313-428 TX313-428 SEARCH RO
CROSS-REFERENCE

United States Patent [19]
Lister

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[45] **Feb. 19, 1974**

[54] **CONVERGENCE DEVICE FOR SHORT NECK IN-LINE CATHODE RAY TUBE**

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[73] Assignee: **General Electric Company**, Portsmouth, Va.

[22] Filed: **Apr. 13, 1973**

[21] Appl. No.: **350,682**

[52] **U.S. Cl.** **335/212**, 313/77
[51] **Int. Cl.** **H01f 1/00**
[58] **Field of Search** 335/210, 212; 313/77

[56] **References Cited**
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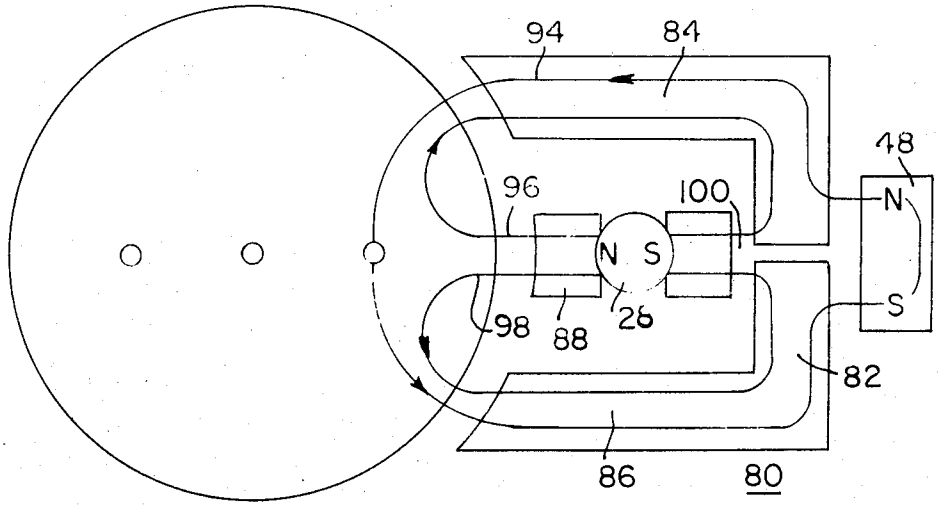
Primary Examiner—George Harris

[57] **ABSTRACT**

A pair of convergence devices lying in a single plane generate and direct fluxes for imparting both horizontal and vertical motion to the outer electron beams in a planar array of three color beams to obtain convergence of the beams. The single magnetic device for each outer beam is a combination of the normal U-shaped device for controlling horizontal movement and the E-shaped device for controlling vertical movement. By the selection and placement of flux controlling means, such as air gaps, isolation between the fluxes is achieved.

7 Claims, 7 Drawing Figures

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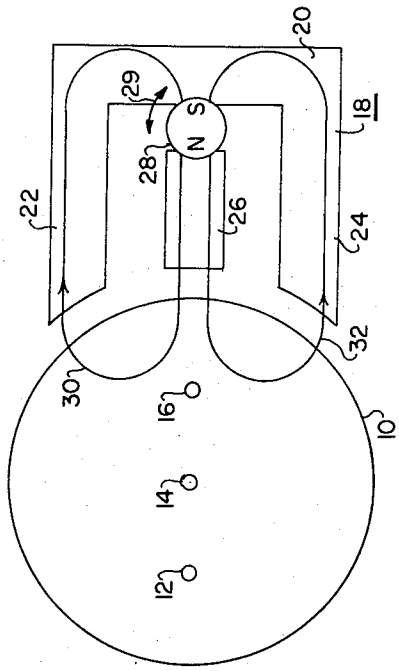


