Sept. 27, 1955 A. W. FRIEND 2,719,249

BEAM ALIGNMENT DEVICE

Filed Dec. 22, 1950

Fig. 1.

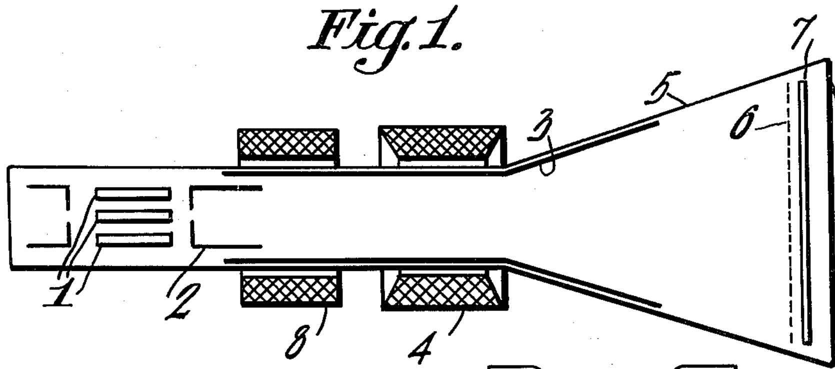


Fig. 2.

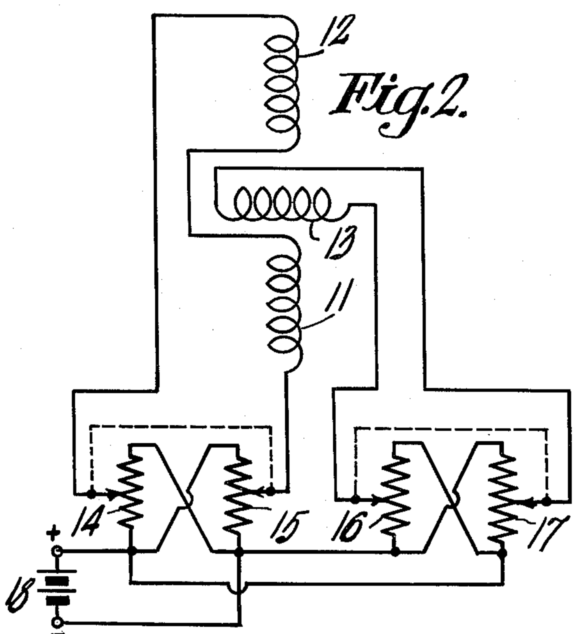


Fig. 3.

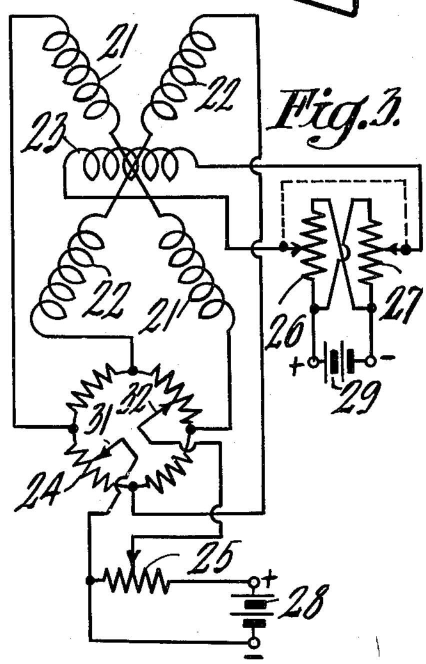
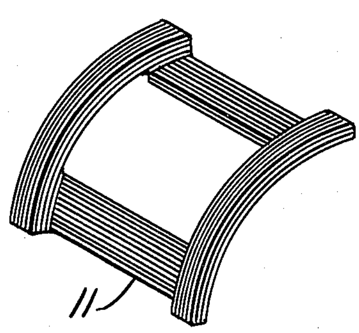


Fig. 4.



INVENTOR
Albert W. Friend
BY
Olin D. Mitchell
ATTORNEY

United States Patent Office

2,719,249

Patented Sept. 27, 1955

1

2,719,249

BEAM ALIGNMENT DEVICE

Albert W. Friend, Princeton, N. J., assignor to Radio Corporation of America, a corporation of Delaware

Application December 22, 1950, Serial No. 202,185

4 Claims. (Cl. 315—13)

This invention relates to color kinescopes and more particularly to kinescopes having a plurality of cathode ray guns each developing a beam which excites a phosphor of only one primary color.

