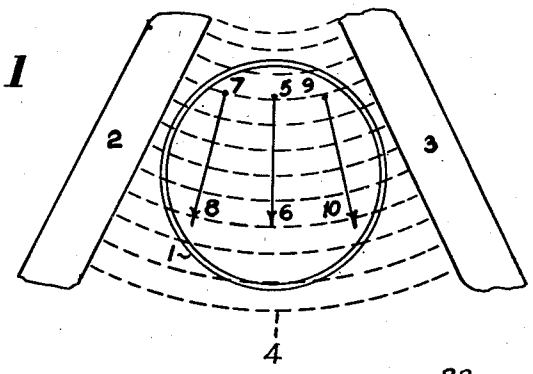
Oct. 14, 1941. G. R. TINGLEY 2,259,233

CATHODE RAY DEFLECTING APPARATUS

Filed May 18, 1939

Fig. 1



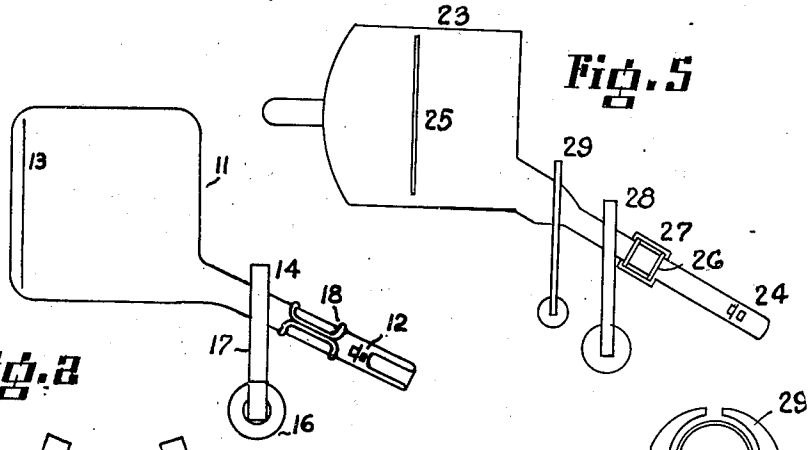


Fig. 5

Fig. 2

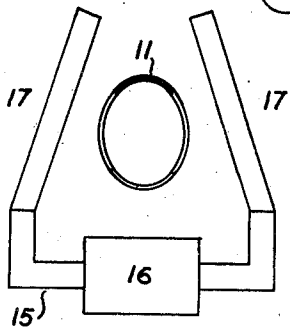


Fig. 3

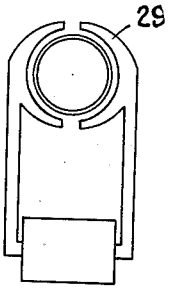


Fig. 7

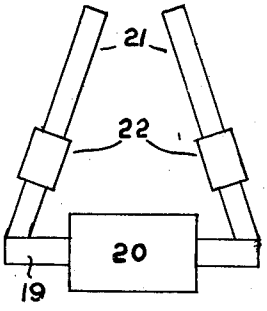


Fig. 4

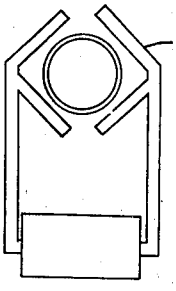


Fig. 6

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CATHODE RAY DEFLECTING APPARATUS

George Richard Tingley, London, England, assignor, by mesne assignments, to Cinema-Television Limited, London, England, a British corporation

Application May 18, 1939, Serial No. 274,353
In Great Britain August 8, 1938

1 Claim. (Cl. 250—157)

This invention relates to deflecting means for use with cathode ray tubes and similar apparatus of the type in which an electron beam is required to be deflected over a surface which is inclined to the undeflected direction of the electron beam and the present invention seeks to provide an improved form of electromagnetic deflecting means for apparatus of this type.

When it is desired to cause an electron beam to scan a rectangular area on a surface which is inclined to the direction of the undeflected electron beam it is necessary to compensate for what is known as the "keystone" effect which is produced if the electron beam is caused to describe a rectangular scan at its point of deflection.

According to the present invention there is provided cathode ray tube apparatus comprising in spatial succession an electron gun, a first deflecting system for deflecting the electron beam in a first coordinate direction, a second deflecting system for deflecting the electron beam in a second coordinate direction and a screen to be scanned by the electron beam, said screen being inclined to the axis of the gun in said second coordinate direction and in which the direction of deflection of the electron beam by said second deflecting system varies in accordance with the position of the beam in said first coordinate direction, the arrangement being such that keystone distortion is avoided or reduced.

It will be apparent that the deflection of the beam by the said second deflecting system is variable in direction and that when reference is made, as in the preceding paragraph, to a second coordinate direction of deflection, it is to be understood that this refers to the mean position of the beam in the said first coordinate direction.

According to a feature of the present invention said second deflecting system comprises an electromagnetic yoke such that the lines of force traversed by the beam in the plane of the yoke lie substantially along concentric circles whose centre lies in the plane of the yoke and on that side of the undeflected position of the electron beam where the angle between said undeflected beam and said screen is obtuse.

According to a further feature of the present invention said second deflecting system comprises means for producing an electrostatic field such that the equipotential lines of the field lie substantially along concentric circles whose centre lies in the plane of the yoke and on that side of the undeflected position of the electron beam where the angle between said undeflected beam is obtuse.

Preferably the plane of the field corresponding to said second deflecting system is approximately parallel to the screen, the exact position being determined by experiment so as to obtain the best results.

