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CATHODE RAY TUBE AUXILIARY DEFLECTION SYSTEMS

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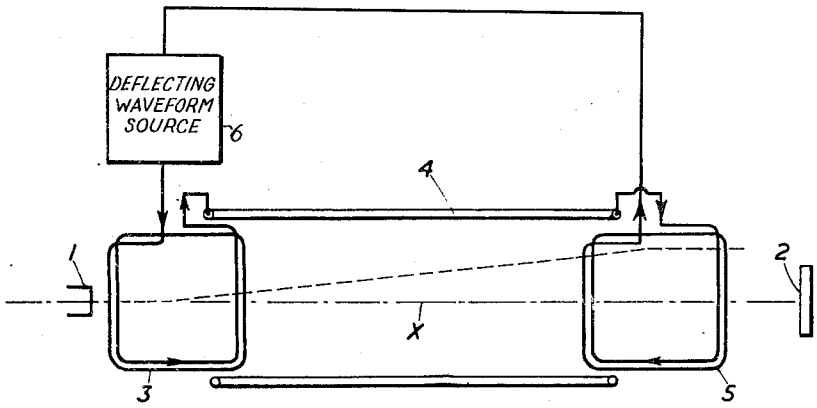

FIG. 1

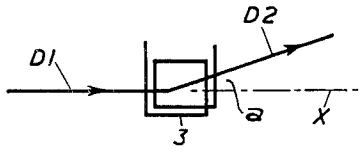

FIG 2a

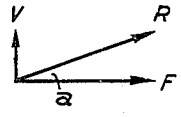

FIG 2b

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CATHODE RAY TUBE AUXILIARY DEFLECTION SYSTEMS

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6 Claims. (Cl. 315—27)

This invention relates to deflection systems for cathode ray tubes and more specifically to deflection systems for cathode ray tubes of the kind employing, when in operation, an applied substantially axial magnetic focusing field. The primary, though not the exclusive application of the invention, is to deflection systems for television camera tubes such as Vidicon tubes and Image Orthicon tubes.

It may be shown that in a cathode ray tube having an applied axial magnetic focusing field, the effect of the applied field on the electrons in the deflected electron beam is to curve their paths in such manner as to make them appear, when viewed in the direction of the axis, approximately cycloidal. Accordingly the transverse component (i.e. transverse with respect to the axis) of the velocity of the electrons must be greater than would be the case were there no axial magnetic field and the electrons must travel more obliquely to reach a given point on the target scanned by the beam than would be the case if the electron paths to the target were rectilinear. This obliquity of electron travel is a cause of geometrical distortion of the scanned area on the target, such distortion being naturally at maximum at the edges of said scanned area where the deflection is at a maximum. Such distortion manifests itself as a picture edge distortion in the case of a camera tube. Edge distortion will also occur due to the fact that it is impossible, with a deflecting coil system of practical dimensions, to obtain substantially completely uniform field over the whole effective cross-sectional area of the tube, and the magnitude of the distortion from this cause will be increased by obliquity of electron travel.

According to this invention a deflection system for a cathode ray tube of the kind referred to comprises auxiliary deflection means situated between the source of the electron beam and the normally provided deflection means, said auxiliary deflection means being adapted and arranged to produce a force on an electron which is in a direction substantially at right angles to that produced thereon by the said normally provided deflection means and such as to combine therewith and with the force produced by the axial focusing field to cause the electron paths resulting from the combined forces to be substantially straight.

The principal application of the invention is to television camera tubes and other high quality cathode ray tubes of the Image Orthicon and similar types. In such tubes it is a requirement that the electrons of the deflected electron beam should strike the target perpendicularly thereto. When applied to such tubes a deflection system in accordance with this invention also includes a second auxiliary deflection means situated between the normally provided deflection means and the scanned target of the tube and adapted and arranged to produce a deflection component which is in a direction substantially opposite to that of the first mentioned auxiliary deflection means and such as to cause the deflected electron paths adjacent the target to be substantially perpendicular thereto.

