United States Patent

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[54] APPARATUS FOR MAINTAINING COLOR BALANCE DESPITE VARIATIONS OF THE SUPPLY VOLTAGE

2 Claims, 1 Drawing Fig.

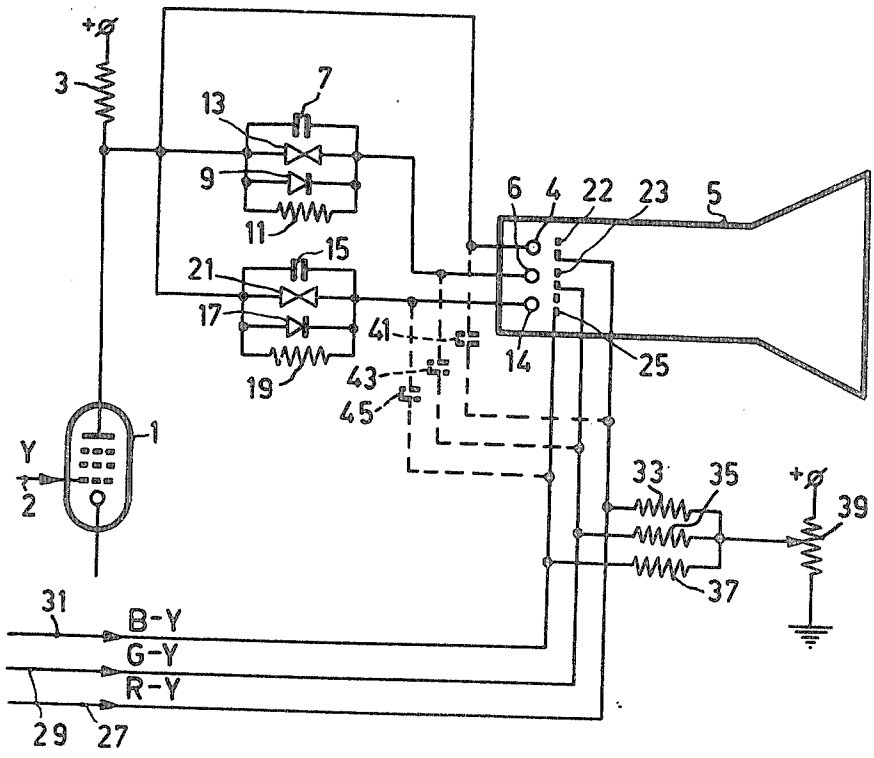
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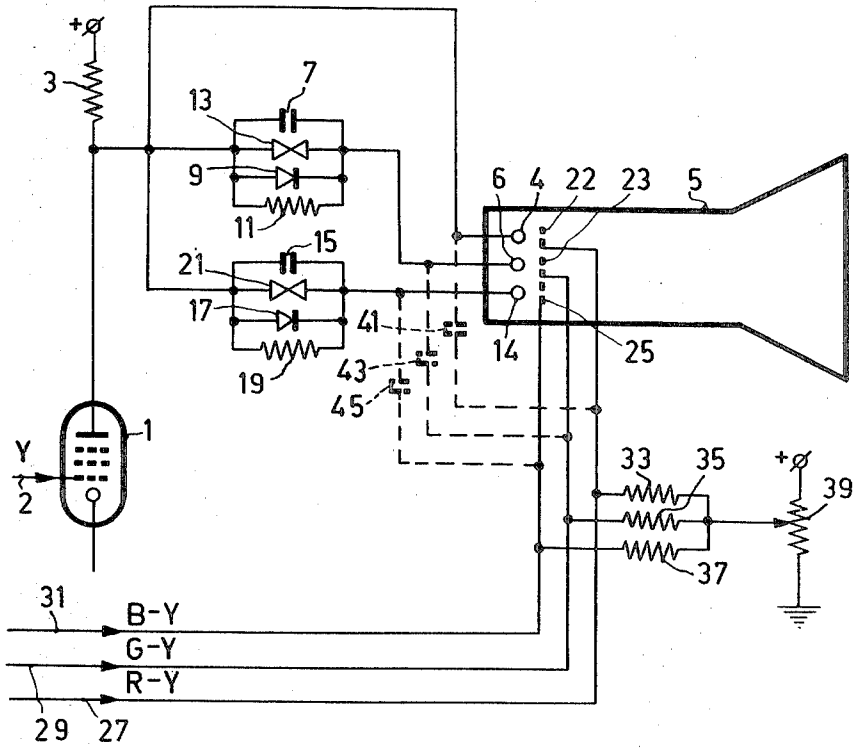
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ABSTRACT: In a three-gun color display tube at least one of the cathodes is connected to the luminance amplifier through a nonlinear negative feedback resistive circuit, which is at least partially shunted by a unilaterally conducting element.



