

June 28, 1960

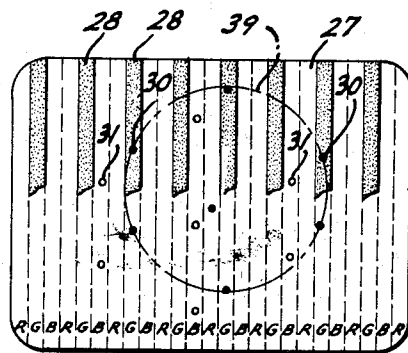
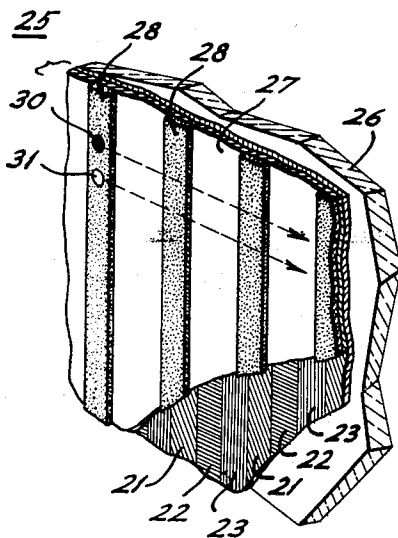
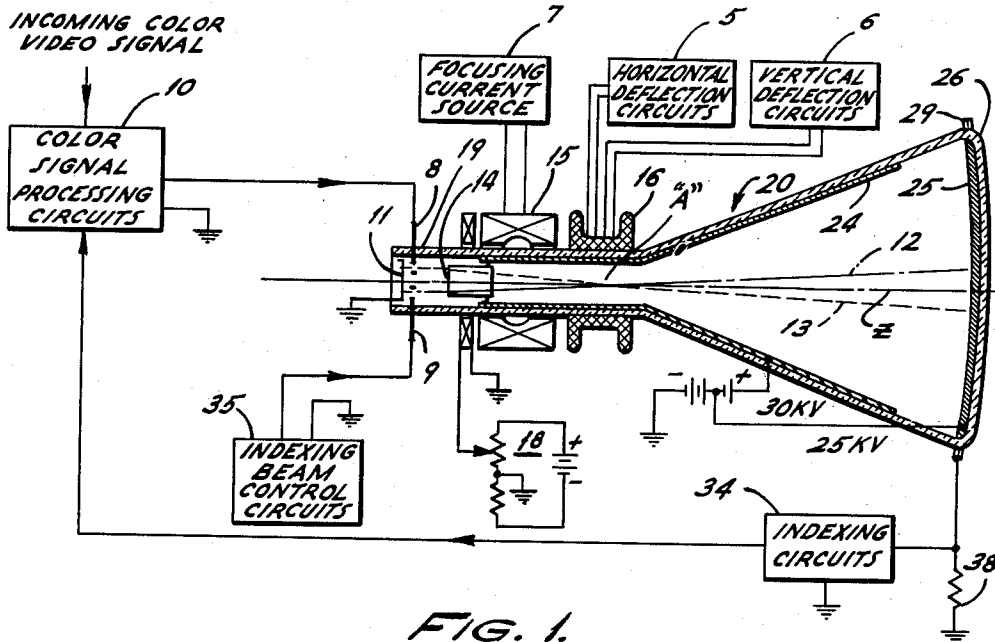
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2,943,219

