **21** and **23.** Magnets **21, 22** and **23** may be formed by selectively magnetizing a single ferrite rod or may be formed individually and intergrated into a single cylindrical structure. The strengths of the three beams may be selected and adjusted to develop a resultant magnetic field of desired configuration and strength.

The ferrite rod is mounted on the base **12** such as by two spaced upstanding flanges **24** having semi-circular shaped recesses **26,** and having slightly yieldable end portions. Rod **19** forcefully pushed into recess **26** is retained therein.

A circular thumbwheel **28** element of nonmagnetic material, having a central hole **32** is mounted on ferrite rod **19.** Rod **19** fits tightly in hole **32** and rotation of thumbwheel **28** permits rotatable movement of rod **19.** Base **12** includes a hole which receives and permits free rotation of thumbwheel **28.** As will be obvious, thumbwheel **28** can be manually adjusted to obtain the desired fine positioning of the north and south magnets of rod **19,** for purposes to be explained.

The purity magnets control the beams such that each beam strikes only its respective set of phosphor dots to cause individual registry of the rasters. The purity magnets comprise two rings **44** and **46** composed of magnetic material and arranged for mounting around the neck **13** of the CRT. The individual rings are polarized such that one-half of each ring is of a positive or north polarity and the opposite one-half of the ring is of a negative or south polarity; and, each of the rings is arranged to be rotated about the central axis of the tube. The rings are placed adjacent to each other such that the field developed by one ring can either augment or substract from the field developed by the other ring. Thus, the strength of the field existing in the space at the center of the rings, and hence, in the center of the tube in the space of aperture **15** which the electron beams traverse, may be varied. For example, the field in the center of the ring may have maximum strength when the ring portions of like polarities of the two rings **44** and **46** are adjacent to each other. And, as one magnet is rotated relative to the other, the magnetic field is decreased, in strength. The field produced by the two rings is essentially uniform and exerts an approximately equal force on all three beams with the force being at right angles to the direction of the magnetic field. With proper rotatable adjustment of one or both purity magnets, such as by manually moving tabs **48** and **49** formed on rings **44** and **46** respectively, the grouped electron beams can be caused to enter the static deflection fields at the proper point such as to pass-through the shadow mask at the proper angles to produce a pure color.

The configuration of the pole piece sub-assembly is an important aspect of the invention and will now be described.

The pole piece sub-assembly, generally labeled **30,** comprises pole piece members or extenders **31, 32, 33, 34, 35, 36, 37** and **38,** each formed of a low coercivity metal ribbon, see FIG. **3** and FIG. **4.** The pole pieces **31–38** are mounted in suitably positioned, vertically split stud members **18** formed on base **12,** see FIGS. **3** and **7.** The narrow width of sections of the ribboned pole pieces are wedged into the split **20** of the stud members **18.**

For purposes of this explanation, the inventive assembly **11** may be considered to have a vertical axis **40** as indicated in FIG. **3,** and the pole piece sub-assembly **30** is symmetrical about axis **40** as will become clear. For purposes of this description, the top of the aperture **15** through which axis **40** passes will be considered as zero degrees (0°) of the circle formed by aperture **15.**

Pole piece or pole piece extenders **31** and **38** are the larger of the pole pieces and are positioned farthest from aperture **15.** Pole pieces **31** and **38** are mirror images one of the other; and, hence a description of pole piece **31** is necessary only. Pole piece **31** is essentially of a modified C-shape with the upper part of the C-shape forming a horizontal section, and having a vertical depending free end portion. The tip of the free end portion is positioned adjacent the north magnetic pole of the center magnet **22.** The bight portion of pole piece **31** extends downwardly at an angle of about 171.5° with the vertical axis **40.** The lower part of the C-shape pole piece **31** is a section which extends at an angle of about 106.5° with respect to the vertical axis **40**; and, the free end thereof is mounted to be tangential to the aperture **15.** The lower tip of pole piece **31** terminates at about 185° on the periphery of the circle of aperture **15.**

As noted above, the pole piece **38** is mounted on the other side of the axis **40** in mirror image position relative to pole piece **31** and aperture **15.** The lower tip of pole piece **38** terminates at about 175° on the periphery of the circle of aperture **15.** The tips of upper ends of the pole pieces **31** and **38** both abut against magnet **22,** and are in spaced relation to one another.

