

**CATHODE-RAY-TUBE DEMAGNETIZING
METHOD**

[Detailed Description of the Invention]

[Industrial Field of the Invention]

The present invention relates to a demagnetizing method for a cathode-ray tube (hereinafter referred to as a "CRT"), and in particular to a demagnetizing method with a demagnetizing coil used in a magnetizing process in the process of producing a Trinitron (trademark) CRT.

[Description of the Related Art]

According to a conventional color CRT, three RGB electron beams emitted from a cathode land on the corresponding fluorescent materials on the internal fluorescent surface of a fluorescent glass panel, so that they emit light. Accordingly, when the landing of the electron beams on the fluorescent materials deflects, the landing error generates a color positional shift, which causes a problem of quality deterioration on screen color and brightness. Therefore, the gap between fluorescent materials of different colors is filled with carbon as black nonfluorescent material. This carbon gives tolerance with respect to deflection in the landing of the electron beams.

In the process of producing a color CRT, there may be the case where the landing position of the electron beams to

the fluorescent surface shifts from the target position, due to the thermal deformation of CRT color-selection electrodes and glass tube, vacuum irregularity occurring as a result of exhausting the glass tube to a vacuum and sealing it, a mechanical shift in the position of the color-selection electrodes, magnetization caused by welding in the production process, and so forth. Normally, when the landing position of the electron beams shifts from the target position, a color positional shift or brightness deterioration is generated, so that predetermined characteristics of image quality cannot be obtained.

There is a known method (cf. Japanese Unexamined Patent Publication No. 62-290034) in which, in order to correct a shift of the landing position of electron beams from the target position, a demagnetizing coil is used to apply an ac attenuation magnetic field to a completed CRT so as to magnetize CRT color-selection electrodes, with a ring coil surrounding the color-selection electrodes used to apply a dc bias magnetic field to the CRT, whereby the path of the electron beams is changed by the magnetizing magnetic field. In addition, a method (Japanese Unexamined Patent Publication No. 48-43219, Japanese Unexamined Patent Publication No. 61-289788) for correcting the paths of electron beams with a magnetic field generated by supplying a dc current to a demagnetizing coil has been proposed.

A magnetizer used in the case where, with a dc bias magnetic field applied to the CRT, the application of an ac attenuation magnetic field with a demagnetizing coil is performed by using a magnetizing process in the process of producing a CRT is formed to have a structure as shown in Fig. 9.

In Fig. 9, in order to generate dc magnetic fields, a magnetizer 12 disposes three pairs of dc-bias mini-Helmholtz coils 14, 15 and 16 comprising pairs of rectangular coils 14xa and 14xb, 15za and 15zb, and 16ya and 16yb formed in the x-axial (CRT-panel horizontal) direction, y-axial (CRT-panel vertical) direction, and z-axial (CRT-tube axial) direction of a CRT 13 so that they surround the six faces of the CRT 13, and disposes two rectangular demagnetizing coils 17 and 18 for generating an ac attenuation magnetic field, formed to the top and bottom of the y-axis of the CRT 13.

In the magnetizer having the above structure, if a 17-type (conventional 17-inch size) is used as the CRT 13, the magnetomotive force of the ac attenuation magnetic field is a maximum of 1000 kA-turns. When it is assumed that each interval of the pairs of mini-Helmholtz coils 14, 15 and 16 is 700 mm, by allowing a current in, for example, the pair of coils 15 for generating a dc bias magnetic field so as to generate a dc bias magnetic field of 300 μ T along the z-axial direction in Fig. 9, and subsequently allowing

currents in the two coils 17 and 18 for generating an ac attenuation magnetic field so that the ac attenuation magnetic field is superposed on the dc bias magnetic field, magnetic members in the CRT 13 is magnetized. In this magnetization, the magnetomotive forces of the dc bias magnetic field and the ac attenuation magnetic field are determined based on a shift Δ of the electron beam center from the stripe center of fluorescent materials, considering the amount of demagnetization in a display unit into which the completed CRT is built.

[Problems to be Solved by the Invention]

According to the above-described conventional magnetizer, the demagnetizing coils 16 and 18 disposed above and under the CRT 13 are far from the CRT. Thus, there are problems in which they need large ampere-turns requiring an extremely strong magnetic-field generator and in which their sizes are enlarged.

The present invention has been made in order to solve the above problems, and its subject to be achieved is to provide a CRT demagnetizing method which can efficiently apply the magnetic flux of an ac attenuation magnetic field to magnetic members bonded to and provided in a CRT and particularly a Trinitron CRT so that magnetizing for correcting the paths of electron beams can efficiently be performed.