BEAM POSITIONING APPARATUS FOR CATHODE RAY TUBES

Filed Sept. 19, 1955

3 Sheets-Sheet 1



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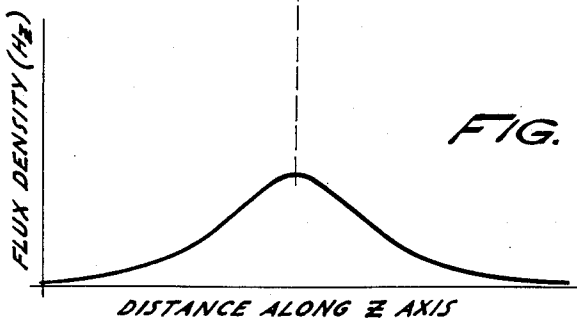
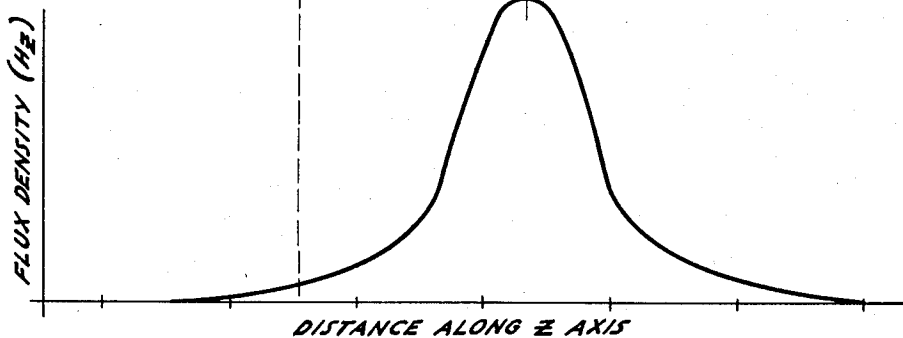
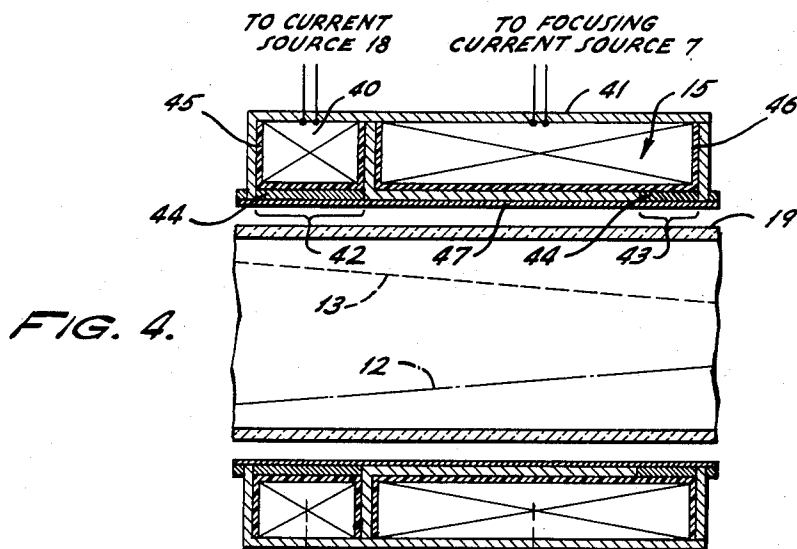
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BEAM POSITIONING APPARATUS FOR CATHODE RAY TUBES

Filed Sept. 19, 1955

3 Sheets-Sheet 2



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BEAM POSITIONING APPARATUS FOR CATHODE RAY TUBES

Filed Sept. 19, 1955

3 Sheets-Sheet 3

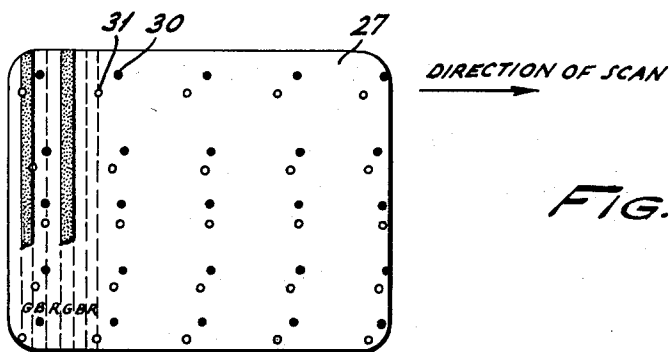


FIG. 6.

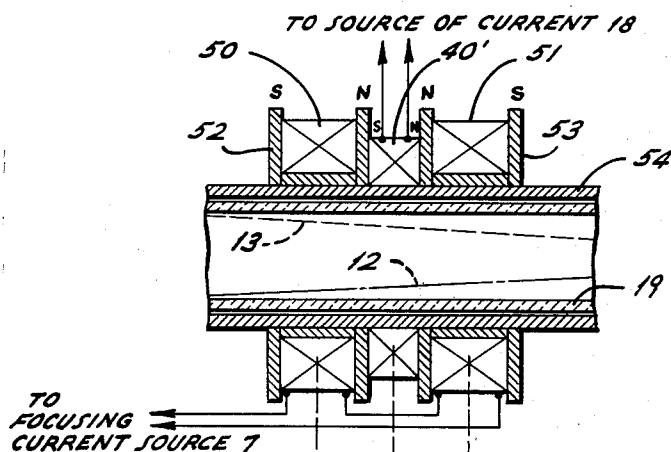


FIG. 7.

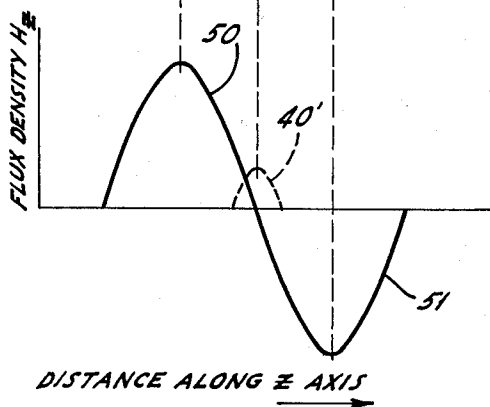


FIG. 8.

