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(72) Inventor ALLEN LEROY LIMBERG

(54) PROTECTION CIRCUIT

(71) We, RCA CORPORATION, formerly Radio Corporation of America, a corporation organised under the laws of the State of Delaware, United States of America of 30 Rockefeller Plaza, City and State of New York, United States of America, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to means for protecting solid-state amplifiers that are a.c. coupled to electrodes subject to arc-over from a high voltage source.

In colour television receivers, for example, it is often desirable to a.c. couple the output electrode of respective transistor amplifiers to respective control grids of a colour kinescope. Whether the amplifiers supply colour difference signals or red, green and blue video signals, circuits are generally provided for setting the d.c. level on the control grids of the kinescope during the line retrace periods. Arc-over from high voltage electrodes within the kinescope to the control grids can cause a surge of current that could impair or destroy the transistors.

According to the present invention there is provided a protection circuit for television receiver transistor video amplifiers which are a.c. coupled by respective coupling networks to a kinescope display device, wherein said amplifier coupling networks include respective first rectifier devices which are keyed into conduction during retrace intervals to establish a desired d.c. voltage level at said kinescope display device, said protection circuit being characterized by a second rectifier device being connected in series with said respective first rectifier devices and a low impedance source of potential, wherein said source of potential has a value sufficient to keep said second rectifier device reverse biased during normal receiver operation.

[*Price 5s. 0d. (25p)*]

The invention may be best understood by reference to the following description taken in conjunction with the accompanying drawing.

In the drawing, signals intercepted by an antenna 2 are applied to means 4 that includes a tuner, intermediate frequency amplifier, second detector and video amplifier. The video signals are coupled to a deflection system 6 that supplies deflection currents to a yoke 8 that deflects the electron beams of a colour kinescope 10 so that they scan a raster on the target structure such as a phosphor dot screen 12 and an apertured mask 14. In a receiver where the matrixing of the luminance or Y signals, and the colour difference signals is performed within the kinescope 10, the video signals are applied with appropriate relative levels to the respective cathodes 16, 18 and 20 via a multiple tap potentiometer 22.

The video signals are also coupled from the means 4 to each of the color signal sources 24, 26 and 28, which, in the particular circuit shown, develop the colour difference signals R—Y, G—Y and B—Y respectively. Base electrodes 30, 32 and 34 of the transistor driver amplifiers 36, 38 and 40 are respectively coupled to the signal sources 24, 26 and 28; and their emitter electrodes 42, 44 and 46 are respectively connected to ground by degenerative resistors 48, 50 and 52. The collector electrodes 54, 56 and 58 are respectively coupled to the control grids 60, 62 and 64 via coupling capacitors 66, 68 and 70 in series with delay resistors 79, 72 and 74. Collector resistors R are connected between each of the collector electrodes 54, 56 and 58 and a point of positive direct current operating voltage. Bias voltage for the control grids 60, 62 and 64 is supplied by the direct current connection of the resistors B to a point of positive operating potential, and although not shown, means are provided for establishing the cathodes 16, 18 and 20 at a more positive potential than the grids in order to set the bias at a correct operating point.

The loss of the direct current level of the color difference signals resulting from the use of the capacitors 66, 68 and 70 can be restored by keyed clamp circuits in which diodes 76, 78 and 80 are respectively connected in direct current paths between the control grids 60, 62 and 64 and a lead 82 that joins resistors 84 and 86. These resistors are connected in series between a point 88 of positive potential and the collector electrode 90 of a transistor 92. The emitter electrode 94 is connected to ground, and positive flyback pulses 96 derived from the deflection system 6 during the line retrace intervals are applied across a resistor 98 that is connected between the base electrode 100 and ground so as to cause saturated conduction in the transistor 92 and place its collector electrode 90 near ground potential. Thus the transistor 92 acts as a switch. Between flyback pulses, the transistor 92 has negligible conduction in view of the fact that ground potential is applied to both the emitter and base electrodes. This permits the elimination of any charge that has accumulated on the capacitors 66, 68 and 70 during the scanning of each line and sets the charge at a value determined by the difference between the voltages at the collector electrodes and the voltage on the lead 82. Since color difference signals are blanked during the line retrace interval, the voltage at the collector electrodes can be set at a level derived for a zero value of the color difference signals. It will be noted that when the transistor 92 conducts, the voltage on the lead 82 is reduced from that at the point 88 by the dividing action of the resistors 84 and 86, but that when the transistor 92 is not conducting, the situation that prevails during line scanning, the voltage on the lead 82 is more positive and equal to that at the point 88. Thus by making the voltage at the point 88 sufficiently positive, the diodes 76,78 and 80 can be back biased so that they do not conduct during the scanning of a line.