[Means for Solving the Problems]

Concerning a CRT demagnetizing method of the present invention, its example is, as shown in Fig. 1, a CRT demagnetizing method for superposing an ac attenuation magnetic field on dc magnetic fields to magnetize magnetic members in a CRT 13 in a CRT production process, whereby the magnetic field of the magnetization corrects the paths of electron beams, wherein pairs of demagnetizing coils 21 and 22 are disposed on the top and bottom, and right and left of the CRT 13, and an ac attenuation magnetic field is generated by each pair of the top and bottom or right and left demagnetizing coils 21 and 22 so as to correct the paths of the electron beams magnetizing the magnetic members in the CRT.

A CRT demagnetizing method of the present invention provides a method in which shifts of electron beams with respect to fluorescent materials can efficiently be magnetized by alternatively causing pairs of demagnetizing coils disposed on the top and bottom, and right and left to generate an ac attenuation magnetic field, whereby the paths of the electron beams can be corrected with small-sized demagnetizing coils.

[Description of the Embodiments]

Before describing a CRT demagnetizing method of the present invention with reference to Figs. 1 to 8, a

Trinitron CRT 13 used in the present invention will be described below. Fig. 5 is a perspective view including a partially cutaway portion of the CRT 13.

As shown in Fig. 5, stripe aperture grill (AG) 2 used in color-selection electrodes 4 of the Trinitron CRT 13 are welded to a frame member (hereinafter referred to as a "frame") formed to be almost rectangular. This frame 3 includes top and bottom horizontal frames 3a and 3a consisting of almost L-shaped iron magnetic materials, and vertical frames 3b and 3b consisting of almost U-shaped iron magnetic members formed so as to be connected to the right and left ends of the top and bottom horizontal frames 3a and 3a. The above-described color-selection electrodes 4 are mounted so as to be opposed to fluorescent stripes 11 (cf. Fig. 7) formed on the internal surface of a panel 1P consisting of glass, and a funnel 1F consisting of funnel-shaped glass and encapsulating an electron gun 6, and the panel 1P are combined by a glass seal 8. In the tube there is provided an internal magnetic shield (hereinafter referred to as an "IMS") 9 consisting of a funnel-shaped magnetic member.

In a production process for obtaining the above-described CRT 13, a positional shift of electron beams with respect to fluorescent materials occurs due to thermal deformation and vacuum deformation of the color-selection electrodes 4 and the glass tube, a mechanical shift in the

position of the color-selection electrodes 4, or magnetization caused by welding in the production process, and so forth. In order to correct this positional shift, magnetization with a dc bias magnetic field and an ac attenuation magnetic field is performed, and a color positional shift of the electron beams is further corrected using a magnetizing process. The present invention relates to a demagnetizing method in this process.

Concerning a CRT demagnetizing method according to the present invention, processing including the above-described magnetizing process will be described below, based on the flowchart shown in Fig. 6.

At first, in order to perform the color-shift correction of electron beams by using a magnetizing process, a shift Δ between the center H_a of one fluorescent stripe 11 and the center H_b of one electron beam 10, as shown in Fig. 7, is measured (step S1). This shift Δ is found as a value obtained such that, while the electron beam 10, which is a monochromatic and is used for green (G), is being swept along the horizontal scanning-line direction, its highest brightness level, in other words, its brightness level which appears when the center H_b of the electron beam 10 is positioned at the center H_a of the fluorescent stripe 11, is measured with a photosensor.

As shown in Fig. 8, the measurement is performed at a

total of nine points composed of three vertical points by three horizontal points on a screen, whose periphery occupies 90% of the screen size. For example, evaluation is performed at the four points (points ①, ③, ⑦, ⑨) at the corners. Concerning the data at the corners, one end of the x-axis is used as a reference so that the influence of changes in the positioning of a deflection yoke can be removed, and using $\Delta 1' = \Delta 1 - \Delta 4$, $\Delta 3' = \Delta 3 - \Delta 6$, $\Delta 7' = \Delta 7 - \Delta 4$, and $\Delta 9' = \Delta 9 - \Delta 6$, shifts between the centers of fluorescent stripes and the centers of electron beams, at points ①, ③, ⑦, ⑨ in Fig. 8, are evaluated.

After the shifts Δ between the centers of fluorescent stripes and the centers of electron beams are measured, the correction of electron beam color positional shift by using the magnetization process, based on the shifts Δ , is performed (step S2). This color-shift correction is conventionally performed such that a dc bias magnetic field and a strong ac attenuation magnetic field are superimposed by the magnetizer 12 in Fig. 9 to magnetize the magnetic members in the cathode-ray tube.