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2,943,219

BEAM POSITIONING APPARATUS FOR CATHODE RAY TUBES

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Filed Sept. 19, 1955, Ser. No. 535,092

10 Claims. (Cl. 313—79)

This invention relates to improvements in cathode-ray tube systems and in particular, to apparatus for preventing certain types of errors which exist in cathode-ray tubes in which a plurality of electron beams are produced.

While not limited thereto, my invention is particularly applicable to certain forms of cathode-ray tubes suitable for use as the image-reproducing devices in color television receivers, and it is with reference to this application that the invention will be described. Certain cathode-ray tubes include means for generating two or more electron beams which are shaped and accelerated toward a beam-intercepting structure by appropriate electromagnetic focussing and anode structures.

The beam-intercepting structure is constituted of a screen having a plurality of groups of parallel strips of phosphor materials, each of which emits light of a particular primary color when bombarded by an electron beam. On the rear surface of these strips a coating of an electron-permeable and light-reflecting material is deposited. On the other side of the latter material a plurality of indexing elements, which may be in the form of strips, for example, are disposed in a predetermined geometrical relation to corresponding ones of the phosphor strips. In one illustrative form these indexing elements may consist of a material such as MgO having a secondary emission characteristic which differs from that of the rest of the beam-intercepting structure. Deflection means are provided which deflect the two beams in unison in a pattern of generally parallel paths which are substantially transverse to the elements of the beam intercepting structure. The two beams may be very close to one another and aligned so that one is positioned just above the other.

The phosphor strips of the beam-intercepting structure are impinged upon by one of the deflected electron beams (hereinafter known as the "video" beam) to produce a luminous image of the scene being televised.

The video beam is modulated in intensity by video signals corresponding to the color components of the scene televised. The other electron beam (hereinafter called the "indexing" beam) is caused to impinge on the indexing elements thus producing indexing signals as a result of the emission of secondary electrons from the indexing elements. These secondary electrons are collected by a relatively positive collector electrode within the tube and the variations in the potential of the beam intercepting structure caused thereby are used to coordinate the position on the phosphor screen of the video beam with the modulation thereof, so that when the video beam strikes a red color-emissive strip, for example, its intensity will be modulated by a video signal whose amplitude corresponds to the red color content of the element of the televised scene which is being scanned. To insure precise coordination between the impingement of the video beam on the respective colored light-emissive strips and the modulation of the video beam in accordance with intelligence representatives of these colors, it is often desirable to maintain the orientation of the video beam constant

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with respect to that of the indexing beam at all points in their traversal of the beam-intercepting structure. Toward this end it may be desirable, for example, for both the video beam and the indexing beam to traverse simultaneously the same phosphor strip at all points on the scanned raster. When the orientation of the video beam is maintained constant with respect to that of the indexing beam at all points on the beam-intercepting structure, the beams are said to "track." However, it may be difficult, in practice, to attain perfect coordination between the position of the video beam and the modulation thereof because of a number of distortions which arise in such cathode-ray tubes as a result of the magnetic fields produced therein, or as a result of other characteristics of such tubes as will be explained in more detail hereinafter.

One type of distortion present in tubes of the type described arises because of the effect of the axial electromagnetic field of the focussing magnet on the electrons of the beams. It is well known that the electrons of the beam in a single beam cathode-ray tube are rotated by an axial electromagnetic field. However, the effects of rotation in a single beam cathode-ray tube used in conventional black-and-white television receivers are minor as compared with the effects of rotation of two beams with respect to one another in a plural-beam cathode-ray tube of the type described when used for color television reception. This may be more readily understood if one realizes that in cathode-ray tubes of the type described, the position of the video beam must be coordinated with the intensity modulation thereof, otherwise the color fidelity of the reproduced image will be seriously degraded. If the orientation of the respective areas of impingement of the beams with respect to one another is not maintained constant over the entire beam-intercepting structure, the signals generated by the impingement of the indexing beam on the indexing elements will not properly indicate the position of the video beam, and hence coordination of the position of the video beam with the modulation thereof will be upset. For example, assume that the desired tracking condition exists when both beams impinge on the same phosphor strip. The effect of the focussing field may be such as to cause the two beams to be moved in opposite horizontal directions. At various points on the beam-intercepting structure the angle that a line joining the centers of the areas of impingement of the two beams makes with an intersecting reference line parallel to the phosphor strips may be constant, but the horizontal component of the distance between the areas of impingement may vary. Thus, in the middle of the screen, the two beams may impinge on adjacent phosphor strips whereas farther away from the center of the structure the areas of impingement of the beams may fall on phosphor strips which are separated by an intermediate phosphor strip. As a result, when the scene televised consists of a single color, a number of distinct ring-like or elliptical configurations appear on the face of the reproducing tube, each configuration being of a single color. If a live scene is being televised, the effect of the error is such that the hue of a person's face, for example, will change as the person changes his position. This type of error may be considered as a static rotational error.

