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2,861,209

CATHODE-RAY-TUBE BEAM-DEFLECTION
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General

This invention relates to cathode-ray-tube beam-deflection systems and, while it is of general application, it is particularly useful in such systems as employed in television receivers.

In cathode-ray-tube beam-deflection systems heretofore proposed, the electron beam generated within the neck of the cathode-ray tube is caused to scan the image-reproducing surface or display screen which closes one end of the enlarged portion of the tube envelope. In such systems, it is sometimes difficult with a given shape and size of envelope to achieve as large a maximum displacement of the spot formed by the electron beam on the display screen as may be desired, owing to the possibility of the electron beam hitting the envelope at the junction between its neck portion and enlarged portion. Such a difficulty may be particularly important in connection with large screen television receivers having a directly viewed cathode-ray tube. Also, for a given maximum spot displacement on the display screen, systems of the type previously proposed necessitate a greater tube length than is desirable for many applications.

It is an object of the invention, therefore, to provide a new and improved cathode-ray-tube beam-deflection system which avoids one or more of the foregoing limitations of such systems heretofore proposed.

It is another object of the invention to provide a new and improved cathode-ray-tube beam-deflection system for obtaining greater maximum deflection of the electron beam without danger of the electron beam striking the neck of the cathode-ray tube.

It is another object of the invention to provide such a system in a simple and inexpensive way by utilizing leakage fields previously thought to be a defect in scanning coils.

In accordance with the invention, a cathode-ray-tube beam-deflection system comprises a cathode-ray tube having an image-reproducing surface and means for producing an electron beam for scanning the surface. The system also includes deflection means disposed adjacent the neck of the cathode-ray tube for producing a primary deflection field for deflecting the electron beam to scan the surface and for producing an auxiliary deflection field for deflecting the electron beam in a direction opposite to that in which it is deflected by the primary deflection field, thereby to enable the electron beam to scan a larger area of the surface without striking the neck of the cathode-ray tube.

For a better understanding of the present invention, together with other and further objects thereof, reference is had to the following description taken in connection with the accompanying drawing, and its scope will be pointed out in the appended claims.

Referring to the drawings:

Fig. 1 is a circuit diagram, partly schematic, of a complete television receiver including a cathode-ray tube

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beam-deflection system constructed in accordance with the present invention, and

Fig. 2 is a cross-sectional view of a portion of the Fig. 1 system showing a deflection-yoke assembly in greater detail.

Description of cathode ray tube beam-deflection system

Referring for the moment to Fig. 1 of the drawing, a cathode-ray-tube beam-deflection system constructed in accordance with the present invention, while of general application, is particularly useful in connection with a television receiver 10. The receiver 10 is of conventional construction and includes an antenna system 11, 12 coupled to the input terminals thereof for supplying received television signals thereto. The cathode-ray-tube beam-deflection system comprises a cathode-ray tube 20 having an envelope including an elongated neck portion 21 joined to an enlarged portion 22 closed at one end by an image-reproducing surface 23 and having means disposed within the neck portion 21 of the envelope for producing an electron beam 25 for scanning the image-reproducing surface 23. The inner surface of the image-reproducing surface 23 is coated with a suitable phosphor material for producing the desired light pattern in response to the electron-scanning beam.

The means for producing an electron beam 25 in cathode-ray tube 20 includes a cathode 26, for producing a supply of electrons, coupled to a suitable potential-supply circuit of the receiver 10. The latter means also includes a control electrode 27 and an accelerating electrode 28 disposed adjacent the cathode 26 and coupled to suitable potential-supply circuits of the receiver 10, the accelerating electrode 28 serving to accelerate the electrons towards the image-reproducing surface 23 while the control electrode 27, in response to video information from the receiver 10, is effective to control the intensity of the electron beam and thereby the brightness of the spot reproduced on the surface 23. The means for producing an electron beam 25 may further utilize a focus winding 29 for focusing the electrons into the desired narrow beam 25, the winding being connected to suitable focusing-current circuits of the receiver 10. Additionally, the latter means may include a high-voltage terminal 30 which is connected to a conductive coating on the inner surface of the tube envelope and which is connected to a suitable high-voltage circuit in the receiver 10 to enable the conductive coating to become a second accelerating electrode.

