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CATHODE RAY TUBE HAVING THREE IN-LINE GUNS AND CENTER BEAM CONVERGENCE SHIELD MODIFYING CENTER BEAM RASTER SIZE

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FIG. 1

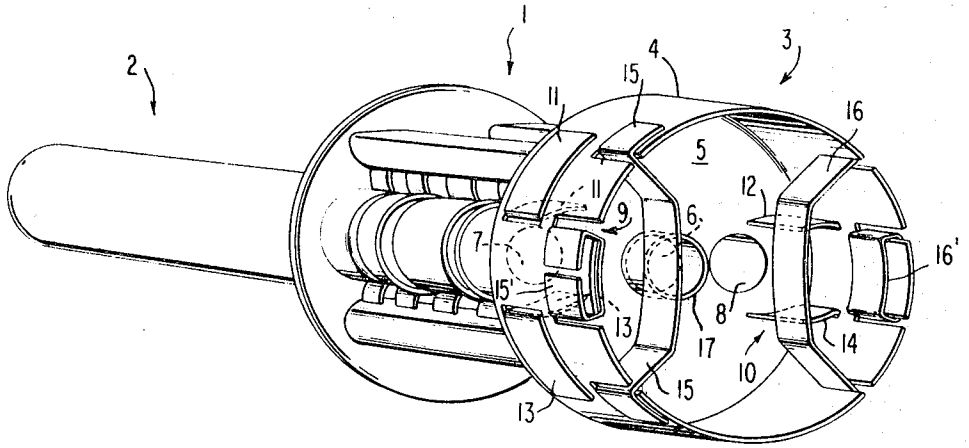
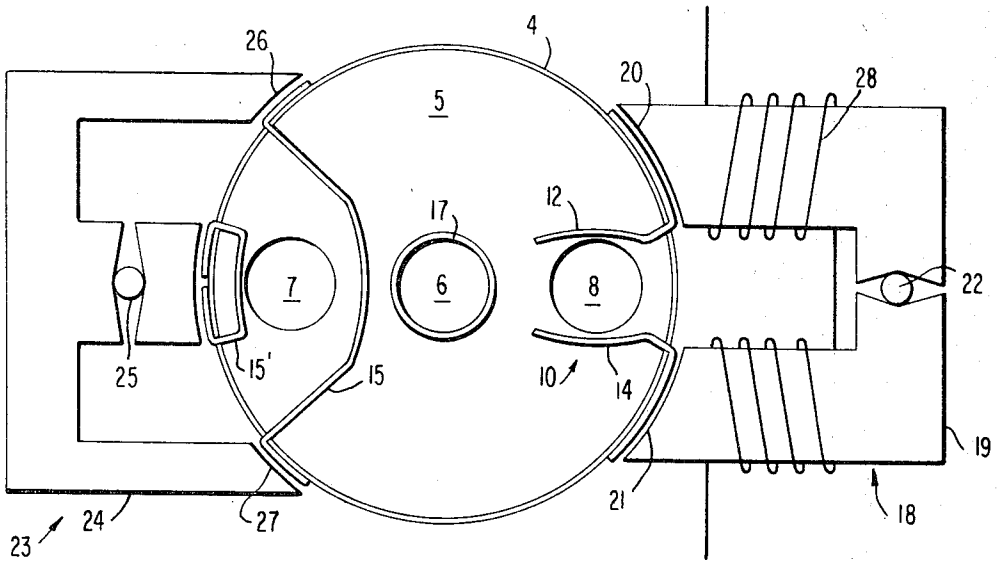


FIG. 2



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CATHODE RAY TUBE HAVING THREE IN-LINE GUNS AND CENTER BEAM CONVERGENCE SHIELD MODIFYING CENTER BEAM RASTER SIZE

