Dec. 6, 1960 B. R. CLAY 2,963,607

ELECTRON BEAM-CONTROLLING APPARATUS

Filed May 4, 1956 2 Sheets-Sheet 1

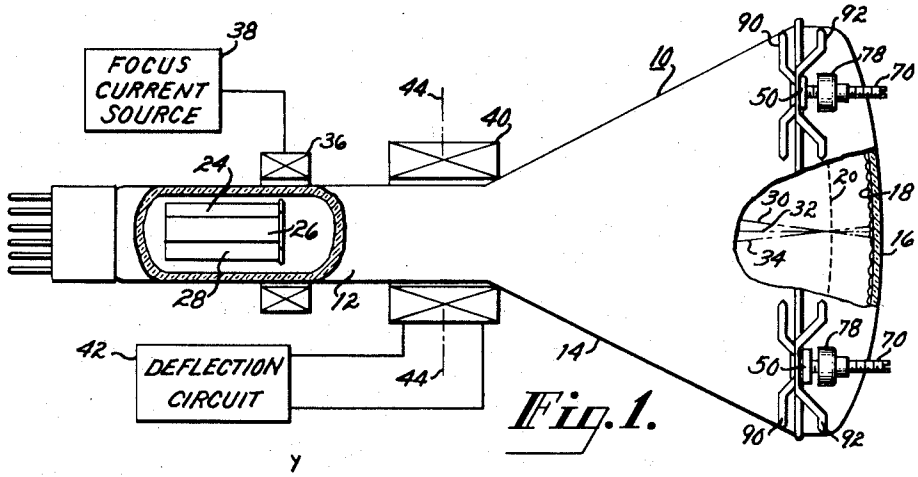



Fig. 1.

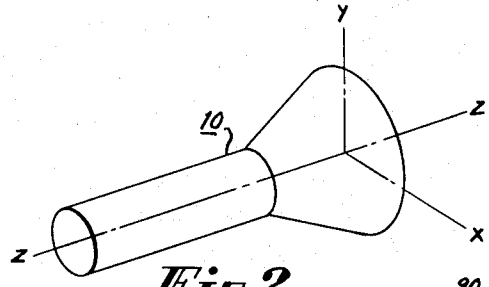



Fig. 2.

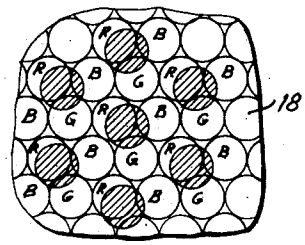



Fig. 3.

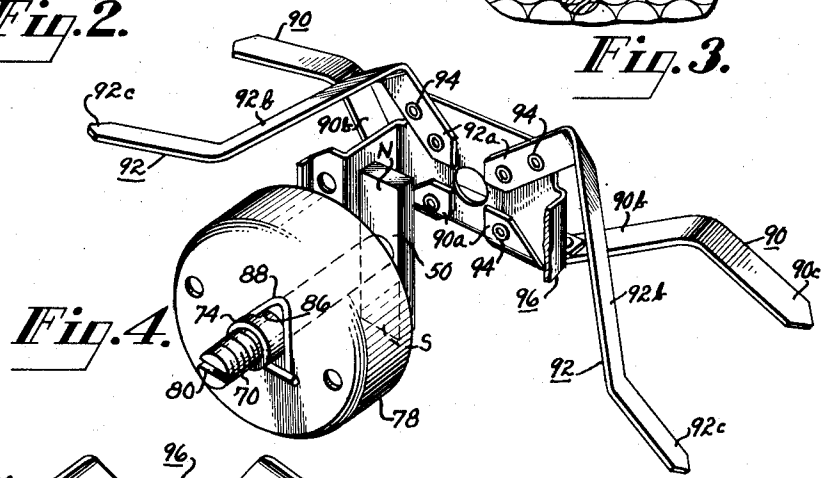



Fig. 4.

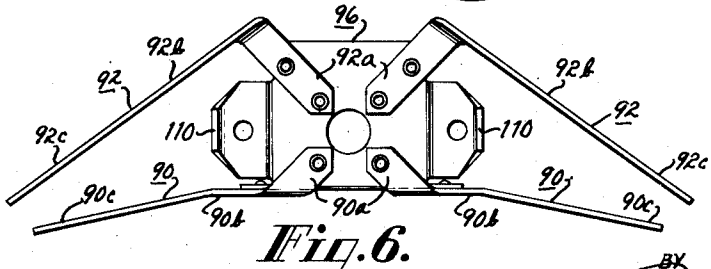



Fig. 6.