Likewise, the pole pieces **32** and **37** are mirror images one of the other and are relatively smaller than pole pieces **31** and **38.** Pole pieces **32** and **37** are positioned relatively closer to aperture **15** than pole pieces **37** and **38.** Pole pieces **32** and **37** are essentially identical; hence, a description of pole piece **32** only is necessary. Pole piece **32** has a horizontally extending upper portion, with a major part thereof being in contact with the north pole of magnet **22.** The bight portion of pole piece **32** extends downwardly at an angle of about 171.5° with respect to the 0° axis **40.** The lower part of pole piece **32** extends at an angle of about 114.5° with respect to the axis **40** and the lower tip of pole piece **32** terminates at the periphery of aperture **15** at approximately 225° relative to the circle of aperture **15.**

Pole pieces **33** and **36,** which are mirror images one of the other, comprise essentially an inverted L-shape. Again, since pole pieces **33** and **36** are essentially identical a description of pole piece **33** only is necessary. The horizontal portion of the pole piece **33** is in contact with the south pole of magnet **22.** The vertical portion of the L-shape extends downwardly at an angle of approximately 83° with axis **40** and the lower tip of pole piece **33** terminates at the periphery of the circle of aperture **15** at approximately 292.5°.

The center pole pieces **34** and **35** are the smallest of the pole pieces **30** and comprise an inverted L-shape configuration. Again, pole pieces **34** and **35** are essentially identical and are positioned to form mirror images, one of the other. The horizontal portion of pole piece **32** abuts and its vertical leg extends downwardly at an angle of 164.5° with respect to the axis **40** and terminates at about 350° on the periphery of the circle of aperture **15.**

The magnets **21, 22** and **23** and the pole piece **30** form in the space encompassed by aperture **15,** a composite magnetic field marked generally by the Greek letter theta (θ). The magnetic lines of force of a first subfield **θ1-L** may be traced from the north pole of the magnet **22** down pole piece **34** extending through the space traversed by the blue beam B down to the lower tip of pole piece **31** and the south pole of magnet **22.**

A similar and symmetrical subfield **θ1-R** may be traced from the north pole of magnet **24** down pole piece **34** to the lower tip of pole piece **38,** then upwardly through pole piece **38** to the south pole of magnet **22.**

The fields **θ1-L** and **θ1-R** effectively combine their magnetic force to primarily affect the blue beam as will be explained.

Another subfield **θ2-L** may be traced from the north pole of magnet **22** through pole piece **34,** and from the tip of pole piece **34** across aperture **15** to the lower tip of pole piece **33** up through the pole piece **33** to the south pole of magnet **22,** and thence, to the north pole of magnet **22.** A similar subfield **θ2-R** which is symmetrically with respect to field **θ2-L** extends across aperture **15** from pole piece **35** to pole piece **36.**

Another subfield **θ3-L** may be traced from the north pole of magnet **21** through pole piece **32** to the lower tip thereof, across aperture **15** to the lower tip of pole piece **33,** and upwardly through pole piece **33** to the south pole of magnet **21.** Field **θ3-L** primarily affects the red beam. A similar field **θ3-R** which is symmetrically with respect to field **θ3-L** may be traced from the lower tip of pole piece **37** across aperture **15** to the tip of pole piece **36.** Field **θ3-R** primarily affects the green beam.

A fourth subfield **θ4-L** extends across aperture **15** from the lower tip of pole piece **32** to the lower tip of pole piece **31.** A similar and symmetrical subfield **θ4-R** extends from the tip of pole piece **37** to the lower tip of pole piece **38.**

In the space which the blue beam traverses, the lines of force of fields **θ1-L** and **θ1-R,** which primarily affect the blue beam, extend essentially parallel to the vertical axis **40.** The field **θ3-L** primarily affects the red beam and has a principle component in a vertical direction in that space which the red beam normally traverses. Likewise, field **θ3-R** has a principle component in a vertical direction in that space which the green beam normally traverses.

The orientation of the lines of force or flux polarity of the fields **θ1-L** and **θ1-R** in the space of aperture **15** is from a north to south downward direction as shown in FIG. **3,** and the direction of the fields **θ3-L** and **θ3-R** which affect the red and green beam is in a relative reversed direction, that is, in a north to south upward direction. The fields **θ2-L** and **θ2-R** are essentially fringe fields and have minor effect on the control of the three electron beams.

