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3,270,128

POWER SUPPLY PROTECTION ARRANGEMENT
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The present invention relates generally to the protection of power supplies, and particularly to arrangements in association with a regulated power supply, such as is employed for satisfying the high voltage requirements of a color television receiver, whereby failure, or other disabling, of the regulator circuitry is prevented from causing the development of excessive output voltages.

In a color television receiver, it is customary to supply a high unidirectional voltage (of the order, for example, of 24 kv.) to the final accelerating or ultor electrode of the color image reproducing tube. Development of this high voltage is usually achieved through the rectification of flyback pulses developed in the horizontal output transformer associated with the line scanning deflection circuitry of the receiver. In the usual color image reproducing tube, such as the well known tri-gun, shadow mask color kinescope, variations in the accelerating voltage can have an adverse effect on the convergence of the multiple beams of the tube. As a consequence, dynamic regulation of the D.C. output of the receiver's high voltage rectifier is deemed a necessity.

A well-accepted procedure for effecting regulation of the high voltage rectifier output involves employment of a triode as a shunt regulator; i.e., the regulator triode is placed in shunt with the kinescope load of the high voltage rectifier, and the triode's grid-cathode potential difference is suitably varied in a manner to present the rectifier with a substantially constant load, the regulator triode drawing more current when the kinescope draws less, and vice versa. One manner in which the desired control of the regulator triode is carried out is to apply a sample of the receiver's B-boost voltage to the regulator triode's control grid. The B-boost voltage, developed in accordance with well known power recovery principles, reflects substantially accurately variations in the loading on the horizontal output transformer due to variations in the kinescope load.

Under normal circumstances, the regulator arrangement described above adequately serves to maintain the high voltage rectifier output within a close tolerance of its desired and intended output level. However, occasions may arise where the regulator circuitry is disabled, as by failure of the regulator tube, or by removal of the regulator tube and mistaken failure to replace it during servicing of the receiver. Under such conditions of regulator circuitry disabling, a check or limit on the magnitude of the developed high voltage is desirable for safety purposes.

The present invention is directed to a protection circuit arrangement whereby under the noted conditions of regulator circuitry disabling the high voltage supply may be precluded from developing excessive output voltages. Desirably, this protection circuit arrangement does not interfere with the normal operation of the receiver under the usual conditions of regulator circuitry operativeness.

In accordance with the present invention, the desired protection against the development of excessive high voltage outputs is obtained by supplying a bias potential to the device driving the horizontal output transformer, which bias potential is substantially invariant during normal operation of the receiver, but which significantly increases in a direction reducing the transformer drive whenever the noted abnormal conditions would tend to produce excessive high voltage output.

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In accordance with a particular embodiment of the present invention, the desired protection is obtained in a color television receiver by providing a resistive connection of appropriate resistance value between the control grid of the horizontal output tube actuating the horizontal output transformer and the control grid of a so-called blanker tube, existing in many color television receivers to derive pulsing waveforms for various color circuits from the flyback pulses developed in the horizontal output transformer. In the operation of such a blanker tube, a negative grid-leak bias is developed at the blanker tube grid, the magnitude of which bias is directly responsive to the amplitude of the flyback pulses derived from the output transformer. Under conditions of regulator circuitry disabling, any tendency of the thereby unregulated high voltage supply to develop excessive output voltages is reflected in an increase in flyback pulse amplitude, thereby increasing the negative bias at the blanker tube grid. By means of a resistive connection from this blanker tube grid to the horizontal output tube grid, such a bias increase is caused to inhibit conduction in the horizontal output tube, thereby reducing the drive to the output transformer, counteracting the tendency of the flyback pulses to increase and limiting the magnitude of the developed high voltage. Under normal operating conditions, with the regulator circuitry functioning properly, the flyback pulse amplitude is relatively fixed, the blanker grid bias therefore is substantially invariant, and the horizontal output tube grid is maintained at a given operating point chosen for the usual reasons of efficient operation.

A primary object of the present invention is to provide a regulated power supply with means for preventing the development of excessive output voltages in case of disabling of the regulator circuitry.

A further object of the present invention is to provide a color television receiver incorporating a regulated high voltage supply with relatively simple circuitry for limiting the high voltage output under abnormal conditions of regulator circuitry malfunctioning.

