April 25, 1967 B. J. SMITH 3,316,432

CATHODE RAY TUBE ELECTRON GUN MOUNT WITH UNITARY MAGNETIC CENTERING AND GETTERING MEANS

Filed Nov. 13, 1963 2 Sheets-Sheet 1

FIG. 1

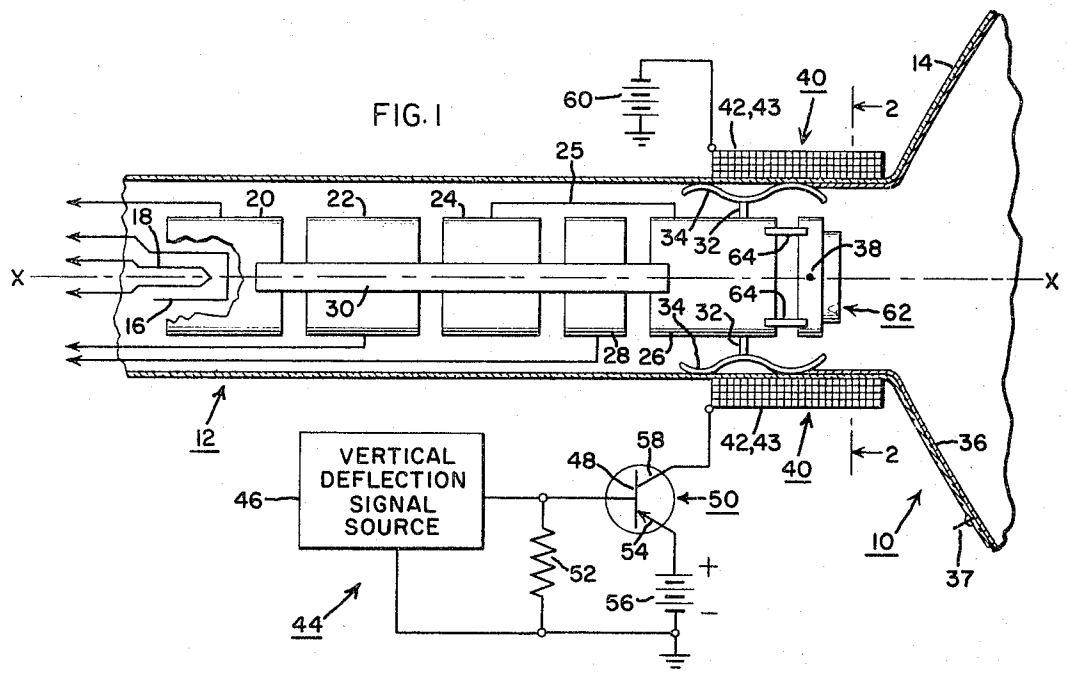
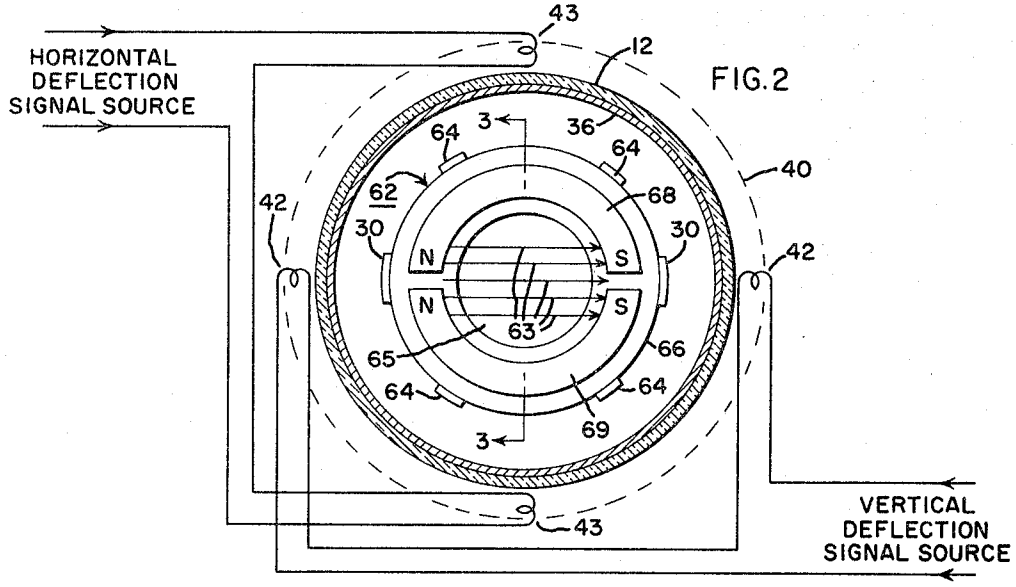


