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3,395,311 7/1968 Harsh 315/22

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[54] **HIGH-VOLTAGE REGULATION AND PROTECTION CIRCUIT**
9 Claims, 1 Drawing Fig.

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R, 27 F

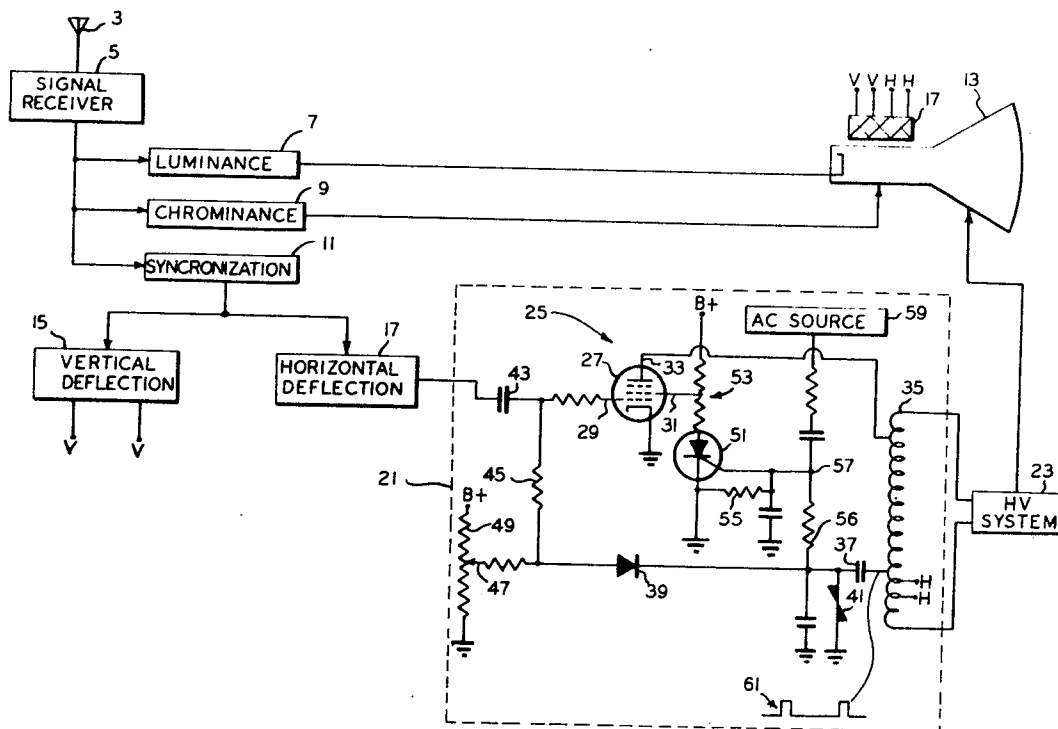
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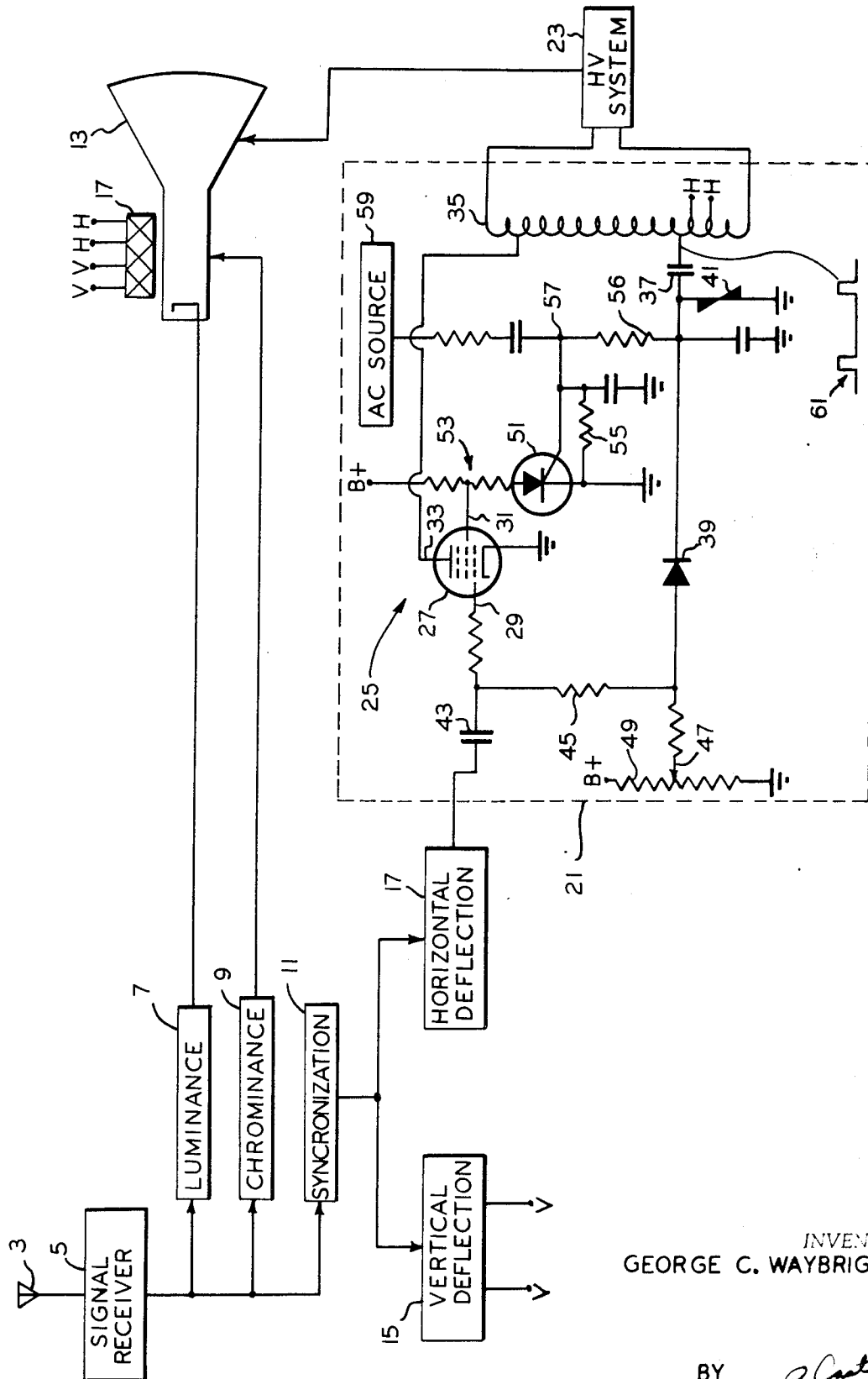
UNITED STATES PATENTS