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ELECTRON BEAM-CONTROLLING APPARATUS

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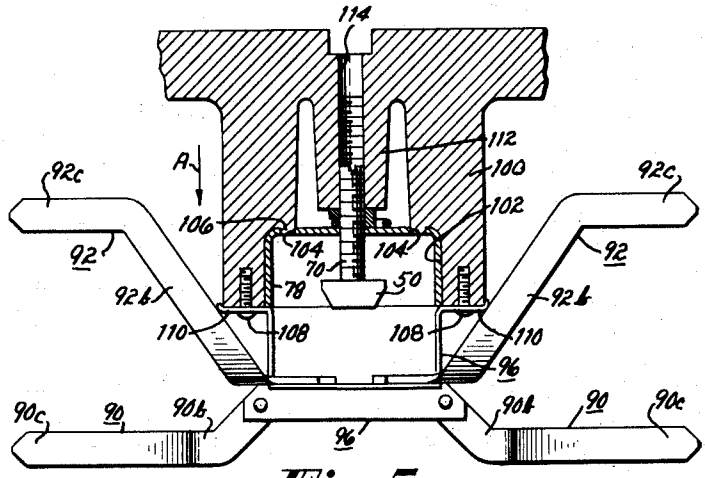



Fig. 5.

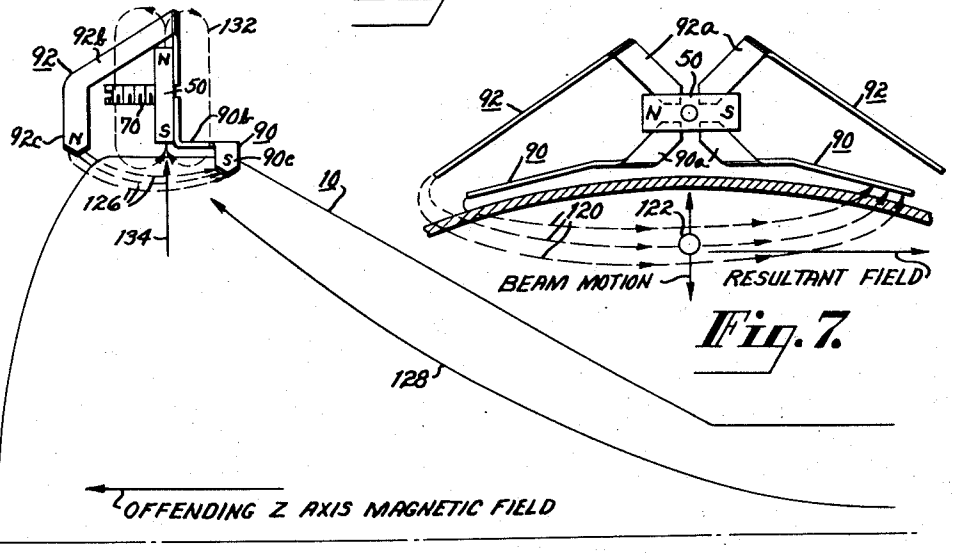



Fig. 8.




Fig. 7.

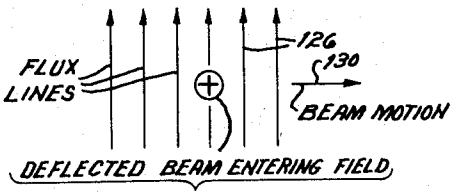
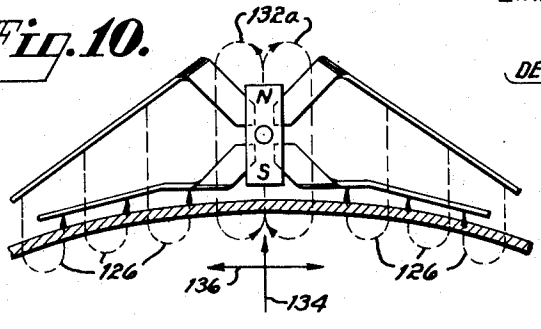



Fig. 9.

Fig. 10.




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United States Patent Office 2,963,607
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2,963,607

# ELECTRON BEAM-CONTROLLING APPARATUS

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Filed May 4, 1956, Ser. No. 582,804

9 Claims. (Cl. 313—77)

This invention relates to new and improved apparatus for use in controlling electrons in cathode ray tubes of the type employed as color television image reproducing devices. Specifically, the invention relates to apparatus adapted for use in conjunction with cathode ray tubes having a plane of deflection at which electrons are subjected to a scanning movement in their transit to a screen unit of the type comprising a mosaic screen and one or more adjacent grills or masks through which electrons pass in different angular directions to preselected dot-like or line-like elemental areas of the mosaic.

While the present invention is herein described as applied to a cathode ray tube of the dot-screen variety disclosed in an article by H. B. Law "A Three-Gun Shadow-Mask Color Kinescope" (October 1951 issue of Proceedings of the I.R.E.), its applicability is not so limited, since the invention may also be employed with other types of cathode ray tubes wherein the angle of approach of an electron beam toward a mosaic screen determines its point of contact with the screen.