It has further been observed that in systems employing cathode-ray tubes of the type described, it takes longer for secondary electrons released from the central portions of the beam-intercepting structure to travel to the collector electrode than it does for secondary electrons released from the more peripheral portions of the beam-intercepting structure. As a result, the indexing signals derived from the released secondary electrons have varying phase. In other words, the indexing signals produced when the indexing beam scans lines toward the top of the raster will be advanced in phase with respect to the in-

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dexing signals produced when the indexing beam is scanning lines toward the center of the raster. Obviously, then, these indexing signals do not convey proper information as to the position of the video beam, even assuming that the video and indexing beams are vertically aligned and impinge on the same phosphor strip at all points of the beam intercepting structure.

It is therefore a principal object of this invention to provide apparatus for compensating for certain errors which occur in plural-beam cathode-ray tubes of the type described.

Another object of the invention is to provide apparatus for assisting in insuring that the several beams of a plural-beam cathode-ray tube track in a predetermined manner.

Another object of the invention is to provide apparatus for use with plural-beam cathode-ray tubes for correcting for rotation introduced into the positions of the beams.

A further aim of the invention is to provide apparatus for stabilizing the operation of an indexing system for use with certain types of color television tubes.

Another aim of the invention is to provide means for controlling the phase of indexing signals generated within plural-beam cathode-ray tubes of the type described.

Another object of the invention is to provide apparatus for improving the color fidelity of images produced by certain types of color television receivers.

These objects, as well as others which will appear, are attained, according to the present invention, by employing electro-magnetic apparatus which is positioned near the electromagnetic field within the cathode-ray tube for controlling the rotation of the several beams therein. To correct for static rotation error, apparatus is located near the focussing magnet for producing an auxiliary axial magnetic field of a desired strength in a region where the intensity of the magnetic field of the focussing magnet is minimal. This apparatus produces a corrective rotational field which does not appreciably affect focus. The same apparatus may also be used to rotate the beams dynamically to compensate for variations in the phase of indexing signals as a result of differences in the time required for secondary electrons emitted from the indexing elements to reach the collector electrode. The amount of rotation is determined by the distance of the area of impingement of the indexing beam from the horizontal axis of the beam-intercepting structure.

Figure 1 is a schematic and block diagram of a color television receiving system in which there is a plural-beam cathode-ray tube with which my invention may be employed;

Figure 2 is a perspective and sectional view of a portion of the beam-intercepting structure of the plural-beam cathode-ray tube shown in Figure 1;

Figure 3 illustrates one type of static rotational error introduced into the beams of a plural-beam cathode-ray tube of the type shown in Fig. 1;

Figure 4 is a sectional and schematic view of apparatus for use with plural-beam cathode-ray tubes for correcting the rotation of the plural beams thereof;

Figures 5a and 5b are graphs of the intensity of the magnetic field produced by the apparatus shown in Figure 4 at various points along the longitudinal axis thereof;

Figure 6 is a schematic representation of a pattern of dynamic rotation introduced into the two beams which overcomes secondary-electron transit time errors in cathode-ray tubes of the type shown in Fig. 1;

Figure 7 is a sectional and schematic view of another form of my invention for use in controlling the rotation of the beams of a plural beam cathode ray tube; and

Figure 8 is a graph of the intensity of the magnetic field produced by the apparatus of Fig. 7 along its longitudinal axis.

Referring to Figure 1 a color television receiving system is shown. Incoming color television signals, which

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may be of the type approved for United States commercial television broadcast, for example, are applied to color signal processing circuits 10. The incoming color video signals are processed therein and applied to a control grid 8 which is situated in front of a cathode 11. Another control grid 9 is also located in front of cathode 11. The cathode and grids produce two electron beams, a video beam 12 and an indexing beam 13. An accelerating anode 14 helps to provide impetus to the beams 12 and 13. A focussing electromagnet 15 is positioned around the neck 19 of the tube 20 which is energized by a current source 7 so that it acts like a converging electron lens and causes the beams 12 and 13 to cross over one another at point "A." The signals applied from the processing circuits 10 to the grid 8 cause the video beam 12 to be modulated in intensity in accordance with the color content of the particular element of the scene being televised.

A deflection yoke 16 is energized by horizontal and vertical deflection circuits 5 and 6 respectively to cause the beams 12 and 13 to be deflected in unison in a plurality of essentially parallel scanning paths across the beam-intercepting structure 25 which is placed in contact with the face plate 26 of cathode-ray tube 20. The direction of scanning is shown in Figure 2, the filled-in circle 30 representing the area of impingement of the video beam 12 whereas the unfilled circle 31 represents the area of impingement of the indexing beam 13 on the beam-intercepting structure 25. An electrically conductive coating 24 is deposited on the inner surface of the face of the bulb portion of the cathode-ray tube 20 and extends back toward the electron gun where the accelerating anode 14 makes contact therewith. The coating 24 has a relatively high positive electric potential applied thereto and establishes a field-free region which helps to accelerate the beams 12 and 13 toward the beam-intercepting structure 25. The coating 24 also serves as the collector for secondary electrons emitted in response to the impingement of beam 13 on the indexing elements 28 as will be explained below.

