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3,037,565

TELEVISION-RECEIVING CIRCUIT ARRANGEMENT

Filed June 16, 1959

PRIOR ART

FIG.1

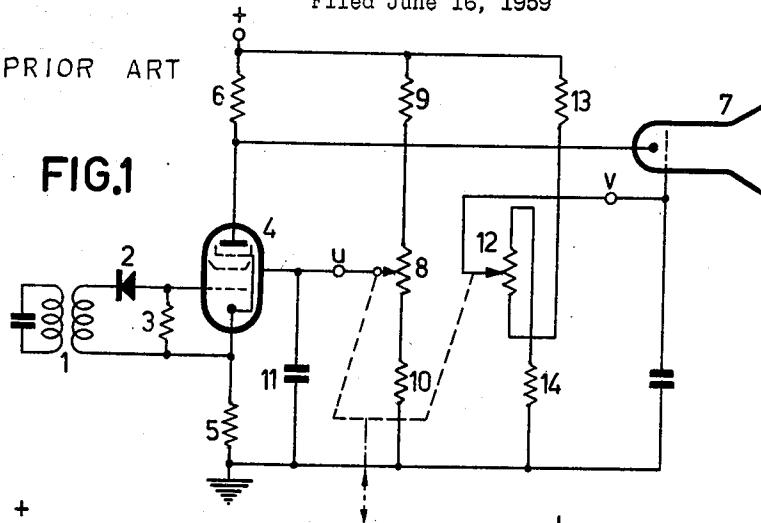
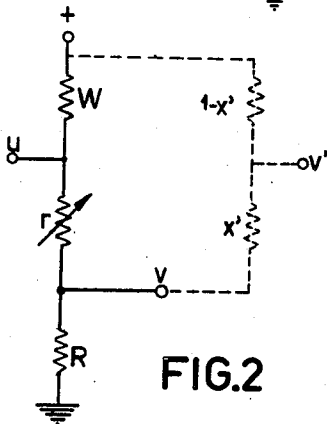


FIG.2

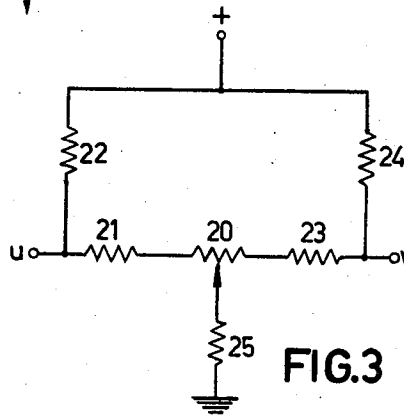


FIG.3

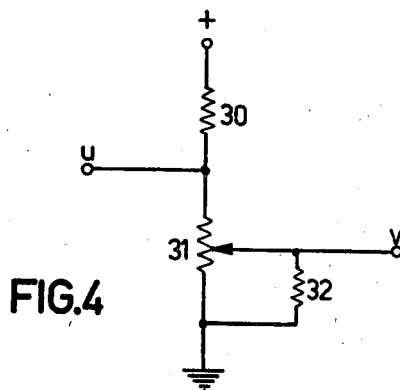


FIG.4

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TELEVISION-RECEIVING CIRCUIT
ARRANGEMENT

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In contrast-control of television receivers, in particular by variation of the screen-grid voltage of the video-amplifying tube, a shift of the working point of the picture tube, which is conductively connected to the video-amplifying tube, is known to happen so that the background brightness increases considerably when increasing the contrast.

It is already known to mitigate this inconvenience by applying the video-voltage to the cathode of the picture tube via a voltage divider which is connected between the anode of the video-amplifying tube and the bias-controlled screen-grid. As a result, the cathode of the picture tube is influenced by the greatly varying anode voltage and also by the oppositely varying screen-grid voltage. By a judicious choice of the voltage divider it can be achieved that the voltage on the picture tube, which determines the black level, is independent of the set contrast.