FIG. 1 PRIOR ART

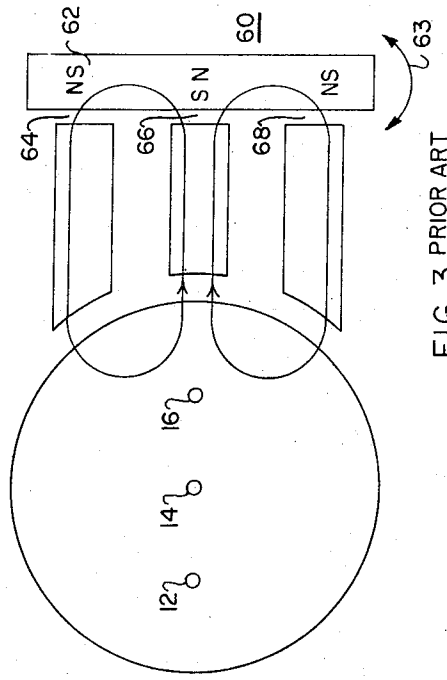


FIG. 3 PRIOR ART

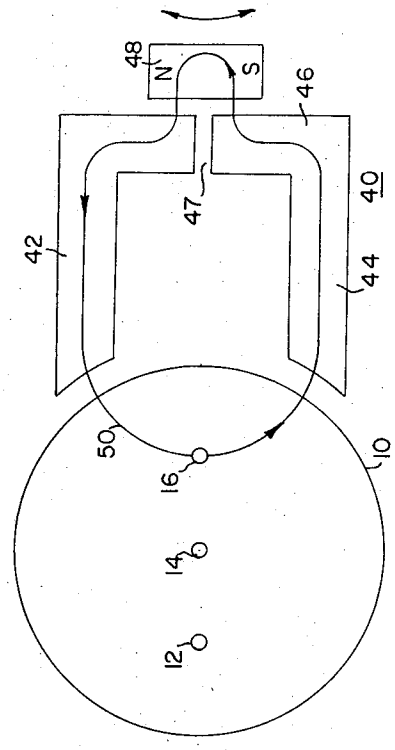


FIG. 2 PRIOR ART

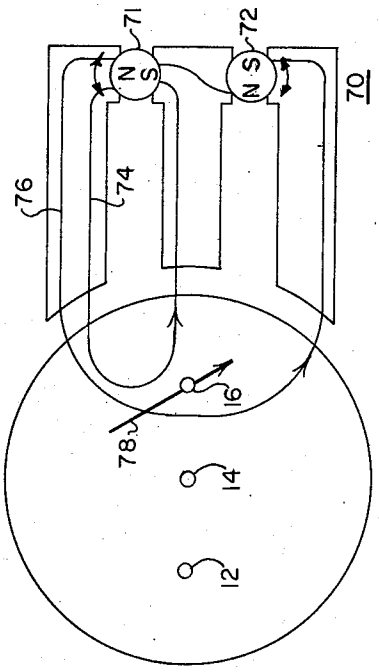


FIG. 4
PRIOR ART

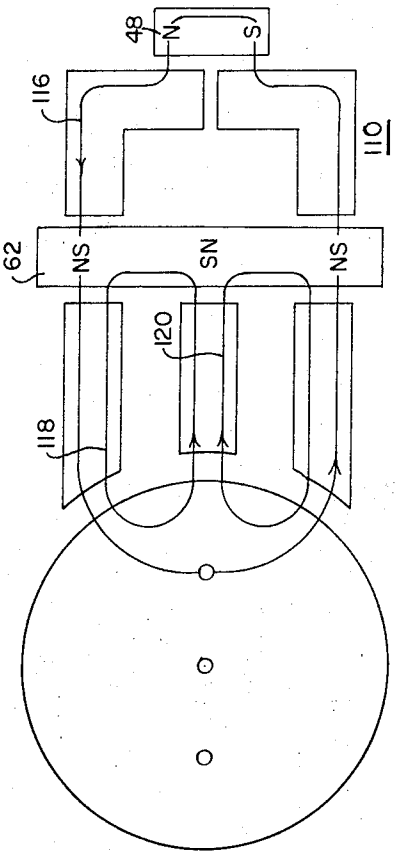


FIG. 6

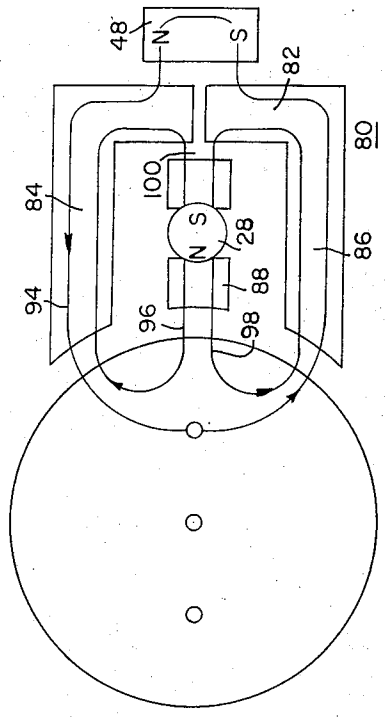


FIG. 5

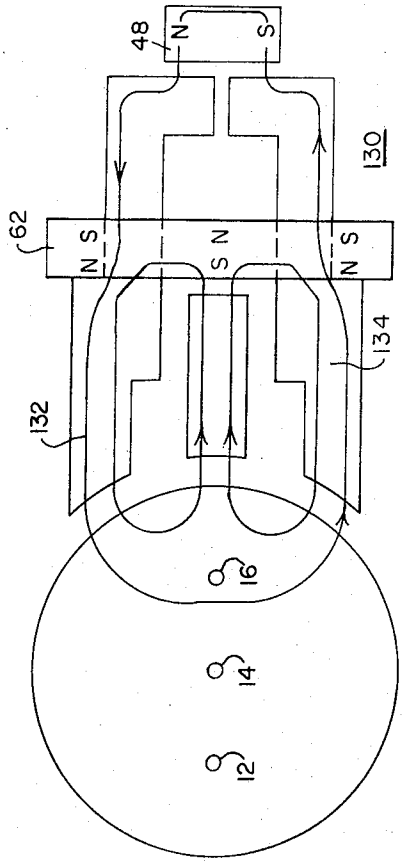


FIG. 7

CONVERGENCE DEVICE FOR SHORT NECK IN-LINE CATHODE RAY TUBE

BACKGROUND OF THE INVENTION

This invention relates to convergence devices for cathode ray tubes. More particularly it relates to convergence devices for cathode ray tubes having an in-line gun configuration wherein the magnetic fluxes for imparting horizontal and vertical movement to each of the outer electron beams are derived from the same convergence device.

Convergence devices for imparting vertical motion to the electron beams within the neck portion of a cathode ray tube having in-line guns have traditionally been a separate device from the convergence devices employed to impart horizontal motion. The vertical convergence device has evolved to have a distinct configuration which for in-line gun type cathode ray tubes has generally taken an E-shaped appearance. This device is normally utilized with pole pieces and other magnetic structure within the neck portion of the tube to guide movement of the flux within the tube so as to impart distinctly vertical movement to the electron beam. The horizontal convergence device has likewise taken on a particular shape, generally quite different from the shape of the vertical convergence device. Horizontal convergence devices are normally U-shaped for in-line gun cathode ray tubes. Much like the vertical convergence device the horizontal convergence device is positioned adjacent the neck portion of the cathode ray tube and is associated with its own quite different magnetic structure internal to the tube neck to control horizontal movement of the adjacent electron beam. Thus, in order to bring about convergence of a planar array of three electron beams by means of horizontal and vertical movement of the outer beams toward the center beam, two convergence devices comprising one E-shaped vertical convergence device and one U-shaped horizontal convergence device are employed on each side of the neck of the cathode ray tube adjacent the outer beams. The employment of two convergence devices on each side of the tube neck adds to the length of the tube in order to accommodate these devices.

