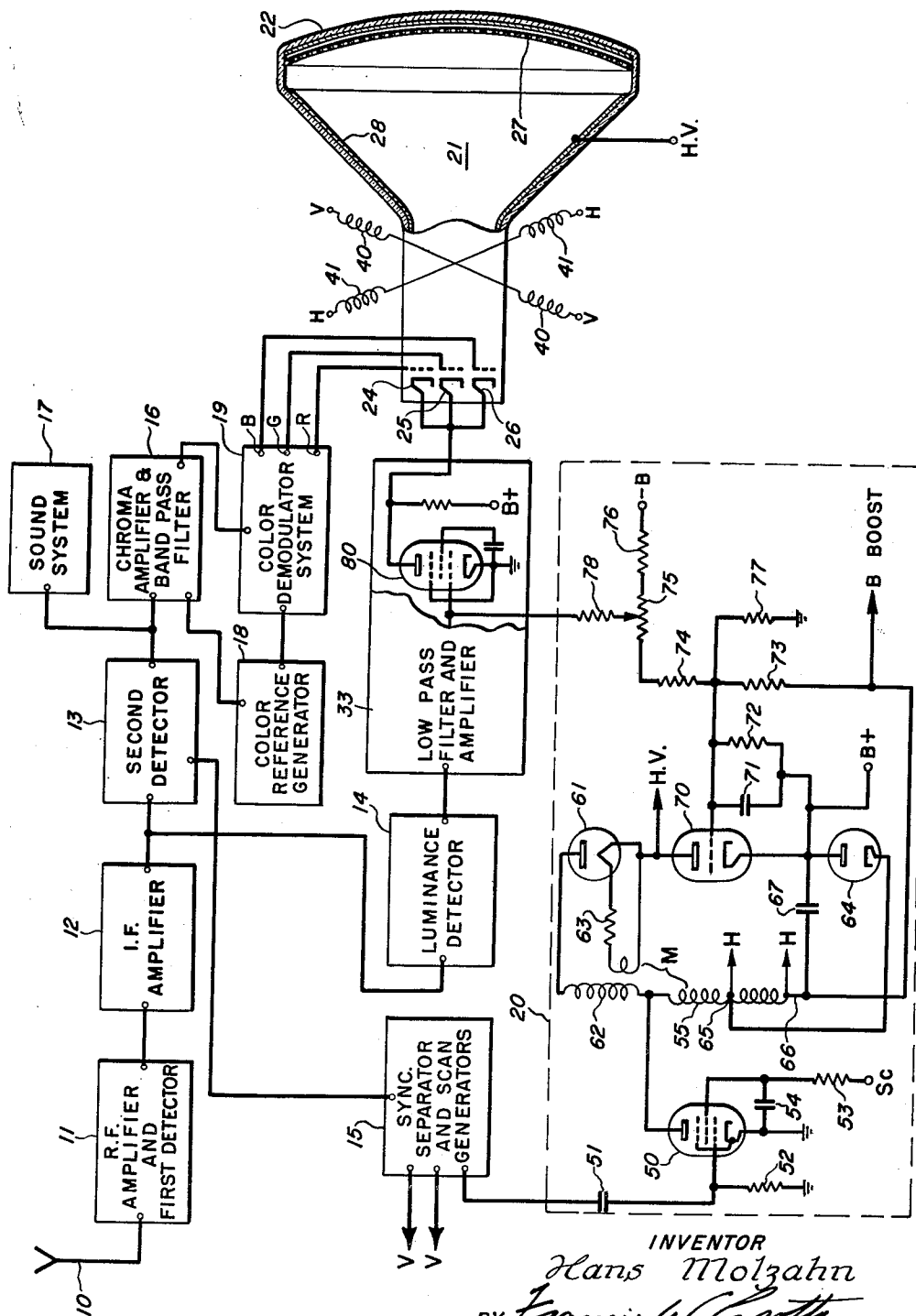


Nov. 5, 1963

H. W. MOLZAHN
HIGH VOLTAGE REGULATION BY VOLTAGE
CONTROL OF VIDEO AMPLIFIER
Filed Jan. 26, 1959

3,109,891



INVENTOR
Hans Molzahn
BY Francis W. Corliss
ATTORNEY

1

3,109,891

HIGH VOLTAGE REGULATION BY VOLTAGE CONTROL OF VIDEO AMPLIFIER

Hans W. Molzahn, Bellwood, Ill., assignor to Zenith Radio Corporation, a corporation of Delaware
Filed Jan. 26, 1959, Ser. No. 789,167
4 Claims. (Cl. 178-7.5)

This invention is directed to a television receiver and is concerned with overcoming a disturbing operational problem encountered in television receivers, particularly those arranged to reproduce images in natural color. While the improvement contributed by this invention is applicable to monochrome as well as to color, for convenience the explanation will address itself to color apparatus where the problem at hand is more acute.