As described in the cited Law article, the particular screen area which is illuminated at any given instant in a cathode ray tube of the type in question is a function of the precise angle at which the electron beam approaches the color screen. When such tubes are manufactured in accordance with present-day mass production methods, it is not always possible to maintain the necessary accuracy in the assembly of the grill or mask and the phosphor screen. By virtue of such difficulties, cathode ray tubes which are otherwise satisfactory in structure must be rejected because of "color dilution." One cause of color dilution is misalignment of the masking electrode about its longitudinal axis with respect to the phosphor screen. This type of misalignment results in color dilution of the "tangential" or "rotational" variety. Radial misalignment of the mask and screen causes the electrons to strike a point on the screen radially displaced from their desired point of impingement, and is herein termed "radial" color dilution. Color dilution of the "tangential" and/or "radial" varieties also result from the presence in the paths of the beam-electrons of stray magnetic fields such, for example, as the earth's magnetic field.

It is, therefore, a primary object of the present invention to provide new and improved apparatus for preventing color dilution of the type stemming from rotational and/or radial misalignment of the tube parts and/or from magnetic fields.

Previously proposed solutions to the problem of color-dilution of the tangential and radial varieties have involved the use of a plurality of magnets located around the screen region of the kinescope, each magnet being adjustable in strength and direction of intensity. In one such arrangement, permanent magnets have been disposed with their axes of rotation oriented radially of the kinescope. Here, tangential error, resulting from ambient magnetic fields parallel to the longitudinal axis of



the tube, is corrected by bucking or cancelling the undesired field by an equal but opposite field from the corrective magnet. A problem presented by such prior arrangements, however, is that of manipulating the magnets about their radial axes for adjustment purposes, so that special receiver cabinets permitting access to the magnets have been required in certain instances.

In accordance with another arrangement, claimed by this inventor in copending application Serial No. 531,705, each magnet is supported rotatably about an axis which is parallel to the longitudinal axis of the tube so that the direction of flux from the magnet may be adjusted, means being additionally provided for effectively controlling the intensity of the fields of the permanent magnets. As will be more fully appreciated, adjustment of the magnets as to strength and polarization may be simply accomplished, in such apparatus, from the front of the cabinet in which the kinescope is housed.

The present invention constitutes an improvement over the latter type of arrangement in that means are additionally provided for effecting greater control over the direction and intensity of the correcting magnetic fields. In general, the present invention provides means for subjecting the electron beams in the region of the screen-unit to substantially constant direct current magnetic fields of such intensity, polarity and orientation as to direct the electrons to their normal or intended points of impact on the screen. More specifically, a plurality of permanent magnets are arranged around the screen region of a kinescope, each magnet being supported for rotation about an axis parallel to the longitudinal axis of the tube. Associated with each of the permanent magnets, in accordance with a specific form of the invention, are two pairs of pole-forming members, the pairs of pole-forming members being so disposed that, with the associated magnet in a first position, the two pairs of pole-forming members serve to produce an elongated magnetic field (measured arcuately of the tube screen) whose flux lines are transverse of the electron beam path whereby to produce a generally radial deflection of the electrons to correct for radial mispositioning of the electrons. The pole-forming members are so arranged that, when the magnet is rotated about its axis 90° from the first-mentioned position, the two pairs of members serve to produce a field whose flux lines are generally parallel to the tube's longitudinal axis, thereby to subject electrons within the field to a tangential movement in a direction dependent upon the orientation of the magnet. By virtue of the novel configuration of the pole-forming members of the invention, leakage flux from the magnet is advantageously utilized, in that the effective field component of such flux is in such direction as to aid the axial flux between the pole members.

The invention is described in greater detail in connection with the accompanying two sheets of drawings wherein:

Fig. 1 is a side elevational view, partly in section, of a three gun tri-color kinescope of conventional construction but which is provided, in accordance with a specific form of the invention, with novel electron beam path controlling apparatus;

Fig. 2 is a diagrammatic illustration of a cathode ray tube oriented with respect to certain axes to be described;

Fig. 3 is a fragmentary front view, greatly enlarged, of the screen of the tube of Fig. 1;

Fig. 4 is a perspective view of one of the magnet and pole-forming assemblies of Fig. 1;

Fig. 5 is a plan view of the assembly of Fig. 4;

Fig. 6 is a front elevational view of the assembly of Fig. 5;

Fig. 7 is a simplified front elevational view illustrating

one aspect of the operation of the apparatus of Figs. 4–6;

Fig. 8 is a simplified side view of the apparatus of Figs. 4–6 illustrating another aspect of its operation;

Fig. 9 illustrates certain magnetic field lines to be described; and

Fig. 10 is a view corresponding to that of Fig. 7 but illustrating another aspect of the operation of the present apparatus.

Referring to Fig. 1: the color kinescope **10** shown therein comprises an evacuated envelope having a cylindrical neck portion **12** of glass, for example, which terminates in a flared "cone" portion **14** whose larger end is closed by a glass face plate **16** through which the color-phosphor screen **18** of a bi-part target structure or "screen-unit" **18—20** is visible. The other element **20**, of the screen-unit comprises an apertured mask. The tube may be of the type disclosed in the above-cited Law article wherein the phosphor screen **18** is of the well-known dot-screen variety. As shown in the drawing, the phosphor screen is deposited directly upon the rear surface of the face plate **16** and the mask **20** is curved approximately like the curvature of the face plate. Specifically, the screen **18** is provided on its rear surface with a multiplicity of groups of red, blue and green phosphor dots, the dots of each group being arranged at the apices of an equilateral triangle.

