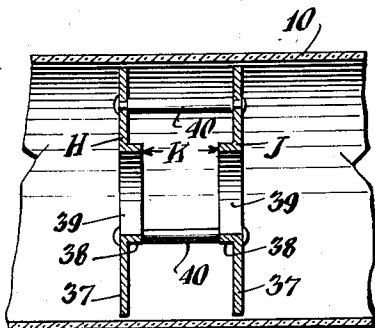
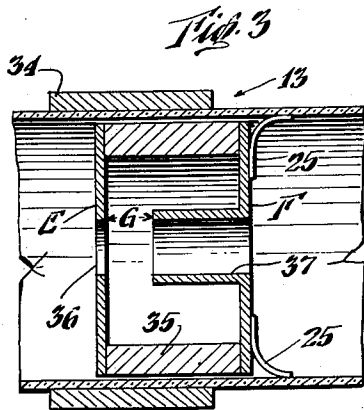
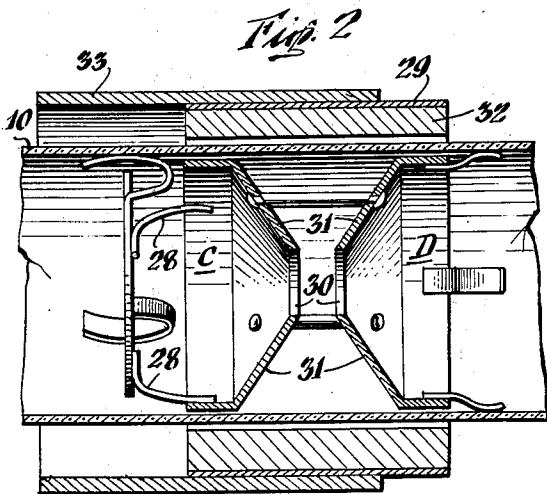
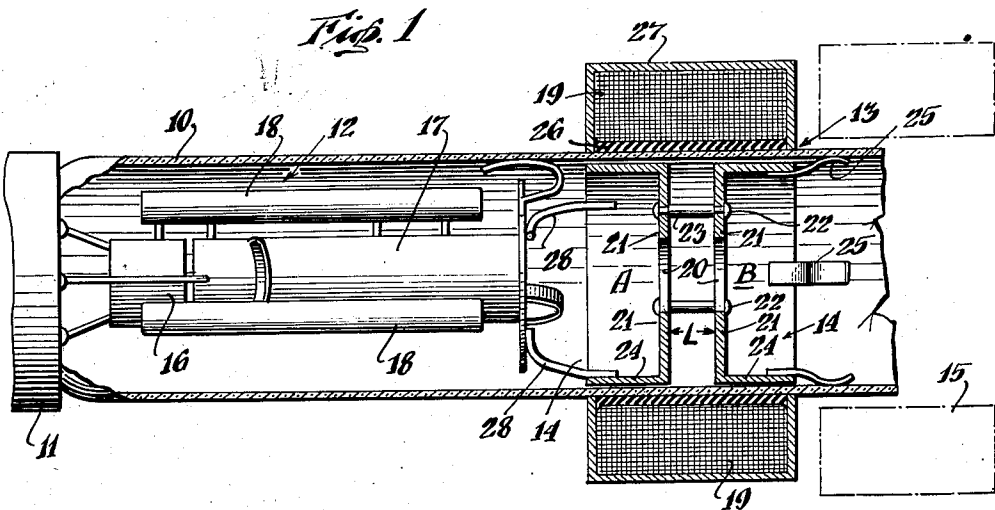


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W. F. STEERS
INTERNAL FOCUSING DEVICE
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INTERNAL FOCUSING DEVICE

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This invention relates to focusing devices for cathode ray tubes and more particularly to the concentration of the flux along the beam.

The object of this invention is to concentrate the electron beam of a cathode ray tube more effectively.

Another object is to provide a more uniform distribution of the flux in focusing devices.

A still further object is to provide a magnetic focusing device in which the flux is brought close to the electron beam.

Other and further objects will appear from the following specification taken in connection with the accompanying drawings in which

Fig. 1 is a view of the neck of a cathode ray tube with a sectional presentation of one form of the invention;

Figs. 2, 3, and 4 are sectional views of other forms of the invention.

Referring to Fig. 1 a neck 10 of a cathode ray tube is shown mounted on a base 11. The glass envelope of the neck is shown in section with an electron gun 12 mounted therein. Adjacent the electron gun 12 is a focusing device 13. Inside the neck 10 and a part of the focusing device 13 are pole pieces 14. The focusing device 13 is conventionally positioned between the electron gun 12 and coils of the deflecting yoke 15 which also encircles the neck 10.