However, the voltage divider connected in the video-circuit involves a disturbing increase in impedance of this circuit, hence a greater influence of the stray capacitances which, in turn, adversely affect the reproduction of the high video-frequencies which are of importance for greater detail of the picture.

A circuit arrangement for contrast control is also known in which the screen grid of the video-amplifying tube is connected to the cathode of an auxiliary triode, the anode of which is connected to the positive terminal of the supply through a resistor. To the control grid of the auxiliary tube there is applied a variable direct voltage which is transmitted to the screen grid of the video-amplifying tube. From the anode of the auxiliary tube a direct voltage is taken which varies oppositely with regard to the screen grid voltage of the video-amplifying tube and by means of which the bias of the control grid of the picture tube is modified. Thus it is achieved that the anode-voltage variation of the video-amplifying tube, which variation is determined by the screen-grid voltage variation and simultaneously occurs at the cathode of the picture tube, is compensated by a corresponding variation of the voltage on the Wehnelt-cylinder of the picture tube, to the effect of maintaining the background brightness constant. However, such circuit arrangements are exceedingly complicated and have, in particular, the disadvantage that the cathode of the auxiliary tube has a high direct voltage potential.

This inconvenience can be met by connecting the picture tube directly to the anode of the video-tube and further, through a resistor, to the screen grid. Also in this manner the anode voltage value determining the background brightness can be maintained constant independently of the screen-grid voltage by means of which the contrast is controlled.

In doing so, the impedances do not increase. However, the resistor between the anode and the screen grid acts as an additional load on the anode circuit and also has an adverse effect. Consequently, this solution is satisfactory only when existing means provide for effective stabilisation of the black level, so that said re-

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sistor has to provide only a slight correction and may be given a satisfactory value.

In television-receiving circuit arrangements for simultaneous contrast control and background brightness control, in which an increasing first auxiliary direct voltage yields an increase in contrast through a video-voltage applied to the first control electrode of the picture tube, preferably its cathode, said inconveniences are avoided while, without affecting the video-circuit of the picture tube, it is possible to obtain a desired correction, in particular to maintain the background brightness of the picture tube at a constant value, without the need for additional stabilisation when using, according to the invention, a variable resistor device which, on operating a control member, supplies the first auxiliary direct voltage and an oppositely varying second auxiliary direct voltage which is applied to a further control electrode, preferably to the control grid (Wehnelt-cylinder) of the picture tube.

In its simplest form, such a circuit arrangement is made up of two mechanically coupled potentiometers. In order to correct the relationship existing between the background brightness setting and the contrast setting relative adjustment of the coupled part may be required, for example for personal taste-matching. The final values of the potentiometers and their control ranges may be limited by series resistors which may be variable individually.

In order that the invention may be readily carried into effect it will now be described in detail with reference to the accompanying drawing which represents the output stage of a television receiver comprising a picture tube.

In the drawing:

FIG. 1 is a circuit diagram of a portion of a television receiver, illustrating a known system for controlling contrast and brightness with a mechanical linkage, and

FIGS. 2, 3 and 4 are circuit diagrams of a portion of the circuit of FIG. 1 with modifications of the contrast and brightness control systems according to the invention, whereby mechanical linkages are not required to compensate the brightness function for changes in contrast.

By means of an intermediate-frequency transformer 1 the oscillations modulated by the video-signal are supplied to a rectifier 2, the output circuit of which comprises a load resistor 3. The demodulated video-voltage set up across this load resistor is applied to the control grid of a video-amplifying tube 4, the cathode of which is grounded through a resistor 5, which may be shunted. The anode of the tube 4 is connected through an output resistor 6 to the positive terminal of the supply. Further, the cathode of a picture tube 7 is connected to the anode.

The screen grid of the video-tube 4 is connected to the sliding contact of a potentiometer 8 which is connected to the positive terminal and negative terminal of the supply through resistors 9 and 10 respectively. The screen grid is earthed with respect to alternating voltage through a capacitor 11.