One object that is often sought after in the design of cathode ray tubes is to develop a shorter tube to obtain a more compact television receiver. In designs attempting to realize this object it has been found that the internal pole pieces normally associated with the convergence assembly may advantageously be eliminated. With this elimination of the different internal structures for the horizontal and vertical convergence devices I have discovered that it is possible to combine these two units into a single convergence device. It is accordingly an object of my invention to provide a pair of convergence devices lying in a single plane for controlling both horizontal and vertical movement of the outer beams of a planar array.

Another object of my invention is to provide a single convergence device for each outer beam in a planar array in which flux paths are provided for fluxes imparting horizontal and vertical motion to the beam, the paths including flux controlling means to individually direct and mutually isolate said fluxes.

BRIEF DESCRIPTION OF THE DRAWINGS

These and other objects and features of my invention

will be more readily understood and appreciated from a detailed description of my invention taken in conjunction with the drawings in which:

FIG. 1 illustrates a prior art convergence device for controlling vertical movement of an electron beam;

FIG. 2 illustrates a prior art convergence device for controlling horizontal movement of an electron beam;

FIG. 3 illustrates a prior art convergence device for controlling vertical movement of an electron beam;

FIG. 4 illustrates a prior art convergence device for controlling two directional movement of an electron beam;

FIG. 5 illustrates a peferred convergence device in accordance with the present invention for controlling horizontal and vertical movement of an electron beam;

FIG. 6 illustrates an alternate embodiment of a convergence unit in accordance with the present invention for controlling horizontal and vertical movement of an electron beam; and

FIG. 7 illustrates an alternate embodiment of a convergence unit in accordance with the present invention for moving an electron beam in vertical and horizontal directions.

While the drawings and the remainder of the description concerns static convergence units, it should be recognized by those skilled in the art that the permanent magnets illustrated could be replaced by or augmented with windings suitably placed on the convergence devices to provide the flux generating means necessary for dynamic convergence of the beams. Therefore, it should be recognized that the present invention is not limited to a structure solely for use with static convergence of electron beams, since the concepts presented are fully applicable to dynamic convergence devices.

The figures of the drawings in general show the neck portion **10** of a cathode ray tube in cross section looking into the tube from the viewing screen. Shown within the tube in a planar array are the three beams **12, 14** and **16** respectively representing the blue, green and red beams of the three color array. Also shown in each of the figures is a static convergence device for imparting movement to the proximate outer beam **16,** it being understood that a duplicate device to that shown in the figure is present at the opposite side of the tube neck to control movement of the outer beam **12.** The same reference numerals are contained throughout the drawings for identical parts.

DISCUSSION OF THE PRIOR ART

FIGS. **1** through **4** of the drawings relate to devices of the prior art. FIGS. **1** and **3** depict E-shaped convergence devices for imparting vertical motion to the proximate electron beam, and FIG. **2** depicts a U-shaped device for imparting horizontal motion.

The E-shaped device **18** in FIG. **1** is shown having outer leg portions **22** and **24,** base portion **20** and center leg portion **26** including a cylindrical permanent magnet **28.** The magnet **28** is adjustably contained in the flux conductive structure permitting rotation as indicated by arrow **29** to adjust the magnitude of the flux generated thereby. The flux is generally indicated by lines **30** and **32** with the arrows indicating flux direction.

The E-shaped vertical convergence device **60** shown in FIG. **3** differs from the device of FIG. **1** predominantly by the employment and placement of rod shaped magnet **62** instead of the cylindrical magnet **28.**

As shown, rod shaped magnet **62** forms the base of the convergence device and is magnetized to contain three pole pairs respectively adjacent each of the legs of the structure. The rod shaped magnet is shown separated from the legs by air gaps **64, 66** and **68** permitting the magnet to be rotated as indicated by arrow **63** to adjust the strength of the field generated. It is noted that as illustrated the flux generated is substantially identical to that shown in FIG. **1** and will impart vertical motion to the beam **16.**

