



TITLE OF THE INVENTION

CRT TYPE PROJECTION DISPLAY APPARATUS AND METHOD FOR
EFFECTING A COLOR CORRECTION ON THE CRT TYPE PROJECTION
DISPLAY APPARATUS

5 BACKGROUND OF THE INVENTION

The present invention relates to a CRT type
display apparatus using primary color CRT's and, in
particular, a CRT type projection display apparatus
which corrects an uneven color caused based on
10 different projection angles of the respective CRT's.

A CRT type projection display apparatus using
primary color CRT's (Blue CRT, Green CRT, Red CRT) are
arranged so that their projection angles are mutually
differently set and, relative to that center CRT,
15 those adjacent right and left side CRT's are arranged
at predetermined angles. As a result, the luminance
distribution of the respective primary color images on
the screen produces a delicate difference and this
causes an uneven color when a full white display is
20 made.

As the conventional technique (JPN PAT APPLN KOKAI
PUBLICATION NO. 3-151786) of the optical disk
apparatus, one example is known in which the correction
of an uneven color is made on a CRT type projection
25 display apparatus. Here, multiplying processing is
applied to an uneven color correction waveform and
primary color video signal and, by driving the CRT with



the use of the multiplied output signal, an uneven color is eliminated.

5 This conventional technique is based on the recognition that the uneven color is caused by the different projection angles and this should be eliminated by a electrical approach. In order to more positively correct the uneven color problem, the technique of this Publication is not adequate and more improved approach has to be taken to solve this
10 problem.

BRIEF SUMMARY OF THE INVENTION

The object of the present invention is to provide a CRT type projection display apparatus with a plurality of primary color CRT's which more positively
15 corrects an uneven color caused based on the different projection angles of the respective primary color CRT's and a method for effecting such a color correction.

In one aspect of the present invention, there is provided a CRT type projection display apparatus having
20 a plurality of CRT's supplied at their cathode with primary color video signals to display a projected image of the respective CRT's on a screen, comprising a separation portion which separates synchronizing signals from an input video signal, a correction signal
25 generation circuit which generates an uneven color correction signal on a screen through the utilization of synchronizing signals separated by the separation

portion, a control circuit which controls the correction signal according to the luminance level of primary color video signals supplied to the CRT's, and a supply section which supplies the correction signal which is controlled by the control circuit to a first grid or second grid of the respective CRT.

BRIEF DESCRIPTION OF THE SEVERAL VIEWS OF THE DRAWING

FIG. 1 is a block diagram showing one practical color correction circuit of a CRT type projection display apparatus according to the present invention;

FIG. 2 is a block diagram showing another practical color correction circuit of a CRT type projection display apparatus according to the present invention;

FIG. 3 is a block diagram showing one example of a CRT type projection display apparatus according to the present invention;

FIG. 4 is a block diagram showing one example of a structure of a deflection circuit of the CRT type projection display apparatus according to the present invention;

FIGS. 5A, 5B and 5C are explanatory views showing one example of an outer appearance of the CRT type projection display apparatus;

FIG. 6 is an explanatory view for explaining horizontal and vertical color correction processing on the CRT type projection display apparatus according to

the present invention;

FIG. 7 is a waveform diagram for explaining the generation operation of a horizontal uneven color correction signal according to the present invention;
5 and

FIG. 8 is a waveform diagram for explaining the generation operation of a vertical uneven color correction signal according to the present invention.

DETAILED DESCRIPTION OF THE INVENTION

10 An embodiment of a CRT type projection display apparatus according to the present invention will be explained in more detail below with reference to the drawing.

< CRT type display apparatus according to the present
15 invention>

FIG. 1 is a block diagram showing one practical color correction circuit in the CRT type projection display apparatus according to the present invention. FIG. 2 is a block diagram showing another practical
20 color correction circuit in the CRT type projection display apparatus according to the present invention. FIG. 3 is a block diagram showing one example of a whole structure of the CRT type projection display apparatus according to the present invention. FIG. 4 is a block
25 diagram showing one practical deflection circuit in the CRT type projection display apparatus according to the present invention. FIG. 5 is an explanatory apparatus

according to the present invention.