In this circuit arrangement, which is known per se, displacement of the sliding contact of the potentiometer 8 permits the screen-grid voltage of the video-amplifying tube and consequently the working point and any amplification of this tube to be varied so as to vary the value (amplitude) of the signal applied to the picture tube 7 and consequently the contrast. As is known, the term "contrast" is to be understood to mean the ratio existing between the brightness level, which corresponds to white level of the signal and the brightness level corresponding to black level of the signal.

In this type of contrast control, displacement of the working point involves an undue shift also of the voltage value associated with black level at the anode of the video-

amplifying tube and consequently also at the cathode of the picture tube so that the anode voltage drops with an increase in screen grid voltage as is required for contrast increase. Due to this lower voltage the drive range of the picture tube is considerably increased so that the beam intensity increases considerably. Consequently, the background brightness is noticeably shifted in the direction of the white levels. In order to compensate this and preferably to maintain constant the back-ground brightness level, the grid voltage of the picture tube has consequently to be reduced by the same amount. In the circuit arrangement shown in FIGURE 1, this is effected by connecting the control grid of the picture tube 7 (for example the Wehnelt-cylinder) to the sliding contact of a potentiometer 12, the ends of which are connected through series-resistors 13, 14 to the supply. By suitably matching, through series-resistors 9, 10, 13, 14, the control ranges of the potentiometers 8 and 12 it is readily obtainable that an increase in screen-grid voltage involves a decrease in grid-voltage of the picture tube so that its grid-cathode voltage for the background brightness remains at least approximately constant. By connecting resistors between the sliding contact of at least one potentiometer and one terminal of the supply or by connecting a resistor between the two sliding contacts, variation of the voltage characteristics is possible so as to obtain any desired curvature of the characteristic. Hence, a non-linear relationship is obtainable to a degree between the controlled voltages, for example for obviating non-linearity between the screen-grid voltage and the anode voltage.

FIG. 2 shows a control device supplying the screen-grid voltage u and the control voltage v for the picture tube, in which only a single resistor need be changed. This control device may consequently be substituted for the device 8, 9, 10, 12, 13, 14 in the circuit arrangement shown in FIG. 1. Connected between the positive terminal of the supply and earth is the series-combination of a series-resistor W , a variable resistor r and a base-resistor R . The screen-grid voltage u is taken from the junction point of the control resistor r and the series-resistor W . An oppositely varying voltage v is obtained at the junction point of the variable resistor r and the base-resistor R . Between the voltage u and v there exists a linear relationship which is determined by the ratio of the resistors W and R . If the resistor r is changed between the limiting values r_1 and r_2 , the voltages u and v change between the limiting values u_1 and v_1 . In this case

$$v_1 > v_2, u_1 < u_2, \text{ if } r_1 < r_2 \quad (1)$$

Moreover, v_1 should be lower than u_1 . Both values are equal if r_1 is zero.

In the circuit arrangement shown in FIG. 2, a certain relationship seemingly exists between the voltages u and v . This permits variation by deriving said voltages with the interposition of voltage dividers, the other end of which is connected either to the positive terminal of the supply or to its negative terminal. This involves variation not only of the absolute values of the voltages but also of their control range. In the case of earthed voltage dividers, however, the relative difference, that is the voltage difference between the starting condition and the final condition with regard to the voltage in the starting condition, remains constant; the absolute values vary in the same ratio. When considering such fixed voltage dividers for the two auxiliary direct voltages it is found that, on calculation, the ratio p of the relative differences is of importance:

$$p = \frac{\frac{u_2 - u_1}{u_1}}{\frac{v_1 - v_2}{v_1}} \quad (2)$$

In one example it proved necessary, in view of the required voltage values, to derive the voltage v' , which is

applied to the control grid of the picture tube, from the voltage v through a voltage divider connected to the positive terminal of the supply, the proportion ratio of which was x' . This is shown by broken lines in FIG. 2; its resistance value was considerable relative to the sum of $r_2 + W$.