The mask **20** of the screen unit **18—20** comprises a thin metal plate containing a multiplicity of apertures arranged in the same triangular pattern as the trios of phosphor dots, there being one mask aperture for each trio of phosphor dots. The aperture mask **20** is supported in spaced relationship with respect to the screen **18** by any suitable means, not shown. Such a tube is described in detail in an article entitled "Development of a 21-Inch Metal Envelope Color Kinescope" by Seelen et al. which appeared in the March 1955 issue of RCA Review.

The cylindrical neck portion **12** of the kinescope **10** houses three electron guns **24**, **26** and **28**, each of which produces an electron beam intended for bombardment of a particular screen color. The guns **24**, **26** and **28** may be arranged at the apices of an equilateral triangle as shown in the Law article or in any other suitable manner such, for example, as an "in-line" arrangement. The electron beams produced by the guns are indicated diagrammatically by the dotted lines **30**, **32** and **34** and are focused in a conventional manner by suitable means indicated as an electromagnetic focus coil **36** energized by currents from a source **38**, whereby to provide fine beam-spots at the screen **18**. The electron beams are subjected to the action of substantially perpendicular magnetic fields for the scanning, in horizontal and vertical directions, of a conventional rectangular raster at the screen unit. Such scanning fields are produced by means of a deflection yoke **40** which may comprise a pair of normally arranged deflection windings disposed about the neck of the kinescope and energized by suitable sawtooth currents of television line and field frequencies from the deflection circuits **42**. As indicated by the dotted line **44—44'**, the plane of deflection for the three beams **30**, **32** and **34** extends transversely through the deflection yoke **40**.

In subsequent portions of the instant specification, reference will be made to the X, Y and Z axes of the kinescope **10**. In order to facilitate an understanding of such designations, Fig. 2 illustrates, in simpilfied form, the kinescope **10** oriented about its several axes X, Y and Z. It will be seen from Fig. 2 that the Z-axis coincides with the longitudinal axis of the tube, while the X and Y-axes are normal to each other and to the Z-axis.

As has been stated generally supra, one object of the present invention is that of eliminating the so-called "tangential" color dilution which results from a situation tantamount to that which exists when the shadow mask of a screen unit is rotationally displaced with respect to the phosphor screen (about their common axis). Fig. 3 illustrates a front view of such a screen unit, showing a typical case of "tangential" dilution. It will be understood that the three beams **30**, **32** and **34** are intended to converge at the shadow mask **20** and diverge therefrom so that the red beam **30** strikes the red-designated phosphor R and the other beams **32** and **34** strike the green and blue-designated phosphors G and B, respectively, which phosphor dots are arranged, as explained, at the apices of an equilateral triangle. Assuming that there is some rotational mislocation of the shadow mask **20** and screen **18** or that there exists a magnetic field in the path of the beams between the shadow mask and phosphor screen unit such that components of the magnetic field are parallel to the Z axis of the tube, color dilution of the tangential type will result. Thus, referring to Fig. 3 wherein it is assumed, for purposes of simplicity of description, that only the red beam **30** is "on" and that only the red screen dots R are intended to be struck by electrons, the tangential color dilution is manifest at peripheral regions of the screen such that the red beam spots are not centered exactly on the red phosphor dots. Rather, the red beam spots are tangent to or overlap and, hence, illuminate peripheral portions of the adjacent blue and green phosphor dots, thus diluting the red light and preventing it from appearing with its proper degree of saturation.

While not illustrated in the drawing, it will be understood that "radial" color dilution, such as may result from a radial misalignment between the shadow mask **20** and screen **18**, would be manifested by the beam spot's being shifted laterally (i.e., horizontally or vertically) from its desired point of impingement, and that the beam spot intended for illumination of red phosphor dot might instead land on an adjacent blue or green dot.

The present invention eliminates or, at least, substantially minimizes both forms of color dilution through the agency of means for subjecting the several electron beams to the action of substantially constant (i.e., D.C.) magnetic fields in their travel between the apertured mask **20** and the phosphor screen **18**. The intensity and polarity of the field are chosen so as to divert the electrons from their predetermined angularly related paths to other angular directions as required to direct them to their intended points of impact upon the phosphor screen **18**.

Fig. 1 illustrates means, in accordance with a specific form of the invention, for providing the requisite axial or transverse magnetic field, such means comprising a plurality of permanent magnets **50** disposed in circumferentially spaced relation around the tube adjacent to its screen-unit **18—20**. The number of magnets thus employed may vary, but the illustrative embodiment shown herein includes six magnets which may be equi-spaced about the screen region of the tube, three on each side of its vertical centerline. The manner in which these magnets perform their functions of minimizing tangential and radial color dilution will be explained later. At this point, one of the magnets will be described in detail in connection with Fig. 4.