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ABSTRACT OF THE DISCLOSURE

A convergence assembly for an electron gun of the multigun, in-line type for use in color cathode ray tubes. The assembly includes a cylindrical cup-like casing provided, in the three beam case, with a center and two outer apertures in the base of the cup (nearest the electron gun) through which the center and two outer electron beams travel. A pair of pole pieces are positioned within the casing in proximity to and vertically opposite each of the two outer apertures for providing horizontal convergence correction before vertical. Vertical convergence correction for the outer beams is then provided by a second set of pole pieces located on the opposite side of the horizontal pole pieces from the base of the convergence cup. A cylindrical shield is positioned within the casing in proximity to the center aperture for shielding the center beam from the deflecting field of the horizontal convergence pole pieces, the characteristics of this cylindrical shield being preselected for a desired height of the center beam raster.

BACKGROUND OF THE INVENTION

This invention relates to electron guns of the multigun, in-line type and, more particularly, to a convergence assembly for this type of electron gun.

Electron guns of the multigun type as used in cathode ray tubes for color television applications comprise basically three components: a battery of electron guns mounted together, a base stem connected to one end of the gun battery and having rigid metal prongs for electrically energizing the guns, and a convergence assembly attached to the other end of the gun battery. The convergence assembly functions to positionally precorrect the electron beams travelling therethrough to statically and dynamically converge the beams at the shadow mask positioned near the screen of the cathode ray tube, thus providing the desired beam landing on specific color dots in the adjacent tube screen. This positional correction is provided by pole piece assemblies located within the convergence assembly to which pole pieces magnetic fields are imparted by associated convergence magnets externally positioned proximal to the neck position of the tube adjacent the interiorly oriented pole piece assemblies.

Electron guns for color television tubes may be placed in two categories, delta and in-line, depending upon the orientation of the the three guns relative to each other. In the in-line gun assembly, to which this invention relates, the three guns are disposed such that the longitudinal axes of the gun lies in the same plane. The three dots on the tube screen, on which the beams must land, lie in a straight line. Convergence of the beams in the in-line system, it has been found, may be advantageously obtained by deflecting each outside beam vertically and horizontally while leaving the center beam essentially undeflected. The external magnets thus apply magnetic fields to the two outer beams through the respective pole piece assemblies located in the convergence assembly. A first design requirement on a convergence assembly for this type of tube, therefore, is to provide a means for shielding the center gun beam from the magnetic fields which impart convergence to the two outer beams. A second requirement is an adjustment of the raster sizes of the three beams. If the raster sizes of the beams should be different, the result would be an improper convergence of the beams on the tube screen. A characteristic of the in-line system is that the two outer electron gun rasters will always be the same size, but the size of the center gun raster has been found to vary. Previously, the raster height and width were adjusted by adding sweep currents to coils wound on the vertical and horizontal convergence magnet cores, respectively, which are place external to the neck of the entire tube. This is known in the art as vertical and horizontal dynamic convergence. It would be desirable, however, if vertical raster size control could be obtained by an internal design of the assembly thus eliminating the need for the addition of sweep currents to the outer magnets which provide vertical correction.

SUMMARY OF THE INVENTION

It is, therefore an object of the invention to provide a convergence assembly for an electron gun of the three gun, in-line type.

It is a more particular object of this invention to provide a convergence assembly for an electron gun of the in-line type which assembly includes separate means for applying horizontal and vertical deflecting fields to the two outer beams and means for providing the necessary shielding of the center beam.

It is a further object of this invention to provide such a convergence assembly for an electron gun of the in-line type wherein control of the raster height may be effected by the design of the assembly rather than by the external addition of vertical dynamic convergence.

DETAILED DESCRIPTION

This invention is recited in the apended claims. A more thorough understanding of the further objects and advantages of this invention may be obtained by referring to the following description taken in conjunction with the included drawings wherein:

FIG. 1 is a side elevational perspective view of an electron gun provided with a convergence assembly constructed in accordance with this invention; and

FIG. 2 is a schematic cross-sectional representation of the convergence assembly of FIG. 1.