3,077,550 2/1963 Macovski 315/22

3,271,617 9/1966 Boekhorst 315/27 VDR

ABSTRACT: High-voltage regulation and protection circuitry includes a current-generating means in the form of an electron device having an output electrode coupled to a load circuit, a feedback bias means coupling a potential from the load circuit to a first control electrode of the electron device, and a switching means coupled to the junction of the feedback bias means and an AC source and to the second control electrode of the electron device whereby the feedback bias means regulates the load circuit potential which controls the high voltage and the switching means responds to a component failure of the feedback bias means to reduce the potential of the load circuit and the high voltage.





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HIGH-VOLTAGE REGULATION AND PROTECTION CIRCUIT

BACKGROUND OF THE INVENTION

Cathode-ray tube systems and particularly cathode-ray tube systems employed in color television receivers require a source of high-voltage potential. Normally, the high-voltage source is subject to undesired variations due to alterations in loading caused by variations in the intensity of the electron beam of the cathode-ray tube. Moreover, it is a common practice to provide some form of regulation, a shunt regulator system for instance, in an attempt to maintain a substantially constant value of high-voltage potential.

Although shunt regulator systems have been and still are widely accepted as a form of high-voltage regulation, it has been found that they do leave something to be desired in that failure of the shunt regulator tube tends to cause an undesired relatively large increase in high-voltage potential. Unfortunately, increased high-voltage potential is practically undiscernable to a nonskilled viewer of the cathode-ray tube. Moreover, increased high voltage is deleterious to the apparatus and usually causes an undesired increase in X-ray radiation emanating from the receiver.