The electron gun 12 has a cathode 16 and an anode 17 supported on glass rods 18 which extend axially in the neck 10. A focusing coil 19 in the focusing device 13 cooperates with the magnetic pole pieces 14 to produce a focusing field in a central passage 20 through the pole pieces 14. The pole pieces 14 in Fig. 1 are a pair of discs A and B each made up of a flanged ring of which flanges 21 extend radially of the neck 10 and terminate short of the center of the neck 10 to provide the aperture 20. The discs A and B as shown in Fig. 1 are circular and symmetrical in shape with circular holes in the center forming the aperture 20. The discs A and B are secured together and spaced apart by non-magnetic shoulder rivets 22. Each rivet 22 has an enlarged central section 23 against which the discs A and B abut and by which they are separated. The central sections 23 form an axial gap L between the flanges 21. Axial flanges 24 of the discs A and B are spaced away from the inner surface of the wall of the neck 10; this spacing is maintained by spring fingers 25 which maintain the pole pieces centered in the neck 10. On the other side the attached pole pieces 14 are supported on the gun assembly 12 by small diameter rods 28.

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The rods 18 which support the anode 17 are supported on the cathode 16 which in turn is supported on the base 11. In the assembly of the tube the internal parts of the focusing device 13 and the electron gun 12 are assembled and mounted on the base 11, inserted and sealed in the neck 10 of the tube. The coil 19 is mounted in an annular insulating ring 26 around the neck 10 as the outside component of the focusing device 13. A shell 27 of mild steel encloses the coil 19 and completes the magnetic circuit outside the coil.

The electron gun 12 creates an axial stream of electrons which shoots through the neck 10 of the tube and against a fluorescent screen (not shown). In extending through the neck 10 the electron stream after leaving the gun 12 passes through the focusing device 13 and then through the deflecting yoke 15. The stream is directed through the aperture 20. Direct current passed through the coil 19 creates a magnetic field with the lines of force passing from disc A to disc B through the flanges 21 and axially across the gap L. The lines of force conducted to the aperture 20 concentrate the field near the electron beam and increase the effect of the field on the beam. By reason of the flanges 21 carrying the lines of force the field is uniformly arranged around the beam and uniformly effects the beam. Thus the pole pieces 14 of this invention carry the magnetic flux to the area of the electron beam and concentrate it in the aperture 20 adjacent the center of the beam. Adjustment of the focus is accomplished by variation of the current in the coil 19.

A modification of this invention is shown in Fig. 2 in which a variation of the focusing device 13 inside the neck 10 produces a concentration of the focusing field in the region of a central aperture 30. The electron gun assembly of the embodiment of Fig. 1 is applicable to the modification of Fig. 2. In the focusing device 13 of Fig. 2 a pair of discs C and D have oblique inwardly extending flanges 31. Otherwise the discs C and D are similar to discs A and B of Fig. 1. The focusing device 13 of Fig. 2 has a permanent magnet 32 around the outside of the neck 10 encompassing the discs C and D. This permanent magnet 32 is formed of a suitable material and may either be in the form of an annular ring or single magnets placed symmetrically around the tube. A shunting ring 33 is placed around and over the magnet 32 in a sliding fit. The shunting ring 33 is spaced from the magnet 32 with a non-magnetic aluminum or brass separator 29.

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interposed between the ring 33 and this magnet 32. This ring 33 is made up of a mild steel or other suitable magnetic metal which when it moves with relation to the magnet 32 changes the field produced within the neck 10 by the magnet 32.

In Fig. 2 the magnetic flux from the magnet is directed to the aperture 30 along the flanges 31. At the aperture 30 a field is produced along the axis of the neck 10 so as to focus the electron beam directed through the aperture 30. The shunting ring 33 when overlying the magnet 32 decreases this magnetic flux and the field in aperture 30. The degree of this minimization of the focusing effect is in direct proportion to the extent of the coverage of the magnet 32 by the ring 33, with the greatest magnetic effect when the ring is completely removed.

In the modification shown in Fig. 3 the focusing device 13 is made up of a shunting ring 34 outside the neck 10 together with a pair of discs E and F, and an inside magnet 35 spacing the discs E and F within the neck 10. The disc E is a flat plate with a central aperture 36 at the center of the neck 10. The disc F has a tubular central passage 37 aligned with central aperture 36 of disc E. The two discs are suitably fastened on the sides of the field producing magnet 35. The resultant unit formed by the two discs E and F and magnet 35 are supported on glass rods at one side and centered in the neck 10 by fingers 25 on the other side. The shunting ring 34 is movable axially along the neck 10 to vary the amount of enclosure of the magnet 35 by the shunting ring 34.

