

UNITED STATES PATENT OFFICE

2,553,039

CATHODE-RAY TUBE COMBINED BEAM
CENTERING AND DEFLECTION DEVICERichard O. Gray, Broadview, Ill., assignor to
Zenith Radio Corporation, a corporation of
Illinois

Application April 26, 1949, Serial No. 89,698

4 Claims. (Cl. 250—156)

1

This invention relates to devices for use in conjunction with electron-discharge devices of the cathode-ray tube type for deflecting and also for centering the electron beam in such discharge devices.

Present-day cathode-ray tubes usually include a source of electrons situated in an elongated, or neck portion of the tube, and a screen situated in an enlarged, or bulbous, portion thereof at the opposite extremity from the electron source. The tube also includes suitable electrodes for forming the electrons from the source into an electron beam and for directing the beam to impinge on the screen. The cathode-ray tube has associated therewith an electro-static or electro-magnetic arrangement for deflecting the beam in a predetermined fashion to scan the screen so that images represented by a received television signal may be reproduced thereon. Furthermore, the tube also usually has associated therewith an electro-static, an electro-magnetic, or a permanent magnetic arrangement for focusing the electron beam so that the images on the screen may be reproduced clearly and distinctly.

It has been found necessary to provide some means for centering the electron beam in cathode-ray tubes in order that images may be reproduced correctly centered on the screen area despite slight misalignments of the elements associated with the tube. Various systems have been proposed for providing an adjustable centering control over the electron beam to center it properly on the screen. One method of accomplishing this consists in providing some means for adjusting the angular position of the magnetic focusing arrangement relative to the cathode-ray tube. The chief disadvantage of this, apart from its inherent awkwardness, is the fact that it is effective only when the beam is off-center by a very small amount. This is because the focusing arrangement is mounted about the neck portion of the cathode-ray tube at a considerable distance from the enlarged portion thereof, since the deflection elements are placed between this focusing arrangement and the enlarged portion. Therefore, when the angular position of the focusing arrangement is adjusted to attempt to compensate for appreciable misalignment of the electron beam, shadows appear in the reproduced image due to the beam being intercepted by the neck portion of the cathode-ray tube upon deflection by the deflection elements.

Another method of providing a centering adjustment for the electron beam of an electromagnetically deflected type of tube consists in passing

2

a controllable unidirectional current through the vertical and horizontal deflection windings. The amount of current passing through the respective deflection windings may be adjusted by any suitable control means, and these control means may be varied until the electron beam is accurately centered on the screen. Since the deflection coils are mounted about the neck portion of the cathode-ray tube in a position adjacent the enlarged portion of the tube, the previously discussed shadow effect is not as critical as it was in the first-mentioned centering arrangement method. Therefore, accurate centering may be provided for appreciable misalignment of the electron beam. However, this method entails the need for extra and relatively expensive components, and those components add materially to the manufacturing cost of the apparatus.

It is a general object of the present invention to provide an improved magnetic structure for deflecting and centering the electron beam in a cathode-ray tube by means of which the aforedescribed disadvantages are overcome.

It is a further object of this invention to provide a magnetic structure for deflecting the electron beam in a cathode-ray tube which structure includes permanent magnet means whereby the electron beam may be conveniently and accurately centered on the screen of the tube.

Another object of this invention is to provide such a structure in which the permanent magnet means is readily and conveniently adjustable and does not require complicated and awkward adjustment mechanism.

Yet another object of this invention is to provide such a structure in which the permanent magnet means is effective for centering the electron beam in a cathode-ray tube without deleteriously affecting the images reproduced on the screen of the tube, even though the beam may normally be misaligned to an appreciable extent.

The features of this invention which are believed to be new are set forth with particularity in the appended claims. The invention itself, however, together with further objects and advantages thereof may best be understood by reference to the following description when taken in conjunction with the accompanying drawing, in which:

Figure 1 shows a cathode-ray tube having one embodiment of the cathode-ray beam deflecting and centering device of the invention associated therewith, and

Figure 2 shows a view of one of the components of this device.

In Figure 1, a cathode-ray tube is designated 10, and includes an electron gun structure 11 for developing a beam of electrons therein. The tube 10 has a deflection yoke 12 associated therewith for deflecting the electron beam over a fluorescent screen 13. The deflection yoke 12 is shown in a particular form, but it is to be understood that any of the well known types of deflection yokes, when modified in accordance with the present invention, may be used. The illustrated deflection yoke 12 is shown partially in section and comprises a pair of horizontal-deflection coils 14 and a pair of vertical-deflection coils 15. The leads 16 and 17 may be connected to suitable deflection generators, not shown, to supply the deflection currents to the respective coils. The yoke 12 has a core 18 for intensifying the deflection fields of the deflection coils, and this core is shown as comprising an iron wire wound about the coils 14 and 15, although other types of core members may be used. The core winding 18 is enclosed by a cylindrical tube 19 having a smooth external surface, and which may be composed of fibre, Bakelite, or other appropriate material. In accordance with the invention, an air gap 20 is formed in the core winding, for reasons to become apparent. The annular member 21 is mounted about the smooth outer surface of the tube 19 in such a fashion that it may be conveniently rotated or moved longitudinally on this surface.