The CRT type projection display apparatus 1 according to the present invention, though being featured by having a color unevenness correction
5 circuit 48 as shown in FIG. 1 or 2, will first be explained below in connection with its whole structure while referring to FIG. 3. The arrangement of FIG. 3 has a tuner portion 41 for receiving a satellite broadcasting, a ground wave analog broadcasting,
10 a ground wave digital broadcasting, etc., a video amplifier portion 42 for properly amplifying a video output from the tuner portion 41, a primary color output portion 44 for outputting primary color signals (R, G, B signals) based on the output from the video
15 amplifying portion 42, a CRT drive circuit 45 for receiving the primary color output signals from the primary color output portion 44 and outputting CRT drive signals, and CRT's 52R, 52G, 52B having their cathodes supplied with the R, G, B drive signals from
20 the CRT drive circuit 45.

A synchronous separation portion 43 is connected to the video amplifier portion 42 to extract horizontal and vertical synchronous synchronizing signals HP and VP. The horizontal and vertical synchronizing signals
25 HP and VP from the synchronous separation portion 43 are supplied from the synchronous separation portion 43, respectively to horizontal and vertical deflection

circuits 46 and 47 to allow horizontal and vertical deflection currents to flow in deflection coils 51 of the CRTs 52R, 52G, 52B.

On the other hand, the horizontal and vertical
5 synchronizing signals HP and VP from the synchronous separation portion 43 are supplied to a color unevenness correction circuit 48. An AFC (Automatic Frequency Control) pulse A, as well as a voltage B (ABL voltage) which varies in response to a luminance
10 signal, is supplied from the horizontal deflection circuit 46 to the color unevenness correction circuit 48. It is to be noted that the ABL voltage B is also supplied to the video amplifier portion 42 to allow a luminance restriction action to be done.

15 Here, the horizontal deflection circuit 46 includes a high voltage transformer and supplies a high voltage to the anodes of CRTs 52R, 52G and 52B and the color unevenness correction circuit 48 supplies a red color correction signal RH to the CRT 52R, a blue color
20 correction signal BH to the CRT 52B and a green color correction signal GH to the CRT 52G.

With reference to FIG. 1, an explanation will be made in more detail below about the color correction circuit 48. In FIG. 1, the color unevenness correction
25 circuit 48 has integrators 11, 12 supplied with the horizontal synchronizing signal HP from the synchronous separation portion 43, adders 13, 14 for receiving the

outputs of the integrators 11, 12, and integrator 15
supplied with a vertical synchronizing signal VP from
the synchronous separation section 43, an inverter
circuit 16 supplied with an output of the integrator
5 15, a voltage converting portion 17 for outputting
a voltage (ABL voltage) which varies in accordance with
a luminance level of the primary color video signal
supplied from the corresponding CRT, and a mask 18 for
applying mask processing to the output of the voltage
10 converting portion 17.

The adder 13 adds the output of the integrator 11
and output of the integrator 15 and supplies a result
of this addition to a multiplier 19. The adder 14 adds
the output of the integrator 12 and output of the
15 inverter circuit 16 and supplies a result of this
addition to a multiplier 20. The output of the
integrator 15 is supplied to the multiplier 21 and
the output of the mask 18 is supplied to amplifiers 19,
20, 21. The outputs of the multipliers 19, 20 and 21
20 are supplied to amplifiers 22, 23 and 24. From the
amplifiers 22, 23 and 24, the corresponding red, blue
and green color correction signals RH, BH and GH are
obtained. These color correction signals are each
supplied to a corresponding grid G1 (or grid electrode
25 G2) of the respective CRT's 52R, 52B, 52G.

It is to be noted that the integrators 11, 12 and
15, being realizable with an ordinary CR circuit, may

be done so with the use of an op amp. It is preferable to construct the integrators 11, 12, 15 as a digital circuit. In this case, if any uneven color components on a screen are detected in the vertical and horizontal directions on the respective coordinates, the uneven color correction can be properly made by corrected values based on digital values so as to eliminate those uneven color components.