According to a further feature of the present invention in addition to the apparatus as above described there is provided deflecting means supplementary to said second deflecting means and producing a constant deflecting field for the purpose of producing a shift of the scanned area on the screen. It has been found that by suitably disposing and arranging this supplementary deflecting means the amplitude of deflection of the electron beam produced by said second deflecting means can be increased.

By the use of the present invention it is possible to produce a rectangular scan on a surface inclined at a considerable angle to the direction of the undeflected electron beam and it is moreover found unnecessary to vary the amplitude of deflection in the direction perpendicular to that produced by the reflecting means according to the invention. Normally a deflecting yoke according to the invention will be placed parallel with the scanned member but in certain cases where the degree of keystone correction is found to be insufficient it may be found advantageous to incline the yoke so that the ends of the extensions are nearer to the plane of the scanned member than the yoke proper.

In order that the nature of the operation of the present invention may be more particularly described reference is now made to the accompanying diagrammatic drawing, of which:

Figure 1 is a diagram illustrating the principle of the present invention;

Figure 2 is a side view; and

Figure 3 is a partial end elevation of deflecting means according to the invention and a cathode ray tube with which the deflecting means is associated;

Figure 4 shows another form of deflecting means according to the invention;

Figure 5 illustrates an embodiment of cathode ray tube apparatus according to a feature of the present invention; and

Figures 6 and 7 illustrate alternative embodiments of part of the apparatus shown in Figure 5.

In Figure 1, 1 represents the neck of a cathode ray tube or like electron discharge device disposed in the field produced between pole-pieces 2 and 3. This field is of such a nature that the lines of force represented by the dotted lines 4 are concentric circles. Consider the deflection of an

electron beam initially at the point 5 which is on the axis of symmetry of the deflecting field produced by varying the strength of the field, the electron beam will be deflected perpendicular to the lines of force in the direction indicated by the arrow 6. If the deflection of an electron beam initially at the point 7 be considered it will be seen that to travel normally to the lines of force of the deflecting field the beam must move in the direction of the arrow 8. Similarly an electron beam initially at the point 9 will be deflected in the direction of the arrow 10. Thus an electron beam which at the top of the scan is deflected horizontally from 7 to 9 will at the bottom of the scan be deflected from 8 to 10 so that when the deflecting yoke 2, 3 is placed substantially parallel with the scanned member and with that end at which the limbs are nearer together towards that part of the scanned member which is further from the electron gun from which the beam is produced, correction for the keystone distortion, which is introduced by the inclined position of the scanned member, is obtained if the radius of curvature of the lines 4 is appropriately small.

In Figure 2 is shown a cathode ray tube 11 in which an electron beam produced by a gun 12 is deflected in a vertical direction over a screen 13 by means of a yoke 14 in accordance with the present invention. As is shown in Figure 3 the yoke 14 comprises a U-shaped portion 15 upon which are wound the deflecting coils 16 and which is provided with extensions 17 which are inclined towards each other and which correspond to the members 2, 3 in Figure 1.

By appropriately adjusting the inclination of the members 17 a substantially rectangular scan may be produced on the screen 13. The other component of the scan may be produced by deflecting coils 18 placed on the neck of the tube as shown.

The embodiment shown in Figure 4 comprises a straight portion 19 on which are placed deflecting coils 20 and which is provided with extensions 21 inclined towards each other in accordance with the invention. Small coils 22 are placed on the extensions 21 for the purpose of compensating for any unbalanced D. C. component produced by the coils 20.

Alternatively, in accordance with a feature of the present invention, the effect of the unbalanced D. C. component may be overcome by the provision of additional means producing a constant deflecting field. Such additional deflecting means is illustrated in Figures 5, 6 and 7.

Figure 5 shows a cathode ray tube 1 in which an electron beam produced by a gun 2 is deflected over a fluorescent screen 3 by appropriate magnetic fields produced by deflecting coils 4, which may be surrounded by an iron member 5, and by a yoke 6 which may be of the type described with reference to Figures 1 to 4. By providing the yoke 7 with arms partially embracing the neck of the cathode ray tube as shown in Figure 6 or 7, an increased degree of scan amplitude correction may be obtained. The exact form and position of the yoke 7 are best determined by experiment for the particular design of cathode ray tube employed.

The form shown in Figure 7 has the advantage that it produces less focus distortion in cases where magnetic focussing is employed. If the gun voltage of the cathode ray tube is increased the deflection sensitivity of the tube is reduced. To overcome this by the use of the present invention the current through the energising coil on the additional deflecting means is increased. By suitable design of the apparatus it may be arranged that the increases of deflection sensitivity in each direction are equal and that the image shift produced by the additional deflecting means is such as to restore the scanned area to the position occupied before the increase in gun potential. Compensation for reduced gun voltage may be similarly arranged.

In certain cases it may be found advantageous to incline the yoke 14 so that its top end is nearer to the screen 13 than its lower end so that more lines of force pass through the region of deflection of the electron beam. The extensions 17 may be provided with comparatively short additional extensions hinged to their top ends in order to produce an additional concentration of the magnetic field in that region and thus decrease the radius of curvature of the lines of force. The yoke is preferably constructed of iron laminae of suitable thickness interleaved at the joints. The deflecting coils may comprise the windings of a feed-back transformer as described in British patent specification No. 463,972.

I claim:

In a cathode ray tube apparatus, an electron gun for producing an electron beam, a surface scanned by said beam, two deflecting systems for deflecting the electron beam in coordinate directions, and means comprised in one of said systems for producing in the path of the beam electric lines of force forming arcs of substantially concentric circles intersecting the beam in substantially the same plane, said means comprising a U-shaped yoke having a coil on its central portion and provided with extensions at the ends of its limbs which extensions are inclined towards each other and are of substantially greater length than the central portion of the U.

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