In FIG. **2** a typical horizontal convergence device **40** is shown. This device has leg portions **42** and **44** and base portion **46** split by an air gap **47.** The air gap **47** is adjacent adjustable disc magnet **48** to prevent the base portion **46** from shorting the magnet. The flux generated by the magnet is indicated by line **50** and as shown has such direction within the tube neck to impart horizontal motion to beam **16.**

FIG. **4** shows a convergence device **70** of the prior art in which two flux generating means, namely cylindrical magnets **71** and **72** located in the base portion of this E-shaped device, are used to impart two directional movement to the adjacent electron beam. As shown, the magnet **71** is in the maximum flux generating position and the magnet **72** is in the minimum flux generating position. The fluxes generated by magnet **71** are indicated by lines **74** and **76.** The flux indicated by line **74** is considerably stronger than the flux indicated by dine **76** due to the shorter return path to magnet **71** by means of the center leg. However, there is a combined effect produced by the two fluxes along the line **78** as indicated to impart diagonal movement to the electron beam **16** generally at a right angle to the arrow **78.** Flux generated by magnet **72,** not shown, will have a symmetrically opposite affect on the beam **16.**

While the device shown in FIG. **4** imparts two directional movement to the adjacent electron beam and the movement of the beam in either direction is relatively independent and therefore linear, movement is not in the X and Y, i.e., horizontal and vertical directions. The significance of this is that the test pattern for obtaining convergence of the three color beams is an X and Y crosshatch. Thus when the beams and the resulting horizontal and vertical lines of the test pattern are moved in horizontal and vertical directions, convergence is quite readily obtained. However, when the lines of the test pattern are moved diagonally, such as with the device of FIG. **4,** obtaining convergence of the beams can be quite difficult. Accordingly, the need for coplanar convergence devices capable of obtaining convergence of the proximate electron beams by means of horizontal and vertical motion has been strongly felt.

DETAILED DESCRIPTION OF THE INVENTION

Referring now to FIG. **5** there is shown a preferred embodiment of my invention. One of a pair of devices is illustrated for imparting vertical and horizontal motion to the outer beams of a planar array of electron beams. The convergence device **80** includes a U-shaped flux conductive device having a base portion **82** and legs **84** and **86** which apply the flux generated by adjustable disc magnet **48** to the beam **16.** This flux, as indicated by line **94,** imparts horizontal movement to the beam. The disc magnet **48** may be rotated as has been previously indicated to adjust the strength of the flux and thereby the degree of horizontal movement.

The convergence device **80** also includes an E-shaped flux conductive device made up of the base member **82,** the legs **84** and **86** and center leg **88.** The center leg **88** includes an adjustable cylindrical magnet **28** which may be rotated to increase or decrease the fluxes indicated by lines **96** and **98** to control the vertical motion imparted to the beam **16.**

It will be noted that there is a general similarity between the convergence device shown in FIG. **5** and the devices of FIG. **1** and **2.** This arises from the fact that the devices of FIGS. **1** and **2** comprise the prior art devices which formed the starting point for my invention of a single convergence device capable of imparting both vertical and horizontal motion to a proximate electron beam. The very fact that the convergence device of FIG. **5** is derived from a combination of the devices of FIGS. **1** and **2,** aptly points up the differences from these prior devices. In combining the E-shaped and U-shaped structures of the prior art, it was not only necessary to discover what combination resulted in minimum structure and optimum performance but also how to achieve integrity of operation, i.e. isolation between the fluxes generated by these structures. To achieve this isolation it was necessary to rearrange elements and to employ flux controlling devices. Thus, in FIG. **5,** in order to prevent the E-shaped structure from interfering with the performance of the U-shaped structure it was necessary to reposition the cylindrical magnet **28** and to remove the center leg **88** from the base portion **82** by means of an air gap **100.** The air gap **100** prevents the center leg from shorting disc magnet **48.**