The permanent magnet **50** is illustrated in Fig. 4 as a bar magnet magnetized along its longitudinal axis and having north and south poles designated N and S. A threaded bolt **70** is secured to the magnet **50**, as by means of a rivet or other means (not shown) so that it is perpendicular to the magnet. The bolt **70** is slidably received by a bushing **74** which is securely held in an aperture located centrally of a cup **78**. The end of the bolt **70** remote from the magnet **50** is provided with a screwdriver slot **80**. The bushing **74** is slotted throughout a portion of its periphery as at **86**. A generally triangular friction spring **88** which surrounds the bushing communicates with the bolt **70** through the slot **86** and engages the bolt. Thus, as will be understood, the spring **88** is in engagement with the threads of the bolt **70**, so that, when the bolt is rotated, it will thread its way to-

ward or away from the cup **78**. Alternatively, the bolt may be pulled or pushed through the bushing **74** along its axis, which movement is permitted by the expansion of the spring **88** as it is cammed outwardly by the threads.

The cup **78** is formed of iron or other magnetic material and is of internal diameter sufficient to receive the magnet **50**. Of the assembly thus far described, all of the members with the exception of the magnet **50** and cup **78** may be of any suitable non-magnetic material. The cup **78** is supported, with respect to the tube, in a manner to be described, so that the magnet **50** is rotatable about an axis parallel to the longitudinal axis of the tube and is movable along the axis of the bolt **70**.

When the magnet is in its extreme retracted position so that it is within the cup **78**, the cup acts as a shunt therefor, short-circuiting the flux from the magnet so that the field of the magnet outside of the ring is substantially zero. On the other hand, when the magnet **50** is in its extended position (as in Fig. 4), the strength of the field produced by the magnet is at its maximum value. For positions of the magnet intermediate the two described extreme positions, proportionately different field strengths may be obtained.

Associated with each of the magnets **50** described thus far is a flux-spreading or pole-forming assembly comprising a plurality of pole-forming members. One such assembly is illustrated in a perspective view in Fig. 4, the magnet **50** and cup **78** being spaced from the pole-forming assembly in the drawing in order that the elements of the assembly may be more readily seen. The pole-forming assembly comprises, in accordance with the specific form of the invention illustrated herein, first and second pairs of pole members **90** and **92** having the configuration shown. The pole members **90** have flux-input terminals at their adjacent ends in the form of upwardly bent ears **90***a*, while the pole members **92** terminate at their adjacent ends in downwardly turned flux-input terminals or ears **92***a*. The ears **90***a* and **92***a* lie in a common vertical plane and are secured, as by means of rivets **94**, to a bracket member **96**. The pole-forming members **90** and **92** are of suitable magnetic material such as iron, while the bracket **96** is formed of a non-magnetic material such as aluminum. As is shown in Figure 4, the ears **90***a* and **92***a* of the pole members **90**, **92**, are located in fixed relation to each other on the bracket **96**, the spacing between the pole member ears being such that the magnet **50**, when oriented in the position shown in Fig. 4, can overlie the ears, such that one pole of the magnet (e.g., the north pole) overlies the ears **92***a* and the other pole of the magnet overlies the ears **90***a*. When the magnet **50** is rotated through 90°, one of its poles will be adjacent to the right hand ears **90***a* and **92***a*, while its other pole is adjacent to the left hand poles **90***a* and **92***a*. Thus, in the first described position of the magnet (i.e. illustrated position), the pole members **92** will be energized by flux from the north pole of the magnet, while the pole members **90** will be energized with flux from the south pole of the magnet, whereby the members **92** serve as north poles and the pole members **90** serve as south poles.

On the other hand, in the second described position of the magnet (i.e., rotated 90° clockwise from the showing of Fig. 4), the right hand pole members **90** and **92** will be energized by the north pole of the magnet and the left hand pole members **90** and **92** will be energized by the south pole of the magnet.

The manner in which the magnet and pole-forming assembly operate in accordance with the present invention is hereinafter described in greater detail. At this point, however, certain specific structural features of the pole members are to be noted. Figs. 5 and 6 are, respectively, top and front elevational views of the assembly of Fig. 4, Fig. 6 being a view in the direction of the arrow A in Fig. 5. As may be seen in these figures, the pole members **90** extend rearwardly from the bracket **96** as indicated by their portions **90***b* and then laterally as indicated by the portions **90***c*, the extremities **90***c* being bent downwardly. Each of the pole members **92** extends downwardly and forward for a portion **92***b* and terminates in a laterally, outwardly extending portion **92***c*. It is to be noted that, as employed herein, "rear" and "rearwardly" refers to the direction of the gun portion of the kinescope which the assemblies are associated, while "front" and "forwardly" refer to the direction away from the gun toward the screen of the kinescope.