Other objects and advantages of the present invention may be readily ascertained by those skilled in the art upon a reading of the following detailed description and an inspection of the accompanying drawing, in which a color television receiver is illustrated, partially in block diagram form and partially in schematic diagram form, the color television receiver incorporating a regulated high voltage supply, together with protection circuitry in accordance with an embodiment of the present invention.

The color television receiver of the drawing is illustratively of the same general receiver form as the RCA CTC-12 color television receiver described in the RCA Color Television Receiver Service Data Pamphlet designated 1962 No. T6. Thus, the receiver incorporates a lineup of tuner, IF amplifier and video detector, the tuner selectively amplifying and converting to intermediate frequencies a radiated television signal, the IF amplifier amplifying the intermediate frequency version of the radiated signal for delivery to the video detector, which recovers therefrom a composite video signal. The composite video signal of detector is supplied to a video amplifier, which delivers an amplified version of the composite signal to a plurality of channels in the color television receiver.

One of the outputs of the video amplifier is supplied to a luminance amplifier, which delivers signals to the cathodes 21R, 21G, 21B of a tri-gun shadow mask color kinescope; the signals delivered to the kinescope cathodes control the brightness of the image reproduced on the screen of the kinescope.

Another output of the video amplifier is applied to

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a chrominance amplifier 31, provided with bandpass characteristics for selectively amplifying the chrominance component (a modulated color subcarrier) of the composite video signal. The modulated color subcarrier output of amplifier 31 is synchronously detected in the color demodulation circuits 33 to produce a pair of color-difference signal outputs. The synchronous detection is achieved in the demodulator circuits 33 under the control of suitably phased outputs of a synchronized color reference oscillator 35, synchronization of the latter being achieved in response to the color synchronizing burst output of a burst separator 37; the burst separator 37 comprises a suitably time-gated device, responding to an output of video amplifier 17 and selectively passing the burst of reference phase subcarrier frequency oscillations appearing on the back porch of the horizontal sync pulse in a composite color television signal.

The pair of color-difference signal outputs developed by the demodulator circuits 33 are passed to a color matrix amplifier 39, which suitably combines the delivered color-difference signals to develop a set of three color-difference signal outputs (e.g. of the well-known form $R-Y$, $G-Y$ and $B-Y$) suitable for application to the respective control grids 23R, 23G, and 23B of the multi-gun color kinescope 20.

Additional operating electrodes of the color kinescope 20 include respective screen grid electrodes 25R, 25G and 25B, energized with respectively adjustable D.C. potentials at terminals S_R , S_G and S_B ; a focussing electrode structure 27, acting in common on all three guns of the kinescope 20, and energized at terminal F with a suitably adjustable D.C. focussing potential; and a final accelerating or ulior electrode 29, in its usual form comprising a conductive coating on the inner surface of the bulb portion of the kinescope 20 envelope. The ulior electrode energizing terminal U is supplied with a suitably regulated high voltage from circuitry to be subsequently described.

An additional output of the video amplifier 17 is supplied to a sync separator 41, which serves to separate the deflection synchronizing components from the remainder of the composite video signal. The sync separator 41 delivers a synchronizing component to the vertical deflection circuits 43 to synchronize the development in the latter of an appropriate scanning waveform for application to the vertical windings of the kinescope's deflection yoke (not illustrated). The sync separator 41 also delivers a separated synchronizing component to the synchronized horizontal oscillator 45 to synchronize the development therein of a horizontal frequency waveform suitable for application to a horizontal output tube 50.

The horizontal output tube 50 comprises a pentode having a cathode 51 directly connected to chassis ground, a control grid 53 receiving the output of oscillator 45 via a coupling capacitor 46 in series with a resistor 48, a screen grid 55 coupled to a source of positive operating potential via a pair of dropping resistors 56 and 58 in series, a suppressor grid 57 directly connected to ground, and an anode 59 coupled to the input terminal I of a horizontal output transformer 60. A grid resistor 47 is associated with the control grid 53, the resistor 47 being coupled between the junction of capacitor 46 and series resistor 48 and a point of positive D.C. bias potential. A further connection is made to the grid 53 for biasing purposes, such further connection to be described subsequently. The screen dropping resistor 58 is bypassed by capacitor 54 coupled between the junction of resistors 56 and 58 and chassis ground. Series resistors 48 and 56 in the control grid and screen grid circuits, respectively, are small valued resistors serving parasitic oscillation suppressing purposes.

