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FOCUSING COIL FOR CATHODE-RAY TUBES

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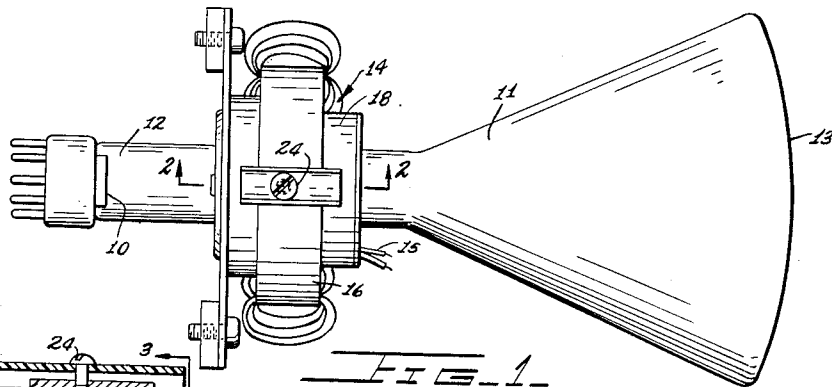


FIG. 1

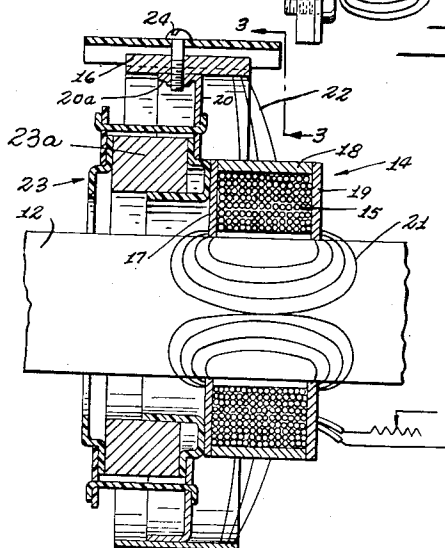


FIG. 2

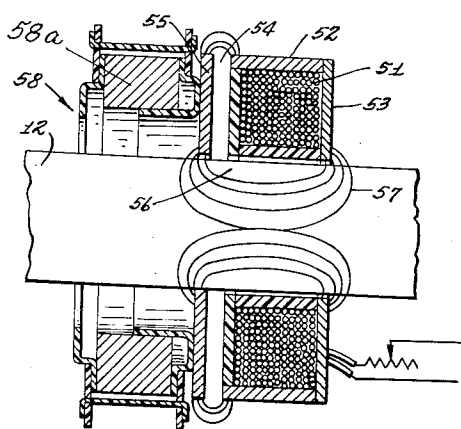


FIG. 4

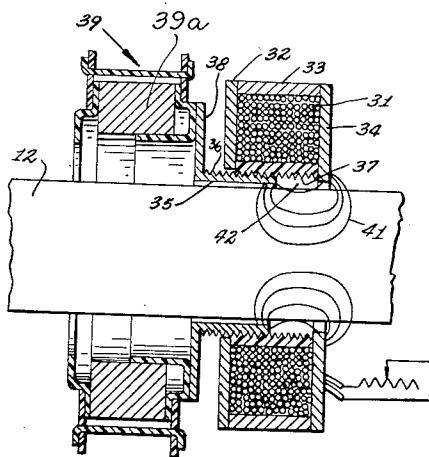


FIG. 3

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FOCUSING COIL FOR CATHODE-RAY TUBES

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4 Claims. (Cl. 313-84)

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My invention relates to cathode ray tubes and more particularly to focusing coils for cathode ray tubes.

In iconoscopes, kinescopes and other applications of cathode ray tubes, deflection plates and yokes in electrostatic and magnetic tubes, respectively, are required. By means of voltage and current variations, various image patterns can be obtained. The size of the scanned raster, linearity and the aspect ratio are all determined by the deflecting plates or yokes which are placed in the neck of the tube.

However, in order to impart the proper deflection on each electron, the electron gun must emit a stream of electrons which enter the deflection region by passing along the axis of the tube. If the electrons should diverge from this path before the deflection region, undesirable shadow effects and improper deflection will result.

Thus, in the section intermediate of the electron gun and the deflection region is placed a focusing coil. As is well-known in the art, the configuration of the magnetic field is such that electrons which pass along the axis of the tube are not deflected by the focusing coil since the electrons will pass parallel to the magnetic field.

Electrons which diverge from this path are acted on by the magnetic field which cause them to rotate about the axis parallel to the tube axis and thus produce inward radial acceleration sufficient to reverse the initial outward radial velocity and to thus bring the beam into alignment with the tube axis as it enters the deflection region.

Heretofore the magnetic focus units were constructed of either a permanent magnet or electromagnet with variations achieved either by variation of location or external adjustment of current through the coil.