As shown in Figure 2 the beam-intercepting structure 25 comprises a plurality of phosphor strips 21, 22 and 23 which are composed of phosphor materials which emit green, blue and red light respectively upon impingement thereupon by an electron beam. The strips 21, 22 and 23 are deposited in contact with the inner surface of the faceplate 26 and recur in a repetitive sequence from left to right. On top of the strips 21, 22 and 23 an electron-permeable and light-reflecting layer 27 (such as a layer of aluminum) is placed which enhances the brightness of the image produced by the tube 20 by reflecting back to the viewer light emitted from the image toward the rear of the tube. In a predetermined relation to certain ones of the phosphor strips 21, 22 and 23 are disposed the indexing strips 28 which are shown as being coincident with the green emissive phosphor strips 21. A strip 29 of a conductive material is painted on the outside of the tube 20 near the faceplate 26. Indexing circuits 34 are coupled to strip 29 across load resistor 38. The strip 29 is capacitively coupled to the aluminum layer 27.

When the indexing beam 13 strikes the elements 28, secondary electrons are released which are collected by coating 24. The charge on the elements 28 therefore is altered accordingly and is transmitted, via the coating 27 to the indexing circuits 34 across load resistor 38. The coating 24 is maintained more positive, say at 30 kv., than the coating 27 which may be at approximately 25 kv. The indexing circuits 34 produce signals that are applied to the color signal processing circuits 10 in order to coordinate the position of the video beam 12 with the intensity modulation thereof. There are a number of particular ways in which this coordination is effected, but since this aspect of the system shown in Figure 1 does not concern the present invention, further description of

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any particular indexing or control system will be omitted herefrom. A description and explanation of the operation of the magnet 40 is given below.

The indexing beam control circuits 35 are coupled to the part of the electron gun 11 which produces the indexing beam 13. Since the indexing beam impinges incidentally on the phosphor strips as well as on the elements 28 the average intensity of the indexing beam 13 is ordinarily maintained lower than the average intensity of the video beam 12 so that the reproduced image is not desaturated by the impingement of the indexing beam on the phosphor strips.

Figure 3 illustrates the effect of the axial focussing field produced by the focussing magnet 15. It is well known that when electrons enter an axial magnetic field they are caused to rotate. As may be seen by inspection of Figure 1 the indexing beam 13 and the video beam 12 enter the magnetic field at an angle with respect to the longitudinal axis "Z" of the cathode-ray tube 20. The amount of rotation imparted to the beams 12 and 13 is a function of the intensity of the axial magnetic field. Assume that the desired mode of operation is one in which the video and indexing beams are to impinge simultaneously on the same phosphor strip at all points on the structure 25. (It should be clearly understood that perfect tracking may also exist when the horizontal component of the mutual displacement of the two beams is maintained constant at all points on the scanned raster.) If the beams are aligned so that a line joining their central rays is parallel to the vertical axis of the raster, the focussing magnet 15 rotates the beam thus producing the pattern shown in Fig. 3. It will be noted that the beams have been tilted clockwise and it will be further noted that the horizontal component of the distance between the centers of the areas of impingement 30 and 31 increases as a function of the distance of the areas from the center of the raster. If a scene which is totally blue is televised, the rotational error caused by the focussing magnet will cause the areas 30 shown (except for the central one) to form a green ring. This happens because the indexing beam lags the video beam by the space of one intermediate phosphor strip. Thus, when the indexing beam strikes an indexing element 28 it generates a signal which, when applied to the processing circuits 10, causes the latter to modulate the video beam in accordance with the intensity of the green component of the televised scene. However, at this time the video beam is impinging on the red phosphor strip. Since the televised scene has no green component the video beam will be blanked. A short time after the production of the indexing signal, the processing circuits 10 operate to modulate the video beam in accordance with the blue components of the televised scene. Since the scene is blue the video beam is modulated at a corresponding intensity, but the video beam is then impinging on a green emissive phosphor strip and hence a green spot of light is produced. A number of green spots at the positions shown (except for the central one) will produce a green ring. At other points on the raster the horizontal component of the separation between the areas of impingement may be greater or smaller than that shown in Fig. 3. Thus, other rings of colors or combinations of colors will also be produced, giving rise to the appellation "bull's-eye" error. Sometimes the patterns formed as a result of the static rotational error will assume other shapes, such as ellipses but the pattern illustrated is sufficient to show some effects of static rotational error.

The presence of a "bull's-eye" error pattern reveals that the indexing signals are not indicating the position of the video beam accurately, and the color fidelity of the reproduced image suffers appreciably as a result.

