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Barkow

[54] INLINE ELECTRON GUN HAVING MAGNETICALLY PERMEABLE PLATES FOR ENHANCING CONVERGENCE OF ELECTRON BEAMS

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- [51] Int. Cl. ... H01j 29/76, H01j 31/20, H01j 29/48
- [58] Field of Search...... 313/70 C, 75, 77
- [56] **References Cited** UNITED STATES PATENTS
- 2,939,979 6/1960 Reiches...... 313/77

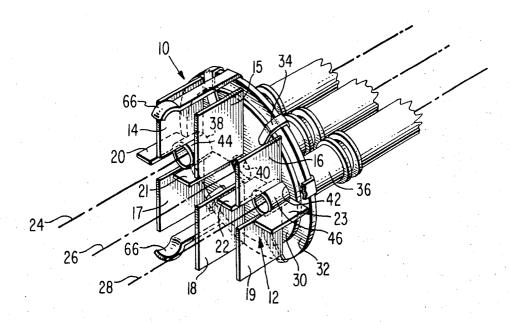
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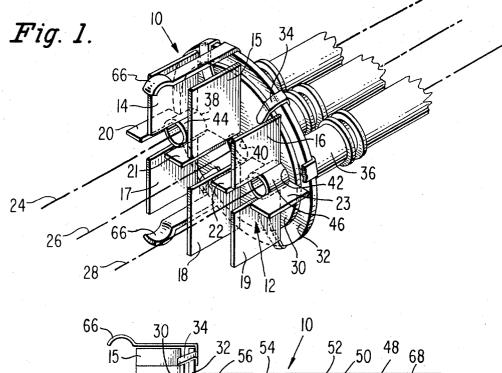
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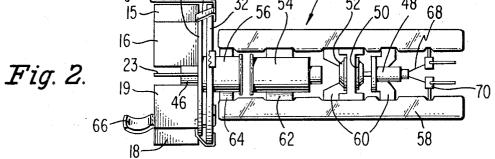
[57] ABSTRACT

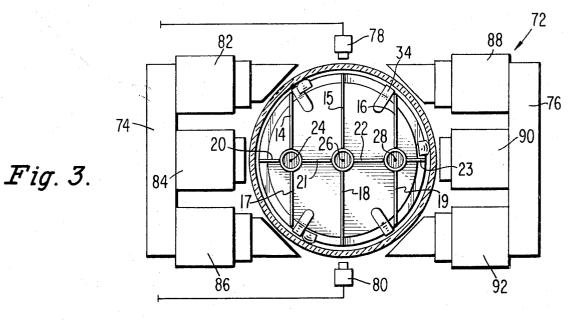
The cathode ray tube electron gun has means for generating and directing a plurality of electron beams along substantially coplanar paths. Two sets of magnetic plates provide independent enhancement of magnetic fields for deflecting the beams perpendicularly to the plane of the paths and in the plane of the paths. Plates in the first set are located between each of the paths and outwardly of the outermost paths. Plates in the second set are in pairs, each pair having one plate on each side of a beam perpendicular to the plane of the beams.

1 Claim, 3 Drawing Figures









INLINE ELECTRON GUN HAVING MAGNETICALLY PERMEABLE PLATES FOR ENHANCING CONVERGENCE OF ELECTRON BEAMS

BACKGROUND OF THE INVENTION

The present invention relates to an improved inline electron gun for a cathode ray tube. Particularly, it relates to an inline electron gun having an improved convergence assembly. Although the improved gun is primarily intended for use in a color tube having a linetype color phosphor screen, the gun could be used in a well-known dot-type color tube having a screen of substantially circular color phosphor dots.

An inline electron gun is one designed to generate at 15 FIG. 1; least two, and preferably three, electron beams in a common plane and to direct those beams along generally convergent paths toward the tube screen. Various methods have been proposed for causing beam convergence near the screen. For example, the gun may be designed to initially aim the beams, from the cathodes, towards convergence at the screen, as shown in FIG. 4 of the Moodey U.S. Pat. No. 2,957,106, wherein the beam apertures in the gun electrode are aligned along convergent paths.

