

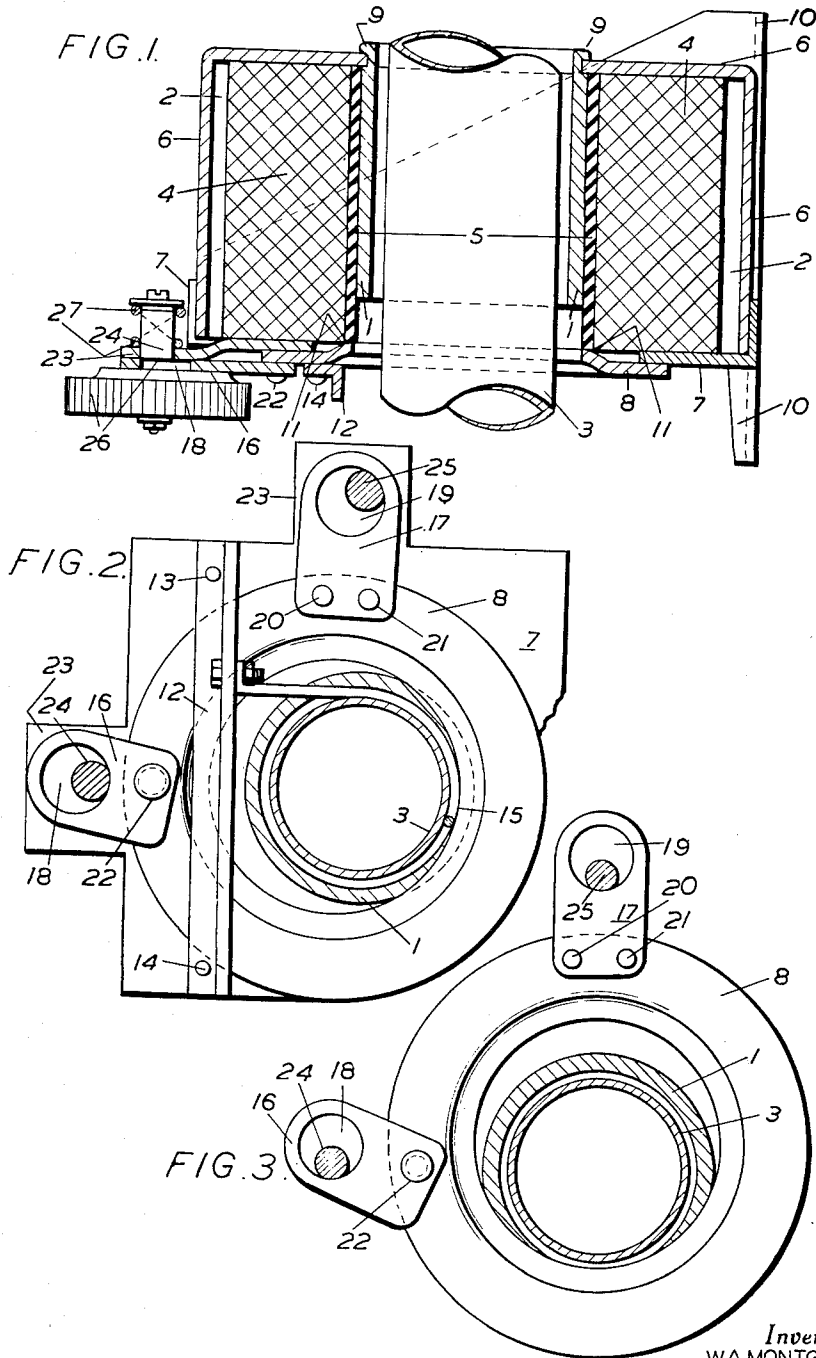
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DEVICES FOR FOCUSING AN ELECTRON BEAM

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DEVICES FOR FOCUSSED AN ELECTRON BEAM

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The present invention relates to focussing and centering arrangements for the electron beams of cathode ray tubes utilising magnetic focussing by means of a permanent magnet or an electromagnet.

The usual arrangement for magnetically focussing an electron beam in a cathode ray tube comprising a magnet assembly positioned about the neck of the tube in a mounting arrangement which provides means for tilting the assembly in order to adjust the magnetic axis for centering the electron beam spot upon the cathode ray tube screen.

According to the present invention the focussing and centering arrangements for the electron beam of a cathode ray tube comprise means for producing a magnetic beam focussing field between a pair of annular pole pieces and means for adjusting the eccentricity of one pole piece with respect to the other.