The operation of the inventive assembly **11** can now be considered. Assume the electron beam current flows through the neck **13** of the CRT in a direction outwardly of the paper. In accordance with the well known "right hand motor rule for electrical flow", the field **θ1-R** and **θ1-L** provided by assembly **11** jointly develop a motion vector labeled M for the blue beam which is directed toward the left as indicated in the Figure. Conversly, since the polarity of fields **θ3** are in an upward direction, a motion vector M' for the red and green beams will be developed directed toward the right as indicated in the Figure.

The relative field strengths are adjusted such that the blue beam will move equally and oppositely to the red and green beams. As mentioned above, in one embodiment, magnets **21** and **23** are arranged to have substantially equal field strengths and magnet **22** has a field strength less than magnets **21** and **23.**

Relative left and right motion of the blue beam is achieved by rotation of the magnet rod **19** such as by moving thumbwheel **28** to vary the strength of the magnetic fields θ developed in aperture **18.** Note that 180° rotation of rod **19** provides a reversal of relative direction of the magnetic flux coupled to the pole piece subassembly. Thus, by rotation of the rod, 180° relative to the position shown in FIG. **3,** the blue beam is movable in a relatively opposite direction or toward the right as indicated in FIG. **3.** Likewise, the red and green beams would then be moveable in an opposite direction or toward the left as orientated in the Figure.

While the invention has been particularly shown and described with reference to preferred embodiments thereof, it will be understood by those skilled in the art that various changes in form and details may be made therein without departing from the spirit and scope of the invention. For example, known different adjustment means, for ferrite rod in lieu of thumbwheel **28** could be utilized; also, the lower ends of pole piece extenders **31, 32, 33, 34, 35, 36, 37** and **38** located around the neck of the CRT may be positioned at different locations while the relative strength between the magnets **21, 22** and **23** may be varied to cause essentially the same motion as herein previously described. Also, while the ends of the pole piece members terminate along the periphery of the tube neck at approximately 10°, 65°, 135°, 175°, 185°, 225°, 295°, and 350°; the exact positioning thereof may be varied within empirical tolerances without adversely affecting the operation of the apparatus.

What is claimed is:

1. Convergence apparatus for mounting on the neck of a cathode ray tube having a triangular arrangement of three electron beams passing through the neck of the tube, said apparatus comprising an array of at least three magnets, pole piece assemblies selectively coupling magnetically to said magnets, said pole piece assemblies each comprising elongated low coercivity members, said members having one end positioned adjacent a respective magnet, and in operating condition, the other end of said members positioned in spaced peripheral relation one to the other, adjacent the neck of the cathode ray tube to develop a first magnetic field having principle components traversing the path of the first beam, a second magnetic field having principle components traversing the path of the second beam, and a third magnetic field having principle components traversing the path of the third beam.

2. Convergence apparatus as in claim 1 wherein a first field has lines of force extending downwardly in a north to south polarity in the path which said first beam traverses and said second and third field lines of force extending upwardly in a north to south polarity in the path which said second and third beams traverse.

3. Convergence apparatus as in claim 1 wherein said magnets comprise a rod positioned substantially along a horizontal axis and wherein said magnets have a polarity orientation in substantially a vertical axis.

4. Convergence apparatus as in claim 1 for controlling and varying the position of said three beams wherein the magnet affecting the first beam is of less strength than the magnets affecting the two other beams.

5. Convergence apparatus as in claim 1 wherein there are a total of eight pole piece members, said pole piece members positioned in spaced relation around the periphery of said neck, and wherein four of said pole piece members provide a path for magnetic fields for affecting the position of the first beam, two of said pole piece members develop a field for affecting a second one of the beams and two pole members develop a field for affecting the third beam.

6. Convergence apparatus as in claim 1 wherein said pole piece members comprise ribbon-like, low coercivity metal.

7. Convergence apparatus as in claim 1 wherein said magnets are formed as a rod, means for rotating said rod to control the lines of force developed in the pole piece members.

8. A convergence apparatus as in claim 1 wherein the end of said pole piece members are positioned around the periphery of said neck at approximately 10°, 65°, 135°, 175°, 185°, 225°, 295°, and 350°.

9. Convergence apparatus as in claim 1 wherein said magnets and said pole piece members are mounted on a substrate having an aperture therein for mounting on the neck of a cathode ray tube.

10. Convergence apparatus as in claim 1 wherein said pole piece members are in mechanical contact with said rods and are positioned in spaced relation one to the other.

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