Receivers of current design utilized for the reproduction of images in color usually feature a reproducing device having three electron gun structures for producing three electron beams which are scanned in relation to a screen having elemental areas for emitting light of one of the primary colors in response to electron excitation. In one arrangement, these color areas are coupled in triads and a barrier, sometimes referred to as a shadow mask, is interposed in the path of the electron beams to the end that any one beam is permitted to see essentially only an assigned color area or component of the screen as the beams are concurrently deflected to scan in the area in a field of parallel lines. This structure and others of similar characteristic but wherein the individual color sensitive segments are strips rather than being of elemental picture size suffer from a lack of brightness. The reasons for the deficiency in brightness are well known and are, in themselves, of no particular interest here except for the fact that they lead to a mode of operation in which the problem solved by the subject invention is exceedingly pronounced.

More specifically, since the reproducer is normally down in brightness the tendency is to adjust the operating voltages and parameters to achieve as bright a picture as possible. This condition, insofar as it is established by selection of operating potentials, is maintained by the provision of a regulated power supply. The operational effect of the power supply is to maintain the excitation potentials of the reproducer at their selected optimum values in spite of variations in brightness and normally this is accomplished satisfactorily. It has been found, however, that from time to time the brightness, which is represented as a direct current component of the transmitted video signal, is so high that the load which the reproducer imposes on the power supply exceeds its regulating capacity. For example, the brightness of the transmitted image is sometimes exceptionally high during commercials and leads to extraordinary loading of the power supply. Where that is experienced, the energizing potentials applied to the receiver and to its image reproducer in particular decrease with highly undesirable results. A reduction in the high voltages applied to the focusing structure and final anode of the reproducer result in what has been termed as "blooming" or "defocusing" of the tube.

Efforts have been made heretofore to obviate blooming by an overload or protection circuit. Generally, the overload circuit includes an electron discharge device which changes its state of conductivity, being turned off or on as the case may be, in response to abnormally large variations in the power-supply load in an effort to return the load to the operative range of the high voltage regulator. While this approach may be followed with some success, it has the disadvantage of undesirably adding to the cost and complexity of the receiver. Color receivers are especially complex and costly and auxiliary circuitry

2

which adds further to the receiver, even though it may accomplish a desired objective, is to be avoided wherever possible.

Accordingly, it is an object of the present invention to provide a television receiver featuring a regulated power supply and which avoids the aforementioned deficiencies of the prior art.

It is a specific object of the invention to provide, in a television receiver having a regulated power supply, an improved arrangement for avoiding blooming and the like during operating intervals in which the load exceeds the capacity of the voltage regulator.

A television receiver, constructed in accordance with the invention, comprises a power supply including a voltage regulator for developing unidirectional operating potentials maintained at substantially constant values in the presence of normal variations of load on the power supply but subject to experience a decrease in value in the presence of abnormally large variations in load. The power supply also develops a bias potential required in the receiver operation and likewise having a substantially constant value in the presence of normal variations in load on the power supply but subject to experience a change in value upon the occurrence of and in an amount determined by the magnitude of abnormally large variations in load. The receiver has a video-frequency channel including an amplifier device and an image reproducing device at least one of which has a control electrode effective to control the brightness characteristic of the reproducing device and further to vary the load represented by that channel as a function of applied bias potential. Means are provided for connecting the video-frequency channel as a load on the power supply and a bias circuit, effective during both normal and abnormal variations in load on the power supply, connects the control electrode of the amplifier or image reproducing device, as the case may be, to the power supply to impress the bias potential on that electrode with a polarity to control the brightness characteristic of the channel in a sense to oppose and thereby compensate abnormally large variations in load.

Other and further objects of the present invention will be apparent from the following description and claims and are illustrated in the accompanying drawing the single FIGURE of which represents a simplified schematic diagram of a color television receiver employing the invention.

The color television receiver represented in the drawing includes an antenna 10 coupled to the input circuit of a tunable radio-frequency amplifier and first detector 11. The output terminals of this amplifier and detector connect through an intermediate-frequency amplifier 12 to a second detector 13 as well as to a luminance detector 14. Detector 13, in turn, connects to a synchronizing-signal separator and scanning generator unit 15, to a chroma amplifier and band-pass filter 16 and to a sound system 17. The sound system includes the usual frequency discriminator, audio amplifier, loud speaker and other stages normally employed in this portion of a television receiver. Chroma amplifier and band-pass filter 16 is coupled to a color reference signal generator 18 which is utilized to supply a color reference signal to a color demodulating system 19, the latter being also coupled to the output of the band-pass filter of unit 16. The synchronizing-signal separator and scan generator unit 15 includes the usual circuitry for developing a vertical or field deflection signal available at output terminals designated V, V. It further includes the usual portions of the horizontal scan system up to the horizontal output tube which, for convenience of illustration, is here represented within broken-line rectangle 20 which includes not only the horizontal deflection transformer but also representa-

tive components of a regulated high voltage power supply. The circuitry of this arrangement will be considered in greater detail hereinafter, suffice it to say for the time being that the horizontal or line deflection signal is available as indicated at the arrows H, H.