The difficulties encountered in combining the prior art U-shaped and E-shaped devices are also illustrated by the embodiments of FIGS. **6** and **7.** FIG. **6** shows an alternate embodiment of my invention in which prior art devices **40** and **60,** formed the starting point for the device **110** of this figure. While no additional air gaps were added to the device shown in FIG. **6,** the employment of the rod shaped magnet **62** in the position shown will provide a degree of isolation between the operation of the E-shaped and U-shaped portions. The ferrite material of the magnet **62** has a high reluctance and acts as an air gap to the flux **116,** while the arrangement of the three pole pairs of this magnet prevents the U-shaped portion from interfering with fluxes **118** and **120.**

In the design of the device shown in FIG. **7** additional flux controlling means are employed. The disadvantage of having the flux generated by the disc magnet **48** cross the high reluctance path offered by rod shaped magnet **62** as per the embodiment of FIG. **6** is overcome in the device **130** of FIG. **7** by making the leg portions **132** and **134** single pieces with a hole therethrough to accommodate rod shaped magnet **62.** These flux controlling means are augmented with a widening of the legs to the left of magnet **62** to accommodate the offset shape of the legs **132** and **134.** This enables the poles of this magnet to be free from the hole in the legs and not shorted thereby.

The foregoing description of three embodiments of my invention is set forth to illustrate the principles I have employed in combining known structures for independently controlling horizontal and vertical motion of a proximate electron beam into a single streucture capable of generating the necessary fluxes to impart both horizontal and vertical movement to the beam in which structure the fluxes are controlled to seek inde-

pendent paths wherever interference would otherwise result. Since many other configurations of independent horizontal and vertical convergence devices are known in the prior art, their combination in accordance with my teachings should not be limited by the specific examples here given, but only as required by the appended claims.

What is claimed and desired to be secured by Letters Patent of the United States is:

1. In a color television receiver including a cathode ray tube having a neck portion containing electron gun means for producing a planar array of electron beams, a convergence assembly for converging the outer ones of said beams, comprising:

a pair of flux conductive means located adjacent said neck portion proximate to respective outer ones of said beams and lying in a single plane orthogonal to said planar array and radial to the axis of said neck portion,

said flux conductive means each having first flux generating means for generating flux imparting horizontal motion to the proximate outer one of said beams and second flux generating means for generating flux imparting vertical motion to the proximate outer one of said beams,

said flux conductive means each including flux controlling means to mutually isolate the fluxes generated by said first and second generating means.

2. The convergence assembly recited in claim **1** wherein said flux conductive means each includes E-shaped flux conductive means for predominantly conducting the flux imparting vertical motion to the proximate outer beam and U-shaped flux conductive means for predominantly conducting the flux imparting horizontal motion to the proximate outer beam.

3. The convergence assembly recited in claim **2** wherein said flux controlling means include air gap means positioned to optimize isolation between said E-shaped flux conductive means and said U-shaped flux conductive means.

4. The convergence assembly recited in claim **3** wherein said E-shaped flux conductive means and said U-shaped flux conductive means are superposed such that the U-shaped flux conductive means comprises the outer legs and base of said E-shaped flux conductive means and the E-shaped flux conductive means includes a center leg,

said center leg including air gap means separating said center leg from said base to minimize interference with said flux imparting horizontal motion.

5. The convergence assembly recited in claim **4** wherein said first flux generating means is a magnet adjustably positioned at the base of said U-shaped flux conductive means to control said flux imparting horizontal motion and said second flux generating means is a magnet adjustably positioned in the center leg of said E-shaped flux conductive means to control said flux imparting vertical motion.

6. The convergence assembly recited in claim **2** wherein said U-shaped flux conductive means includes said first flux generating means,

said first flux generating means comprising magnet means positioned to adjustably control said flux imparting horizontal motion.

7. The convergence assembly recited in claim **6** wherein said E-shaped flux conductive means includes said second flux generating means,

said second flux generating means comprising magnet means positioned to adjustably control said flux imparting vertical motion.

* * * * *