The horizontal output transformer 60 provides step-down autotransformer coupling between output tube 50 and the horizontal windings of the deflection yoke (not illustrated) associated with color kinescope 20; the trans-

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former 60 also provides step-up autotransformer action for delivering flyback pulses of augmented amplitude to the high voltage rectifier, diode 70. The deflection yoke windings are coupled across a transformer winding section defined by end terminal BB and an intermediate tap Y (between input terminal I and end terminal BB). An additional tap D is located on the primary winding section of transformer 60 between the input terminal I and the yoke connection tap Y; damper diode 80 has its cathode electrode coupled via choke 81 to the tap D.

The anode of damper diode 80 is coupled via a choke 83 in series with an adjustable linearity or efficiency controlling inductor 85 to the B+ supply of the receiver. The inductor 85 is shunted by the series combination of capacitors 87 and 89, with the junction between the capacitors directly connected to the transformer end terminal BB. The damper diode serves conventional reaction scanning and power recovery purposes. Periodic conduction of the damper diode 80 develops a charge across the capacitors 87 and 89 which adds to the B+ supply potential to provide at terminal BB a so-called B-boost voltage, which thereupon constitutes a supply voltage of augmented amplitude.

The high potential end terminal H of the transformer 60 is directly connected to the anode of the high voltage rectifier diode 70. The cathode of diode 70 is directly connected to the energizing terminal (U) for the ulior electrode 29 of color kinescope 20. A high voltage filter capacitor 71 appears between the ulior electrode and chassis ground; this capacitor is generally constituted by the capacity inherently provided between the inner conductive coating of the kinescope 20 bulb which constitutes the ulior electrode 29, and a conductive coating on the outer surface of the kinescope 20 bulb, which coating is grounded to the chassis.

Regulation of the high voltage output of rectifier 70 is effected through the use of a rectangular triode 90. The anode 95 of regulator triode 90 is directly connected to the cathode of diode 70, while the cathode 91 of regulator triode 90 is returned to the receiver's B+ supply via a cathode resistor 96. The control grid 93 of regulator triode 90 is bypassed to the cathode 91 for video signal frequencies by a capacitor 98. A control voltage input is applied to control grid 93, the control voltage being derived from a B-boost voltage divider comprising a series combination of resistor 101, resistor 103 and adjustable resistor 105. The voltage divider is connected between the end terminal BB of transformer 60 and chassis ground, and an intermediate point on the divider (viz the junction between resistors 101 and 103) is directly connected to the regulator control grid 93.

In normal operation of the regulator circuitry, a change in the kinescope loading on the high voltage rectifier 70 is compensated for by an opposite change in the regulator triode loading thereon. If, for example, due to the presentation of a relatively dark picture, the kinescope load drops, the resultant tendency of the high voltage output of rectifier 70 to increase is reflected in an increase in the B-boost voltage at terminal BB; the B-boost voltage sample applied to control grid 93 causes an increase in the conduction in triode 90 so as to oppose the tendency of the high voltage output to increase. Conversely, kinescope current increases due to presentation of a relatively bright picture will result in a reduced amplitude B-boost voltage sample that will provide a compensating lowering of the current drawn by the regulator 90. The overall effect, within reasonable limits, is to present a substantially constant total load to high voltage rectifier 70 despite variations in the content of the picture displayed on color kinescope 20.

It will be readily appreciated that should the regulator tube 90 fail or should it be removed from its socket, the regulator circuitry can play no part in controlling variations in the high voltage output of rectifier 70. Under such conditions of regulator circuitry disability, it is de-

sirable for safety purposes to assure that the then unregulated output of high voltage rectifier 70 be precluded from reaching excessive levels, as when kinescope loading is low.

To achieve such protection, the invention embodiment illustrated in the drawing takes advantage of the operation of a receiver stage not heretofore described. This stage comprises a so-called blanker tube, triode 110, which responds to a flyback pulse output P derived from the horizontal output transformer 60. A capacitive voltage divider comprising the series combination of capacitors 106 and 108 is coupled between the damper tap D on transformer 60 and chassis ground. The junction between the divider capacitors 106 and 108 is coupled via a capacitor 112 in series with resistor 114 to the control grid 113 of the blanker triode 110. A grid leak resistor 116 is connected between the control grid 113 and chassis ground. The blanker triode 110 is provided with respective anode and cathode loads, across which appear respectively oppositely phase versions of the pulse input to grid 113. The cathode load comprises a cathode resistor 118, shunted by a capacitor 120, the parallel combination being connected between the blanker cathode 11 and chassis ground. The anode load comprises an anode resistor 122 connected between the blanker anode 115 and a source of positive D.C. potential.