According to a feature of this invention a deflection system for a cathode ray tube of the kind referred to comprises a main electro-magnetic deflection winding, an auxiliary electro-magnetic deflection winding situated between the electron beam source and the main winding and adapted and arranged to produce a deflection component which is in a direction substantially at right angles to that of said main winding and such as to combine therewith and with the axial focusing field to cause the deflected electron paths resulting to be substantially straight.

Preferably a second auxiliary electro-magnetic winding is provided between the main winding and the target to be scanned, said second auxiliary winding being adapted and arranged to produce a deflection component which is in a direction substantially opposite to that of the first mentioned auxiliary winding and such as to cause the deflected electron paths adjacent the target to be substantially perpendicular thereto.

Though it is not essential, it is preferred to connect the main winding and the auxiliary winding or windings in series.

An auxiliary winding provided in accordance with this invention between the electron gun and the normally provided deflection winding is in a position very similar to that of a so-called alignment coil as normally provided on high grade cathode ray tubes such as television camera tubes. As will readily be appreciated, such an auxiliary winding may therefore be designed and arranged, in carrying out this invention, so as to serve also as an alignment coil in accordance with known principles.

The invention is illustrated in the accompanying drawings in which FIGURE 1 is a diagrammatic representation of one form of deflection system in accordance with the invention, and FIGURES 2*a* and 2*b* are explanatory diagrams.

Referring to FIGURE 1 this shows a deflection system in accordance with the invention for a Vidicon, Image Orthicon or other camera tube, the axis of which is represented by the chain line X and which, for simplicity in drawing, is represented only by its electron gun **1** and its target **2**. Outside the envelope (not shown) of the tube is a deflection coil system comprising three windings diagrammatically represented at **3**, **4** and **5**. The winding **4** is in structure and arrangement like an ordinary deflection winding as normally provided for a tube of the kind in question. The winding **3** is in an auxiliary winding provided by this invention between the winding **4** and the gun **1** and arranged to produce a force on an electron at right angles to that produced thereon by the normally provided winding **4**. A third winding **5**, which is also an auxiliary winding provided in accordance with this invention, acts on the beam between the winding **4** and the target **2**. The winding **5** also produces a force on an electron at right angles to that produced by the winding **4**, but opposite to that produced by the winding **3**, and such as to halt any further movement of the electron away from the axis. In the example illustrated in the drawing, the three windings are fed in series from a deflecting waveform source **6**, the sense of the windings **3** and **5** being, as indicated, opposite to one another. In FIGURE 1*a* typical resultant electron path is indicated by the broken line.

As already explained, due to the presence of the axial focusing field—so as not to complicate the drawing the coil for producing this axial field is not shown but the said coil is provided in accordance with well-known practice—the effect of the deflecting coil **4**, if it were the only deflecting coil, would be to cause the electron paths when viewed in the direction of the axis, to be approximately cycloidal with consequent edge distortion. However, this is prevented by the preliminary auxiliary deflecting winding **3**, the deflection of which is of such sense and magnitude as to make the electron paths straight. This action is illustrated vectorially in FIG-

URES 2*a* and 2*b* which are drawn for a particular instant of time, FIGURE 2*a* illustrating the motion of an electron passing transverse to the axis of winding 3 and FIGURE 2*b* being a vector diagram. At the instant applying to FIGURE 2*a* the direction of the deflecting field due to the winding 3 is outwards and an electron travelling axially in the direction D1 is deflected upwards into a direction D2 at an angle *a* to the axis X. At the same time winding 4, carrying the same current as winding 3, produces a flux directed vertically as represented by vector V in FIGURE 2*b*. This vector combining with the vector F which represents the axial focusing field in FIGURE 2*b* produces a resultant R and the numbers of turns of windings 3 and 4 are so chosen that the angles *a* in FIGURES 2*a* and 2*b* are equal. Accordingly the electron travelling in direction D2 will not be deflected from its straight line path until it is influenced by a final auxiliary winding 5 which produces a field giving a force on the electron which is directed vertically downwards (in FIGURE 1) and is just sufficient to alter the direction of motion into one parallel to the axis as the electron emerges from the winding 4. Thus the electron paths finally reach the target at right angles thereto.