In place of using the above mentioned horizontal synchronizing signal HP and vertical synchronizing signal VP, the correction circuit 48 preferably uses, as shown in FIG. 2, an AFC pulse A from the horizontal deflection circuit 46 and a vertical deflection circuit 47. That is, the correction circuit 48 of FIG. 2 has a horizontal timing pulse generator circuit 31 supplied with the AFC pulse A from the horizontal deflection circuit 46. The output of the pulse generator circuit 31 is supplied to integrators 11 and 12. The horizontal timing pulse generator circuit 31 is comprised of, for example, a monostable multivibrator and which generates a timing pulse of a horizontal color correction signal for red and blue CRT's. Further, through the utilization of the vertical parabolic signal PP for dynamic focus coming from the vertical deflection circuit 47, a parabolic signal PP for vertical period can be obtained without providing the integrator 15 shown in FIG. 1 and this signal is

supplied to an inverter circuit 16, adders 13 and 14 and multiplier 21. The remaining portion of the correction circuit is the same as that of FIG. 1 and any further explanation of it is, therefore, omitted.

5 Here, the arrangement of the horizontal deflection circuit 46 and vertical deflection circuit 47 will be explained below with reference to FIG. 4. In FIG. 4, the horizontal deflection circuit 46 has a horizontal driving circuit 61 supplied with the horizontal
10 synchronizing signal HP output from the synchronous separation portion 43, a horizontal output circuit 62 supplied with an output from the horizontal driving circuit 61 and a horizontal output circuit 62 supplied with an output from the horizontal driving circuit 61,
15 and a high voltage transformer (FBT) 63 connected to the horizontal output circuit 62. The output of the high voltage transformer 63 is delivered to a focus pack 64 and it is supplied to a focusing electrode of the respective CRT. The high voltage output of the
20 high voltage transformer 63 is supplied to the anode of the respective CRT.

 Further, a horizontal AFC pulse A is obtained from a predetermined winding of the high voltage transformer 63. The output of the horizontal output circuit 62 is
25 connected to the horizontal deflection coil of the deflection yoke 51. In the practical form shown in FIG. 2, the horizontal AFC pulse A is supplied to the

color unevenness correction circuit 48. An S shape
correction circuit 65 is connected to the horizontal
deflection coil of the deflection yoke 51. The S shape
correction circuit 65 includes a capacitor, not shown,
5 for S shape correction and a parabolic waveform of
a horizontal period is generated across the S0 shape
correction capacitor. Therefore, this parabolic wave
is utilized as a signal for horizontal dynamic focus.

On the other hand, the vertical deflection circuit
10 47 has a vertical deflection/DPC correction control IC
71 supplied with a vertical synchronizing signal VP
output from a synchronous separation portion 43, a DPC
circuit 72 supplied with an output of the correction
control IC 71, a vertical dynamic focus output portion
15 74 supplied with a vertical dynamic focus parabolic
signal PP, and a vertical deflection output circuit 73
supplied with an output from the correction control IC
71. The output of the vertical deflection output
circuit 73 is supplied to the vertical deflection coil
20 of the deflection yoke 51. It is to be noted that the
DPC represents the right/left pincushion distortion
correction.

A dynamic focus output portion 14 is supplied with
the vertical dynamic focus parabolic signal PP and
25 horizontal dynamic focus signal from the S shape
correction circuit 65 and applies a focus voltage to
the focus electrode of the CRT. Here, in the above

mentioned practical form shown in FIG. 2, the above mentioned vertical dynamic focus parabolic signal PP is supplied to the color unevenness correction circuit 48.

5 The CRT type projection display apparatus 1 according to the present invention has an outer appearance as shown in FIGS. 5A, 5B and 5C. FIG. 5A is a plan view showing a screen S as a display section on a front side, FIG. 5B is a front view showing a green
10 color CRT 52G at a center with red and green color CRT's 52R and 52G arranged at predetermined angles relative to the green color CRT, and FIG. 5C is a side view showing the screen S.
(operation)

15 First, the basic operation of the CRT type projection display apparatus thus structured will be explained below. First, a video signal channel selected at the tuner section 41, after being demodulated, is supplied to a video amplifier portion
20 42 and then to the primary color output portion 44 where the primary colors (R, G, B signals) are obtained. The respective primary color signals R, G, B are supplied through the CRT drive circuit 45 to the cathodes of the CRT's 52R, 52G, 52B. The light beams
25 projected from the CRT's 52R, 52G, 52B are imaged on the screen S and displayed as an image. It is to be noted that the video signal may be not only a video

signal coming from a broadcasting signal received at the tuner portion 41 but also a video signal coming from an outer source, such as a VTR.

