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2,442,975

FOCUSING SYSTEM

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Fig. 1

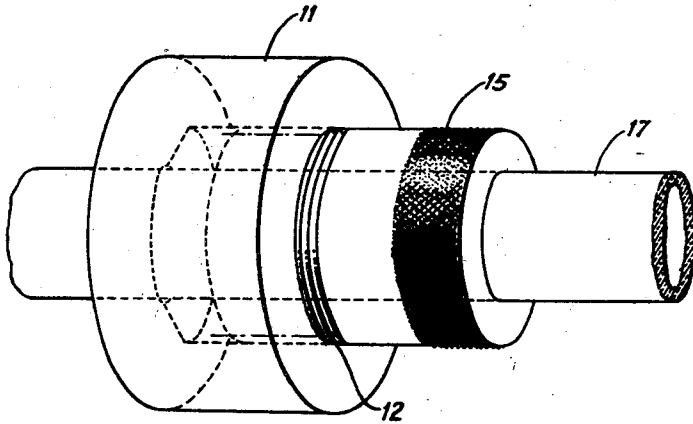
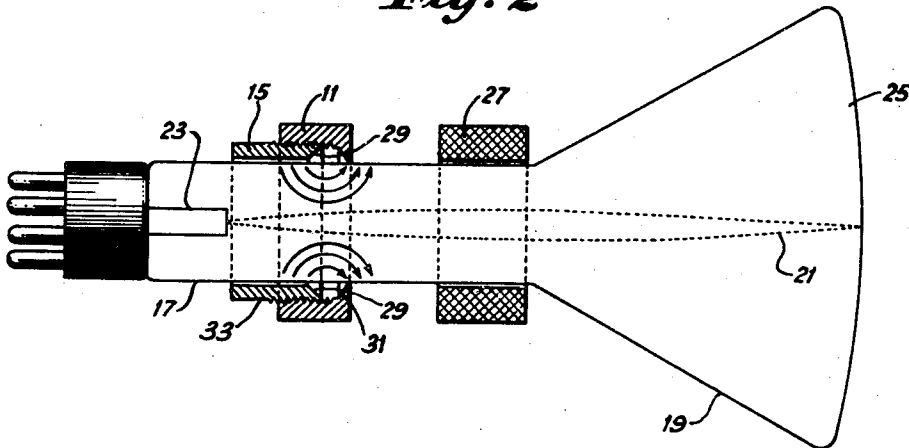


Fig. 2



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FOCUSING SYSTEM

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2 Claims. (Cl. 250-161)

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This invention is directed to electronic apparatus of the cathode ray tube type and involves the use of electro-magnetic means and suitable shielding arrangements therefor to provide a focusing field which would serve to concentrate a bundle of electrons developed within the scanning tube upon an impact target.

In the prior art it has been recognized, for many years, that an electron beam developed within a cathode ray tube and projected toward an impact target may be suitably concentrated and focused by means of a magnetic field, all as disclosed, for instance, in the patent granted to R. Rankin, U. S. Patent No. 838,273, granted December 11, 1906. Under such circumstances, an electro-magnetic field extending axially of the tube is developed and serves to bring the electrons within the scanning beam into a focus at some desired point.

The present invention provides an extremely simple method of accomplishing the focusing effect by means of a permanent magnet which is arranged to surround the neck of the cathode ray tube and to be positioned intermediate the electron gun and the electron beam deflecting system.

In order to adjust the axial field strength, provision is made for moving a cylinder of soft iron or steel inside the field of the permanent magnet and so shaping the cylinder as to direct the magnetic flux in the direction of propagation of the electrons.

It accordingly becomes an object of this invention to provide a simplified arrangement for magnetically focusing an electron beam within a cathode ray tube so as to bring the beam to focus at a desired distance from the electron gun from which it is developed.

A further object of the invention is to provide electron beam focusing arrangements which can readily be adjusted in operation and which do not require any current flow for their operation so as to eliminate any unnecessary drains on power supply systems.

Other objects of the invention will of course become apparent and at once suggest themselves to those skilled in the art to which the invention is directed when the following specification is considered in connection with the accompanying drawings and claims.

By the drawings,

Fig. 1 shows in a schematic form the arrangement of a permanent magnet and the soft core arranged to be movably inserted relative thereto; and

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Fig. 2 shows schematically a cathode ray tube with a focusing magnet and the adjustable iron core in co-operative relationship with both the electron gun and the deflecting coils.

Referring now to the drawings and first to Fig. 1 thereof, the permanent magnet preferably consists of a magnetized member such as "Alnico." This magnet has a central opening indicated by the circle 12 which is slightly larger than the neck of the cathode ray tube. Within this central opening in the magnet member 11 there is adapted to be positioned adjustably, a cylindrical member 15 which is preferably of soft iron or steel.

The cylindrical member 15 has a central opening, designated as 17, which corresponds in diameter substantially to that of the tube neck and base of the cathode ray tube with which the arrangement is to be associated. The movable cylinder is, of course, of magnetic material and is positioned in such a way as to be movably adjusted for varying the field strength of the magnet 11 relative to the tube.