The flyback pulses applied to grid 113 are positive-going, and produce similarly phase, positive-going pulses across cathode resistor 118, as well as oppositely phased, negative-going pulses across anode resistor 122. As shown in more detail in the aforementioned CTC-12 Service Data Pamphlet, the positive-going pulses appearing across cathode resistor 118 are applied to the chrominance amplifier 31 in such manner (as by direct coupling to the chrominance amplifier tube's cathode) as to disable the chrominance amplifier during each pulse occurrence. This results in blanking of the chrominance amplifier during each horizontal retrace interval, and serves to prevent the application of the color synchronizing bursts occurring during these intervals to the color demodulator circuits 33. The blocking of burst application to the demodulator circuits is desirable from several points of view, including the prevention of the lighting up of retrace lines by demodulated bursts, as well as avoidance of interference with D.C. establishing circuitry in stages subsequent to the demodulators.

As also illustrated in more detail in the aforementioned CTC-12 Service Data Pamphlet, the negative-going pulses appearing across anode resistor 122 are applied via capacitor 124 to the color matrix amplifier 39 in such manner (as by common application to the matrix amplifier tube cathodes) as to cause grid current flow in the respective matrix amplifier tubes. This inducing of grid current flow in the matrix tubes during each horizontal retrace interval serves the purpose of establishing the D.C. operating point for each tube in a highly advantageous manner, as explained in more detail in U.S. Patent 2,901,534, issued to Charles B. Oakley on August 25, 1959. Such pulse application to the matrix tubes also serves the purpose of supplying a horizontal blanking waveform to the color kinescope 20.

The amplitude and polarity of the flyback pulses applied to blanker tube grid 113 are such as to cause the flow of grid current in blanker tube 110 (i.e., in the unidirectional current path presented between the grid and cathode electrodes of tube 110) during each pulse occurrence, with a resultant charging of capacitor 112 in a direction developing a negative bias voltage at the grid 113. In normal operation of the receiver, the action of regulator 90 in maintaining constant loading of the high voltage supply substantially stabilizes the amplitude of the flyback pulses developed in transformer 60. As a consequence the negative bias appearing at grid 113 is maintained substantially invariant. A resistor 126 is connected between the blanker tube grid 113 and the horizontal

output tube grid 53. By virtue of this connection, the output tube grid 53 is connected to an intermediate point on a D.C. voltage divider including the series combination of resistors 47, 48 and 126. One end terminal of this divider is at a positive D.C. potential (e.g. +140 volts) provided in the receiver's B+ supply; the other end of the voltage divider is at a negative D.C. potential (e.g. -140 volts) established by grid leak biasing at the blanker tube grid 113. By suitable choice of the resistance value of resistor 126 relative to the values of resistors 47 and 48, the voltage division at the grid 53 connection point may be chosen to establish a negative D.C. voltage at the grid 53 of a level corresponding to an optimum operating point for efficient utilization of the output tube 50. The output tube grid bias thus established is substantially invariant during normal operation of the receiver with the regulator 90 functioning in its intended manner.

In the case, however, when regulator triode 90 fails, is removed from its socket, or is otherwise disabled, the negative bias at blanker 113 will follow any resultant changes in flyback pulse amplitude. Any tendency of the high voltage output to become excessive will provide a significant increase in flyback pulse amplitude, directly resulting in a significant increase in the negative bias developed at blanker grid 113. Due to the connection provided by resistor 126, this increase in blanker grid bias will cause a shift in the operating point of output tube 50 in a direction reducing conduction therein and opposing the high voltage increase. A check is thereby placed on the maximum magnitude of the high voltage output of rectifier 70, even under conditions of regulator circuitry disabling, whereby high voltage development is kept within desired safety tolerances. It will be noted that, in the illustrated embodiment, the safety feature is provided at relatively little expense, and with substantially no interference with normal operation of the receiver.

As an alternative to the returning of the output tube grid resistor 47 to a positive D.C. potential supply point, this resistor may be returned to chassis ground. However, with the latter connection, the voltage division necessary to obtain the same output tube operating point will call for a larger value for the grid connecting resistor 126, with the further result that a given change in grid bias at blanker grid 113 will produce a smaller percentage change in the output tube grid bias than is obtained in the illustrated circuit arrangement.