It will be appreciated that in order to achieve the objects of the invention to the fullest extent, the ampere-turns of the three windings 3, 4 and 5 must be in precisely chosen relationship. It may not always be convenient or practical to obtain this relationship by coil design alone, i.e. solely by selection of the number of turns and size of turns in the windings 3, 4 and 5, and in practice, it may be convenient or desirable to provide for adjustment by trial and error after coil manufacture. This may be easily done by any convenient known means, e.g. shunt variable impedances, for individually adjusting the currents in two or all three of the deflection windings.

For simplicity of drawing and explanation the change of direction of any electron is shown in FIGURE 2*a* as being sharp and instantaneous and this has been implicitly assumed in the relevant description. In practice, of course, because of the fact that the winding 3 will occupy an appreciable axial length, the change of electron direction from D1 to D2 (FIGURE 2*a*) through the angle *a* will be gradual and accordingly the winding 4 should be such that the field produced thereby builds up gradually over a distance which is substantially the same as that occupied along the axis by the winding 3 so that, as the direction of motion of an electron is changed it will, at every point, be travelling in the direction of the resultant vector (R in FIGURE 2*b*) of the vectors V and F (FIGURE 2*b*). The value of the field produced by the winding 4 should be approximately proportional to the integral of the field produced by winding 3 along the path of the electron. Similar considerations apply to the change of electron direction occurring when an electron is influenced by winding 5 the field of which should be approximately proportional to the differential of the field produced by winding 4.

I claim:

1. A deflection system for a cathode ray tube of the kind having an electron beam source and a target and employing an applied substantially axial magnetic focusing field, said system comprising the normally provided main deflection means including a deflective waveform source, auxiliary deflection means situated between the source of the electron beam and said normally provided main deflection means, said auxiliary deflection means being coupled to said waveform source to produce a force on an electron which is in a direction substantially at right angles to that produced thereon by the said normally provided deflection means and such as to combine therewith and with the force produced by the axial focusing field to cause the electron paths resulting from the combined forces to be substantially perpendicular to said target.

2. A deflection system for a television camera tube of the image orthicon or similar type having an electron beam source and a target, said system comprising, in addition to the normally provided main deflection means, first auxiliary deflection means including a deflecting waveform source situated between the source of the electron beam and the normally provided deflection means, said auxiliary deflection means being coupled to said waveform source to produce a force on an electron which is in a direction substantially at right angles to that produced thereon by the said normally provided deflection means and such as to combine therewith and with the force produced by the axial focusing field to cause the electron paths resulting from the combined forces to be substantially straight, and second auxiliary deflection means situated between the normally provided deflection means and the scanned target of the tube and adapted and arranged to produce a deflection component which is in a direction substantially opposite to that of the first mentioned auxiliary deflection means and such as to cause the deflected electron paths adjacent the target to be substantially perpendicular thereto.

3. A deflection system for a cathode ray tube of the kind having an electron beam source and a target and employing an applied substantially axial magnetic focusing field, said system comprising a main electro-magnetic deflection winding having a deflecting wave form source coupled thereto, an auxiliary electro-magnetic deflection winding situated between the electron beam source and the main winding and coupled to said waveform source to produce a deflection component which is in a direction substantially at right angles to that of said main winding and such as to combine therewith and with the axial focusing field to cause the deflected electron paths resulting to be substantially straight.

4. A deflection system as claimed in claim 3 wherein a second auxiliary electro-magnetic winding is provided between the main winding and the target, said second auxiliary winding being coupled to said waveform source to produce a deflection component which is in a direction substantially opposite to that of the first mentioned auxiliary winding and such as to cause the deflected electron paths adjacent the target to be substantially perpendicular thereto.

5. A deflection system as claimed in claim 3 wherein the main and auxiliary windings are in series.

6. A deflection system as claimed in claim 3 wherein said auxiliary winding between the electron gun and the normally provided deflection winding also serves as an alignment coil.

References Cited by the Examiner

UNITED STATES PATENTS

2,216,266	10/40	Farnsworth	313—77
2,707,248	4/55	Goodrich	313—77

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