On calculation it is found that the desired voltage values are obtainable when fulfilling the condition:

$$\frac{r_1}{R} = \left[\frac{u_1}{v_1'} + \left(\frac{v}{v_1'} - 1 \right) \frac{u_1(1+p) - V}{(V-1)V} \right] - 1 \quad (3)$$

where v_1' is the desired output value, which should occur when the other auxiliary direct voltage assumes the value u_1 , and V represents the supply voltage. The ratio x' of the voltage division is calculated according to the expression

$$v_1' = \left(\frac{V - u_1}{u_1(1+p) - V} + 1 \right) x' V \quad (4)$$

The ratio between the base-resistor R and the series-resistor W is found from the equation:

$$\frac{R}{W} \left(\frac{1 - x'}{x'} \right) = \frac{V}{u_1(1+p) - V} \quad (5)$$

Finally, the limiting values r_1 and r_2 are obtained from the equation:

$$u = \frac{1}{1 + \frac{W/R}{1 + r/R}} \quad (6)$$

where corresponding limiting values u_1, u_2, r_1, r_2 hold for u and r .

As stated before, still further voltage dividers may be used, in particular to fulfill the condition according to Equation 3. With voltage dividers with regard to earth p remains unchanged, and the values holding in the Expression 3 are increased by the reciprocal of the voltage proportion ratio.

In said practical embodiment shown in FIG. 2 using a battery voltage of 220 v. the voltage u varied between approximately 90 v. and 210 v. and at the same time the voltage v' between 130 v. and 55 v. when varying the resistor r between 0 and 70 kohm; the base resistor R amounted to 2.8 kohm, the series-resistor W was 4 kohm. The proportion ratio of the voltage divider was 0.215. Since with an anode resistor 6 of 3.5 kohm the anode voltage fluctuated between approximately 205 v. and 120 v. the value of the background brightness slightly increased with an increase in contrast. This is particularly efficient if due to incident light from the surroundings the background brightness has to be increased for adequately boosting the grey stages in the proximity of black level, while on the other hand the video-voltage has to be increased for maintaining substantially constant the contrast of the reproduced picture.

FIG. 3 shows a further form of a control device, from which the desired oppositely varying voltages are derived. It comprises a potentiometer 20, the ends of which are connected to the positive terminal of the supply through the series-combination of each two resistors 21, 22 and 23, 24 respectively, while the sliding contact may, if desired, be earthed through a resistor 25. At the junctions of the resistors 21, 22 and 23, 24 respectively voltages u and v occur. At a battery voltage of 220 v. the voltage u varied between approximately 73 v. and 200 v., the voltage v between approximately 127 v. and 55 v. when using the following resistance values:

	Kohm
Potentiometer 20	100
Resistor 21	5
Resistor 22	10
Resistor 23	30
Resistor 24	90

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Insofar as the voltages u and v are loaded with a considerable current this may, if desired, be allowed for in known manner by increasing also the parallel current of the regulating device by reducing the resistance values. The circuit arrangement shown in FIG. 3 shows an often desired non-linear relationship between the voltage values u and v . The curvature of the characteristic may be reversed by exchanging the connections for the supply voltage of the device 20 to 24. The characteristic may also be acted upon by inserting a resistor 25 in the lead between the sliding contact of the potentiometer and the supply.

Finally, FIG. 4 shows a further embodiment of the circuit arrangement according to the invention, in which a series-resistor 30 and a potentiometer 31 are connected in series between the positive terminal of the supply and earth. The sliding contact of the potentiometer 31, from which the voltage v is taken, is earthed through a resistor 32. The voltage u is taken from the junction of the potentiometer 31 and the series-resistor 30.

If the resistors 32 and 33 are equal, for example 5 kohm, while the resistor 31 has a value ten times that of the resistor 32, say 50 kohm, the voltage u varies between approximately 200 v. and 125 v., while the voltage v rises from 0 v. to approximately 110 v. Also in this circuit arrangement, a voltage divider as shown in broken lines in FIG. 2 and, if desired, further earthed voltage dividers permit, in particular, the output voltage v to be matched to the desired conditions.