One known form of apparatus for overcoming the above-mentioned problem of shunt regulator tube failure is set forth in U.S. Pat. No. 3,440,481 issued Apr. 22, 1969 to D. W. Rhee et al. and assigned to the assignee of the present application. Therein, a unidirectional conductive device in series connection with the shunt regulator tube serves, in essence, as a switch disconnecting a reference voltage upon failure of the shunt regulator tube whereupon the bias voltage of the system is increased and the high-voltage potential reduced.

Another known system for overcoming shunt regulator tube failure is depicted in U. S. Pat. No. 3,445,717 issued on May 20, 1969 to R. R. Eckenbrecht et al. and assigned to the assignee of the present application. Therein, a unidirectional conduction device couples the shunt regulator tube to a potential reference level and, upon failure of the shunt regulator tube, a bias-developing means applies an increased bias potential to a signal brightness amplification means causing a reduction in brightness of the cathode-ray tube. While the above-mentioned circuitry and apparatus is particularly adapted to shunt regulation systems employing a shunt regulator tube, it has been found that other high-voltage systems also need regulatory and protective circuitry. For instance, it has been found that multiplier-type high-voltage systems wherein the high-voltage potential for the cathode-ray tube is developed by voltage multiplier apparatus need not only voltage regulation circuitry but also protective circuitry in the event of component failure in the voltage regulator circuitry.

OBJECTS AND SUMMARY OF THE INVENTION

It is an object of the present invention to provide protection circuitry for a cathode-ray tube system. Another object of the invention is to provide component failure protection for a cathode-ray tube system. A further object of the invention is to provide feedback bias regulation circuitry in conjunction with component failure protection for a cathode-ray tube high-voltage system.

These and other advantages and capabilities are achieved in one aspect of the invention by high-voltage regulation and protection circuitry for a cathode-ray tube system wherein a current-generating means has an output electrode coupled to a load circuit, a feedback bias means couples the load circuit to a first control electrode, and a switching means couples a junction intermediate the feedback bias means and an AC source to a second control electrode of the current-generating means.

BRIEF DESCRIPTION OF THE DRAWING

The sole figure illustrates, in block and schematic form, a television receiver having a cathode-ray tube system employing a preferred form of high-voltage regulation and protection circuitry.

DESCRIPTION OF THE PREFERRED EMBODIMENT

For a better understanding of the present invention, together with other and further objects, advantages and capabilities thereof, reference is made to the following disclosure and appended claims in conjunction with the accompanying drawing.

Referring to the drawing, a color television receiver includes an antenna 3 for intercepting broadcast signals. The antenna 3 is coupled to a signal receiver 5 having the usual radio frequency (RF) and intermediate frequency (IF) amplifier and detector stages wherefrom is provided a composite video signal. This composite video signal is applied to a luminance channel 7, a chrominance channel 9, and a synchronizing channel 11.

In the usual manner, the luminance channel 7 provides a signal representative of brightness information which is applied to a cathode-ray tube 13. The chrominance channel 9 responds to the composite video signal to provide signals representative of color information which are applied to the cathode-ray tube 13.

Also, the synchronizing channel 11 responds to the composite video signal to provide activation of a vertical deflection stage 15 wherefrom vertical deflection signals appearing at a pair of output terminals V—V are applied to a pair of terminals V'—V' of deflection apparatus 17 associated with the cathode-ray tube 13. The synchronizing channel 11 also activates a horizontal deflection stage 19 which is coupled to a high-voltage regulation and protection circuit 21. In turn, the high-voltage regulation and protection circuit 21 is coupled to a high-voltage system 23, which may be in the form of a voltage multiplier for instance, wherefrom high-voltage potentials are developed and applied to the cathode-ray tube 13.

In the high-voltage regulation and protection circuit 21, a current-generating means 25 in the form of a horizontal output stage includes an electron device 27 having a first control electrode 29, a second control electrode 31, and an output electrode 33. A flyback transformer or load circuit 35 is coupled to the output electrode 33 and includes the usual coupling to the high-voltage system 23 as well as a pair of terminals H—H wherefrom horizontal deflection signals are applied to a similar pair of terminals H'—H' of the deflection apparatus 17 associated with the cathode-ray tube 13.