FIG. 2



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FIG.3

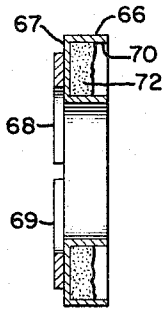
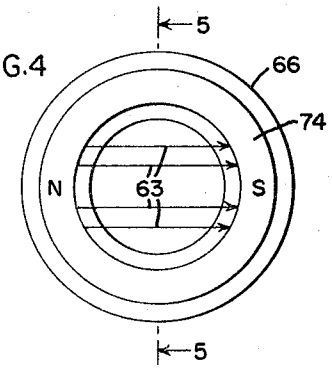


FIG.4



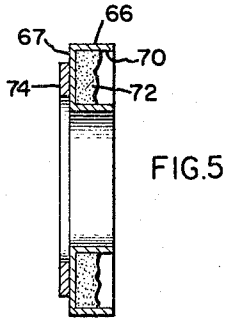
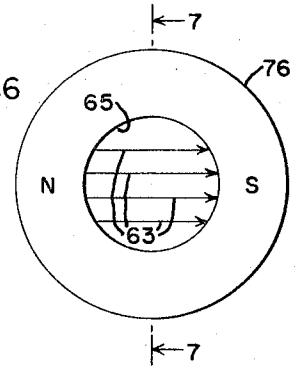


FIG.5

FIG.6



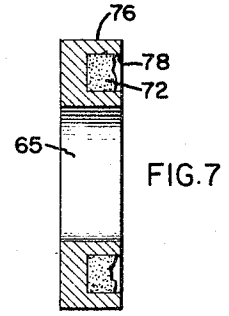


FIG.7

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CATHODE RAY TUBE ELECTRON GUN MOUNT WITH UNITARY MAGNETIC CENTERING AND GETTERING MEANS

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2 Claims. (Cl. 313—75)

The present invention relates to improvements in electron beam centering devices for cathode ray tubes and particularly to static magnetic beam centering devices for cathode ray tubes, including kinescopes, iconoscopes, vidicons, and the like, having direct drive systems.

In cathode ray tubes designed for electromagnetic deflection of the electron beam, it is desirable to provide a beam centering means for centering the beam on the target or screen of the tube. In home television receivers, the electron beam is deflected in a series of vertically displaced horizontal scans to provide a rectangular scan raster on the display screen of the cathode ray tube. Ordinarily, centering of the beam and the scan raster is effected by proper orienting of a suitably energized deflection system and the tube. By electron-beam optics, there may be calculated a desired beam deflection center situated within the neck portion of the cathode ray tube from which the electron beam must be deflected for proper centering of the beam, and of the scan raster of the beam on the display screen. In electromagnetic deflection systems, an electromagnetic deflection yoke is positioned concentrically about the neck portion of the tube at an axial displacement therealong which effects coincidence of the magnetic beam deflection center, defined by the windings of the yoke, and the desired beam deflection center. Generally, to effect this coincidence relationship, the yoke is positioned closely adjacent the flared-out portion of the tube which integrally joins the neck and screen portions. This positioning must be relatively exact if distortion-free images are to be produced on the screen of the display tube and properly centered thereon.

In the past, the electrical drive systems employed for energizing the electromagnetic deflection yokes to effect the scanning deflection of the electron beam usually included an impedance coupling transformer for coupling the output signal from a deflection signal amplifier to the windings of the yoke. In these prior art systems, the use of the transformer for impedance coupling was necessary due to the relatively low impedance of the deflection windings of the yoke compared to the relatively high impedance of the vacuum tube in the output of the amplifier. Recent developments, however, have enabled the elimination of the coupling transformer. There are now available high impedance toroidally wound deflection yokes which may be directly driven by the output stage of the signal deflection amplifier. Conversely, transistorized amplifiers may be employed, the output impedance of which permits direct coupling to the more conventional, low-impedance magnetic deflection yokes.

The elimination of the coupling transformer is desirable in that it reduces manufacturing costs while contributing to a more efficient system. Further, there is provided lighter weight, space-saving construction offering particular advantages in portable television receivers. Despite the many advantages gained by eliminating the impedance-coupling transformer, however, a very detrimental effect arises in direct drive systems due to the direct current connection between the output of the deflection signal amplifier and the windings of the electromagnetic deflection yoke.