In color television receivers that do not employ a blanker tube, such as tube 110, or wherein the components associated with the blanker tube do not assure sufficient stability of the blanker grid bias under normal operating conditions, a different protection circuit arrangement may be employed. That is, reliance on flyback pulse amplitude responsive D.C. voltage development by the blanker tube may be precluded, but an additional element or elements may instead be added to the receiver to develop the desired negative D.C. biasing voltage. One simple arrangement contemplated for this eventuality comprises the application of the pulses delivered by capacitor 112 across a VDR (voltage dependent resistor), with resistor 126 returned to the junction of capacitor 112 and the added VDR, rather than returned to the blanker grid.

Where a blanker tube is provided in the color receiver, but the tolerances of the components associated with the blanker grid circuit are such as to leave too wide a range of developed grid bias voltage, receiver to receiver, to assure obtaining of optimum biasing of the output tube grid with a fixed value of resistance for resistor 126, the circuit of the illustrated embodiment may readily be altered to make resistor 126 an adjustable resistor, or, for example, to connect the output tube grid 53 to the adjustable tap on a potentiometer shunted between blanker grid 113 and chassis ground. Such an arrangement permits adjustment in each receiver of the operating bias supplied to output tube grid 53, whereby

output tube 50 may be operated at optimum efficiency.

Set forth in a table below are a set of values for the circuit parameters of the illustrated embodiment, such parameter values having provided satisfactory operation in a given working embodiment. It will be appreciated that these values are given by way of example only:

Resistor 47	-----megohms--	10
Resistor 48	-----ohms--	100
Resistor 56	-----do----	47
Resistor 58	-----do----	13,000
Resistor 96	-----do----	1,000
Resistor 101	-----megohms--	1.5
Resistor 103	-----do----	1.5
Resistor 105	-----ohms--	500,000
Resistor 114	-----do----	68,000
Resistor 116	-----do----	390,000
Resistor 118	-----do----	390
Resistor 122	-----do----	47,000
Resistor 126	-----megohms--	1.5
Capacitor 46	-----microfarad--	.01
Capacitor 54	-----do----	.1
Capacitor 82	-----micromicrofarads--	22
Capacitor 87	-----microfarad--	.068
Capacitor 89	-----do----	.082
Capacitor 98	-----do----	.01
Capacitor 106	-----micromicrofarads--	68
Capacitor 108	-----do----	180
Capacitor 112	-----do----	150
Capacitor 120	-----do----	820
Capacitor 124	-----microfarad--	.22
Choke 81	-----microhenries--	5.6
Choke 83	-----do----	5.6

What is claimed is:

1. In a color television receiver including a color image reproducing device having an electrode requiring a high unidirectional energizing potential, means for developing periodically recurring voltage pulses and including an electron discharge device having an input electrode, high voltage rectifying means responsive to said periodically recurring pulses for developing and supplying said high unidirectional energizing potential to said reproducing device electrode, and high voltage regulator circuitry for maintaining, when operative, substantially constant loading on said high voltage rectifying means;

the combination comprising:

means responsive to said periodically recurring pulses for developing a substantially invariant bias voltage when said regulator circuitry is operative, and for developing a variable bias voltage, the magnitude of which varies directly with variations in said high unidirectional energizing potential, whenever said regulator circuitry is undesirably disabled;

and means for coupling said discharge device input electrode to said bias voltage developing means so that the bias upon said discharge device input electrode is maintained substantially invariant at some desired operating point when said regulator circuitry is in operative condition, and varies, when said regulator circuitry is undesirably disabled, in a direction to reduce the magnitude of said periodically recurring pulses should the high unidirectional potential increase under such regulator circuitry disability conditions.