A feedback bias means including a series connected capacitor 37 and unidirectional conduction device 39 with a voltage dependent resistor (VDR) 41 coupling the junction of the capacitor 37 and unidirectional conduction device 39 to a potential reference level, such as circuit ground, couples the load circuit 35 back to the first control electrode 29 of the electron device 27. Also, the first control electrode 29 is coupled by a capacitor 43 to the horizontal deflection stage 19 and by a resistor 45 to the adjustable arm 47 of a resistor 49 coupled intermediate a potential source B+ and a potential reference level such as circuit ground.

A switching means in the form of a silicon control rectifier (SCR) 51 has an anode coupled by way of a voltage divider 53 to the second control electrode 31 of the electron device 27 and to a potential source B+. The cathode of the SCR 51 is coupled to circuit ground and via a resistor 55 to the gate electrode of the SCR 51. This gate electrode is coupled to a junction 57 intermediate the jointure of the series connected capacitor 37 and a resistor 56 coupled to the unidirectional conduction device 39 of the feedback bias means and an AC source 59.

As to operation, a flyback plus voltage 61 available at the load circuit 35 has a magnitude which varies inversely with the brightness of the cathode-ray tube 13. In other words, an increase in brightness of the cathode-ray tube 13 causes a decrease in the magnitude of the flyback pulse voltage 61. This flyback pulse voltage 61 is applied to the capacitor 37 of the feedback bias means whereon a charge potential is developed by way of the voltage dependent resistor (VDR)

The charge potential developed at the capacitor 37 is applied via the diode 39, which is forward biased, to the first control electrode 29 of the electron device 27. Also, a predetermined amount of bias potential of a polarity opposite to the charge potential of the capacitor 37 and developed at the adjustable resistor 49 is applied to the first control electrode 29 of the electron device 27. In other words, the potential difference between the charge potential of the capacitor 37 and the developed potential at the resistor 49 is the bias potential applied to the first control electrode 29 of the discharge device 27. Moreover, the charge potential of the capacitor 37 and the bias potential applied to the first control electrode 29 varies in a manner which is dependent upon the brightness of the cathode-ray tube 13 and serves to regulate the high voltage applied to the cathode-ray tube 13.

As to the protective circuitry, the silicon control rectifier 51 is normally maintained in a nonconductive state due to the application to the gate electrode thereof of a relatively small bias potential. This small bias potential is derived from the charged capacitor 37 and applied to the gate electrode via the voltage divider resistors 55 and 56. Due to the nonconductive state of the SCR 51, a desired potential, derived from the potential source B+ and suitable for normal operation of the electron device 27, is applied to the second control electrode 31. Thus, the electron device 27 responds in a normal manner to signal variations at the first control electrode 29 to provide corresponding variations at the output electrode 33.

However, failure of a component of the feedback bias means circuitry, the VDR 41 for instance, causes a substantial reduction in the charge potential developed at the capacitor 37. In turn, the forward biased conduction condition of the diode 39 is switched to a reverse biased nonconduction condition whereupon grid current flow occurs at the first control electrode 29 of the electron device 27 developing a charge on the capacitor 43 to provide a self-bias condition of the electron device 27.

Also, the reduction in charge potential at the capacitor 37 is applied via the voltage divider resistors 55 and 56 to the gate electrode of the SCR 51. This reduced potential encounters a positive-going portion of potential from the AC source 59 in an amount sufficient to activate the gate electrode and cause conduction of the SCR 51. In turn, conduction of the SCR 51 causes a reduction in the potential applied to the second control electrode 31 from the potential source B+ via the voltage divider 53. As a result, the output potential available from the output electrode 33 of the electron device 27 and applied to the load circuit 35 decreases causing a decrease in high-voltage potential from the high-voltage system 23 which is applied to the cathode-ray tube 13.

It should be noted that the potential from the AC source 59 becomes available at the same time or later than the availability of a potential from the high-voltage system 23. Should the potential from the AC source 59 appear before the potential from the high-voltage system 23, it can readily be seen that the SCR 51 would be undesirably triggered into a conductive state whereupon the desired output and high-voltage potentials would not be achieved.

Thus, the cathode-ray tube 13 is protected from the application of excessive high voltage even though there is a component failure of the feedback bias means which normally maintains a substantially uniform high voltage. Also, the viewer is protected from excessive X-ray radiation from the cathode-ray tube 13 even though an undesired failure of a component of the feedback bias means occurs. Moreover, the protective means serves to effect alteration of the viewed scene such that an observer is made aware of an existing problem and can institute remedial action.