According to the present invention, between step S1 and step S2, the step (step ST₁) of disposing pairs of demagnetizing coils on the top and bottom, and right and left of the CRT 13 is added, whereby the magnetizer 12, which is small, performs demagnetization without using the

large demagnetizing coils 17 and 18 used in the magnetizer 12, as shown in Fig. 9.

Accordingly, CRT structures as shown in Fig. 1 to Fig. 4 are used. In other words, the first step ST1 of respectively disposing pairs of demagnetizing coils 21 and 22 on the top and bottom, and right and left of the CRT 13 is added.

Fig. 2 shows the structure of a magnetizer used in a CRT demagnetizing method of the present invention. A pair of demagnetizing coils 21 and 21, which have an almost rectangular coil shape, disposed on the top and bottom with respect to the longitudinal direction (horizontal scanning-line direction) of a panel 1P of the CRT 13, and demagnetizing coils 22 and 22, formed to be almost rectangular and disposed on the right and left with respect to the widthwise direction of the panel of the CRT 13, are on the outside of the cathode-ray tube to form a Trinitron CRT whose inside is similar to that described in Fig. 5. The CRT, which is provided with the demagnetizing coils 21 and 22 in the first step ST1 in the above manner, is disposed in a magnetic field generated by the mini-Helmholtz coils 14, 15 and 16 (14xa, 14xb, 15za, 15zb, 16ya, 16yb), in which currents are allowed to flow, and an ac attenuation magnetic field is superposed on a dc bias magnetic field in the demagnetizing coils 21 and 22, whereby the magnetic

members in the tube are demagnetized.

In Fig. 2, magnetomotive forces generated by the demagnetizing coils 21 and 21, and 22 and 22 are determined by the number of turns and currents in the demagnetizing coils. The directions of arrows in Fig. 2 indicate the directions of the currents when they flow. In this magnetizer, the magnetic field generated by the pair of top and bottom demagnetizing coils 21 and 21 is vertical in the CRT 13. Accordingly, the AG 2 in the color-selection electrodes 4 of the CRT 13 and the vertical pieces 3b of the frame 3 are mainly demagnetized. In addition, the magnetic field generated by the pair of right and left demagnetizing coils 22 and 22 is horizontal in the CRT 13. Accordingly, the horizontal pieces 3a of the frame 3 in the color-selection electrodes 4, and the IMS 9 in the funnel 1F are demagnetized.

Demagnetization is performed, for example, when demagnetization with the pair of right and left demagnetizing coils 22 and 22 is initially performed, and demagnetization with the pair of top and bottom demagnetizing coils 21 and 21 is subsequently performed. In such a way, it is not possible to perform simultaneous magnetization. This is because, in the case where simultaneous magnetization with the demagnetizing coils 21 and 21, and 22 and 22 is performed, among the demagnetizing

coils 21 and 21, and 22 and 22, the distance from one demagnetizing coil to one adjacent demagnetizing coil is shorter than the distance between one pair of demagnetizing coils, and the desired magnetization cannot be obtained. Needless to say that the order of demagnetization may be reversed, in other words, demagnetization with the pair of top and bottom demagnetizing coils 21 and 21 may be performed before performing demagnetization with the pair of right and left demagnetizing coils 22 and 22.

In the above-described example, the pair of right and left demagnetizing coils 22 and 22 is disposed so that their centers almost correspond to the center of an implosion-protected band. However, they can be disposed along the funnel 1F on the back side of the CRT 13, as shown in Fig. 3 and Fig. 4. In this manner, by disposing the pair of right and left demagnetizing coils 22 and 22 along the funnel 1F, the demagnetizing coils 22 and 22 can be close to the IMS in the funnel 9, which allows the magnetic flux caused by the magnetic field of the demagnetizing coils 22 and 22 to sufficiently flow in the IMS 9, whereby the IMS 9 can be effectively demagnetized.

As described above, the correction of electron-beam color positional shift by using a magnetization process is performed. When the correction of electron-beam color positional shift by using a magnetization process ends,

demagnetization is performed simulating demagnetization in a display in which the CRT 13 complete with the demagnetizing coils 21 and 21, 22 and 22 is used (step 3).

The intensity of the ac attenuation magnetic field used in the magnetization process according to the present invention is set larger than the intensity of an ac attenuation magnetic field used in a demagnetization (degauss) circuit built into a commercial television or display.

