Title:

COLOR CATHODE RAY TUBE DEFLECTION YOKE ADJUSTMENT

United States Patent 3748526

Abstract:

A process for making the axial adjustment of the deflection yoke on a color cathode ray tube display assembly of the shadow mask variety. Before this adjustment is attempted, the color purity adjustment must first be made. This involves disabling two of the three electron guns and then, by known manipulation of the "color purity magnets" causing the beam landings to coincide with the correct phosphor dots in the center of the tube. The deflection yoke is then adjusted while normal operating potentials are applied to the tube, except for the disabled guns, normal deflection signals are supplied to the yoke, and an axial magnetic field is applied at the tube faceplate. The axial field is made strong enough to shift non axial electron beams to the adjacent phosphor dots thereby creating a color display pattern having radial components of a color corresponding to that of one or more of the two disabled electron guns. When the deflection yoke is correctly positioned, the radial pattern components will be symmetrical and will have straight lines. Incorrect adjustment will result in skewed or curved components. The yoke is moved to achieve a pattern having the highest degree of symmetry and straight edges.

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US Patent References:

3421043	METHOD AND APPARATUS FOR ADJUSTING PURITY	January 1969	MacIntyre et al.
2927239	Information storage tube	March 1960	Hunter

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Claims: I claim

1. A process for making the deflection yoke axial adjustment on an operating color cathode ray tube display assembly of the shadowmask variety, said process comprising the steps of:

2. The process of claim 1 wherein an additional step comprises degaussing said tube.

3. The process of claim 1 wherein said magnetic field is produced by a permanent magnet located adjacent the center of the face of said cathode ray tube, and said propeller shape is produced by controlling the proximity of said magnet to said face.

4. The process of claim 1 wherein said magnetic field is produced by passing a direct current through a coil located adjacent the face of said cathode ray tube, and said propeller shape is produced by controlling the current passing through said coil.

5. The process of claim 4 wherein alternating current is passed through said coil to degauss said tube after making said deflection yoke adjustment.

Description: BACKGROUND OF THE INVENTION

In a color cathode ray tube (CRT) of the shadowmask variety, as is currently used in the majority of color television receivers, three separate electron guns excite three separate phosphors on the faceplate. The phosphors are broken up into small dots arranged in triads of triangular form. Each triad includes a red, blue, and green dot and is aligned with a mating hole in the shadowmask so that each color dot is energized by the correct electron gun. Color purity in the term that describes the ability of one electron gun to activate only phosphor dots of the intended color.

To achieve overall color purity on a CRT display, it is necessary that the electron beams be centered along the tube axis so that they will pass through the design center or zero field region of the deflection yoke, and the deflection yoke must be located so that the center of deflection of the non axial electron beams coincides with that center for which the tube was designed and manufactured. Since manufacturing tolerances result in most electron gun assemblies being slightly off center in varying amounts, so called "color purity" magnets are employed to compensate for such CRT assembly errors. A magnetic field for purity adjustment is established perpendicular to the tube axis. The magnitude and direction of this field is adjusted so that the electron beams are deflected to their desired positions. The field is made large enough to act simultaneously on all three guns.

While the color purity magnets establish the proper electron beam landings on the correct phosphor dots at the tube axis or center of the faceplate, deflected or non-axial beams will not only achieve the correct landing if their angle of arrival is correct. This can occur only if the deflection center is located at the correct axial tube position. If the deflection center of the yoke is too close to the faceplate, the beam angle with respect to the faceplate is too small and the wrong phosphor dots will be illuminated. This results in increasing lack of color purity at increasing deflection angles. If the deflection center of the yoke is too far from the faceplate, the beam angle with respect to the faceplate is too large and again the wrong phosphor dots will be excited.

Accordingly in the prior art the deflection yoke has been adjusted so that correct color purity is obtained around the periphery of the display. In a conventional shadowmask tube, where the electron beams are slightly smaller than the phosphor dots, beam landings can readily be observed with a microscope. The deflection yoke is slid back and forth on the tube neck until the electron beams land in the center of the phosphor dots in the corners of the display. This procedure requires the use of a microscope and, to be done effectively, the simultaneous efforts of two persons.

An expedited prior art procedure involved disabling two electron guns (usually the blue and green guns) and pulling the deflection yoke away from the faceplate to deliberately destroy peripheral color purity thereby leaving a bullseye which is then adjusted for correct color (usually red) and centering with the purity magnets. Then the yoke is slid towards the faceplate until the desired color purity is observed over the entire display. This is a single operator procedure that has proven adequate for field and factory receiver production use.