Further, the synchronous separation portion 43
5 separates/extracts the horizontal and vertical synchronizing signals HP and VP from the video signal sent from the video amplifier portion 42, and supplied to the horizontal and vertical deflection circuits 46 and 47 by which these signals allow the deflection
10 currents to flow in the horizontal and vertical deflection coils of the deflection yoke 51. Further, the horizontal synchronizing signal HP or horizontal AFC pulse A is sent from the horizontal deflection circuit 46 to the color unevenness correction circuit
15 48 and the vertical synchronizing signal VP or vertical dynamic focus parabolic waveform PP is supplied to the color unevenness circuit 48. Further, the ABL signal is also supplied to the correction circuit 48.

(Color unevenness correction processing)

20 Here, the operation of the color unevenness correction circuit 48 will be explained below with the use of timing charts and explanatory diagrams of FIGS. 6 to 8. In the CRT type projection display apparatus 1 according to the present invention, any
25 uneven color derived from any different projection angles among a plurality of CRT's is corrected by the color unevenness correction circuit 48. This

processing is done by a color correction signal generated based on the horizontal and vertical synchronizing signals HP and VP in the practical form shown in FIG. 1 and by the color correction signal
5 generated based on the horizontal AFC pulse A and vertical dynamic focus parabolic signal PP in the practical form shown in FIG. 2.

It is assumed that, for example, any uneven color areas occur on the screen S as shown in FIG. 6.
10 In this example, a shortage of G, R occur at the top and bottom portions, a shortage of R at a right side portion and a shortage of B at a left side portion of the screen.

In this case, in order to correct any uneven
15 color areas, as shown in FIG. 6, with the use of the correction circuit 48, the horizontal synchronizing signal HP is supplied from the horizontal synchronizing signal HP to the integrators 11 and 12. By setting a proper time constant to the respective integrator,
20 it is possible to obtain corrected waveforms C1, C2 approximate to saw tooth waveforms (see FIG. 6) based on the horizontal synchronizing signal HP. The corrected waveform C1 corresponds to a horizontal color corrected signal for the blue color CRT 52B and
25 the corrected waveform C2 to a horizontal color corrected signal for the red color CRT 52R. These corrected signals C1, C2 emphasize a blue and a red

color shortage at the left and right side areas of the screen S.

Further, the vertical synchronizing signal VP is supplied to the integrator 15 and, as a result of integration, a parabolic waveform C4 is obtained in synchronism with the vertical synchronizing signal VP and, on the other hand, the parabolic waveform C4 is inverted by the inverter circuit 16 to obtain a parabolic waveform C3. The corrected waveform C3 is a vertical color corrected signal for the blue color CRT 52B while, on the other hand, the corrected waveform C4 is a vertical color corrected signal for green and red color CRT's 52G and 52R. The corrected signal C4 is used to emphasize the shortage of G, R at the top and bottom portions of the screen S and the corrected signal C3 is used to deemphasize a blue color component at the top and bottom portions of the screen S, so that correction is made to obtain uniform blue, red and green colors as a whole.

The horizontal color corrected signal C2 and vertical color corrected signal C4 are added together at the adder 13 and the horizontal color corrected signal C1 and vertical color corrected signal C3 are added together at the adder 14. The outputs of the adders 13 and 14 are supplied to the multipliers 19 and 20, respectively, and the vertical color corrected signal C4 is supplied to the multiplier 21. The color

corrected signals from these multipliers 19, 20 and 21 are supplied, respectively, through the amplifiers 22, 23 and 24 to the grid electrodes G1 of the red, blue and green color CRT's 52R, 52B and 52G, so that the
5 horizontal and vertical uneven colors are corrected.