2. In a color television receiver including a color image reproducing device having an electrode requiring a high unidirectional energizing potential, means for developing periodically recurring voltage pulses and including an electron discharge device having an input electrode, high voltage rectifying means responsive to said periodically recurring pulses for developing and supplying said high unidirectional energizing potential to said reproducing device electrode, and high voltage regulator circuitry for maintaining, when operative, sub-

stantially constant loading on said high voltage rectifying means;

the combination comprising:

means responsive to said periodically recurring pulses for developing a substantially invariant bias voltage when said regulator circuitry is operative, and for developing a variable bias voltage, the magnitude of which varies directly with variations in said high unidirectional energizing potential, whenever said regulator circuitry is undesirably disabled;

and means for coupling said discharge device input electrode to said bias voltage developing means so that the bias upon said discharge device input electrode is maintained substantially invariant at some desired operating point when said regulator circuitry is in operative condition, and so that said bias varies, when said regulator circuitry is undesirably disabled, in a direction to reduce the magnitude of said periodically recurring pulses should the high unidirectional potential increase under such regulator circuitry disability conditions;

said bias voltage developing means comprising a device presenting a unidirectional current path between a pair of electrodes thereof, a capacitor, means for coupling said capacitor between said voltage pulse developing means and one of said pair of device electrodes, and means for coupling the other of said pair of device electrodes to a point of reference potential;

and said means for coupling said discharge device input electrode to said bias voltage developing means comprising resistive means connecting said discharge device input electrode to said one electrode of said unidirectional current path presenting device.

3. In a color television receiver including a color image reproducing device having an electrode requiring a high unidirectional energizing potential, means for developing periodically recurring voltage pulses and including an electron discharge device having an input electrode, high voltage rectifying means responsive to said periodically recurring pulses for developing and supplying said high unidirectional energizing potential to said reproducing device electrode, and high voltage regulator circuitry for maintaining, when operative, substantially constant loading on said high voltage rectifying means;

the combination comprising:

means responsive to said periodically recurring pulses for developing a substantially invariant bias voltage when said regulator circuitry is operative, and for developing a variable bias voltage, the magnitude of which varies directly with variations in said high unidirectional energizing potential, whenever said regulator circuitry is undesirably disabled;

and means for coupling said discharge device input electrode to said bias voltage developing means so that the bias upon said discharge device input electrode is maintained substantially invariant at some desired operating point when said regulator circuitry is in operative condition, and so that said bias varies, when said regulator circuitry is undesirably disabled, in a direction to reduce the magnitude of said periodically recurring pulses should the high unidirectional potential increase under such regulator circuitry disability conditions;

said bias voltage developing means comprising a device presenting a unidirectional current path between a pair of electrodes thereof, a capacitor, means for coupling said capacitor between said voltage pulse developing means and one of said pair of device electrodes, and means for coupling the other of said pair of device electrodes to a point of reference potential; said means for coupling said discharge device input electrode to said bias voltage developing means comprising resistive means connecting said discharge device input electrode to said one electrode of said unidirectional current path presenting device;

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said unidirectional current path presenting device including an additional electrode;
 means for deriving amplified output pulses from said additional electrode;
 and means for utilizing said amplified output pulses to periodically blank said color image reproducing device.

4. In a color television receiver including a color image reproducing device having an ultor electrode, said receiver also including respective luminance and chrominance signal component processing channels for developing signals for application to said color image reproducing device, and a deflection yoke associated with said color image reproducing device for developing a scanning raster; apparatus comprising the combination of:
 respective horizontal and vertical deflection circuits for energizing said deflection yoke, said horizontal deflection circuit including a horizontal output tube providing a scanning waveform output, and a horizontal output transformer for coupling said scanning waveform to said deflection yoke, horizontal flyback pulses being periodically developed in said horizontal output transformer;
 a high voltage rectifier coupled to said horizontal output transformer for developing an operating voltage for said ultor electrode;
 a high voltage regulator device providing a variable current path between the output terminal of said high voltage rectifier and a point of reference potential;
 means for controlling the current in said variable current path of said regulator device in response to variations in the output of said high voltage rectifier in a direction tending to counteract such variations;
 a pulse amplifying device having an input electrode, an output electrode and a common electrode;
 means for applying flyback pulses derived from said horizontal output transformer to the input electrode of said pulse amplifying device in a polarity tending to induce current flow between said input electrode and said common electrode, said applying means including means responsive to current flow between said input electrode and said common electrode for developing a unidirectional bias voltage at said input electrode, the amplitude of said unidirectional bias voltage being dependent upon the amplitude of the flyback pulses applied to said input electrode;
 means applying a pulse output of said pulse amplifying device to said chrominance signal component processing channel for modifying signals applied to said color image reproducing device;
 and means for utilizing said unidirectional bias voltage to bias said horizontal output tube, the biasing of said horizontal output tube being substantially invariant during normal operation of said regulator device, but varying, whenever said regulator device is undesirably disabled, in response to flyback pulse amplitude changes in such a manner as to alter development of said flyback pulses in a direction opposing said changes.