By this means, instead of tilting the whole of the magnetic assembly, it is necessary only to adjust one portion thereof, which may very readily be done if this be a small mass such as may be obtained by using a centrally apertured plate, adjustable in position, for one of the pole pieces.

More specifically, embodiments of the invention provide a focussing and centering arrangement for the electron beam of a cathode ray tube comprising a cylindrical sleeve of magnetic material to be placed around the longitudinal axis of the said beam, a plate of magnetic material spaced from the end of the said sleeve substantially at right angles to the longitudinal axis thereof, and having a central circular aperture surrounding said axis, magnetic means for producing a beam focussing magnetic field in the space between the said end of the sleeve and the said plate and means for adjusting the eccentricity of the central aperture of the said plate with respect to the longitudinal axis of the said sleeve to provide any required steady deflection for centering the electron beam.

The invention is applicable both to permanent magnetic and to electromagnet focussing means. An embodiment using an electromagnet will be described with reference to the accompanying drawings in which:

Fig. 1 shows in part section a view of a focussing and centering arrangement according to the present invention,

Fig. 2 shows, in part section and in part diagrammatically a front view of the arrangement of Fig. 1 with the centrally apertured plate in one extreme position with respect to the said sleeve, and

Fig. 3 shows a view similar to that of Fig. 2 but with the apertured plate in another extreme position.

Referring to the drawing, 1 represents the magnetic core (the said sleeve) of an electromagnetic focussing unit 2 in concentric relation to the neck portion 3 of a cathode ray tube (not fully shown). The focussing unit comprises a coil 4 wound on a bobbin 5, which fits over the cylindrical magnetic sleeve 1. Except for a said air gap at one end the coil 4 is completely enclosed magnetically by the sleeve 1, a cup-shaped shroud 6, which

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may be of drawn steel, an end plate 7 of magnetic material and the aforementioned apertured plate (indicated at 8).

In the embodiments shown, the sleeve 1 is provided at one end with a shoulder 9 which fits inside a central hole in the base of shroud 6, the end of the sleeve being swaged over the metal of the shroud. The end cap 7 is secured to a mounting bracket 10 and after insertion of the coil 4, the shroud 6 is secured to the end cap 7 in any convenient manner which will ensure good magnetic contact between them. The mounting bracket 10 is fixed to the chassis of the cathode ray tube unit in such manner that the axial position of focussing unit 2 may be adjusted with respect to the tube 3.

It will be observed that in the embodiment shown in Fig. 1, the end cap 7 does not completely cover the end of the coil 4; the closure is completed by the centrally apertured plate 8, which we call a shift plate, held in sliding contact over the base of the end cap 7. This shift plate forms one pole of the focussing magnet the end of the sleeve 1 the other. As will be explained later, the shift plate 8 is dished, so that the more central portion lies in the same plane as the base of the end cap.

The passage of current through the coil 4 sets up a predominantly axial magnetic field in the space between the adjacent end of sleeve 1 and the inner circumference of the shift plate 8. If the sleeve 1 and the aperture in the shift plate 8 are coaxial, the radial components of the magnetic field are symmetrical about the axis and the focussing arrangement merely provides a magnetic lens for focussing the electron beam to form a spot upon the cathode ray tube screen. In order that the electron optical magnification may be a maximum, the focussing arrangement should be mounted with the shift plate facing the cathode ray tube screen.

If the shift plate 8 be mounted so as to be eccentric with respect to the axis of the sleeve 1, a resultant radial component of the magnetic field will exist in the air gap and will cause deflection of the electron beam; thus by adjustment of the shift plate in its own plane, the electron beam can readily be centered on the tube screen in spite of eccentricity of mounting of the tube and sleeve 1 or of the electron gun within the tube. A small movement of the shift plate 8 in its own plane is sufficient to shift the electron beam over a relatively large distance.

It is to be noted that if the shift plate 8 is not in magnetic contact around the entire circumferential interface 11 between the plate and the focussing unit 2, there is a tendency to produce an unwanted shift of the electron beam due to the distortion of the magnetic field caused by the gaps present. To improve the uniformity of this magnetic field by decreasing the effect of small gaps between the focussing unit 2 and the shift plate 8 the latter has been designed in the form of a dished annular plate.

To ensure good magnetic contact between the shift plate and the end cap 7, an angle bar 12 of metal (say aluminum in the present embodiment) is riveted to the end cap 7 by rivets 13 and 14 so as to press against the shift plate.