By deciding the time constants of the integrators 11, 12 and 15 according to the uneven color extent in the above mentioned correction processing, it is possible to realize a desired color level correction
10 while setting the degrees of the integration to a proper level.

On the other hand, a voltage (ABL voltage) which varies according to the variation of the luminance signal level is supplied from the voltage converting
15 section 17 to the multipliers 19, 20 and 21 to control the degree of the color correction in accordance with the brightness of the screen. That is, at a full black signal inputting time, the screen appears dark as a whole and, when an uneven color corrected signal is
20 applied to the grid electrode G1, the light emissions of the phosphors cannot be uniformly interrupted, so that an uneven color is generated at a darker portion. In order to prevent this problem, control is made such that, in the case of being a lower luminance level,
25 the potential on the grid electrode G1 is set to a 0V while, at a higher luminance signal level and at a wholly bright image screen, an uneven color corrected

signal is supplied to the grid electrode G1.

Further, a vertical blanking pulse VBLK is supplied to the mask circuit 18 and, at the vertical retrace interval, any uneven color correction is not done, so that any rise of the luminance level during the vertical retrace interval is prevented.

FIGS. 7 and 8 show the operation waveforms for generating the above mentioned correction signals C1, C2 and C3. FIG. 7 shows the horizontal AFC pulse A in the circuit arrangement shown in FIG. 2 and a timing pulse T from the horizontal timing pulse generator circuit 31. The horizontal timing pulse generator circuit 31 makes use of, for example, a monostable multivibrator and can obtain timing pulses T (solid and dotted pulses). The corrected signal C1 is obtained by integrating the timing pulse T (solid line) by the integrator 12 and the corrected signal C2 is obtained by integrating the timing signal T (dotted line) by the integrator 11.

FIG. 8 shows an operation waveform of the integrator 15 shown in FIG. 1 and the vertical synchronizing signal VP is integrated once to obtain a saw tooth waveform and integrated twice to obtain a parabolic waveform of a vertical period. It is to be noted that the parabolic waveform of a vertical period can also be utilized for the vertical dynamic focus parabolic signal PP in which case it is possible to

eliminate the integrator 15 as shown in FIG. 2.

According to the embodiments of FIGS. 1 and 2, therefore, any desired color correction signal can be obtained by utilizing the signals for use in
5 the horizontal deflection circuit 46 and vertical deflection circuit 47.

The color correction processing need not necessarily be done on the horizontal and vertical components at a time and it is also been done
10 effectively on the horizontal component only. Or, the correction processing may be done on the vertical component alone.

In the present invention, any uneven color correction signal is not applied to the video signal and it is supplied to the grid electrode G1 (or grid
15 electrode G2) for correction to be made. It is, therefore, possible to suppress, to a minimal extent, any adverse effect on an image quality at any high frequency area which might be produced due to the
20 addition of the uneven color correction circuit 48.

The present invention can be realized by those skilled in the art based on the various embodiments achieved either singly or in combination. The present invention can be applied over a broader range of any
25 disclosed principles and over a range not inconsistent with the novel features disclosed in the above mentioned embodiments of the present invention and

should not be restricted to the above mentioned
embodiments alone.

WHAT IS CLAIMED IS:

1. A CRT type projection display apparatus including a plurality of CRT's having cathodes supplied with primary color video signals and displays an image which is projected from the CRT's onto a screen, comprising:

a separation portion which separates synchronizing signals from an input video signal;

a correction signal generating circuit which generates correction signals for correcting any uneven color on the screen through the utilization of the synchronizing signals separated by the separation portion;

a control circuit which controls the correction signal according to a luminance level of the primary color video signals which are supplied to the CRT's; and

a supply section which supplies the correction signal which is controlled by the control circuit to a first grid or a second grid of the respective CRT.

2. A CRT type projection display apparatus according to claim 1, wherein the plurality of CRT's are arranged so that a green color CRT is located at a center with adjacent red and blue color CRT's are set relative to the center green color CRT in a symmetrical relation.

3. A CRT type projection display apparatus

according to claim 1, wherein a mask is provided for inhibiting the supply of the correction signal to the first grid or second grid of the CRT's during a vertical retrace interval.