Figure 4 is a sectional schematic view of apparatus for overcoming the static rotational scanning pattern which is manifest as the bull's-eye pattern of Figure 3. Around

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the neck 19 of the tube 20, at the place indicated in Figure 1, the combination focussing magnet 15 and rotator coil 40 is placed. To guide the magnetic flux lines into the proper regions of the cathode ray, the two magnets are encased in a very highly permeable soft iron shield 41 which has two gaps 42 and 43 which are filled with a non-magnetic material 44 such as brass. The rotator coil 40 may be layer wound around a non-magnetic coil form 45 made of Bakelite, for example, whereas the main focussing coil 15 is wound around a non-magnetic coil form 46. The coil forms 45 and 46 are mounted on a non-magnetic cylindrical sleeve 47 which may be maintained in position on the tube neck 19 by means of longitudinal resilient members (not shown) attached to the inner surface of the sleeve 47 which make contact with the exterior surface of the neck 19. The rotator coil 40 is supplied with a direct current from current source 18 (Fig. 1) whose intensity depends on the degree of rotation to be counteracted. The focussing magnet 15 is likewise supplied with a direct current from source 7 whose intensity depends on the degree of focussing to be imparted to the two beams. Assume that the rear (i.e., in the direction of the source of electrons) end of the magnet 15 is a north pole while the forward end is a south pole. The polarity of the field of the rotator coil 40 will ordinarily be made to be just the opposite, i.e., the rear end thereof will be a south pole and the forward end will be a north pole. This is so because the direction of rotation of the beams depends upon the polarity of the field into which the electrons are introduced, so that if the focussing magnet 15 is polarized N—S and causes clockwise rotation, the rotator coil 40 should be polarized S—N so as to cause the beams to be rotated counter-clockwise by a certain amount to offset the effect of the focussing magnet 15. However it is possible in certain cases that the fields of coil 40 and focussing magnet 15 may be similarly polarized. For example, certain types of focussing magnets are known to introduce 60° clockwise rotation. To compensate therefor the apertures of the grids 8 and 9 are oriented 60° in a counter-clockwise direction. However, because of manufacturing inaccuracies the apertures may have been oriented too far in a counter-clockwise direction. It would therefore be necessary to introduce an auxiliary clockwise rotation by means of rotator coil 40 in addition to the clockwise rotation caused by magnet 15 to complete the vertical alignment of the beams.

In Figures 5a and 5b the field intensity of the respective magnets 15 and 40 is plotted as a function of distance along the longitudinal axis Z of the tube 20. It will be observed that the maximum field intensity of the focuser 15 coincides approximately with the longitudinal midpoint of the focuser 15, assuming that the latter is symmetrical. The maximum field intensity of the rotator coil 40, on the other hand, exists in a region within the neck 19 in which the field of the focussing magnet 15 is very small. The rotator coil 40 is deliberately placed at this point so as efficiently to provide the necessary rotating field with the minimum effect on the focus of the two beams. It is also possible to locate the rotator coil elsewhere in proximity to the main focussing coil, as for example in front of the focussing magnet, but when located in the position shown in Figures 1 and 4 better results are obtained. Another mounting position for the rotator coil is shown in Fig. 7, and a full description of that assembly appears below in connection therewith.

The apparatus shown in Fig. 4 (and in Fig. 7) is also useful in preventing transit time errors in the phase of the indexing signals as mentioned previously. A more detailed analysis of that error will assist in understanding how this error is prevented using apparatus according to my invention. As may be seen in Fig. 1 the coating 24 is spaced from the beam-intercepting struc-

ture 25. Electrons emitted in response to the impingement of the indexing beam on the indexing elements 28 are attracted to the coating 24. It is evident that the secondary electrons emitted from the central portions of the beam-intercepting structure 25 require a longer time to reach the collector anode 24 than do electrons emitted further toward the periphery of the structure 25. This variation in the time of travel of the secondary electrons to the coating 24 and the consequent varying phase of the indexing signals is known as "transit-time error" and exists in two directions, i.e., horizontal and vertical. It is possible to correct for transit-time error in a horizontal direction, i.e., the variations in the time required for the different secondary electrons emitted during the scanning of a single line to reach the coating 24 at the left and right sides of the scanned raster by changing the velocity of the horizontal sweep to compensate therefor. A parabolic voltage applied to the horizontal deflection coil, for example, will help to accomplish this variation in velocity.

To correct for transit-time error caused by the variations in the time required for electrons emitted during the scanning of different lines near the top and bottom of the raster to travel to the coating 24 a different approach may be taken. As the two beams sweep across the structure 25 from the top toward the center, the phase of the indexing signals becomes more delayed line-by-line because of the greater distance of the lines toward the center from the coating 24 than those toward the top. Let us assume that the desired tracking condition is one in which the video and indexing beams are to impinge simultaneously on the same phosphor strip at all points of the structure 25. Assume further that the video and indexing beams, as represented by their areas of impingement 30 and 31, are scanning the structure 28 in a number of parallel paths beginning at the left and extending to the right. Then indexing signals will be generated whenever the indexing beam falls on the indexing elements 28 and will indicate that the video beam is simultaneously impinging on the green phosphor strip coincident therewith, at least in the scanning line equidistant between the top and bottom of the raster, as shown in Fig. 6.