The member 21 is shown in detail in Figure 2 and comprises two or more permanent magnets 22, 23 fixed to an annular mount 24 composed of Bakelite, fibre, or other material. The permanent magnets 22, 23 are magnetized as shown, to produce a magnetic field substantially perpendicular to the longitudinal axis of the yoke 12. The direction of this field may be rotated by rotation of the annular member 21, and the magnitude of the field may be varied by movement of the member 21 along the longitudinal axis of the deflection yoke 12. When the member 21 is centered over the air gap 20, the field due to the permanent magnets 22 and 23 is a maximum, and when the member is centered over the core 18 this field is a minimum due to the fact that the major portion of the field flux produced by the magnets 22 and 23 is confined in the core 18.

When desired, instead of providing an air gap 20 in the core 18, the core may be constructed with varying thickness and hence with varying magnetic reluctance from one end to the other. This provides a gradual increase or decrease in the beam-centering field due to the magnets 22 and 23 as the member 21 is moved along the longitudinal axis of the deflection yoke 12. Furthermore, the annular member 21 may take the form of a simple, properly magnetized, annular ring, when for reasons of economy it is desired to reduce the cost of the permanent magnet device to an absolute minimum.

It can be seen that by manipulation of the annular member 21, control can be exercised on the electron beam in the cathode-ray tube 10 to center the beam. The member 20 is rotated until the field due to the magnets 22 and 23 is in the proper position to direct the electron beam to the center of the cathode-ray tube screen, and the member is then moved longitudinally until this field is of the proper magnitude to bring the electron beam back to the exact center point.

The illustrated embodiment of the combined cathode-ray beam deflecting and centering device comprises a usual deflection yoke having an

air gap formed therein, and a magnetic member rotatably and slidably mounted on the yoke. Centering of the electron beam may be effected with a high degree of accuracy with this simple device, and the need for complicated physical adjusting means to vary the angular position of the focusing arrangement of the cathode-ray tube, or for costly circuit components to supply adjustable unidirectional currents to the deflection yokes, to obtain this centering control, is thereby obviated. Furthermore, since the centering field is produced by means within the deflection yoke, which is adjacent the enlarged portion of the cathode-ray tube, the shadow effect that arises when it is attempted to center the beam by movement of the focussing coil, which is displaced from this enlarged portion, is greatly reduced. It has been found that this invention can be used for accurately centering the electron beam in a cathode-ray tube, without deleteriously affecting the images reproduced on the screen thereof, even when the beam is normally misaligned from the longitudinal axis of the tube to a substantial degree.

While a particular embodiment of the invention has been shown and described, modifications may be made, and it is intended in the appended claims to cover all such modifications as fall within the true spirit and scope of the invention.

I claim:

1. A magnetic structure for deflecting and centering an electron beam in a cathode-ray tube having an elongated neck portion comprising: at least one pair of beam-deflection windings having a portion circumscribing said neck for producing a magnetic field within said tube to deflect said beam; a tubular-shaped core member of magnetic material surrounding said portion of said beam-deflection windings in concentric relation with respect thereto and having a varying magnetic reluctance along its length; and an annular permanent magnet member mounted on said core member in concentric relation with respect thereto for longitudinal and rotational movement relative to said core for producing a transverse magnetic field in said tube to center said electron beam.

2. A magnetic structure for deflecting and centering an electron beam in a cathode-ray tube having an elongated neck portion comprising: at least one pair of beam-deflection windings having a portion circumscribing said neck for producing a magnetic field within said tube to deflect said beam; a tubular-shaped core member of magnetic material surrounding said portion of said beam-deflection windings in concentric relation with respect thereto and having an air gap extending therethrough; and an annular permanent magnet member mounted on said core member in concentric relation with respect thereto for longitudinal and rotational movement relative to said core for producing a transverse magnetic field through said air gap to center said electron beam.

3. A magnetic structure for deflecting and centering an electron beam in a cathode-ray tube having an elongated neck portion comprising: two pairs of beam-deflection windings forming a yoke circumscribing said neck portion for producing magnetic fields within said tube to deflect said beam; a tubular-shaped core member of magnetic material surrounding said yoke in concentric relation with respect thereto and having an annular peripheral air gap extending there-

through; and a ring member, including a pair of oppositely disposed permanent magnet segments, mounted on said core member in concentric relation with respect thereto for longitudinal and rotational movement relative to said core, said segments being magnetized to produce a transverse magnetic field through said air gap for centering said electron beam.

4. A magnetic structure for deflecting and centering an electron beam in a cathode-ray tube having an elongated neck portion comprising: two pairs of beam-deflection windings forming a yoke circumscribing said neck portion for producing magnetic fields within said tube for deflecting said beam; a pair of tubular-shaped core members of magnetic material mounted on said yoke in concentric relation with respect thereto and spaced apart to define an annular air gap with a longitudinal dimension small compared with the overall length of said cores; a cylindrical tube of insulating material mounted coaxially on said core members; and an annular permanent magnet member mounted on said cylindrical tube in concentric relation with respect thereto for longitudinal and rotational

movement relative to said cylindrical tube for producing a transverse magnetic field through said air gap to center said electron beam.

RICHARD O. GRAY.

REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

	Number	Name	Date
10	2,004,099	Bedford	June 11, 1935
	2,102,421	Kuehni	Dec. 14, 1937
	2,157,182	Maloff	May 9, 1939
15	2,177,688	Cawein	Oct. 31, 1939
	2,188,579	Schlesinger	Jan. 30, 1940
	2,200,039	Nicoll	May 7, 1940
	2,207,777	Blain	July 16, 1940
	2,211,613	Bowie	Aug. 13, 1940
20	2,456,474	Wainwright	Dec. 14, 1948
	2,499,065	Heppner	Feb. 28, 1950

FOREIGN PATENTS

	Number	Country	Date
25	464,637	Great Britain	Apr. 21, 1937