Although not specifically shown on the drawings, a spring clip can be added, if necessary, say to the bottom of the end cap 7, to act as an additional retainer for the shift plate 8. Alternatively, the bar 12 may be replaced by a plurality of such spring clips.

If, as in the present embodiment, a retaining bar 12 be used, a clamping stirrup 15 for supporting the neck 3 of the cathode ray tube may conveniently be secured to the bar.

For the movement of the shift plate 8 in its own plane, that is in a plane transverse to the axis of the cathode ray tube, in two directions so as to be able thus

to adjust the position of the central aperture in relation to the sleeve 1 and thereby produce the necessary influence on the field to shift the electron beam, the shift plate 8 is secured to two shaped metal plates 16 and 17 to be identified hereinafter as links. As will be seen from the drawings, each of the links 16 and 17 is a U-shaped metal plate, of aluminium, say, having near the curved end thereof a circular aperture (18 and 19 respectively). One of the links, 17 in the case of the example under consideration, is riveted to the shift plate 8, as shown at 20 and 21, while the other link 16 is pivoted in any known manner to the shift plate 8 as shown at 22; this manner of fixing ensuring easier control of the movement of the shift plate.

Two raised lugs 23, one of which is shown in Fig. 1, and both of which are indicated diagrammatically in Fig. 2, are provided on the front surface of the end cap 7 for mounting two spindles, 24 and 25, provided with eccentric bearing portions fitting within the respective apertures 18 and 19. Each spindle carries a control knob in the form of a thumb wheel 26, as shown in Fig. 1. Each thumb wheel is retained against the front surface of its respective link by means of spring loading, indicated at 27 in Fig. 1, between the rear end of the spindle and the lug 23, thus introducing sufficient friction between the respective links 16 and 17 and the end cap 7 to keep the shift plate 8 in any desired position once the thumb wheels have shifted it from its normal central position with respect to the sleeve 1. In Figs. 2 and 3 the aperture and movement of the shift plate have been exaggerated for purposes of illustration, the shift plate in Fig. 2 being shown in the extreme position in one direction while that in Fig. 3 is in the extreme position in a direction substantially at right angles to that in Fig. 2.

In a practical application of the invention to a twelve inch diameter television receiving tube operating at a beam accelerating potential of 10 kv., the magnet coil 4 was designed to provide 500 ampere turns and a gap of $\frac{1}{4}$ inch was provided between the end of the sleeve 1 and the rear of the shift plate 9. The magnetic lens gave a magnification of 6.3. Under these conditions it was found that a movement of $\pm\frac{3}{32}$ inch of the shift plate produced on the cathode ray tube screen a corresponding spot deflection of $\pm 1\frac{1}{4}$ inch.

While the principles of the invention have been described above in connection with specific embodiments and particular modifications thereof, it is to be clearly understood that this description is made only by way of example and not as a limitation on the scope of the invention.

What we claim is:

1. A focussing and centering arrangement for the electron beam of a cathode ray tube, comprising a cylindrical sleeve of magnetic material, a cup-shaped shroud of magnetic material fixed at one end of said sleeve and extending substantially parallel with said sleeve and beyond an end thereof to provide an annular cup-shaped opening, a magnetic coil positioned over said sleeve within said cup-shaped opening, a closure member of magnetic material extending from said shroud at said opening radially inwardly toward the axis of said sleeve to leave a predetermined circular opening, a plate of magnetic material mounted on said closure member in shiftable relation thereto and provided with a second circular opening smaller than said predetermined opening, whereby a magnetic gap is provided between said other end of said sleeve and the edges of said second circular opening, and providing a closed magnetic flux path about said coil except for said gap, said plate being dish-shaped at its central portion so that said central portion is coplanar with the radial portion of the closure member, and means for shifting said plate to adjust the eccentricity of said second circular opening with respect to said sleeve axis to control the centering position of said beam, said last named means comprising a pair of lugs secured to said closure member, corresponding links mounted on said plate each provided with circular openings extending over said lugs, one of said links being pivotally secured to said plate and the other being rigidly secured thereto, rotatable spindles mounted on said lugs and provided with eccentric bearings fitting respective circular openings in said links, and means for rotatably adjusting said spindles to shift the position of said plate.

2. An arrangement according to claim 1, further comprising a retaining member secured to the said closure member and bearing against the outer surface of the said plate.

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