The magnetic flux of the magnet 35 is conducted by the discs E and F to the aperture 36 and tubular passage 37. The flux is thus concentrated in producing a field across the space G lying between the inner end of tubular passage 37 and the disc E. The stream produced by the electron gun 12 passing through the aperture 36 and the tubular passage 37 is focused by the field across G. The focusing adjustment of the device 13 in Fig. 3 is accomplished by positioning of the shunting ring 34. In a further modification the ring 34 may be omitted. The focus may be controlled by varying the second anode voltage when the internal magnet is of such a size as to provide a correct flux for a conventional tube at normal line voltages and normal anode voltages.

A still another modification of this invention is shown in Fig. 4. Discs H and J are shown positioned within the tube neck 10 similar to the positioning of the discs in the embodiments of Figs. 1, 2 and 3. The discs H and J are incorporated in a focusing device which produces lines of force as described above. This focusing device may have either a focusing coil or a permanent magnet as the flux producing means. Each of the discs H and J have a radial portion 37 with a short axial flange 38 circumscribing a central aperture 39. The flanges 38 of the discs H and J face inwardly toward each other forming a gap K which is less than the distance between the radial faces of the portions 37. The discs H and J are held together and separated by shoulder rivets 40 similar to the rivets 23 of the embodiment in Fig. 1. In the embodiment of Fig. 4 the focusing flux is concentrated by the discs H and J across the gap K between the flanges 38.

The focusing device of this invention provides a small diameter aperture for focusing the electron beam. The discs inside the tube guide the flux to the aperture. The discs cooperate with

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the flux producing beams, coil or magnet to facilitate the concentration of the flux at the aperture and increase the effect of the flux on the focusing of the electron stream.

The flux as it emanates from the flux producer may have an unsymmetrical nature. The conveying of the lines of force through the discs of this invention will tend to even out this lack of symmetry and thus sharpen the effect the focusing device has on the electron stream.

The discs inside the neck 10 are composed of a highly permeable material. It is an advantage of this invention that the electrical force to provide a given required flux at the electron stream is lowered. A further resultant advantage is a reduction in the demands on the flux producing parts. Through this invention a reduction in the amount of the necessary materials in the focusing device brings about an economy of materials with consequent conservation.

A further advantage of this invention as applied to television picture tubes is the improved quality of focusing. A more symmetrical flux in the focusing field causes the electron stream to produce a more circular spot on the fluorescent field. Moreover, flux leakages from the focusing device to other tube components such as the ion trap and deflection yoke, are minimized. A collateral advantage of this invention is that the disc or pole piece adjacent the electron gun can serve the dual purpose of transmitting and concentrating the focusing flux and also serving as the accelerating electrode or second grid of the electron gun assembly with all the consequent advantages.

The above described embodiments are for the purpose of illustration of this invention and it will be understood that various modifications may be made without departure from the spirit of this invention.

I claim:

1. A focusing device for a cathode ray tube having a glass wall with a cylindrical neck around an electron gun adapted to emit a stream of electrons comprising a flux source concentric with the cylindrical neck and adjacent the emitting end of the electron gun and extending longitudinally along the neck of the tube with the poles longitudinally spaced to provide lines of flux extending in a longitudinal direction to form concentric areas of flux lines around the central axis of the tube in front of the emitting end of the electron gun, a pair of axially spaced flux conducting members mounted on the emitting end of the electron gun and concentric with the flux source and in the flux field, said members having an outer diameter substantially equal to the diameter of the inner surface and being insertable within the neck of the tube, one of said members being mounted on the end of said electron gun and the other member having spring guides pressing against the inner surface of the neck to position each member concentrically within the neck, each member having a central opening and an outer portion formed in one continuous piece of thin metal from the periphery of the central opening concentrically with the axis of the neck to the periphery of the outer portion adjacent the end of said flux source to concentrate said flux across the edges of said opening, said openings being of the source size and longitudinally spaced along the central axis and each having a diameter from one quarter to one third the diameter of said neck and longitudinally spaced apart a distance substantially equal to

slightly less than the diameter of said openings to form a concentric centrally shaped flux field between said members at said openings and around the path of the electron beam from said gun to force said electrons into a concentrated beam.

2. A focusing device as claimed in claim 1 wherein said flux source is outside of said neck and each member comprises a cylindrical member adjacent said inner surface and extending from a pole end of said flux source to a radial portion extending inwardly to said opening.

3. A focusing device as claimed in claim 1 wherein flux source is outside of said neck and each member comprises a cylindrical member adjacent said inner surface and extending from a pole end of said flux to a conically shaped member extending inwardly to said opening.

WILLIAM F. STEERS.

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