FIG. 1 shows an electron gun of the in-line type which includes a battery **1** of three electron guns disposed such that the longitudinal axes of the three guns lie in the same plane, a glass stem **2** attached to the rear end of the battery, and a convergence assembly **3** attached to the forward end of the battery and constructed in accordance with this invention. The convergence assembly comprises a hollow cylinder having a wall **4** within which is included a base element **5** at one end, and which is open at the other end. The base element **5** is provided with a center aperture **6** and two outer apertures **7, 8** which are accurately aligned with the three electron guns. Also included within the cylinder is first convergence means including two sets of pole pieces **9, 10** for applying a horizontal deflecting field to the two outer beams. In this particular illustration each of the means **9, 10, 11,** comprises a pole piece assembly including first **11, 12** and second **13, 14** metal plates, each attached to the cylinder wall **4** near the base element **5** and extending within the cylinder so as to partially coincide with the perimeter of the corresponding outer aperture. A magnetic field is applied to the pole piece assemblies **9, 10** by external magnets as will be evident from a further reading of the specification. Also included within the assembly is sec-

ond convergence means having two sets of pole pieces **15, 15'** and **16, 16'** for applying a vertical deflecting field to the two outer beams. Each of the means **15, 15'** and **16, 16'** comprises a pair of pole piece elements formed from metal strips attached at both ends of the cylinder wall near the open end and extending inwardly so that in the case of pole pieces **15** and **16**, their innermost portions are disposed between the center and the corresponding outer beam. A magnetic field is imparted to each of these pole piece elements in a manner to be described further on in the specification.

In the in-line type of electron gun, convergence of the three beams is obtained by deflecting each of the outside beams vertically and horizontally while maintaining the center beam essentially undeflected. With this requirement it is obviously necessary that the center beam be shielded from any of the deflecting fields applied to the two outer beams. The geometry of the pole piece elements **15, 15'** and **16, 16'** is such that no undesirable effect is produced on the center beam. More particularly, the fields imparted by the pole piece elements **15, 15'** and **16, 16'** to the outer beams are confined to the region surrounded thereby. The pole piece assemblies **9, 10** which apply the horizontal deflecting field, on the other hand, produce fringe effects which interfere with the center beams as it exits from the aperture **6**. There is thus provided in the convergence assembly of this invention means **17** for shielding the center beam from the horizontal deflecting field. The shape of the means **17** should be such as to allow passage therethrough of the center beam. In this particular illustration the means **17** comprises a cylinder attached to the base element **5** with one end coinciding with the perimeter of the center aperture **6**. The means **17**, on the other hand, could comprise a pair of plates disposed perpendicular to the base element **5** and interposed between the center beam and the pole piece assemblies **9, 10**. The shield **17** should be made of high permeability material such as nickel-iron alloy or stainless steel. The material should also have low retentivity so that it does not retain any magnetism caused by transient effects such as high voltage arcing in the tube. By virtue of the provision of the magnetic shield the requirement of the isolation of the center beam from the convergence effects on the outer beams is thus satisfied.

FIG. 2 is a schematic cross-sectional representation of the convergence assembly **3** of FIG. 1. In particular, it shows the cylinder wall **4**, the base element **5** and the three apertures **6, 7,** and **8**. The pole piece assembly **10** is represented schematically as is the pole piece assembly **15**. It has been found advantageous to provide slots in the cylinder wall **4** through which the metal strips **11–14** and **15, 16** may extend with the ends thereof coinciding with the surface of the cylinder wall. The magnetic field for each of the pole piece assemblies is provided by an external convergence magnet. The magnet **18** for the assembly **10** is shown and it comprises a core **19** having pole faces **20, 21** each in alignment with an extension of each of the metal strips **12, 14** and a static converging magnet **22** included within the core. Similarly, the magnetic field for each of the pole piece assemblies is provided by a magnet positioned external to each of the assemblies **15** and **16**, one of which is indicated at **23** in FIG. 2. It also comprises a core **24** having a converging magnet **25** located therein, and pole faces **26, 27** aligned with extensions of the metal strip **15**.