In a conventional color tube where the phosphor dots abut each other, and where electron beam size is close to the size of phosphor dots, it can be seen that the slightest shift of beam landing wall excite other than the red phosphor. Therefore a small shift in yoke position readily creates a well defined bullseye region. However, this is not true for all CRT designs and especially for the recently developed black matrix tube. In this tube the phosphor dots are made smaller then the electron beam as defined by the shadowmask holes. The space between phosphor dots is filled with a black opaque material, such as carbon. This substantially reduces faceplate reflectivity and permits increased faceplate glass transmissivity which in turn increases brightness. The increased brightness more than offsets the reduced phosphor area so that a black matrix tube has improved brightness and contrast.

Unfortunately the black matrix tube introduces a color purity adjustment problem. As the yoke is pulled back, thereby shifting the non-axial beam landing points, instead of shifting the beams onto another color phosphor, they fall on the black matrix. Therefore instead of shifting to another color the raster intensity is merely reduced and this is difficult to see. The result is a very poorly defined bullseye region. To compensate for this effect, the yoke must be pulled back a much greater distance to provide sufficient beam landing shift to traverse the black matrix and cause the beam to strike the adjacent phosphor dot. While this is effective, it has been found that adequate yoke clearance is often not available. In most cases it is necessary to move or completely remove the convergence assembly to give sufficient clearance. This is quite undesirable particularly where it is desired to adjust or check the purity and yoke setting without disturbing the convergence adjustments. Removing, or even moving, the convergence assembly usually requires repeating the convergence adjustments. Also, since the convergence fields interact to some degree with the purity field, the initial purity adjustment may be impaired.

Another problem associated with black matrix tubes occurs because the electron beam diameter exceeds that of the phosphor dot. Beam landing position can no longer be observed with a microscope and any adjustment based upon such observations is practically impossible.

Additionally it can be seen that as the deflection yoke is moved into its final position, it will be difficult to tell when the desired peripheral color purity is optimum. As pointed out above, there is no sharp transition of the beam from one color dot to the next. Rather a gradual reduction of intensity occurs as the beam is deflected off of the phosphor dot. The result is a substantial range of yoke position that appears to give the correct display, but only one position in this range will yield a satisfactory white field when all three CRT guns are turned on.

SUMMARY OF THE INVENTION

It is an object of this invention to provide a simplified adjustment of color CRT deflection yoke position.

It is a further object to improve the accuracy of the yoke adjustment.

It is a still further object to facilitate yoke adjustments on black matrix cathode ray tubes.

It is a still further object to incorporate the yoke adjustment into a combined purity adjustment and degaussing system.

These and other objects are achieved by applying an axial magnetic field to the CRT which is also supplied with normal potentials and deflection signals while only one gun (for example the red gun) is operating. The field is made strong enough to shift the beam landing of non-axial electrons toward adjacent phosphor dots in the dot triads. The result is a bullseye of color (red if the red gun is operating) surrounded by alternate colors that vary with azimuth. The propeller-like display is characterized as having a red hub and green blades on a blue background (or blue blades on a green background).

First the purity magnets are adjusted for a proper bullseye color centered on the display. Then the yoke is adjusted until the propeller blades are symmetrical and straight. This accurately locates the yoke. The axial field is removed and desirably the tube is degaussed to remove any residual magnetism induced by the applied axial field.

BRIEF DESCRIPTION OF THE DRAWING

FIG. 1 of the drawing is a view of a color CRT assembly, showing the neck components and the axial field producing coil;

FIG. 2 shows the CRT display produced by the preferred value of axial magnetic field;

FIG. 3 shows a useful coil mounting arrangement, and

FIG. 4 shows an alternate coil mounting arrangement.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

In reference to FIG. 1, a typical CRT assembly is shown. The tube 1 has a mounting ring 2 which secures the assembly inside the TV receiver cabinet by means of lugs 3. A magnetic shield 4 is bolted to the mounting ring. Deflection yoke 5 is secured on the tube neck by means of clamp 6. The convergence assembly 7 and blue lateral assembly 8 are located back of the deflection yoke. Purity assembly 9 containing a pair of ring magnets at 10 mounts just forward of tube socket 11. Block 23 comprises conventional means, e.g., the normal circuitry, for supplying operating voltages and normal deflection signals in tube 1 and yoke 5.

For use with 19 V to 25 V color tubes, the axial field-producing coil 12 may consist of 200 turns of number 25 insulated wire. Desirably this coil will have an outside diameter of about 12 inches. For smaller tubes the coil can have a correspondingly smaller diameter. Coil leads 13 connect the coil to control box 14. The control box contains a three position switch 15. The center position is the "off" state. In the upper position of switch 15, coil 12 is connected to a source of alternating current 16 such as the conventional a-c power mains. In this position coil 12 can be used in the conventional "degaussing" function. The only requirement is that the peak degaussing current exceed the maximum value of direct current used in the coil.

If desired the degaussing circuit may contain additional well known but not shown means that cause the applied a.c. to drop to zero after a short period of operation. Alternatively the coil, with a.c. applied, can be removed from the vicinity of the CRT.

In the position of switch 15, coil 12 is connected to a source of direct current 17 by way of rheostat 18 which is used to adjust the current value.