When, in the magnetizer 12 shown in Fig. 9, mini-Helmholtz coils 14, 15 and 16 are used to apply a dc bias of 1 G to the screen of the CRT 13 along the right and left X-axial directions, when the demagnetizing coils 17 and 18 in Fig. 9 are used to superimpose an ac attenuation magnetic field having a magnetomotive force of 1000 kA-turns, and when an amount in which shifts Δ between the electron beams 10 and the fluorescent stripes 11 can be corrected is set to 1.0, magnetomotive forces, due to the top and bottom, and right and left demagnetizing coils 21 and 22, whose correctable amount is 1.0 in the case where the ac attenuation magnetic field is superposed in the order of the right and left demagnetizing coils 22 and the top and bottom demagnetizing coils 21, are found. The results are shown below.

(1) When the ac attenuation magnetic field was applied

to a pair of right and left demagnetizing coils 22 and 22, and is next applied to a pair of demagnetizing coils 21 and 21, there was 4.0 kA-turns in the top and bottom demagnetizing coils 21 and 21, and the right and left demagnetizing coils 22 and 22, at the same time.

(2) When the ac attenuation magnetic field was applied to a pair of demagnetizing coils 21 and 21, and is next applied to a pair of right and left demagnetizing coils 22 and 22, there was 4.3 kA-turns in the top and bottom demagnetizing coils 21 and 21, and the right and left demagnetizing coils 22 and 22, at the same time.

As these results show, the magnetomotive force needs to have relatively small power, and power-supply cost and maintenance are facilitated.

[Advantage]

As described above, according to a CRT demagnetizing method, a demagnetizer, used in a step for using a magnetizing process to correct the colors of electron beams, generates ac attenuation magnetic fields by using pairs of demagnetizing coils disposed on the top and bottom, and right and left of a CRT, whereby demagnetizing magnetic members such as color-selection units in the CRT. Thus, dc magnetic fields can efficiently be magnetized, and shifts Δ of the electron beams with respect to fluorescent stripes can efficiently be corrected.

[Brief Description of the Drawings]

[Fig. 1]

Fig. 1 is a structural view of a magnetizer used in the present invention.

[Fig. 2]

Fig. 2 is a schematic perspective view showing the arrangement of demagnetizing coils according to the present invention.

[Fig. 3]

Fig. 3 is a perspective view showing another perspective view showing the arrangement of demagnetizing coils according to the present invention.

[Fig. 4]

Fig. 4 is a plan view showing another example of the arrangement of demagnetizing coils according to the present invention.

[Fig. 5]

Fig. 5 is a partially cutaway view showing a cathode-ray tube used in the present invention.

[Fig. 6]

Fig. 6 is a flowchart according to the present invention.

[Fig. 7]

Fig. 7 is a drawing illustrating the amount of a shift.

[Fig. 8]

Fig. 8 is a drawing illustrating points for measuring the amount of a shift.

[Fig. 9]

Fig. 9 is a structural view of a conventional magnetizer.

[Reference Numerals]

- 1P: panel
- 1F: funnel
- 2: aperture grill (AG)
- 3: frame
- 4: color-selection electrode
- 9: internal magnetic shield (IMS)
- 13: cathode-ray tube (CRT)
- 15, 16, 17(14xa, 14xb, 15za, 15zb, 16ya, 16yb): mini-Helmholtz coils
- 21, 22: demagnetizing coils



Claims

1 A cathode-ray-tube demagnetizing method comprising the steps of magnetizing magnetic members in the cathode-ray tube by superposing ac attenuation magnetic fields on dc bias magnetic fields in the process of producing the cathode-ray tube, and using the superposed magnetic field to correct the paths of electron beams,

wherein pairs of demagnetizing coils are disposed on the top and bottom, and right and left of the cathode-ray tube so that ac attenuation magnetic fields are generated by the pair of top and bottom demagnetizing coils and the pair of right and left demagnetizing coils, whereby the paths of the electron beams are corrected by magnetizing said magnetic members in the cathode-ray tube.

2 A cathode-ray-tube demagnetizing method according to Claim 1, wherein, among the pair of top and bottom demagnetizing coils and the pair of right and left coils, the pair of demagnetizing coils disposed on the right and left of the cathode-ray tube is provided along the curved surface of the funnel of the cathode-ray tube.

3 A cathode-ray-tube demagnetizing method according to Claim 2, wherein the maximum intensity of said ac attenuation magnetic fields is set to be greater than the intensity of demagnetizing coils disposed in a display with which the cathode-ray tube is used.