In three-gun color picture tubes it is necessary that the raster sizes of the three beams be equal so that proper convergence of the beams on the color dots in the screen may be obtained. It is a characteristic of the in-line type of assembly that the size of the two outer gun rasters will always be equal. The size of the center gun raster, however, can vary relative to the size of the two outer rasters. The width of the rasters has been controlled by adding sweep currents to a coil wound on each of the external convergence magnets which provide a horizontal deflecting field for each of the outer beams. Such a coil **28** is shown in FIG. 2, wound on the core **19**. Likewise the height of the center gun raster can be controlled by adding sweep currents to a coil wound on each of the other external convergence magnets which provide vertical deflection. The deflection yoke, which is positioned external to the neck of the entire tube and down from the end of the electron gun in a direction toward the tube screen and which is used to effect scanning of the three beams over the entire surface of the tube, is known to generate a magnetic field back in the direction of the electron gun. It was found that the two pole piece assemblies **9, 10** and **15, 16** provided for each of the two outer beams as well as the shield **17** provided for the center beam attenuate this backwardly directed magnetic field generated by the yoke. Moreover, the degree of attenuation was found to affect the raster heights of the three fields. The degree of attenuation of this field by the magnetic shield **17** and hence the height of the center gun raster can be varied, it was determined, as a function of the permeability of the shield and the length, thickness or diameter of the shield. Thus by means of the design of the shield **17**, for example its axial length, the height of the center gun raster may be adjusted so as to be equal to the raster height of the outer guns. This therefore eliminates the need for applying sweep currents to the vertical deflecting magnets. An example of a shield design useful for this purpose in a 10V" color picture tube is one made of a nickel-iron alloy of approximately 50% nickel and an axial length of approximately 200 mils. Such a shield has a permeability of approximately 2000 gauss per oersted, and a retentivity when fully annealed of approximately 0.3 gauss although values up to 1.0 gauss are considered acceptable. In another example, a 14V" color picture tube employs a certain beam shield consisting of the same nickel-iron alloy and an axial length of approximately 250 mils. In both cases, the wall thickness of the shields is approximately 10 mils. It will be appreciated to one skilled in the art from the foregoing that other combinations of material and dimensions can be employed which will achieve the desired combination of shielding and control of raster size of the center beam relative to the outer beams.

While the invention has been described with specificity, it is the intent of the appended claims to cover all variations which come within the true spirit and scope of the foregoing disclosure.

What is claimed is:

1. An in-line electron gun and beam convergence assembly for a cathode ray tube, comprising:

(a) means for producing at least three electron beams oriented in a line transverse to the longitudinal axis of the tube; and

(b) a convergence assembly with a cylindrical wall within which there are located:

(1) a base element attached to the beam producing means and having beam apertures in register with said beams,

(2) first convergence means having a set of convergence pole pieces adapted to provide first convergence correction on at least one of said beams in a direction parallel to said transverse line,

(3) second convergence means having a set of convergence pole pieces adapted to provide second convergence correction on at least one of said beams in a direction orthogonal to said transverse line, and

(4) shield means for both isolating the central beam from the effects of said first convergence correction and modifying the central beam raster that is produced by the deflection means of the tube in said orthogonal direction so that the raster is substantially equal in size to

the corresponding beam rasters of the outer beams.

2. The invention of claim 1 wherein said first convergence correction is along the horizontal direction and said second convergence correction is along the vertical direction.

3. The invention of claim 1 wherein the first mentioned means produce three beams in a line; and the convergence means pole pieces are adapted to provide convergence correction on the outer two beams, and said shield means is comprised of high permeability material isolating the central beam from the effects of said first convergence correction and having a substantially low value of retentivity of the order of one gauss and less.

4. The invention of claim 3 wherein said shield means

is so proportioned as to provide said central beam raster in said orthogonal direction which is substantially equal in size to said corresponding beam rasters of said outer beams.

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