Residual direct current exists both in the plate-cathode circuit of a vacuum tube and in the collector-emitter

conduction path of a transistor even in the absence of a deflection signal due to energization of these devices by their bias sources. This residual direct current, which was blocked from the deflection windings of previous electromagnetic deflection systems by the impedance-coupling transformer, is directly coupled to the deflection windings in a direct drive system, producing a static magnetic field in the region of the desired beam deflection center. This static magnetic field effects a constant displacement of the magnetic deflection center from the desired deflection center, resulting in a constant deflection of the electron beam and consequent off-centering of the scan raster on the display screen. This off-centering effect is difficult to overcome by compensation in the deflection signal amplifier due to the complexities of the deflection field required to be generated by the windings of the yoke. Magnetic deflection compensation is difficult to achieve due to the increasing compactness in design of cathode ray tube systems and due to the fact that attempted compensation by a magnetic field created externally of, and passing through, the field of the electromagnetic deflection yoke would require the compensating magnetic field to be of undesirably high strength, resulting in distortions in the scan raster.

It is therefore an object of this invention to provide an improved beam centering device providing centering of the electron beam in a cathode ray tube having electromagnetic beam deflection.

It is further an object of this invention to provide a beam centering device for use with a cathode ray tube having a direct drive electromagnetic deflection system.

It is still another object of this invention to provide a static magnetic beam centering device providing compensation for off-centering of the electron beam of a cathode ray tube having a direct drive electromagnetic deflection system.

In carrying out this invention in one form thereof, there is provided a ring member mounted axially within the neck portion of a cathode ray tube, the ring member having a central aperture therein through which the electron beam passes. The ring member comprises structurally interconnected static magnetic beam deflection means and gettering means, the static magnetic beam deflection means producing a static magnetic field of parallel flux lines passing through the central aperture in a direction transverse to the electron beam in the region of a desired beam deflection center within the neck protion. An electromagnetic deflection yoke, the windings of which define a magnetic deflection center, is positioned concentrically about the neck portion of the tube and located thereon to effect coincidence of the magnetic deflection center with the desired deflection center. The static magnetic field produced by the static magnetic beam deflection means compensates for off-centering of the electron beam effected by direct current energization of the windings of the deflection yoke in a direct drive system.

For a better understanding of the invention, as well as for further objects and features of advantage thereof, reference may be had to the following detailed description and drawings in which:

FIGURE 1 is a drawing of a cathode ray tube employing the device of the invention and including in schematic form a transistor-type electromagnetic direct drive deflection system,

FIGURE 2 is an enlarged view of the device of the invention taken along the section line 2—2 of FIGURE 1,

FIGURE 3 is a view of the device of the invention taken along the section line 3—3 of FIGURE 2,

FIGURE 4 is an alternative embodiment of the device of the invention,

FIGURE 5 is a side view taken along the section 5—5 of FIGURE 4,

FIGURE 6 is a further alternative embodiment of the device of the invention, and

FIGURE 7 is a side view taken from along the line 7—7 of FIGURE 6.

In FIGURE 1 there is shown a cathode ray tube **10** having a neck portion **12** integrally joined with a screen (not shown) by flared-out portion **14**. Suitably mounted within the neck portion **12** is a cathode **16** arranged to be heated by heater **18** for the emission of electrons. Various grid and accelerating electrodes **20, 22, 24, 26** and **28** are provided for forming the electrons into a beam and accelerating the beam along the axis X—X through the neck portion **12**. For this purpose, suitable electrical leads are indicated attached to the various electrodes, the lead **25** electrically interconnecting the accelerator electrodes **24** and **26** and electrical leads extending out the base (broken away) of the neck portion **12** and providing electrical connection to the grid electrodes **20** and **22** and the suppressor grid electrode **28**.

Axially extending insulating arms **30**, only one of which is seen in FIGURE 1, are joined peripherally to the generally cylindrical electrodes **20, 22, 24, 26** and **28**, mechanically interconnecting these elements. The electrode **20** is secured to the base of the neck portion **12** and the electrode **26** is secured resiliently within the neck portion **12** by spacer members **32** and resilient spring members **34**, whereby all of the electrodes are axially mounted within the neck portion **12**. In addition to providing structural support, the spacer members **32** and resilient spring members **34** electrically connect the accelerator electrode **26** to the coating **36** conventionally employed in cathode ray tubes as a sink for secondary electrons and as a post-deflection acceleration anode. The coating **36** extends along the interior surface of the flared-out portion **14** of the tube **10** and connects the accelerator-electrode **26** to the high voltage accelerating potential terminal **37** which extends through the wall of the flared-out portion **14** in a hermetically sealed fashion.