5. In a color television receiver including a color image reproducing device having an ultor electrode, said receiver also including respective luminance and chrominance signal component processing channels for developing signals for application to said color image reproducing device, and a deflection yoke associated with said color image reproducing device for developing a scanning raster; apparatus comprising the combination of:
 respective horizontal and vertical deflection circuits for energizing said deflection yoke, said horizontal deflection circuit including a horizontal output tube providing a scanning waveform output, and a horizontal output transformer for coupling said scanning waveform to said deflection yoke, horizontal fly-

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back pulses being periodically developed in said horizontal output transformer;
 a high voltage rectifier coupled to said horizontal output transformer for developing an operating voltage for said ultor electrode;
 a high voltage regulator device providing a variable current path between the output terminal of said high voltage rectifier and a point of reference potential;
 means for controlling the current in said variable current path of said regulator device in response to variations in the output of said high voltage rectifier in a direction tending to counteract such variations;
 a pulse amplifying tube having a cathode, an anode and a control grid;
 means for applying positive-going flyback pulses derived from said horizontal output transformer to the control grid of said pulse amplifying tube to induce grid current flow during the pulse occurrences, said applying means including means responsive to the flow of grid current in said pulse amplifying tube for developing a negative bias voltage at said control grid, the amplitude of said negative bias voltage being dependent upon the amplitude of the flyback pulses applied to said control grid;
 means applying a pulse output of said pulse amplifying device to said chrominance signal component processing channel for altering signals applied to said color image reproducing device;
 and means for utilizing said unidirectional bias voltage to bias said horizontal output tube, the biasing of said horizontal output tube being substantially invariant during normal operation of said regulator device, but varying, whenever said regulator device is undesirably disabled, in response to flyback pulse amplitude changes in such a manner as to alter development of said flyback pulses in a direction opposing said changes.

6. In a color television receiver including a color image reproducing device having an ultor electrode, said receiver also including respective luminance and chrominance signal component processing channels for developing signals for application to said color image reproducing device, and a deflection yoke associated with said color image reproducing device for developing a scanning raster; apparatus comprising the combination of:
 respective horizontal and vertical deflection circuits for energizing said deflection yoke, said horizontal deflection circuit including a horizontal output tube having a control electrode and providing a scanning waveform output, and a horizontal output transformer for coupling said scanning waveform output, and a horizontal output transformer for coupling said scanning waveform to said deflection yoke, horizontal flyback pulses being periodically developed in said horizontal output transformer;
 a high voltage rectifier coupled to said horizontal output transformer for developing an operating voltage for said ultor electrode;
 a high voltage regulator device providing a variable current path between the output terminal of said high voltage rectifier and a point of reference potential;
 means for controlling the current in said variable current path of said regulator device in response to variations in the output of said high voltage rectifier in a direction tending to counteract such variations;
 a pulse amplifying tube having a cathode, an anode and a control grid;
 means for applying positive-going flyback pulses derived from said horizontal output transformer to the control grid of said pulse amplifying tube to

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induce grid current flow during the pulse occurrences, said applying means including means responsive to the flow of grid current in said pulse amplifying tube for developing a negative bias voltage at said control grid, the amplitude of said negative bias voltage being dependent upon the amplitude of the flyback pulses applied to said control grid; 5

means applying a pulse output of said pulse amplifying device to said chrominance signal component processing channel for altering signals applied to said color image reproducing device; 10

and means for utilizing said unidirectional bias voltage to bias said horizontal output tube control electrode, the biasing of said horizontal output tube control electrode being substantially invariant during normal operation of said regulator device, but varying, whenever said regulator device is undesirably disabled, in response to flyback pulse amplitude changes in such a manner as to alter development of said flyback back pulses in a direction opposing said changes; 15 20

said last-named means including first resistive means

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for connecting said horizontal output tube control electrode to said pulse amplifying tube control grid, and second resistive means for additionally connecting said horizontal output tube control electrode to a point of positive reference potential, said first and second resistive means being relatively proportioned in resistance value such that, under conditions of normal operation of said regulator device, there is developed at said horizontal output tube control electrode a net bias potential of negative polarity and of a magnitude permitting efficient operation of said horizontal output tube.

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