In accordance with my invention, I apply an adjustable permanent magnet which can effect large range of variations of the focusing magnetic field which is produced jointly by the permanent magnet and an electro-magnetic coil.

Accordingly, an object of my invention is to provide a novel magnet focusing device for a cathode ray tube.

A further object of my invention is to provide a novel magnetic focusing unit for a cathode ray tube utilizing an adjustable permanent magnet used in conjunction with an electro-magnetic coil.

A still further object of my invention is to provide an adjustable shunt permanent magnet for a focusing cathode ray beam.

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A still further object is to provide a novel series permanent magnet for focusing an electron beam.

The foregoing and many other objects of my invention will become apparent when taken in connection with the following description and drawings in which:

Figure 1 is a side view of a cathode ray tube showing one form of my novel focusing magnet using an adjustable shunt permanent magnet.

Figure 2 is a view taken along line 2-2 of Figure 1.

Figure 3 is a partial view in cross-section of a modified form of adjustable permanent magnet with a series path.

Figure 4 is a partial view in cross-section of another modified form of my focusing unit with an adjustable shunt path.

Referring to Figure 1, the cathode ray tube 11 of the usual construction comprises a conical portion with a right end 13 coated on the interior surface with a fluorescent material. At the left end of the conical section is the neck 12 with a socket and electron gun indicated generally at 10. The electron beam emitted from the cathode gun at 10 traverses the neck 12 and conical section and then impinges on the fluorescent screen surface 13. The remaining portion of the cathode ray tube is not here shown as this is well-known in the art.

As may be observed in Figures 1 and 2, the electromagnet 14 is comprised of windings 15 which are wound inside a U-shaped annulus 17, 18, 19 placed concentrically with the axis of the neck 12. The annulus 17, 18, 19 is made of a magnetic material such as silicon steel or any other material of high permeability.

Thus, the flux lines 21 set up by current flow in the windings 15 will follow the magnetic path of 17, 18, 19 and through the neck 12 of the tube 11. As will be observed, the magnetic field 21 in the neck of the tube has a radial component.

It is this component which will be effective in deflecting or focusing the electrons which have diverged from the path along the axis of the tube.

In accordance with my invention, I provide a magnetic circuit arrangement either in the form of a by-pass magnetic path or a series path of increased reluctance for the control of this magnetic field.

A permanent magnet 16 of hollow cylindrical form is slidably mounted on the flanged portion 20a of magnetic material 20. The magnetic piece 20 forms an integral part of a slidably mounted unit 23 which is concentric with the neck 12 and is positioned to the left of the electromagnet 14. The permanent magnet 16 is rigidly

idly attached by screw 24 or any other suitable means to the slidable adjustable unit 23. Sliding of the unit 23 along the neck 12 will position the permanent magnet 16 with respect to the electromagnet 14.

Figures 1 and 2 illustrate the position of the permanent magnet 16 in its extreme right position where a maximum amount of the magnetic flux 22 from the magnet 16 will be shunted through the annular ring 17, 18, 19. In the position indicated, the magnetic field 21 will be of great strength. As the cylindrical magnet 16 is moved to the left by means of sliding unit 23, less of the lines of force will be shunted through the core material 17, 18, 19 and thus the magnetic field 21 will be materially reduced.

Thus, adjusting the axial position of permanent magnet 16 by means of sliding unit 23 and shunt 23a the desired radial magnetic field strength in the neck 12 may be obtained to give correct forming of the electron beam.

In Figure 3 I have shown the combination of the electromagnet and permanent magnet, the latter adjustable, but instead of having the permanent magnet surrounding or encasing the electromagnet coil, the permanent magnet in this case is mounted inside the electromagnetic coil.

Thus, the coil 31 (Figure 3) as in the first example is mounted on the neck of the cathode ray tube and coaxial therewith and as in the previous case is provided with a U-shaped annular magnetic core 32, 33, 34 for providing a magnetic path for the flux.

The permanent magnet 35 provided with screw threads 36 thereon with corresponding teeth on the inner surface 37 of the housing for the electromagnetic coil is concentric with the electromagnetic winding 31. The magnetic flux resulting from current flowing from the winding of the coil 31 normally extends over the magnetic path including a magnetic core 32, 33, 34 and into the neck 12 of the tube as shown by the lines of force 41.

The threaded permanent magnet 35 is rigidly attached to the disc piece 38 which is mounted on the slidable rotatable unit 39 and shunt 39a. The lines of flux 41 emanating from both the magnet 35 and coil 31 will traverse the magnetic path of the annular ring 32, 33, 34 across the air gap 42 and through the magnet 35.

As the permanent magnet 35 is rotated by means of unit 39, it will thread to the right, thus reducing the air gap 42 and reducing the reluctance of the magnetic path which will increase the magnetic lines of force in the neck 12 of the tube. When the magnet 35 is rotated to move to the left, it will increase the air gap and reluctance of the magnetic path which will thus decrease the amount of lines of force that will be in the neck 12 of the tube.