With the circuit thus far described, an arc-over from a high voltage point such as the ultor 12 to any of the control grids 60, 62 or 64 would produce a surge signal across the corresponding transistor amplifier that could impair or even destroy it. In accordance with this invention, a diode 102 is connected between the lead 82 and the point of positive potential 88. The capacitor 104 that is connected between the point 88 and ground is the large capacitor usually found at the output of a.c. to d.c. power supplies for television receivers. If an arc-over occurs to any one of the control grids, a low impedance path to ground is provided through its respective clamping diode, the protection diode 102 and the capacitor 104 so that the voltage at the grid cannot exceed the positive voltage applied at the point 88. This restricts the excursion of the surge voltage coupled through capacitors 66, 68 or 70 to the transistors 36, 38 and 40 to a value which they can withstand. The delay resistors 79, 72 and 74 form RC circuits with any stray capacitance to ground that limit the rate of build-up of the current flowing from the grids to a rate below that at which current can build up in the clamping diodes 76, 78 or 80 and the protection diode 102.

In some color television receivers, red, green and blue color signals are applied to the control grids 60, 62 and 64 respectively, thus avoiding the necessity of applying the luminance signals Y to the cathodes 16, 18 and 20. The voltages at the collector electrodes 54, 56 and 58 would correspond to black during the line retrace intervals when the charge on the capacitors 66, 68 and 70 is being adjusted. In either case one or more of the diodes 76, 78 or 80 acts in combination with the protection diode 102 that is connected in series with them to clamp the control grids 60, 62 or 64 to a positive potential.

WHAT WE CLAIM IS:—

1. A protection circuit for television receiver transistor video amplifiers which are a.c. coupled by respective coupling networks to a kinescope display device, wherein said amplifier coupling networks include respective first rectifier devices which are keyed into conduction during retrace intervals to establish a desired d.c. voltage level at said kinescope display device, said protection circuit being characterized by a second rectifier device being connected in series with said respective first rectifier devices and a low impedance source of potential, wherein said source of potential has a value sufficient to keep said second rectifier device reverse biased during normal receiver operation.

2. A protection circuit according to claim 1 wherein said first rectifier devices are diodes and are operative to couple a d.c. voltage, derived from a resistive voltage dividing network connected in series between said low impedance source of potential and a switching device connected to a reference potential, to said kinescope, characteriezd by said second rectifier device being connected across a portion of said dividing network.

3. A protection circuit according to claim 2 further characterized by one side of said second rectifier device being connected directly to said low impedance source of potential.

4. A protection circuit substantially as describd and illustrated in the accompanying specification and drawing.

The loss of the direct current level of the color difference signals resulting from the use of the capacitors 66, 68 and 70 can be restored by keyed clamp circuits in which diodes 76, 78 and 80 are respectively connected in direct current paths between the control grids 60, 62 and 64 and a lead 82 that joins resistors 84 and 86. These resistors are connected in series between a point 88 of positive potential and the collector electrode 90 of a transistor 92. The emitter electrode 94 is connected to ground, and positive flyback pulses 96 derived from the deflection system 6 during the line retrace intervals are applied across a resistor 98 that is connected between the base electrode 100 and ground so as to cause saturated conduction in the transistor 92 and place its collector electrode 90 near ground potential. Thus the transistor 92 acts as a switch. Between flyback pulses, the transistor 92 has negligible conduction in view of the fact that ground potential is applied to both the emitter and base electrodes. This permits the elimination of any charge that has accumulated on the capacitors 66, 68 and 70 during the scanning of each line and sets the charge at a value determined by the difference between the voltages at the collector electrodes and the voltage on the lead 82. Since color difference signals are blanked during the line retrace interval, the voltage at the collector electrodes can be set at a level derived for a zero value of the color difference signals. It will be noted that when the transistor 92 conducts, the voltage on the lead 82 is reduced from that at the point 88 by the dividing action of the resistors 84 and 86, but that when the transistor 92 is not conducting, the situation that prevails during line scanning, the voltage on the lead 82 is more positive and equal to that at the point 88. Thus by making the voltage at the point 88 sufficiently positive, the diodes 76,78 and 80 can be back biased so that they do not conduct during the scanning of a line.

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A. A. THORNTON & CO.,
Chartered Patent Agents,
Northumberland House,
303/306 High Holborn,
London, W.C.1.

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