In a circuit arrangement as shown in FIG. 4 a non-linear relationship is obtained between the voltage values u and v similarly as in FIG. 3.

What is claimed is:

1. A television receiving circuit comprising an amplifying device having an input electrode, a characteristic control electrode and an output electrode, an image reproducing device having first and second control electrodes, a source of video signals, means applying said video signals to said input electrode, means connecting said output electrode to said first control electrode of said image reproducing device, and means for simultaneously controlling contrast and background brightness of an image on said image reproducing device comprising a source of a direct voltage, a resistive potentiometer circuit having first, second, third and fourth terminals and a single variable resistive element, means connecting said first and second terminals to said source of direct voltage, means connecting said third terminal to said control electrode of said amplifying device, and means connecting said fourth terminal to said second control electrode, said potentiometer circuit comprising resistance means connected to said variable resistive element to provide potentials at said third and fourth terminals that vary in opposite directions with variations in said single variable resistive element.

2. A television receiving circuit comprising an amplifying device having an input electrode, a characteristic control electrode and an output electrode, an image reproducing device having first and second control electrodes, a source of video signals, means applying said video signals to said input electrode, means connecting said output electrode to said first control electrode of said image reproducing device, and means for simultaneously controlling contrast and background brightness of an image on said image reproducing device comprising a source of direct voltage, a first group of at least three serially connected resistors connected in series with said source of direct voltage, one of said series connected resistors being variable, means connecting the junction of two of said series connected resistors to said control electrode of said amplifier device, a second group of at least two series con-

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nected resistors connected in parallel with at least two but less than the total number of resistors of said first group and including said variable resistor, and means connecting the junction of said two resistors of said second group to said second control electrode whereby variation of said variable resistor varies the voltages on said control electrode of said amplifying device and said second control electrode in opposite directions.

3. A television circuit comprising an electron discharge device having a cathode, a control grid, a screen grid, and an anode, an image reproducing device having a cathode and a control grid, a source of video signals, means applying said video signals between the control grid and cathode of said discharge device, means connecting said anode to the cathode of said image reproducing device, and means for simultaneously controlling contrast and background brightness of an image on said image reproducing device comprising a source of direct voltage, first, second and third resistors serially connected with said source of direct voltage, said second resistor being variable, means connecting the junction of said first and second resistors to said screen grid, fourth and fifth serially connected resistors connected in parallel with said first and second resistors, and means connecting the junction of said fourth and fifth resistors to the control electrode of said image reproducing device.

4. A television circuit comprising an electron discharge device having a cathode, a control grid, a screen grid, and an anode, an image reproducing device having a cathode and a control grid, a source of video signals, means applying said video signals between the control grid and cathode of said discharge device, means connecting said anode to the cathode of said image reproducing device, and means for simultaneously controlling contrast and background brightness of an image on said image reproducing device comprising a source of direct voltage, a series circuit of first, second and third resistors in that order, means connecting one end of said series circuit to said screen grid, a fourth resistor connecting said one end to one terminal of said source of direct voltage, means connecting the other end of said series circuit to the control electrode of said image reproducing device, a fifth resistor connecting said other end to said one terminal, a variable tap on said second resistor, and means connecting said tap to the other terminal of said source of direct voltage.

5. A television circuit comprising an electron discharge device having a cathode, a control grid, a screen grid, and an anode, an image reproducing device having a cathode and a control grid, a source of video signals, means applying said video signals between the control grid and cathode of said discharge device, means connecting said anode to the cathode of said image reproducing device, and means for simultaneously controlling contrast and background brightness of an image on said image reproducing device comprising a source of direct voltage, first and second resistors connected serially with said source of direct voltage, means connecting the junction of said first and second resistors to said screen grid, a variable tap on said second resistor, means connecting said tap to said control grid of said image reproducing device, and a third resistor connected between said tap and the end of said second resistor connected to said source of direct voltage.

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