While the manner in which the pole forming assembly is mounted in operative relationship with respect to the kinescope **10** does not per se form a part of the present invention, one suitable mounting structure is illustrated in Fig. 5 and is herein described in the interest of completeness. Although not shown in its entirety, there may be provided a mask structure in the form of a continuous element of plastic or other suitable insulating material which surrounds the extreme peripheral portion of the screen end of the tube. At each magnet location, the mask is formed with axial, rearwardly extending cylindrical extensions **100**, each such cylindrical extension having a seat **102** for receiving snugly the cup **78** with which the permanent magnet **50** is associated. The cup **78** may be provided with spaced apertures **104** in its front face, which apertures receive lugs or key portions **106** extending axially rearwardly from the seat **102**, whereby the cup **78** is keyed against rotational movement by the lugs. The bracket member **96** is secured to the cylindrical extension **100** as by means of screws **108** which fasten outwardly bent flanges **110** of the bracket member to the face of the extension **100**. The bracket **96** thus additionally serves to hold the cup **78** in its seat **102**.

The threaded bolt **70** of the magnet is threadedly received within an internally threaded tubular extension **112** which is within and concentric with the cylindrical extension **100**. Thus, the slotted end of the bolt **70** may be reached by the shank of a screwdriver through the opening **114** which extends through to the front of the support **100**.

The manner in which the magnet and pole member assemblies serve to control the paths of electrons traveling toward the screen of the kinescope **10** is now described in connection with Figs. 7–10. Fig. 7 illustrates diagrammatically one of the magnet and pole member assemblies and its relation to the peripheral rim portion of the kinescope **10** in the region of its screen. As may be seen from the front elevational view of the assembly, the pole members **90** conform generally to the curvature of the kinescope and extend over an appreciable portion of the peripheral dimension of the kinescope. The pole members **92**, as described in connection with Figs. 4–6, extend forwardly of the pole members **90** and also encompass an appreciable arcuate portion of the kinescope screen region. The magnet **50** is further illustrated in Fig. 7 in a position for controlling radial positioning of the electron beams traveling toward the screen. That is to say, the magnet is rotated in the plane perpendicular to the Z-axis of the tube such that the poles of the magnet lie along a line parallel to a tangent to the tube. Thus, the north pole of a magnet is illustrated as overlying the ears **92***a* and **90***a* of the left hand pair of the pole members, while the south pole of the magnet overlies the ears **92***a* and **90***a* of the right hand pair of pole members. By reason of the orientation of the magnet **50** in Fig. 7, the left hand pole members **90** and **92** serve as north poles, while the right hand members serve as south poles, the magnetic flux lines being indicated by the dotted lines **120** and the direction of the flux lines being indicated by the arrowheads thereon. It will be appreciated, therefore, that the flux lines **120** constitute a magnetic field whose resultant component in a plane of the drawing is as represented by the arrow designated "resultant field," whereby electrons passing through the

field are deflected along a radius of the tube screen, as represented by the arrow labeled "beam motion," one of the beams being shown in section by the circle **122**.

From the foregoing description of Fig. 7, it will be noted that the magnet and pole-forming assembly of the present invention may be readily employed for the correction of radial color error. The direction of such correction may be reversed from that described by rotating the magnet **50** through 180° from the position shown in Fig. 7, while the strength of the resultant magnetic field and, therefore, the degree of correction may be controlled by retraction of the magnet within the cup **78** or extension of the magnet from the cup for less or greater correction, respectively.

Figs. 8–10 illustrate the manner in which the magnet and pole-forming assemblies of the present invention may be employed for the correction of tangential color error or dilution as defined above. Fig. 8 is a diagrammatic side elevation of one of the magnet and pole-forming assemblies shown in operative relation with respect to the kinescope **10**. In Fig. 8, the magnet **50** is positioned with its north and south poles lying along a line which is a radius of the screen of the kinescope (the position shown in Fig. 4). Thus, the front pole members **92** are energized by the north pole of the magnet and serve as north poles of the magnetic system while the rear pole members **90** are energized by the south pole of the magnet and constitute the south poles of the system. The flux lines of the magnetic field between the pole members **92** and **90** are shown by the dotted lines **126** and are, in general, parallel to the Z-axis of the kinescope. In the position shown, the apparatus is capable of correcting tangential color dilution such as might be produced by an offending magnetic field extending in a direction parallel to the Z-axis of the kinescope and thus designated in Fig. 8. As will become more fully apparent, the apparatus of the present invention serves in two distinct ways to correct for such tangential error. Specifically, one way in which tangential error is corrected may be understood from the showing of Fig. 8, in that the flux lines **126** between the pole members **92** and **90** constitute an axial field which is of the proper direction and whose intensity may be controlled to neutralize or "buck" the offending Z axis magnetic field. Viewed otherwise, an electron beam in its deflected position as shown by the curved line **128** "sees" a transverse magnetic field as shown in Fig. 9, so that the beam is deflected laterally or tangentially as indicated by the arrow **130** in Fig. 9.