In Figure 4 I have shown a further modified form of my invention in which the permanent magnet is adjustable to increase the series of reluctance of the magnetic path. The electromagnetic coil 51 is wound in an L-shaped annular core 52, 53 and encloses the neck 12 of the cathode ray tube 11.

The magnetic path for the flux lines 57 will be through the core material 52—53, then the focus region 56 in the neck 12 and then the permanent magnet 55 and through the air gap 54.

The permanent magnet 55 is attached to the slidable unit 58 and shunt 58a so that when the unit 58 is moved to the left the air gap 54 will

increase. This will cause the reluctance of the magnetic path to increase which will reduce the effective magnetic field in the neck of the tube.

When the permanent magnet 55 is moved closer to the electromagnetic coil 51, the reduction in the air gap 54 will reduce the reluctance of the magnetic path, thus increasing the strength of the lines of force 57 in the neck of the tube. By proper adjustment of slide 58 the correct field strength can be obtained to give desired focusing of the electron beam.

While I have in the above shown three embodiments of my invention, it will now be understood that in general it comprises the adjustment of the magnetic lines of force available for focusing the beam by an adjustment of the permanent magnet in relation to the magnetic path of the electromagnetic coil.

In addition to this adjustment, the usual adjustments of the coil made by varying the current through the windings of the electromagnetic coil may also be made, thus providing a wide range of adjustments as well as fine or vernier adjustments and I do not wish to be limited except as set forth in the appended claims.

I claim:

1. A cathode ray beam focusing system for a cathode ray tube comprising an electromagnet having windings and a U-shaped annulus fixedly mounted concentrically with the axis of the neck of said cathode ray tube, said windings being supported on said annulus, said annulus being made of high permeability material, a magnetic slidably mounted unit concentric with the neck of said cathode ray tube positioned on one side of said electromagnet, said magnetic unit being slidable on the neck of said tube with respect to said electromagnet, said unit having a flanged portion, said unit also comprising a permanent magnet of hollow cylindrical form having a greater diameter than said electromagnet mounted on said flanged portion of said magnetic unit and slidable therewith, means for rigidly attaching said permanent magnet to said slidable adjustable unit, said means being a screw, said permanent magnet being concentric with said winding and providing a variable by-pass for the flux of said winding in accordance with its position with respect to said electromagnet, and means for varying the current flow in said windings wherein said means is a variable resistor.

2. A cathode ray beam focusing system for a cathode ray tube comprising an electromagnet having windings and a U-shaped annulus fixedly mounted concentrically with the axis of the neck of said cathode ray tube, said windings being supported on said annulus, said annulus being made of high permeability material, a magnetic slidably mounted unit concentric with the neck of said cathode ray tube positioned on one side of said electromagnet, said magnetic unit being slidable on the neck of said tube with respect to said electromagnet, said unit having a flanged portion, said unit also comprising a permanent magnet of hollow cylindrical form having a greater diameter than said electromagnet mounted on said flanged portion of said magnetic unit and slidable therewith, means for rigidly attaching said permanent magnet to said slidable adjustable unit, said means being a screw, said permanent magnet being concentric with said winding and providing a variable by-pass for the flux of said winding in accordance with its position with respect to said electromagnet,

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and means for varying the current flow in said windings.

3. A cathode ray beam focusing system for a cathode ray tube comprising an electromagnet having windings and a U-shaped annulus fixedly mounted concentrically with the axis of the neck of said cathode ray tube, said windings being supported on said annulus, said annulus being made of high permeability material, a magnetic slidably mounted unit concentric with the neck of said cathode ray tube positioned on one side of said electromagnet, said magnet unit being slidable on the neck of said tube with respect to said electromagnet, said unit having a flanged portion, said unit also comprising a permanent magnet of hollow cylindrical form mounted on said flanged portion of said magnetic unit and slidable therewith, means for rigidly attaching said permanent magnet to said slidable adjustable unit, said means being a screw, said permanent magnet being concentric with said winding and providing a variable by-pass for the flux of said winding.

4. A cathode ray beam focusing system for a cathode ray tube comprising an electromagnet having windings and a U-shaped annulus fixedly mounted concentrically with the axis of the neck of said cathode ray tube, said windings being supported on said annulus, said annulus being made of high permeability material, a magnetic slidably mounted unit concentric with the neck of said cathode ray tube positioned on one side of said electromagnet, said magnetic unit being slidable on the neck of said tube with respect to said electromagnet, said unit having a flanged portion, said unit also comprising a permanent magnet of hollow cylindrical form having a

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greater diameter than said electromagnet mounted on said flanged portion of said magnetic unit, means for rigidly attaching said permanent magnet to said slidable adjustable unit, said means being a screw.

BURROWS CORSON VAN GILDER.

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