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APPARATUS FOR MAINTAINING COLOR BALANCE DESPITE VARIATIONS OF THE SUPPLY VOLTAGE

In a three-gun color display tube at least one of the cathodes is connected to the luminance amplifier through a nonlinear negative feedback resistive circuit, which is at least partially shunted by a unilaterally conducting element.

The invention relates to a display device for a color television system including a display tube at least one of the cathodes of which is connected with respect to direct current through a nonlinear negative feedback resistive circuit to the output electrode of a luminance signal amplifier, said output electrode furthermore being connected through a resistor to a supply source.

A display device of the type described above is known from Dutch Pat. application 292,267. A very satisfactory color balance in the picture displayed is maintained in a simple manner with the aid of such a device upon variations in the supply voltage. However, in such a display device unwanted aftereffects in the form of so-called color smears may become visible upon some color transitions in a picture displayed.

It is an object of the invention to limit these aftereffects as much as possible.

To this end a display device of the kind described in the preamble according to the invention is characterized in that the nonlinear negative feedback resistive circuit is at least partly shunted by an element unilaterally conducting in the direction from the output electrode to the cathode.

The applicant has found that the aftereffects are the result of the parasitic capacitance between the cathode and the associated control electrode of the gun (or the guns) in the cathode line which include a nonlinear negative feedback resistor. In fact, the nonlinear resistor has a large value when the cathode of the relevant gun is greatly positive relative to the control electrode and has a smaller value when the cathode is less positive. Upon a variation of the voltage difference between the relevant cathode and the corresponding control electrode, at which the cathode becomes more positive relative to the control electrode, the time constant of the series arrangement of the nonlinear negative feedback resistor and the parasitic capacitance between the cathode and the control electrode increases, so that this capacitance is recharged more slowly. A positive going step of the voltage at the output electrode of the luminance signal amplifier relative to that at the associated control electrode cannot be followed sufficiently quickly by the relevant cathode, unless the step according to the invention is taken.

An unilaterally conducting element provided across the voltage dependent cathode-resistor according to the invention recharges the said parasitic capacitance, when the voltage at the cathode is lower than that at the output electrode of the luminance signal amplifier. This results in a quick following of the cathode voltage during the above-mentioned voltage steps.

In order that the invention may be readily carried into effect, an embodiment thereof will now be described in detail by way of example with reference to the accompanying diagrammatic drawing.

In the drawing, which has only one FIGURE, details which are not important for a good understanding of the invention have been omitted.

The FIGURE illustrates by way of a nondetailed diagram a connection between a luminance signal output value and the cathodes of a color television picture display tube according to the invention.

An anode of a luminance signal amplifier output value 1 to the control grid of which a luminance signal Y is applied through an input 2, is connected through a resistor 3 to a positive supply voltage source. The anode of the valve 1 is furthermore directly connected to a cathode 4 of a picture display tube 5. A second cathode 6 of the picture display tube 5 is connected to the anode of the value 1 through a parallel arrangement of a capacitor 7 and a resistor 13 shunted by a diode 9 and a resistor 11 according to the invention. A third cathode 14 of the picture display tube 5 is connected to the

anode of the valve 1 through a parallel arrangement of a capacitor 15 and a nonlinear resistor 21 shunted, according to the invention, by a diode 17 and a resistor 19.

The picture display tube 5 has three control electrodes 22, 23 and 25 which are arranged opposite the cathodes 4, 6 and 14, respectively. The control electrodes are connected to inputs 27, 29 and 31 to which color difference signals R–Y, G–Y and B–Y are applied from sources having impedances which are low at least with respect to high frequencies. The control electrodes 22, 23 and 25 are furthermore connected through resistors 33, 35 and 37 to an adjustable tapping on a potentiometer 39 connected to a supply source. The luminance of the picture to be displayed can be adjusted with the aid of the potentiometer 39.