The second way in which the present apparatus corrects for tangential error stems from the fact that a certain amount of leakage flux, shown by the curved lines **132** in Fig. 8, surrounds the magnet **50**. This leakage flux is three-dimensional and is further illustrated by the flux lines **132***a* in Fig. 10. With the magnet oriented with its north pole overlying the ears of the pole members **92** as in Figs. 8 and 10, there is present an effective field component which may be termed a "quadrature" field which is represented by the arrow **134**. This quadrature field component will be understood as being radial of the tube, so that an electron beam in the region of the field is moved tangentially as represented by the line **136** (Fig. 10). The direction in which the beam is thus moved tangentially by the quadrature field of the magnet **50** is determined by the orientation of the magnet.

It is further important to note that, with the specific configuration of pole members illustrated herein, the quadrature field component **134** which is the resultant of the leakage flux of the magnet when aligned along the radius of the tube is always in such direction as to aid the axial flux lines (e.g., the flux lines **126** in Figs. 8, 9 and 10). Thus, the direction in which electrons are tangentially deflected by the quadrature component is the same as that in which it is deflected by the axial component represented by the lines **126**. The reason for this aiding effect may be explained as follows: in order that the magnet may be rotatable for adjustment in a plane perpendicular to the Z axis of the kinescope and in order for the pole members to be capable of producing an axially extending field such as that represented by the flux lines **126**, the two pairs of pole members must converge in a plane or planes parallel to the plane of rotation of the magnet. This requirement, in turn, results in the requirement that the ear portions of one pair of pole members (i.e., the pole members **92**) be located farther out along a radius of the tube than the other pair (i.e., the members **90**). The foregoing conditions may be met in either of two ways, namely, with the pair of pole members whose ear portions are farther from the tube extending forwardly of the other pair or rearwardly of the other pair.

In order for the quadrature component **134** to aid the axial component regardless of whether clockwise or counter-clockwise tangential movement of the beams is to be produced in a given case, however, that pair of pole pieces energized by the upper pole of the magnet (by "upper" is meant the pole farther from the tube when the magnet is aligned along a radius of the tube) must be located forwardly of the other pair of pole members. That is to say, in the illustrative example shown, the pole members **92** are energized by the upper pole of the magnet **50** when it is oriented along the radius of the tube and these pole members extend forwardly of the other pair of pole members (i.e., the members **90**). It has been found that, unless this last-mentioned condition exists, the quadrature flux component **134** will "buck" or be of the opposite sense from the axial flux **126**. It will be appreciated, however, that the apparatus of the present invention affords greater control over tangential error than that which is available in the absence of the pole-forming members. As in the case of radial correction described above, the degree of tangential correction may be varied by movement of the magnet along its axes of rotation toward or away from its cup.

What is claimed is:

1. An adjunct for a cathode ray tube of the type including a plane of deflection at which electrons are subjected to a scanning deflection in their transit along the longitudinal axis of such tube toward a screen unit including a target made up of a plurality of respectively different elemental areas, said adjunct comprising: a permanent magnet having north and south poles; means for supporting said magnet in the region of such screen unit for rotation in a plane substantially perpendicular to the longitudinal axis of such tube; and pole-forming members having flux-input terminals disposed adjacent to said magnet in a plane substantially perpendicular to said longitudinal axis and including means for directing flux from said magnet selectively in lines generally parallel to such axis or in lines which are generally tangential to such screen unit as determined by the angle of rotation of said rotatably supported magnet.

2. An adjunct for a cathode ray tube of the type including a plane of deflection at which electrons are subjected to a scanning deflection in their transit along the longitudinal axis of such tube toward a screen unit including a target made up of a plurality of respectively different elemental areas, said adjunct comprising: a permanent magnet having north and south poles; means for supporting said magnet in the region of such screen unit for rotation in a plane substantially perpendicular to the longituidnal axis of such tube; a member of flux permeable material; means for producing relative movement between said magnet and said member for controlling the effective intensity of the field of said magnet; and pole-forming members associated with said magnet for directing flux from said magnet in lines generally parallel to such longitudinal axis, said pole-forming members being arranged to extend over an arcuate portion of such screen unit and having flux-input terminals dis-

posed adjacent to said magnet in a plane substantially perpendicular to said longitudinal axis.

3. An adjunct for a cathode ray tube of the type including a plane of deflection at which electrons are subjected to a scanning deflection in their transit along the longitudinal axis of such tube toward a screen unit including a target made up of a plurality of respectively different elemental areas, said adjunct comprising: a permanent magnet having north and south poles; means for supporting said magnet in the region of such screen unit for rotation in a plane substantially perpendicular to the longitudinal axis of such tube; and pole-forming members associated with said magnet for directing flux from said magnet in lines which are generally tangential to such screen unit, said pole-forming members extending laterally outwardly on both sides of said magnet and having flux-input terminals disposed adjacent to said magnet in a plane substantially perpendicular to said longitudinal axis.