Figure 6 is a schematic view of the beam-intercepting structure 28 as seen from the electron gun. The phase of the indexing signals must be equalized so that it will be relatively constant with respect to the phase of signals produced when the beams are scanning the central horizontal line of the raster. This means that, as the beams scan from the top to the central horizontal line, the phase of the indexing signals produced by the indexing beam impinging upon the elements 28 must be delayed.

Since the top scanning line is closest to the coating 24, the phase of the indexing signals must be delayed the most. This is accomplished by rotating the relative position of the indexing beam and the video beam, that is to say, a horizontal displacement component is introduced so that the indexing beam lags behind the video beam as shown. As the two beams are swept in scanning lines farther down the raster the indexing beam is made to lag by smaller amounts so that, when the beams scan the central horizontal line, they are vertically aligned.

In the lower half of the raster the converse is true, i.e., from the central horizontal line to the bottom line the indexing beam is made to lag the video beam more and more. Note that the amount by which the indexing beam lags the video beam does not change within any one horizontal line, but only from one line to the next. It is thus seen that the phase of the indexing signals, at least for transit-time error in the vertical direction, is equalized by rotating the two beams with respect to one another dynamically. Thus, rotation of the beam is desired here in contradistinction to the earlier case of the undesired static rotational error called "bull's-eye error."

To effect this desired dynamic rotation it is possible

to apply a varying current through the rotator coil 49 shown in Fig. 4 (which has been previously described in connection with static rotation error) so that the beams are rotated by the proper amount. If a current having a parabolic waveform is passed through rotator 40 the desired result would be accomplished.

Another apparatus for accomplishing either static or dynamic rotation is pictured in Fig. 7. By applying an unchanging direct current to the rotator coil 40' correction of static rotational error may be achieved. By applying a varying current to the rotator coil 40' dynamic rotation may be effected to correct for transit-time errors in the vertical direction. The focusing magnet shown in Fig. 7 consists of two windings 50 and 51, which are wound on spools 52 and 53 of non-magnetic material. The spools 52 and 53 encircle a non-magnetic cylindrical sleeve 54 which is slipped about the neck of the cathode-ray tube. The focuser-rotator combination shown in Fig. 7 differs from the one shown in Fig. 4 in that the windings 50 and 51 of the focuser combine to produce a non-rotational field. It is well known that non-rotational focussers may be constructed in a way such that their magnetic fields are opposed as indicated in Fig. 7. To produce dynamic rotation as shown in Fig. 6 the rotator coil 40' is energized with a varying current suitable for the rotational pattern desired.

It should be appreciated that a rotator coil such as coils 40 and 40' may be employed to correct for transit time errors in the vertical direction without regard to any electromagnetic focuser at all. If internal electrostatic focussing is employed no rotational error will be introduced into the beams thereby, yet a rotator coil may still be desired to correct for transit time errors.

In Fig. 8 the intensity of the magnetic fields produced by the winding 50 of the focuser, the rotator coil 40', and the winding 51 of the focuser are plotted as a function of distance along the Z (or longitudinal) axis of the cathode-ray tube. The solid line is a plot of the intensity of the field of the windings 50 and 51 of the focuser, whereas the broken line shows the contribution of the rotator coil 40' to the overall field produced by the combination. It should be noticed that the rotator coil 40' is placed so that its magnetic field is at a peak in a region where the field intensity of the focuser parts 50 and 51 passes through zero.

It will be understood that still other embodiments and applications of my invention will occur to those skilled in the art. Consequently I desire the scope of this invention to be limited only by the appended claims.

I claim:

1. In a cathode ray tube system comprising a cathode ray tube having means for producing a plurality of electron beams which are to be deflected in a predetermined pattern and further comprising means for producing a single magnetic field to which said beams are simultaneously subjected, said field being a strong and primarily axial field for focussing said beams; means for producing, in the region of said tube where said beams are undeflected, a relatively weak and primarily axial auxiliary magnetic field, said auxiliary field being principally located near said focussing field in a region where the intensity of said focussing field is minimal thereby to avoid producing any substantial effect on the focus of said beams, said auxiliary field being arranged to rotate simultaneously the axes of said beams with respect to one another.

2. A cathode ray tube system comprising, in combination, a cathode ray tube having means for producing a plurality of electron beams, first magnetic means for producing a strong axial magnetic field in said tube for focussing said beams, and second magnetic means positioned near said first magnetic means for rotating said beams simultaneously by producing a relatively weak auxiliary magnetic field which has primarily axial components in said tube in a region where the intensity of

said focussing magnetic field is minimal thereby to avoid producing any substantial effect on the focus of said beams.