The cathode-ray-tube beam-deflection system, constructed in accordance with the present invention, also comprises deflection means disposed adjacent the neck 21 of the cathode-ray tube 20 for producing a primary deflection field for deflecting the electron beam to scan the surface 23 and for producing an auxiliary deflection field for deflecting the electron beam in a direction opposite to that in which it is deflected by the primary deflection field, thereby to enable the electron beam to scan a larger area of the surface 23 without striking the neck 21 of the cathode-ray tube 20. The deflection means may comprise, for example, a deflection-yoke assembly 32 having a pair of vertical deflection coils or windings connected by way of wires 33 and 34 to terminals 35, 35 of a suitable vertical deflection-current circuit of the television receiver 10. Similarly, the deflection-yoke assembly 32 includes a pair of horizontal deflection-current windings coupled by way of wires 36 and 37 to terminals 38, 38 of a suitable horizontal deflection-current circuit of the receiver 10.

As indicated by the more detailed cross-sectional view of Fig 2, the deflection means preferably also includes a core 44 of ferromagnetic material so shaped as to provide the desired auxiliary or leakage deflection field rep-

resented, for example, by the field 45 for deflecting the electron beam in a direction opposite to that in which it is deflected by the primary deflection field represented, for example, by the field 42. The core 44 is in the general form of a shell or cylinder enclosing a portion of the deflection windings as indicated by "horizontal" deflection windings 40 and 41. The "vertical" deflection windings, not shown in the Fig. 2 cross-sectional view, are effectively disposed adjacent the neck 21 of cathode-ray tube 20 at right angles to the windings 40 and 41 in a conventional manner. Each of the windings may be of the conventional saddle type such that it fits the contour of the tube neck 21. It should be noted that the upper and lower windings 40 and 41 are called "horizontal" deflection windings because the effect of the magnetic field 42 produced thereby is such as to deflect the electron beam in a horizontal plane. For a similar reason the windings, not shown, disposed on either side of the tube neck 21 are called "vertical" deflection windings.

In order to enhance the leakage field 45, segments of ferromagnetic material represented, for example, by the upper and lower segments 46 and 47 may be located adjacent the tube neck 21 in the path of the leakage field. Similar segments may be disposed on either side of tube neck 21 in order to enhance the leakage field from the deflection windings, not shown, located on either side of the tube neck 21 at right angles to windings 40 and 41. These segments do not touch one another and must be so shaped as not to misdirect the leakage fields.

Depending on design of the cathode-ray tube, it may be desirable to shape the core 44 so that a leakage field is established by only one pair of the deflection windings, for example, the upper and lower windings 40 and 41.

Operation of cathode-ray-tube beam-deflection system

Considering the operation of the cathode-ray-tube beam-deflection system just described, the television receiver 10, including the antenna system 11, 12, is effective to supply video signals to the control electrode 27 of the cathode-ray tube 20 for controlling the intensity of the electron beam, thereby to control the brightness of the phosphors on the surface 23 which are excited by the beam. The television receiver 10 also supplies suitable potentials and currents to the cathode 26, accelerating electrode 28, focus winding 29, and high-voltage terminal 30 for enabling the desired production, acceleration, and shaping of the electron beam.

The receiver 10 also supplies suitable vertical and horizontal deflection currents to the vertical and horizontal deflection windings of the deflection-yoke assembly 32 for enabling the electron beam to scan the image-reproducing surface 23 in both vertical and horizontal directions, thereby to reproduce the desired image.

As indicated by, for example, the horizontal deflection windings 40 and 41 of Fig. 2, the deflection currents supplied thereto are effective to establish the primary deflection field 42 between the two windings. The iron core 44 serves as a low reluctance return path for the flux lines of the primary field 42. Because this core 44 does not cover all of the effective portion of the windings, some of the flux lines towards the rear of the windings are enabled to radiate outward from the windings. Some of these lines in establishing a return path cross the axis of the cathode-ray tube in a vertical direction, thereby establishing a leakage field 45 which may be used for deflection purposes. The ferromagnetic segments 46 and 47 serve to enhance the leakage field 45. Though not indicated in Fig. 2, vertical-deflection windings establish a similar primary deflection field at right angles to the horizontal primary deflection field 42, the vertical deflection windings also establishing a corresponding vertical leakage field at right angles to the horizontal leakage field 45.

In a conventional beam-deflection system, the core corresponding to the core 44 of Fig. 2 is designed to cover

all of the horizontal portion of the deflection windings 40 and 41 within region A to prevent leakage fields from occurring. Hence, the electron beam is deflected only by the deflection field occurring over region A of the beam path of Fig. 1 in a manner indicated by dashed line 25a. As will be noted, for maximum spot displacement on the image-reproducing surface 23, the electron-beam path indicated by dashed line 25a passes undesirably close to the neck 21 of the cathode-ray tube.