The construction of kinescopes of this general type will be described in connection with a three-gun kinescope for use in a system in which three primary colors, say red, green and blue, are used. The applicability of the invention to other systems will be clear. In these tubes, the phosphor screen comprises a multiplicity of closely spaced dot groups of phosphor. Each dot group consists of three dots of phosphors, one for each of the primary colors. An apertured mask is interposed between the three guns and the dot-phosphor screen in such a manner that the electrons from any one gun can strike only phosphor dots of a single color no matter which part of the raster is being scanned. The mask is comprised of a sheet of metal spaced from the phosphor screen and containing one hole for each of the tri-color-dot groups. This hole is so registered with its associated dot group that the difference in the angle of approach of the scanning beams determines the color.

In the construction of this type of kinescope, it is necessary to produce extremely precise alignment of the apertured mask with respect to the phosphor screen. Linearly, the alignment should be within a range of from about .0005 inch to about .0020 inch. Similarly the mask must be maintained to within a very small fraction of a degree in rotation. It is likewise necessary to align the three guns very precisely with respect to the central axis which is normal to the phosphor screen. This alignment should be within about 0.1 degree or less. These are difficult tolerances to work within, particularly when the kinescopes are being produced in quantity.

If the general system of guns is aimed incorrectly, that is to say, incorrectly oriented about the longitudinal axis of the kinescope, or if the mask is slightly shifted transversely with respect to the screen, the errors may be compensated for by deviating the three beams from the three cathode ray guns, or from a triple gun, in unison, so that they may be directed at the correct angles as they approach the magnetic deflecting fields of the scanning yoke. If the various beams are so directed, they will then follow the desired angular paths toward the aperture plate, so that correct and undiluted color fields are produced.

It has been suggested that the necessary deviation to correct for misalignments be obtained by placing large permanent magnets of the bar or horseshoe type at a relatively large distance from the kinescope and to orient and arrange them so as to obtain the desired deviation. It has also been suggested in the case of camera pick-up tubes of the orthicon or image orthicon type to use auxiliary magnetic coils to produce a transverse field similar to the deflection field to redirect a cathode ray beam from a misaligned cathode ray gun prior to deflection. The latter arrangement is shown in United States Patent No. 2,454,378 granted to Stanley V. Forgue on May 28, 1945.

2

It is an object of this invention to provide a simple and convenient means for correcting for mechanical misalignment of the elements of a multi-gun color kinescope.

It is a further object of the invention to provide a multibeam deviating system which reduces non-uniformity of the beam bending effects between the various beams to a negligible quantity.

A further object of the invention is to provide a beam bending arrangement of the type described which may be easily and simply adjusted to give the desired degree of deviation to the beams.

Briefly, in accordance with the invention, a beam alignment or deflecting magnetic device comprising a plurality of direct current energized coils is placed between the beam converging electrode and the deflecting yoke. One set of coils produces a beam deflecting and another a beam rotating field. By applying the correct direct current potential to the coils, the desired degree of deviation is obtained.

The above and other objects and advantages of the invention will become apparent upon a consideration of the following detailed description taken in conjunction with the accompanying drawings in which:

Fig. 1 is a diagrammatic representation of a three color kinescope constructed in accordance with the invention;

Fig. 2 represents schematically one arrangement for energizing the coils of the invention;

Fig. 3 represents schematically a different arrangement of magnet coils and their energizing circuits; and

Fig. 4 shows a completed coil for use with the invention.

Referring to Fig. 1 there has been shown a tri-color kinescope containing a set of three electron guns **1**, arranged symmetrically about the longitudinal axis of the kinescope, a beam converging electrode **2**, a final anode **3** which may include as a portion thereof the cone **5** of the kinescope envelope, an apertured mask **6**, and a dot phosphor screen **7**. There is also provided an external deflecting yoke **4** which causes the cathode ray beams to scan over the surfaces of the mask and phosphor screen. So much of the kinescope just described represents the normal construction of tubes of the type under consideration. In accordance with the invention there is also provided a beam alignment or deflecting magnetic device **8**. This device contains a pair of transverse coil windings similar to those used in the ordinary deflecting yokes except that the windings are so placed that when direct current is passed through them an essentially constant and uniform magnetic field is set up throughout the inside of the neck of the kinescope in the region of the three electron beams.