Referring now to Fig. 2 of the drawings, it will be seen that the cathode ray tube with which the assembly shown by Fig. 1 is to be associated, comprises the neck portion 17 and the conical portion 19.

A cathode ray beam 21 is adapted to be developed within the tube and to emanate from the electron gun, conventionally represented at 23, to which suitable operating voltages are to be applied in known manner, and the electron beam, when projected through the tube, is arranged to impinge upon a target area 25 which is conventionally shown as a luminescent screen of the tube, although it is, of course, apparent that the target may be of any type, such as a planar electrode, positioned in desired location with the tube, such, for example, as the well known mosaic electrode in many tubes of the "Iconoscope" type.

In this arrangement, electro-magnetic beam deflecting coils 27 are frequently used for deflecting the developed beam 21 in two directions normal to each other in known manner. Accordingly, the coils are shown in purely schematic manner.

It is, of course, apparent that electrostatic deflecting means may be used, or that the deflecting means may be a combination of electro-magnetic and electrostatic means. The magnetic member 11, shown more particularly by Fig. 1, is then positioned to surround the neck portion 17 of the tube and located intermediate the electron gun 23 and the deflecting coils 27.

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Within the magnetic member 11 the soft steel or iron tubular member is arranged to be inserted.

It will be noted that the outer edge 29 of the movable cylinder 15 is beveled in the direction shown, in order that the magnetic flux developed from the magnet 11 shall go toward the axis of the magnet. At the same time, the effective area of the magnet 11 to develop a field, such as that indicated by the arrows, for instance, to focus the beam, is determined by the amount by which the movable cylindrical member 15 overlaps the magnet 11, in that the short circuiting effect of the movable member becomes more pronounced the more the movable member protrudes within the magnet. Under these conditions, it will be understood that the movable cylindrical element 15, in effect, short circuits the magnet when it is fully within the central opening thereof so that the magnetic field then becomes a minimum. The end of the magnet 11 may be charged, as indicated by the sloping edge 31, in order to produce the desired field pattern.

By arranging the combination of the magnet 11 and the movable cylinder 15 in such a manner that both elements are threaded, as shown, with respect to each other, and located in the manner indicated with respect to the cylindrical neck portion of the tube, it is apparent that an adjustment of these elements may be readily obtained by the threaded adjustment and that the focusing field once established may be maintained.

If now, the range of voltages applied to the tube to produce the electron beam is varied, it of course becomes evident that the point or plane at which the electron beam 21 will normally focus will change and, accordingly, by varying the position of the movable cylindrical member 15, adequate compensation may readily be made and the beam may be caused to focus at the desired plane.

While various arrangements of the magnet are possible, it may be considered, for illustration, that the magnet face nearest to the deflection yoke, as shown, is the south pole of the magnet, while the magnet face nearest the electron beam source may then be regarded as the north pole of the magnet. Accordingly, with this assumed form of arrangement, the field adjusting element when being positioned within the magnet will be moved in the direction from the north pole face toward the south pole face to short circuit the greatest proportion of the magnetic field.

Having described my invention, what I claim is:

1. In electronic apparatus, a cathode ray tube having a neck portion which includes an electron gun for developing a cathode ray beam and a target portion whereupon the developed cathode ray beam is adapted to impinge, a substantially cylindrical permanent magnet element surrounding the tube neck in the region substantially adjacent the electron gun and intermediate the electron gun and the target, a field strength

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varying element positioned to surround the tube neck in the region intermediate the electron gun and the said magnet, said element having a beveled edge portion for increasing the effectiveness and concentration of magnetic field from the magnet which is effective within the tube, and means for moving the said field strength adjusting element internally of the said magnet thereby to vary the magnetic field strength effective upon the electron beam so as to produce a converging electrical field to focus the cathode ray beam to a sharply defined spot upon the target area of the tube.

2. In electronic apparatus having a cathode ray tube with a neck portion which includes an electron gun for developing a cathode ray beam and a target portion whereupon the developed cathode ray beam is adapted to impinge, the combination comprising a substantially cylindrical permanent magnet element for surrounding the tube neck in the region substantially adjacent the electron gun and intermediate the electron gun and the target, said magnet being bevelled at the end thereof remote from the electron gun and having its larger internal diameter more closely adjacent the electron gun, a field strength varying element positioned to surround the tube neck in the region intermediate the electron gun and the said magnet, means for moving the said field strength adjusting element internally of the said magnet thereby to vary the magnetic field strength effective upon the electron beam so as to produce a converging electrical field to focus the cathode ray beam to a sharply defined spot upon the target area of the tube, said field strength adjusting element having the end thereof which is positioned directly within the magnetic field bevelled for increasing the effectiveness and concentration of magnetic field within the tube neck, the said bevelled edge being provided in a direction complementary to that of the bevelled edge of the magnet.

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