5 4. A CRT type projection display apparatus according to claim 1, wherein the correction signal generation circuit generates a horizontal color correction signal for red and blue color CRT's, based on the horizontal synchronizing signal separated from
10 the input video signal.

 5. A CRT type projection display apparatus according to claim 1, wherein the correction signal generation circuit has integrator circuits which integrates a signal which is synchronized with the
15 horizontal synchronizing signal by a respective different time constant, and generates a horizontal color correction signal for the red color CRT and a horizontal color correction signal for the blue color CRT.

20 6. A CRT type projection display apparatus according to claim 1, wherein the correction signal generation circuit generates, based on a horizontal AFC pulse, horizontal correction signals for the red and blue color CRT's.

25 7. A CRT type projection display apparatus according to claim 1, wherein the correction signal generating circuit generates, based on a vertical

synchronizing signal separated from the input video signal, vertical color correction signals for the red and green color CRT's and, by inverting the phase of the vertical color correction signal, generates
5 a vertical color correction signal for the blue color CRT.

8. A CRT type projection display apparatus according to claim 7, wherein the correction signal generating circuit has an integration circuit which
10 integrates a signal which is synchronized with the vertical synchronizing signal to generate vertical color correction signals for red and green color CRT's and a phase inverting circuit which phase inverts the vertical color correction signal from the integration
15 circuit, and generates a vertical color correction signal for the blue color CRT.

9. A CRT type projection display apparatus according to claim 7, wherein the correction signal generation circuit generates vertical color correction
20 signals for the red and green color CRT's with the use of a vertical dynamic focus signal generated by the vertical synchronizing signal and generates a vertical color correction signal for the blue color CRT by phase inverting the vertical dynamic focus signal.

25 10. A CRT type projection display apparatus having a green color CRT and adjacent red and blue color CRT's arranged on both ends of the green color

CRT and supplies primary color video signals to the respective CRT's and display projection images from the respective CRT's onto a screen, comprising;

5 a synchronous separation portion which separates horizontal and vertical synchronizing signals from an input video signal;

a first correction signal generation circuit configured to, in order to correct a horizontal uneven color on the screen caused by the red and blue color CRT's, generate first and second horizontal correction signals of saw tooth waveforms through the utilization of a signal synchronized with the horizontal synchronizing signal;

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a second correction signal generating circuit configured to, in order to correct a vertical uneven color on the screen caused by the red and green color CRT's, generate a first vertical color correction signal of a parabolic waveform synchronized with the vertical synchronizing signal and configured to,

15

20 in order to correct a vertical uneven color on the screen caused by the blue color CRT, generate a second vertical color correction signal by inverting the first vertical color correction signal;

a first adding circuit which adds the first vertical color correction signal to the first horizontal color correction signal;

25

a second adding circuit which adds the second

vertical color correction signal to the second
horizontal color correction signal;

5 a control circuit which controls the outputs of
the first and second adding circuits and first vertical
color correction signal according to the luminance
levels of primary color video signals which are
supplied to the respective color CRT's;

10 a supply section which supplies the correction
signal which is controlled by the control circuit to a
first grid or second grid of the corresponding CRT; and

a mask which inhibits the supply of the correction
signal to the first grid or second grid of the
respective CRT during the vertical retrace interval.

11. A method for effecting a color correction on
15 a CRT type projection display apparatus, comprising:

a step of supplying primary color video signals to
a plurality of CRT's;

20 a step of generating a correction signal for
correcting an uneven color on a screen through the
utilization of synchronizing signals separated from
an input video signal;

a step of controlling the correction signal
according to the luminance level of the primary color
video signal supplied to the CRT; and

25 a step of supplying the controlled correction
signal to a first grid or second grid of each CRT.

12. A method according to claim 11, wherein the

plurality of CRT's are arranged so that a green color CRT is arranged at a center and adjacent red and blue color CRT's are symmetrically set relative to the green color CRT.

- 5 13. A method according to 11, wherein the supply of the correction signal to the first grid or second grid of the respective CRT is inhibited during a vertical retrace interval.