Conventional delta type electron guns generally use a plurality of pairs of internal magnetic pole pieces, one pair for each beam, coupled to external electromagnets for both static and dynamic convergence of the electron beams. U.S. Pat. No. 3,268,753, issued to Richard 30 H. Hughes, illustrates a typical delta type three beam arrangement in which the pole pieces are mounted on and extend inwardly from a cylindrical nonmagnetic convergence cup on opposite sides of the three beam paths. A magnetic convergence field extending perpendicularly between the pole pieces deflects the beam radially. The convergence pole pieces are usually spaced as far as possible from the horizontal and vertical deflection or scanning yoke to minimize coupling of the yoke fields into the pole pieces that may cause beam spot distortion.

The conventional delta type three gun shadow mask kinescope previously described, requires four independent motions, three radial and one tangential, to con-45 verge the three beams on the cathode ray tube screen. The horizontal inline three gun shadow mask cathode ray tube also requires four independent motions for convergence. These are horizontal and vertical motion of each of the two outside beams. If the prior art pole 50 piece pairs of the delta type guns were used for horizontal motion in an inline gun and another set of pole pieces were used for vertical motion, the neck length of the cathode ray tube would have to be increased and the distance between the convergence plane and the 55 deflection plane would have to be increased thereby resulting in increased degrouping errors. Therefore, it is desirable to provide internal structures that permit horizontal and vertical convergence motions of the individual beams in a single plane without undue lengthening of the cathode ray tube neck.

SUMMARY OF THE INVENTION

An inline electron gun for a cathode ray tube includes means for generating and directing a plurality of electron beams along substantially coplanar paths. First magnetic means coplanar with the electron beams are located between each path and outwardly of the outer-

most paths. The first magnetic means provide independent enhancement of a magnetic field for deflecting the beams perpendicular to the plane of the paths. Second magnetic means perpendicular to the plane of the 5 beams are located on each side of each beam. The second magnetic means provide independent enhancement of another magnetic field for deflecting the beams within the plane of the beams.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a perspective partial view of an inline electron gun having a convergence assembly embodying the present invention;

FIG. 2 is a complete side view of the electron gun of FIG. 1;

FIG. 3 is a front end view of the convergence assembly with its associated convergence coils.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

FIG. 1 shows the front end of a three beam inline electron gun 10. A convergence assembly 12 comprises ten enhancer type magnetic or high permeability material plates, 14-23, arranged in three crosses of four pole pieces each. Each cross surrounds one of the three 25 beams 24, 26 or 28 and provides for horizontal and vertical motion for each beam. The enhancer plates of the convergence assembly fall into two categories based on the beam correction they permit. First, a set of four plates 20-23, aligned coplanar with the beam paths 24, 26 and 28, extend between each of the beam paths and outwardly of the outermost paths to the exterior of the electron gun. These plates permit bending the beams in directions normal to the horizontal plane containing the electron paths. The second set of plates, 14-19, comprises pairs of plates extending from each of the beam paths to the edge of the gun. These plates extend in planes that are substantially normal to the beam path plane and parallel to each other. This second set of 40 plates permits deflection of the beams in the horizontal direction of the beam path plane.

In the gun embodiment shown in FIG. 1, each of the enhancer plates 14-23, is attached to a nonmagnetic circular disk 30 which is held to a slightly larger disc 32 by clips 34. The larger disk 32 is attached directly to the final electrodes 36 of the gun. Each disk has three apertures 38, 40 and 42 therein for providing passages for the three electron beams 24, 26 and 28, respectively. Nonmagnetic tubular extensions 44 and 46 protrude from the last electrodes 36 of the outer two beams 24 and 28 to provide alignment for the disk 30 and therefore alignment of the plates 14-23 with respect to the electron beams 24, 26 and 28.