As a result of the nonlinear negative feedback resistors 13, 21 in the cathode lines of the cathodes 6 and 14, it is achieved that the sensitivity of the three electrode systems of the display tube 5 is substantially equal. In case of supply voltage variations the correct color balance is therefore maintained on the display tube 5.

The operation of the circuit arrangement will now be described in so far as this is important for the understanding of the invention.

The first cathode 4 of the picture display tube 5 and the control electrode 22 are supplied by a signal source having a low impedance. The second and third cathodes 6 and 14 are each supplied through an impedance by the output valve 1. As a result of parasitic capacitance (shown in the FIGURE by a broken line and indicated by the reference numerals 41, 43 and 45) between the corresponding cathodes and control electrodes, these mentioned impedances exert influence on the display of steplike signals which are supplied to the cathodes 6 and 14 and the control electrodes 23 and 25. As an example will now be checked the behavior of the cathode-wehnelt combination 6, 23 in cooperation with the impedance formed by the parallel arrangement 7, 9, 11 and 13. When the cathode 6 is slightly more positive than the control electrode 23, much current flows through the nonlinear resistor 13 and its resistance is small. The value of the resistor 11 is now large relative to that of the nonlinear resistor 13. In a stationary condition the capacitor 7 and the diode 9 do not convey current. In fact, the diode 9 is connected in such a manner that is is blocked when a current flows from the cathode 4 to the anode of the valve 1, which will always be the case in the stationary condition. If the cathode 6 becomes more positive relative to the control electrode 23, little current flows through the nonlinear resistor 13 and its resistance is large. If the influence of the resistor 11 is left out of consideration, the behavior of the circuit arrangement in case of a sudden transition from the one above-described stationary condition to the other is as follows. For a transition at which first little and then much current flows through the cathode 6, a negative voltage step at the anode of the valve 1 must occur relative to the signal source connected to the input 29. Part of this voltage step in a negative direction is immediately transferred by the capacitor 7 to the parasitic capacitor 43, whereafter the capacitor 43 is quickly further discharged through the then low resistance of the nonlinear resistor 13. The diode 9 thus remains blocked all the time.

If a voltage step in a positive direction occurs between the anode of the valve 1 and the signal source connection 29 for the purpose of changing a large cathode current into a small one, the value of the nonlinear resistor 13 will increase so that it will not be able to quickly charge the parasitic capacitor 43. At the beginning of the voltage step the voltage across the cathode 4 and the parasitic capacitor 43 will remain lower than that across the anode of the valve 1. The diode 9 then conducts and the parasitic capacitor 43 is quickly charged through the diode 9. Without this diode 9 a positive going voltage step could not be followed sufficiently quickly by the parasitic capacitor 43 and hence by the cathode 6. This could become visible in the displayed picture as an aftereffect, the so-called color smears. In case of small positive going voltage

steps the diode **9** is not very active due to the curvature of its characteristic. The resistor **11** connected in parallel with the diode **9** provides a somewhat quicker charge of the parasitic capacitor **43** in case of these small voltage steps and consequently a decrease of the aftereffect.

The influence of the diode **17** and the resistor **19** for voltage steps between the cathode **14** and the control electrode **25** can be explained in an analogous manner.

In the foregoing a parallel arrangement is described of a diode **9**, **17** and a resistor **11**, **19** to improve the transfer of positive going voltage steps from the anode of the valve **1** to the cathode **6**, **14** through the nonlinear resistor **13**, **17**. It will be evident that any combination of elements which has a nonlinear characteristic equal to that of the parallel arrangement of said elements will be usable to prevent the said aftereffects. It will furthermore be evident that the diodes **9** and **17** may be

connected across part of the nonlinear resistors **13** and **21** if these are built up from a number of components.

We claim:

1. A display device for a color television system including a display tube at least one of the cathodes of which is connected with respect to direct current through a nonlinear negative feedback resistive circuit to the output electrode of a luminance signal amplifier, said output electrode being furthermore connected through a resistor to a supply source, characterized in that the nonlinear negative feedback resistive circuit is at least partly shunted by an element unilaterally conducting in the direction from the output electrode to the cathode.

2. A display device as claimed in claim **1**, wherein the unilaterally conducting element is a diode, characterized in that the diode is shunted by a resistor.