The construction of these coils may be understood by reference to Fig. 4 which illustrates one of the coils **11**. A pair of coils so constructed are placed on a tubular form adapted to circle the neck of the kinescope. These coils are connected so as to be series aiding, or they may be connected in parallel with aiding magnetic fields.

A third winding, of essentially circular or cylindrical shape, which is placed with its central axis essentially coincident with that of the neck of the kinescope, may be included as a part of the beam alignment device **8**, but is not necessary for all tubes. In addition, an outer magnetic shield shell or cylinder (not shown), which also acts as a magnetic return path, may be added if desired.

A preferred arrangement for exciting the coils of the beam alignment device **8** is shown in Fig. 2. Here the transverse coils **11** and **12** are excited from a pair of ganged potentiometers **14** and **15** whereby the direction and magnitude of the current flow through the coils may be varied. In like manner the coaxial coil **13** is variably excited by means of ganged potentiometers **16** and

17. Both sets of potentiometers derive their voltages from a source of direct current potential 18.

When the transverse coils 11 and 12, which are displaced so as to produce a transverse field, are excited by passage of direct current, the current amplitude may be varied by means of the ganged potentiometers 14 and 15 to adjust the magnetic field strength to the desired value to cause proper alignment of the cathode ray beams relative to the longitudinal axis of the kinescope. The field produced by these coils is such as to deflect equally the paths of the beams along essentially parallel lines at right angles to the longitudinal axis of the tube in a manner similar to the deflection produced by the customary deflection coils. The sense and degree of deflection along the parallel lines may be varied by changing the current strength in the coils by means of the ganged potentiometers.

The entire coil assembly may be rotated about the axis of the tube so that the direction of the parallel lines may be changed. By combining the effect of a change in current flow through the coils and the mechanical rotation of the coil assembly, the beams may be deflected in any direction and to any degree to insure that they approach the field of the deflection yoke 4 in a direction normal to the planes of the mask 6 and the phosphor screen 7. In cases where the mask and screen are not in true alignment it may be desirable to have the beams approach the field of the deflection yoke at other than a direction normal to the plane of the mask. In such cases the direction of approach required to obtain true color may be obtained by a combination of the adjustment of the field produced by the coils and the customary beam centering control.

It is also desired that the individual red, green and blue phosphor dots shall be aligned with their corresponding electron guns in angular rotation so that the electron beams will fall directly upon the phosphor dots without angular displacement therefrom. The coaxial coil 13 is provided to produce a weak magnetic lens for the production of any desired rotational effect of the three converging beams about the axis to compensate for any small error in relative mechanical orientation of the three electron guns with respect to the sets of three color phosphor dots on the phosphor screen 7. The effect of the field produced by the coaxial coil alone is to deflect equally the paths of the three beams along lines radial to the axis of the tube, to vary the degree of convergence of the beams toward the tube axis. At the same time, due to the fact that the beams are being converged by a magnetic lens there is a resultant spiraling effect which causes the beams to rotate about the axis of the tube. The incidental change of convergence produced thereby can be compensated for by changing the potential applied to the convergence electrode 2. As the strength of the magnetic lens produced by the coaxial coil is increased, the rotation of the three cathode ray beams about the axis is increased. The current in the coaxial coil is varied in direction and magnitude by means of potentiometers 16 and 17 to give the desired rotation to the three beams to provide for the above described desired alignment.

In order to avoid the necessity for the physical rotation of the beam alignment device 8, it is possible to provide an additional pair of transverse field coils in the beam alignment device. The additional transverse coils are arranged at right angles to the above described transverse coils. Their individual effect is similar thereto with the exception that the deflection is along parallel lines at right angles to the parallel lines of the first transverse coils. The arrangement is similar in effect to the horizontal and vertical deflecting coils of the deflecting yoke so that the composite direct current magnetic field from both sets of coils can act in any direction in a plane normal to the axis of the kinescope to produce deflection in any direction.