A side view of the complete gun 10 is illustrated in FIG. 2. Each portion of the three beam gun comprises a cathode assembly 48, a control grid 50, a screen grid 52, a focus electrode 54, and an anode 56 all off which are mounted in axially aligned relationship along six insulator, e.g., glass support rods 58. The cathode assembly 48 control grid 50 and screen grid 52 are supported from the rods 58 by integral strap-like tabs 60. The focus electrodes 54 and anodes 56 are supported from the rods 58 by straps 62 and 64, respectively. Spring bulb spacers 66, attached to the disk 32, provide location and support for the electron gun in the neck of a cathode ray tube. Heater filaments 68 for the cathodes are supported from the rods 58 by sectional straps 70.

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The novel convergence assembly previously described can be used with an external driver assembly 72, as shown in FIG. 3, to provide X and Y motion on each of the three beams. This driver assembly 72 consists of two ferrite cores 74 and 76, each having three coil assemblies (82, 84 and 86 and 88, 90 and 92, respectively) and two air coils 78 and 80. The magnetic flux required for horizontal convergence motion of one of the outer electron beams is generated by one pair of of the E core driving that beam. For example, excitation of coils 88 and 92 form a field that runs vertically through the beam path 28 and is enhanced or concentrated by plates 16 and 19. Since the electron beam moves perpendicularly to the lines of flux of the field, 15 inch above the center). The added degree-of-freedom the beam 28 is deflected horizontally by excitation of coils 88 and 92. Of course, direction of the deflection is dependent on the polarity of the field.

The magnetic flux required for vertical convergence motion of this outer beam 28 is generated by the coil 20 90 around the central leg of the same E core 76. The lines of flux from this coil 90 have a return path via the two outer legs of the core 76. Each of the three coils on an E core is composed of two windings, to provide the desired convergence motions at horizontal and ver- 25 tical scanning frequencies. The additional pair of coils 78 and 80 are mounted in a vertical plane above and below the central beam 26. These coils generate the magnetic flux required for horizontal convergence motion of the central beam 26. When used in this manner, 30 the convergence assembly provides 5°-of-freedom relative to the three beams, (e.g., horizontal and vertical motion for each of the two outer beams and horizontal motion for the central beam). The fifth degree-offreedom provides motion for the central beam to com- 35 pensate for the interaction of the adjacent fields. If the central beam were completely shielded, only 4°-offreedom would be necessary. The 4°-of-freedom are sufficient for convergence to the central beam spot at

any point on the screen.

An additional degree of freedom, namely, vertical motion of the central beam, substantially independent of the other 5° of freedom, may be provided by suitably connecting the two pairs of outer coils of the two E cores. The two coils on the outer legs of one E core are driven to serve as a north pole and those of the other E core as a south pole for the required magnetic flux. Since the fields on any outer beam are equal they cancoils with each coil wound around one of the outer legs 10 cel at the outer beams and act mainly on the central beam. When used in this manner, this coplanar convergence assembly with 6°-of-freedom permits one to converge statically at any point in the immediate vicinity in the center of the screen (within a circle radius of one may be useful in correcting for gun misalignment by proper choice of the point of static (center) convergence.

I claim:

1. In an inline electron gun for a cathode ray tube including means for generating and directing three electron beams along substantially coplanar paths, the improvement comprising:

four first magnetically permeable plates coplanar with said electron beams and with each other being located at a beam exit from said gun between each of said paths and outwardly of the outermost paths for independently enhancing a magnetic field for deflecting said beams perpendicularly to the plane of said paths; and

six second magnetically permeable plates all perpendicular to the plane of said beams being located at a beam exit from said gun, arranged in parallel pairs, the plates of ech pair being coplanar to each other and each pair having one plate on each side of a beam for independently enhancing another magnetic field for deflecting said beams within the plane of said beams.