In accordance with the present invention, however, the core 44 shown in Fig. 2 is so shaped as to provide a leakage field over the portion of the beam path lying in region B of Fig. 1. As indicated in Fig. 2, the direction of the leakage field 45 over the region B is opposite to the direction of the primary deflection field 42 over region A. Thus, as indicated by the solid line 25b of Fig. 1, the electron beam will be deflected by the leakage field in a direction opposite to that in which it is deflected by the primary deflection field, the auxiliary deflection due to the leakage field being through a small angle α which is substantially proportional to the angle β through which the electron beam is deflected by the primary deflection field. When the electron beam comes under the influence of the primary deflection field, it will, therefore, be displaced from the axis of the cathode-ray tube in a direction opposite to that in which it is displaced when it reaches the screen 23 and, with this arrangement, it is easier to obtain a desired maximum displacement of this spot formed by the electron beam on the surface 23 without risk of the electron beam hitting the envelope at the junction between its neck portion 21 and enlarged portion 22 than would be the case with the conventional arrangement in which the electron beam is still on the axis of the cathode-ray tube when it comes under the influence of the primary deflection field. It will, of course, be appreciated that the angle through which the electron beam is deflected by the leakage field must always be sufficiently small to ensure that the electron beam does not hit the neck portion 21 of the envelope before coming under the influence of the primary deflection windings 32.

As mentioned, it has heretofore been the practice to eliminate the leakage fields associated with deflection windings as completely as possible because they were thought to be a defect. It will be noted, however, that the present invention by retaining them and giving them proper magnitude makes use of these leakage fields to achieve a desirable result, namely, greater maximum deflection of the electron beam for a given set of cathode-ray-tube dimensions or vice versa. In so doing, the desired result is accomplished without adding to the cost of the apparatus, additional cost factor being the probable reason why other expedients for the same purpose (British Patent 488,188) are commercially unattractive.

It will also be apparent that the advantages of the present invention need not be utilized in both the vertical and horizontal deflection directions because in some applications increased maximum spot displacement on the surface 23 is necessary in only one of the directions of beam deflection. Also, by enabling a greater maximum spot displacement of the electron beam without danger of the beam striking the neck portion 21 of the cathode-ray tube, the present invention enables a given size of image to be reproduced by a cathode-ray tube of shorter length which results from shortening of the length D of the enlarged portion of the tube envelope.

From the foregoing description of the invention, it will be apparent that a cathode-ray-tube beam-deflection system constructed in accordance with the present invention represents an improved system for obtaining greater maximum deflection of the electron beam.

While there has been described what is at present considered to be the preferred embodiment of this invention, it will be obvious to those skilled in the art that various changes and modifications may be made therein without

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departing from the invention, and it is, therefore, aimed to cover all such changes and modifications as fall within the true spirit and scope of the invention.

What is claimed is:

1. A cathode-ray-tube beam-deflection system comprising: a cathode-ray tube having an image-reproducing surface and means for producing an electron beam for scanning said surface; and deflection means disposed adjacent the neck of the cathode-ray tube for producing a primary deflection field for deflecting the electron beam to scan said surface and for producing an auxiliary deflection field comprising leakage flux from the primary deflection field for deflecting the electron beam in a direction opposite to that in which it is deflected by the primary deflection field, thereby to enable the electron beam to scan a larger area of said surface without striking the neck of the cathode-ray tube.

2. A cathode-ray-tube beam-deflection system comprising: a cathode-ray tube having an image-reproducing surface and means for producing an electron beam for scanning said surface; and a deflection coil having a magnetic core disposed adjacent the neck of the cathode-ray tube for producing a primary deflection field for deflecting the electron beam to scan said surface, the core including means for providing a leakage field comprising leakage flux from the primary deflection field for deflecting the electron beam in a direction opposite to that in which it is

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deflected by the primary deflection field, thereby to enable the electron beam to scan a larger area of said surface without striking the neck of the cathode-ray tube.

3. A cathode-ray-tube beam-deflection system comprising: a cathode-ray tube having an image-reproducing surface and means for producing an electron beam for scanning said surface; and a deflection coil having a magnetic core disposed adjacent the neck of the cathode-ray tube for producing a primary deflection field for deflecting the electron beam to scan said surface, the core including means for providing between the beam-producing means and the primary field a leakage field comprising leakage flux from the primary deflection field for deflecting the electron beam in a direction opposite to that in which it is deflected by the primary deflection field, thereby to enable the electron beam to scan a larger area of said surface without striking the neck of the cathode-ray tube.

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