While the coil 12 and associated excitation components are preferred, a permanent magnet could be used as shown in dotted outline at 19. In this case a bar magnet of suitable strength is located along the CRT axis and the field strength established by its proximity to the faceplate as shown by the dotted arrow. To use this device for degaussing it would be pivotally suspended at its center (by means not shown). If the magnet is removed from the vicinity of the faceplate while spinning it, the degaussing action could also be accomplished.

FIG. 2 shows the appearance of the CRT display for the assembly of FIG. 1 when coil 12 is energized by a suitable value of direct current. For this display it is assumed that deflection is normal and that no video modulation is present. The blue and green guns have been disabled leaving only the red gun operating. Since axial electrons will not be deflected by the magnetic field produced by coil 12, the central bullseye 20 will be red. The axial magnetic field will tend to deflect or rotate the nonaxial beams so that just outside the bullseye the beam landings will be rotated toward the adjacent phosphor dots. Field regions 21 will be either blue or green depending on the magnetic field polarity while field regions 22 will be either green or blue depending on the magnetic field polarity. In any event field regions 21 and 22 will constitute the other two phosphor colors. This display is referred to as propeller shaped. Bullseye 20 constitutes the hub while the alternate color regions outside the hub are the blades.

The display appearance shown in FIG. 2 indicates the preferred value of current in coil 12. At reduced current, the bullseye becomes larger and the definition of field regions 21 and 22 degrades. At greater than optimum current, field regions 21 and 22 further break up into a complex display and renders interpretation somewhat difficult.

Once the desired current is achieved and the coil 12 accurately centered on the CRT faceplate, bullseye 20 is adjusted by means of color purity magnets 10 (in FIG. 1) to fall in the center of the CRT faceplate. The deflection yoke adjustment can now be made.

Referring to FIG. 1, clamp 6 is loosened so that yoke 5 can be moved axially along the CRT neck. The yoke is positioned to obtain the propeller pattern of FIG. 2 and then clamp 6 is tightened. If the yoke is not properly positioned, the propeller blades will be skewed rather than straight and the pattern will not be symmetrical as shown.

Since the d-c magnetic field will tend to magnetize the CRT parts, particularly the shadowmask, the adjustment procedure is completed by moving switch 15 to the upper position and degaussing the CRT by removing coil 12 from the vicinity of the CRT. Switch 15 can then be moved to its center off position.

Using the above technique, a precise setting of the deflection yoke can be achieved without disturbing any other components and the technique is equally applicable to black matrix cathode ray tubes.

FIG. 3 shows a device useful in making the purity adjustments on a large variety of CRT sizes. The coil 12 is similar to the one detailed in connection with FIG. 1. Spring mounted wires 30 are attached to clamps 31 located at 90° apart on the periphery of coil 12. The cross over of wires 30 defines the center of the field produced by the coil. These wires and clamps can if desired be replaced by elastic bands. Suction cups 32 secured to the coil by means of clamps 33 may be employed to releasably mount the coil on the front panel of a CRT or TV receiver. The wires, clamps, and other parts used on coil 12 should be composed of non-magnetic material to avoid distorting the coil field. To use this assembly the center of the CRT must first be determined. This can be done by means of a straight-edge and crayon or grease pencil. The straight-edge is first laid across the faceplate so as to pass over diagonally opposite corners and a mark made along the edge passing through the faceplate center. A similar mark is made for the other two corners. The intersection of these marks identifies the center of the display. The coil FIG. 3 is then mounted so that the cross wires 30 intersect at the center of the faceplate. Special templates or devices for positioning the coil and marking the center of the CRT can also be used as will be described hereinafter. The bullseye as shown in FIG. 2 is then centered by adjusting the purity magnets so that it is centered on the cross wires 30.

FIG. 4 shows a device useful in practicing the invention on picture tubes of one particular size and is therefore more useful in a production-type of operation. A sheet of transparent plastic 34, made of polystyrene for example, is curved to conform with the curvature of the particular shape encountered on a television receiver. Ears 35 are shaped to conform exactly to two corners of the TV display. These ears can either be molded into sheet 34 of otherwise attached thereto. When this device is held against the TV receiver display its location is precise with respect to the display. Coil 12 can be attached to or molded directly into sheet 34 so that its center coincides with the center of the faceplate. Indicia 36, marked permanently on the surface of the sheet, indicates the center of the faceplate to assist in locating the bullseye during purity adjustment.

While the above description has detailed preferred embodiments, numerous departures within the scope of the invention will occur to one skilled in the art. For example, more elaborate degaussing circuits will usually be incorporated into the electrical equipment and the field-producing coil current could be electronically regulated. While the bullseye is normally centered, a slight off-centering may be employed in certain cases due to special CRT characteristics or due to environmental magnetic fields. It is intended that the scope of the invention be limited only by the following claims.

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