4. An adjunct for a cathode ray tube of the type including a plane of deflection at which electrons are subjected to a scanning deflection in their transit along the longitudinal axis of such tube toward a screen unit including a target made up of a plurality of respectively different elemental areas, said adjunct comprising: a plurality of permanent magnets, each of which has a north and south pole; means for supporting said magnets around the screen unit of such tube for rotation in a plane substantially perpendicular to the longitudinal axis of such tube; and pole-forming members associated with each of said magnets for directing its flux along lines generally parallel to such longitudinal axis, said pole-forming members each having flux-input terminals disposed adjacent to its magnet with the terminals of all said members disposed in a common plane substantially perpendicular to said longitudinal axis.

5. An adjunct for a cathode ray tube of the type including a plane of deflection at which electrons are subjected to a scanning deflection in their transit along the longitudinal axis of such tube toward a screen unit including a target made up of a plurality of respectively different elemental areas, said adjunct comprising: a plurality of permanent magnets, each of which has a north and south pole; means for supporting said magnets around the screen unit of such tube for rotation in a plane substantially perpendicular to the longitudinal axis of such tube; and pole-forming members associated with each of said magnets for directing its flux along lines generally tangential to such screen unit, said pole-forming members each having flux-input terminals disposed adjacent to its magnet with the terminals of all said members disposed in a common plane substantially perpendicular to said longitudinal axis.

6. An adjunct for a cathode ray tube of the type in which electrons are subjected to a scanning deflection in their transit along the longitudinal axis of such tube toward a screen unit including a target made up of a plurality of respectively different elemental areas, said adjunct comprising: a permanent magnet having north and south poles; means for supporting said magnet in the region of such screen unit for rotation in a plane substantially perpendicular to the longitudinal axis of such tube; first and second pole members, each having a first extremity located adjacent to said magnet and arranged so that said first extremities are spaced generally along a radius of such screen unit, one of said pole members extending rearwardly of said magnet and the other of said pole members extending forwardly of said magnet.

7. An adjunct for a cathode ray tube of the type in which electrons are subjected to a scanning deflection in their transit along the longitudinal axis of such tube from an electron source toward a screen unit including a target made up of a plurality of respectively different elemental areas, said adjunct comprising: a permanent magnet having north and south poles; means for supporting said magnet in the region of said screen unit for rotation in a plane substantially perpendicular to the longitudinal axis of such tube, first and second pole members, each having a first extremity located adjacent to said magnet and arranged so that said first extremities are spaced generally along a radius in such screen unit whereby, when said magnet is oriented with its poles aligned along a radius of the screen unit, said first pole member is energized by that pole of the magnet nearer said longitudinal axis and said second pole member is energized by the other pole of the magnet, said first pole member extending rearwardly from said magnet toward such electron source and said second pole member extending forwardly from said magnet.

8. An adjunct for a cathode ray tube of the type in which electrons are subjected to a scanning deflection in their transit along the longitudinal axis of such tube from an electron source toward a screen unit including a target made up of a plurality of respectively different elemental areas, said adjunct comprising: a permanent magnet having north and south poles; means for supporting said magnet in the region of such screen unit for rotation in a plane substantially perpendicular to the longitudinal axis of such tube; first and second pole members, each having a first extremity located adjacent to said magnet and arranged so that said first extremities are spaced generally along a radius of such screen unit whereby, when said magnet is oriented with its poles aligned along a radius of the screen unit, said first pole member is energized by the pole of the magnet nearer said longitudinal axis and said second pole member is energized by the other pole of said magnet, said first pole member extending rearwardly toward such electron source and laterally over an arcuate portion of such screen unit and said second pole member extending forwardly from said magnet and laterally in the same direction as the lateral extension of said first pole member.

9. An adjunct for a cathode ray tube of the type in which electrons are subjected to a scanning deflection in their transit along the longitudinal axis of such tube from an electron source toward a screen unit, said adjunct comprising: a permanent magnet having north and south poles; means for supporting said magnet in the region of such screen unit for rotation in a plane substantially perpendicular to the longitudinal axis of such tube; the pole members of said first and second pairs each having a first extremity located adjacent to said magnet, each of said first extremities being arranged in a plane parallel to the plane of rotation of said magnet and all converging toward the axis of rotation of said magnet such that, when said magnet is oriented with its poles aligned along a radius of such screen unit, the pole members of said first pair are energized by the pole of the magnet nearer the longitudinal axis of such tube and the pole members of said second pair are energized by the other pole of said magnet, the pole members of said first pair extending rearwardly toward such electron source and outwardly toward opposite sides of said magnet and the pole members of said second pair extending forwardly from said magnet and to opposite sides thereof.

**References Cited** in the file of this patent

UNITED STATES PATENTS

| | | |
|---|---|---|
| 2,258,643 | De Gier et al. | Oct. 14, 1941 |
| 2,513,221 | Webb | June 27, 1950 |
| 2,541,446 | Trott | Feb. 13, 1951 |
| 2,816,244 | Hillegass | Dec. 10, 1957 |
| 2,825,835 | Heppner | Mar. 4, 1958 |

OTHER REFERENCES

R.C.A. Service Data, 1954, No. T–13, 1st printing, November 24, 1954.