In this manner, there has been provided unique high-voltage regulation and protection circuitry for a cathode-ray tube system which is believed to be unavailable in any other apparatus. The circuitry is relatively inexpensive and not only maintains a substantially constant high-voltage potential but also protects the viewer in case of component failure and

serves to provide a visual indication that AC failure has occurred. Moreover, the circuitry is readily employed with multiplier-type high-voltage systems as well as other known circuitry normally utilized in high-voltage systems for cathode-ray tubes.

While there has been shown and described what is at present considered the preferred embodiment of the invention, it will be obvious to those skilled in the art that various changes and modifications may be made therein without departing from the invention as defined by the appended claims.

I claim:

1. In a cathode-ray tube system having a high-voltage source and a cathode-ray tube with a high-voltage electrode coupled to the high-voltage source, high-voltage regulation and protection circuitry comprising in combination:

current generating means including an electron device having a first control electrode, a second control electrode, and an output electrode and a load circuit coupling the output electrode to said high voltage source;

feedback bias means coupling said load circuit to said first control electrode of said electron device to effect variations in bias potential applied to said electron device in accordance with variations in potential of said load circuit;

an AC source providing a potential available upon the availability of a potential from said high-voltage source; and

switching means coupled to a junction intermediate said feedback bias means and said AC source and said second control electrode of said electron device whereby failure of a component of said feedback bias means causes activation of said switching means effecting a reduction in potential applied to said second control electrode and said load circuit.

2. The combination of claim 1 wherein said feedback bias means includes a capacitor coupling said load circuit to said first control electrode of said electron device and a voltage dependent resistor coupling the junction of said capacitor and first control electrode to a potential reference level.

3. The combination of claim 1 wherein said feedback bias means includes a capacitor and a second switching means series connected intermediate said load circuit and said first control electrode of said electron device and a voltage dependent resistor coupling the junction of said series connected capacitor and second switching means to a potential reference level.

4. The combination of claim 1 wherein said switching means is in the form of a silicon control rectified (SCR) having a gate electrode coupled to said junction intermediate said feedback bias means and said AC source.

5. The combination of claim 1 wherein said switching means is in the form of a silicon control rectified (SCR) having an anode electrode coupled to a DC potential source and to said second control electrode of said electron device, a cathode electrode coupled to a potential reference level, and a gate electrode coupled to a junction intermediate said feedback bias means and said AC source.

6. The combination of claim 1 wherein said current-generating means includes a bias-setting means in the form of an adjustable resistor coupled intermediate a potential source and a potential reference level and to said first control electrode of said electron device.

7. In a television receiver having a cathode-ray tube coupled to a high-voltage source, high-voltage regulation and protection circuitry comprising in combination:

a horizontal output stage including a load circuit and an electron device having a first control electrode coupled to a bias means and to a signal source, a second control electrode coupled to a potential source, and an output electrode coupled to said load circuit, said load circuit being coupled to said high voltage source;

5

feedback bias means including a capacitor coupling said load circuit to said first control electrode of said electron device and a voltage dependent resistor coupling the junction of said capacitor and first control electrode to a potential reference level:
an AC source providing a potential available upon availability of a potential from said high voltage source; and protection switching means including a switching means connected intermediate a potential source and a potential reference level and coupled to said second control electrode of said electron device and to a junction intermediate said feedback bias means and an AC source whereby said feedback bias means controls the operation of said horizontal output stage and said high-voltage source and said protection switching means responds to component failure of said feedback bias means to reduce

6

the potential from said high-voltage source.
8. The combination of claim 7 wherein said load circuit is in the form of a horizontal output transformer coupled to a high-voltage source in the form of a voltage multiplier circuit and said feedback bias means includes a capacitor, diode, and impedance series connected intermediate said load circuit and said first control electrode of said electron device and a voltage dependent resistor coupling the junction of said capacitor and diode to a potential reference level.
9. The combination of claim 7 wherein said feedback bias means includes an impedance in the form of an adjustable resistor connected intermediate a potential source and a potential reference level with alterable arm coupled to said first control electrode of said electron device and by a diode to said capacitor.

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