3. A cathode ray tube system comprising a cathode ray tube having means for producing a plurality of electron beams, first magnetic means for producing a strong axial magnetic field in said tube for focussing said beams, and second magnetic means positioned near said first magnetic means for producing an auxiliary axial magnetic field which is weak relative to said focussing field and which has primarily axial components in said tube in a region where the intensity of said focussing magnetic field is minimal, said auxiliary field having a polarity opposite that of said focussing magnetic field and being arranged to rotate said beams simultaneously without appreciably affecting the focus thereof.

4. A cathode ray tube system comprising, a cathode ray tube having means for producing a plurality of electron beams therein, first magnetic means for producing an axial magnetic field in said tube for focussing said beams, and second magnetic means positioned between said beam-producing means and said first magnetic means for producing a strong auxiliary magnetic field whose components are primarily axial and whose intensity is adjustable in said tube in a region where the intensity of said focussing magnetic field is minimal, said auxiliary axial magnetic field being weak relative to said focussing field and polarized so as to rotate said beams simultaneously in a direction opposite the rotation caused by said focussing magnetic field without appreciably affecting the focus of said beams.

5. A cathode ray tube system comprising a cathode ray tube having means for producing a plurality of electron beams therein, first magnetic means having a first portion and a second portion, said first magnetic means producing a strong composite axial magnetic field in said tube for focussing said beams, and second magnetic means positioned between said first and second portions, said second magnetic means being constructed and arranged to produce an auxiliary magnetic field of a predetermined intensity which is low relative to the intensity of said focussing field and which has primarily axial components in a region where the intensity of said focussing magnetic field is minimal thereby to avoid producing any substantial effect on the focus of said beams, said auxiliary magnetic field being polarized so as to rotate said beams in a direction opposite the direction caused by one of said portions.

6. A cathode ray tube system according to claim 5 wherein said first and second portions of said first magnetic means produce oppositely polarized magnetic fields.

7. A cathode ray tube system comprising a cathode ray tube having means for producing two electron beams therein, a beam-intercepting structure in said tube which comprises a plurality of elongated electron-sensitive elements disposed in a first direction, a plurality of secondarily-emissive indexing elements disposed in said first direction and in a predetermined spatial relation to selected ones of said electron-sensitive elements, a collector for the secondary electrons emitted from said indexing elements, different points on said indexing elements being located at different distances from said collector, means for deflecting said beams in unison over said structure in a regular pattern of scanning lines which are transverse to said indexing elements, and means for varying the distance between said beams whereby the indexing signals produced in successive scanning lines are made to occur at substantially the same times relative to the respective beginnings of said lines so that phase differences in said indexing signals are substantially independent of the

different distances between points on said indexing elements and said collector.

8. A cathode ray tube system comprising a cathode ray tube having a beam-intercepting member therein, means for directing electrons toward said member so that some of said electrons impinge on one area and others impinge on another area thereof simultaneously, means for causing said electrons to scan said member, the positions of said areas being subject to rotation with respect to one another during said scanning, and means for producing a magnetic field to which all of said electrons are subjected to substantially the same extent for substantially preventing said rotation, said field-producing means being constructed and arranged to prevent said field from having any appreciable focussing effect on said electrons.

9. A cathode ray tube system comprising a cathode ray tube having a screen comprised of a plurality of electron sensitive fluorescent elements disposed substantially parallel to one another, means for directing electrons toward said screen so that some of said electrons impinge on one area and others impinge on another area thereof simultaneously, means for causing said electrons to scan said screen in a plurality of substantially parallel scanning paths, the positions of said areas being subject to being rotated with respect to one another during said scanning as a function of the deflection of said electrons, and means for producing a magnetic field to which all of said electrons are subjected to substantially the same extent for substantially offsetting said rotation, said field-producing means being constructed and arranged to prevent said field from having any appreciable focussing effect on said electrons.

10. A cathode ray tube system comprising a cathode ray tube having a screen which includes a plurality of substantially parallel electron sensitive fluorescent elements, means for directing electrons toward said screen so that some of said electrons impinge on one area and others impinge on another area thereof simultaneously, means for deflecting said electrons whereby said areas scan said screen in a plurality of substantially parallel scanning paths transverse to said elements, the positions of said areas being subject to rotation with respect to one another during said scanning, said rotation varying as a function of the change in the deflection angle of said electrons, and means for producing a single axial magnetic field to which all of said electrons are subjected to substantially the same extent, said field-producing means correcting said rotation by introducing various amounts of complementary counter-rotation of the electrons which respectively cause the formation of said areas to correspond to the change in said deflection angle whereupon both of said areas are caused to impinge on substantially the same element simultaneously, said field-producing means being constructed and arranged so that said field has a minimal focussing effect on all of said electrons.

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