In operation, upon the application of suitable electrical potentials to the various conducting leads respectively associated with given ones of the electrodes, an electron beam will be formed at the cathode **16** and accelerated axially through the neck portion **12** of the tube **10** along the axis X—X to the desired beam deflection center indicated at the point **38**. The desired beam deflection center is calculated by electron beam optics and is the point at which the electron beam must be deflected from its axial path for proper scanning of the screen of the tube **10**.

Electromagnetic deflection yoke **40** is positioned, concentrically about the neck portion **12** and firmly secured thereto. Although in the cross section of FIGURE 1 only horizontal deflection windings normally would be visible, the magnetic deflection yoke **40** has been indicated to include both vertical deflection windings **42** and horizontal deflection windings **43**. The vertical deflection windings **42** and the horizontal deflection windings **43** define a magnetic deflection center at which the electron beam is deflected to effect the scanning. Ideally, the magnetic deflection center will coincide with the desired beam deflection center at the point **38**.

Referring to FIGURE 2, a cross sectional view of the neck portion **12** and the coating **36** is shown. The electromagnetic deflection yoke **40** is generally indicated in dotted lines surrounding the neck portion **12** of the tube **10**, the windings of the yoke **40** being schematically represented by the series-connected vertical deflection windings **42** and the horizontal magnetic deflection windings **43**.

A vertical beam deflection circuit **44** for the electromagnetic deflection yoke **40** is indicated in schematic form in FIGURE 1, and comprises a vertical deflection signal source **46** connected to the base **48** of transistor **50**, the base **48** also being connected through resistor **52** to ground. The emitter **54** is connected to a source of forward biasing potential **56**, and the collector **58** is connected to one terminal of the vertical deflection windings **42** of the electromagnetic deflection yoke **40**, the other terminal of the vertical deflection windings **42** being connected through a suitable source of collector biasing potential **60** to ground. The deflection circuit **44** energizes the vertical deflection windings **42** of the electromagnetic deflection yoke **40** which in turn produce a field of magnetic flux passing transverse to the path of the electron beam and effecting vertical deflection of the electron beam for scanning the display screen.

The circuit **44** comprises a direct drive system, evidenced by the direct connection of the collector **58** to the vertical deflection windings **42**. Even in the absence of a deflection signal from the deflection signal source **46**, there exists a residual collector-emitter current from the potential sources **56** and **60**. Due to the direct connection, the residual current passes through the vertical deflection windings **42** of the yoke **40**, creating electromagnetically a static flux field in the vicinity of the desired beam deflection center. The static electromagnetic flux will displace the magnetic deflection center from the axial location **38** of the desired beam deflection center. Thus, the electron beam will be deflected, in scanning the screen, from a deflection center which is vertically displaced from the location **38** of the desired beam deflection center, and the raster scan will be off-centered on the display screen.

In accordance with this invention, the decentering effect of the direct drive deflection system is compensated by the addition of a static magnetic deflection means structurally interconnected with a gettering means and positioned axially within the neck portion of the tube. The static magnetic deflection means creates a static magnetic field of parallel flux lines passing in a transverse direction to the electron beam in the region of the desired deflection center at **38** which compensates for the off-centering of the beam arising from the static field generated by the direct drive system.

The structurally interconnected member comprising both the gettering means and the static magnetic deflection means is indicated generally by the annular member **62** which is mounted axially within the neck portion **12** by straps **64**. Referring to FIGURE 2, the structurally interconnected static magnetic deflection means and gettering means is seen, in general outline, to be ring-shaped thereby providing a central circular aperture portion **65** through which a planar field of horizontal parallel flux lines **63** passes. The flux lines **63** are directed in the horizontal plane such as to compensate for the vertical displacement of the magnetic beam deflection center from the desired beam deflection center **38** due to the direct or static current component of the energizing current in the vertical deflection windings **42** of the magnetic deflection yoke **40** in a direct drive system. Thus, the resultant magnetic beam deflection center is made to coincide with the desired beam deflection center to provide proper centering of the electron beam.