An arrangement for energizing these coils, including a coaxial coil, is shown in Fig. 3. Here, pairs of transverse coils 21 and 22 are set to produce magnetic fields at right angles. These coils are excited from a circular potentiometer 24 so that when coils 21 carry maximum current coils 22 carry no current. The reverse condition is also true. Opposed rotary contacts 31 and 32 apply the direct current in the desired rotational orientation while potentiometer 25 varies the magnetic field strength by variations of the current from a source of direct current 28. The construction, operation and excitation of the coaxial coil 23 is similar to that of the coaxial coil in the arrangement previously described. Excitation thereof is derived from ganged potentiometers 26 and 27 which are supplied with current from a source of direct current 29. While separate sources of direct current have been indicated, it is obvious that the same source can be used as a supply for all coils. It is also to be understood that while, the sources of direct current have been shown as batteries, any suitable source may be utilized.

Although the invention has been described in connection with the use of three-gun kinescopes, it may be applied without modification to tubes of the single gun type wherein the generated cathode beam is rotated about the longitudinal axis of the tube prior to horizontal and vertical deflection to produce the varying angles of approach whereby only the phosphors of the desired color are activated. In such cases, the beam aligning device 8 would be placed either between the beam rotating means and the deflection yoke, or near the gun, depending upon the desired action.

The invention may also be used with phosphor screens of the line type wherein the phosphors are arranged in a series of lines of alternating color and the particular line impacted by the beam depends upon the angle of approach of the beam. Here, also, the beam aligning device would be placed between the angular determining means and the deflection yoke.

What is claimed is:

1. Color television cathode ray apparatus comprising in combination a cathode ray tube having a plurality of electron guns producing a corresponding plurality of cathode ray beams, and horizontal and vertical beam deflecting elements, a coaxial coil mounted on the tube only between said electron guns and said deflecting elements and energizable by direct current, said coil producing a magnetic field operable to converge the cathode ray beams and to effect angular movement thereof about the axis of the tube, and additional means also located between said guns and said deflecting elements having a controlled convergence effect on the cathode ray beams, whereby suitable energization of the coaxial coil can produce both desired angular movement and desired convergence of the beams.

2. Apparatus according to claim 1 in which the additional means is a convergence electrode positioned adjacent to the electron guns.

3. Color television cathode ray apparatus comprising in combination a cathode ray tube consisting of a target section and a neck section, a plurality of electron guns mounted in the neck section for producing a corresponding plurality of cathode ray beams, said cathode ray apparatus being of the type whose color of reproduction is sensitive to beam rotation, horizontal and vertical beam deflecting elements mounted on the neck section for scanning the beams over the target, coils mounted on the neck section on the electron-gun side of the deflecting elements and energizable by direct current to adjust the paths of the electron beams in a direction transverse to the longitudinal axis of the tube, a coaxial coil also mounted on the neck section on the electron-gun side of the deflecting elements and energizable by direct current, said coil producing a magnetic field operable to converge the cathode ray beams and to effect rotation thereof about the tube axis, and means for compensating for an adjustable portion of the convergence effect of the

coaxial coil, whereby suitable currents through said coils can produce alignment of the cathode ray beams transversely of the tube and both desired convergence and desired rotation of the beams.

4. Color television apparatus comprising in combination a cathode ray tube having a color screen whose color is dependent upon the direction of approach of an electron beam, said cathode ray tube also having a plurality of cathode ray beam guns producing a corresponding plurality of cathode ray beams, at least some of said cathode ray beam guns positioned off the axis of said cathode ray tube whereby the said cathode ray beams are spaced apart from each other at a point adjacent said cathode ray beam guns, horizontal and vertical deflecting coils, associated with said cathode ray tube for deflecting said cathode ray beams in a predetermined scanning raster, a beam alignment coil mounted on said cathode ray tube between said cathode ray beam guns and said deflecting coils, means for energizing said coil with a direct current, said beam alignment coil producing a magnetic field transverse said cathode ray beams upon energization to act substantially uniformly on each of said cathode ray beams to position said cathode ray beams with respect to the axis of said tube prior to the entrance of said cathode ray beams into the field of said deflecting coils whereby electrical readjustment of the alignment of said electron guns and said color screen may be accomplished.

References Cited in the file of this patent

UNITED STATES PATENTS

2,274,586	Branson	Feb. 24, 1942
2,348,133	Iams	May 2, 1944
2,454,378	Forgue	Nov. 23, 1948
2,521,061	Heisig	Sept. 5, 1950
2,581,487	Jenny	Jan. 8, 1952

FOREIGN PATENTS

866,065	France	Mar. 31, 1941