It is noteworthy that the annular member **62** is a combined gettering means and static magnetic beam deflection means. A ring-shaped gettering ring is commonly employed in cathode ray tubes and positioned generally in the manner of the annular member **62**, namely, axially within the neck portion **12**. Further, with the development of short-neck cathode ray tubes, the gettering ring is frequently positioned in the immediate vicinity of the desired beam deflection center such as at **38**. Thus, in the embodiment of the invention shown in FIGURES 2 and 3, the annular member **62** may comprise a gettering ring **66** component of the energizing current in the vertical deflechaving arcuate permanent magnet members **68** and **69** mounted symmetrically thereon, the annular member **62** supporting the members **68** and **69** for concentric positioning within the neck portion **12**. The gettering ring **66** has a channel or recess **70** within which gettering material **72** is received for structural support thereof during assembly

of the tube. The arcuate magnets **60** and **69** are mounted on the solid planar wall **67** of the gettering ring **66** in any suitable fashion, such as by welding.

In FIGURES 4 and 5 there is shown an alternative embodiment of the invention comprising a gettering ring **66** similar to that of FIGURES 2 and 3, and having a recess **70** therein within which gettering material **72** is received. Mounted on the planar wall surface **67** thereof is an annular magnet **74** which is polarized at diametrically opposed ends thereof to create a field of parallel magnetic flux lines **63** in the same manner as indicated in FIGURE 2.

In a further embodiment of the invention, shown in FIGURES 6 and 7, a permanent magnet is employed which, in addition to providing a static magnetic field, also provides the structural support of the gettering material. In FIGURE 6, a permanent magnet **76** of an annular shape is provided with a central aperture **65** through which the field of parallel magnetic flux lines **63** passes. The cross-sectional view of FIGURE 7 indicates that the annular magnet **76** is provided with an annular recessed portion **78** within which gettering material **72** is received.

The various embodiments of the invention shown and described herein are effectively functional equivalents of one another and each may be positioned within the neck **12** of the tube **10** as is indicated by the annular member **62** in FIGURE 1 for creating the static magnetic field of parallel flux lines required for centering of the electron beam.

In the system shown, compensation has been provided for only vertical deflection or off-centering of the beam, it having been assumed that the beam is properly centered in the horizontal plane. It is apparent, however, that horizontal off-centering of the electron beam may be compensated by a static magnetic deflection means in accordance with the invention when mounted at a suitable angular orientation within the neck portion **12**.

The usefulness of the device of the instant invention will be readily appreciated by those skilled in the art. The use of a ring-shaped or annular gettering member positioned axially within the neck of the tube and adjacent the desired beam deflection center is rather standard construction, especially in short-necked cathode ray tubes. Thus, the device of the invention encompasses the use of a structure conventionally employed, namely, the gettering means, and combines with it the static magnetic deflection means which, because of its strategic positioning within the neck of the tube, and because of its structural interrelation with the gettering means, provides an extremely effective beam centering device. Further, the simplicity of the structure and the relative ease in mounting of the beam contering device of the invention provide a structure which is very inexpensive to manufacture.

It will be obvious to those skilled in the art that many variations and modifications of the beam centering device of the invention may be made without departing from the spirit and scope of the invention. Therefore, this invention is to be considered as limited only in accordance with the teaching thereof as set forth in the claims appended hereto.

What I claim as new and desire to be secured by Letters Patent of the United States is:

1. In a cathode ray tube having integrally joined neck and screen portions wherein an electromagnetic deflection yoke is axially mounted on the neck portion and energized for deflecting an electron beam passing therethrough for scanning the screen portion of the cathode ray tube, and wherein the magnetic beam deflection center defined by the yoke is to coincide with a desired beam deflection center within the neck portion, a beam centering device comprising an annular permanent magnet mounted axially within the neck portion of the tube and providing a central aperture through which the electron beam passes, said annular permanent magnet having a recess therein for reception of gettering material, and being poled to produce a static magnetic field of parallel flux lines extending across said aperture in a direction transverse to the electron beam in the region of said desired beam deflection center for effecting a constant deflection thereof sufficient to center the electron beam on the screen portion.

2. In a cathode ray tube having integrally joined neck and screen portions wherein an electromagnetic deflection yoke is axially mounted on the neck portion and energized for deflecting an electron beam passing therethrough for scanning the screen portion of the cathode ray tube, and wherein the magnetic beam deflection center defined by the yoke is to coincide with a desired beam deflection center within the neck portion, a beam centering device comprising an accelerator electrode mounted adjacent said beam deflection center within the neck portion and an annular permanent magnet mounted on said accelerator electrode for concentric positioning thereof within the neck portion and having a central aperture through which the electron beam passes, said annular permanent magnet having a recess therein for receiving gettering material and being poled to produce a static magnetic field of parallel flux lines extending across said aperture in a direction transverse to the electron beam in the region of said desired beam deflection center for effecting a constant magnetic deflection thereof sufficient to center the electron beam on the screen portion.

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