The color receiver additionally includes a color image reproducer 21 which may be a conventional shadow mask picture tube including a tri-color image screen or target 22 to be scanned by a group of three electron beams developed by individual guns 24, 25 and 26. A parallax mask 27 is included in the image reproducer to restrict the electron beams generated by guns 24-26 in known manner so that each beam is permitted to impinge upon only one color phosphor of image target 22. For convenience of illustration, only the cathode and first grid or control electrode have been represented for each of the three electron guns of reproducer 21. The screen electrodes and other components of the electronic lens system as well as the convergence arrangement normally employed with such devices have been omitted for the simple reason that the subject of the present invention is not concerned with the details of this portion of the reproducer. The three cathodes of electron guns 24-26 are conductively connected together and may therefore be considered as a common cathode which connects to luminance detector 14 by means of a low-pass filter and amplifier 33. The control electrodes of the three guns, in turn, connect with the individual output terminals of color demodulating system 19. If it be assumed that guns 24, 25 and 26 are the red, blue and green guns, respectively, then their control electrodes connect to the corresponding terminals R, G and B of the demodulator as indicated. Two pair of deflection coils 40 and 41 are provided for the picture tube and are driven from the scan generators by connections (not shown) of terminals VV of generator 15 and points HH of unit 20 to like designated terminals of the deflection coils.

As thus far described, the receiver of FIGURE 1 is entirely conventional so that only a brief description of its operation need be recited here. A received color telecast intercepted by antenna 10 is selected by appropriate adjustment of the tunable stages of RF amplifier and first detector 11 wherein it is amplified and converted to an appropriate intermediate-frequency signal which is amplified in amplifier 12. The intermediate-frequency signal is then applied to second detector 13 and to luminance detector 14. The output signal of luminance detector 14 is supplied to amplifier 33 to develop a luminance signal which is applied to the cathodes of electron guns 24-26. The output signal from second detector 13, on the other hand, drives sound system 17 in known manner to produce the audio program accompanying the telecast and is also supplied to color demodulating system 19 through chroma amplifier and band-pass filter 16. The color synchronizing signal generally included in the received telecast is selected in unit 16 and employed to control the operation of color reference generator 18. The reference signal developed by this generator is supplied to demodulating system 19 which also receives the chroma signal from unit 16. Demodulating system 19 develops three individual color difference signals at its terminals R, G and B from which they are appropriately applied to the control electrodes of the assigned electron guns 24-26.

The horizontal and vertical frequency synchronizing components of the received telecast are utilized in sync separator and scan generator 15 to control the vertical and horizontal sweep circuits. Accordingly, appropriately synchronized scanning signals are developed and applied to the deflection yoke 40, 41 of picture tube 21 to deflect the three electron beams issued by guns 24-26 across target electrode 22 and develop the usual image raster thereupon. Since the electron beams are suitably modulated by the luminance information from detector 14 and by the chroma information derived in

demodulating system 19, their traverse of target 22 under the influence of deflection fields of the scanning yoke results in the reproduction of a visual image. Since the parallel electrode or shadow mask 27 enables each electron beam to see but a single color phosphor in its traverse of target 22, the reproduction is, in fact, that of three image fields effective superposed to yield an image in simulated natural color.

The regulated power supply of unit 20 is employed to supply the necessary excitation potentials to the several stages of the receiver and the operating parameters are so adjusted that the image developed on screen 22 is as bright as the power supply capabilities permit. This desired operating condition is maintained so long as the regulating capabilities of the power supply are not exceeded but if the load imposed on the power supply should surpass its regulating ability, defocusing and blooming result as mentioned above. The new and improved arrangement of the power supply and its load in accordance with the teaching of this invention minimizes blooming and defocusing even in the face of abnormally large variations in the load on the power supply. The operation of the invention in achieving that end will be clear from the following consideration of the details of the power supply and its connection to its load.

Referring now more particularly to unit 20, it comprises an electron-discharge device or vacuum tube 50 connected to the horizontal-discharge tube that is included in the horizontal portion of scan generator 15. Their coupling is through a condenser 51 to the first control electrode of tube 50 which is returned to ground through a resistor 52. The cathode is likewise grounded; the suppressor may be connected internally to the cathode and the screen electrode returns to a source Sc of excitation potential through a screen dropping resistor 53. Generally, this screen is bypassed for signal frequencies by a condenser 54. This tube is the usual horizontal output and its anode is connected to a deflection transformer 55 having taps H, H from which the transformer may energize the pair of horizontal deflection coils 41 associated with picture tube 21.

The power supply of unit 20 is integrated with the horizontal scanning system in the usual manner and includes a high voltage source, and a B boost source, and may have a separate supply for such requirements as the screen or electron lens system of the picture tube, if desired. For present purposes, it is sufficient to consider the high voltage source and the B boost source.

The high voltage power supply comprises a diode rectifier 61 having an anode and a filament or cathode. The anode is connected to one terminal of a winding 62 of the output transformer, the remaining terminal of this winding being connected to the anode of discharge tube 50. The cathode of rectifier 61 is coupled to the transformer by means of a winding as represented by the symbol M and is connected in series with a resistor 63 in a conventional manner. A lead from the cathode represented by arrow HV is the high voltage bus for connection with the final anode of tube 21 which has a high voltage terminal likewise designated HV.

The B boost circuit of the power supply includes the usual damper diode 64 having a cathode connected to a terminal 65 of the output transformer and an anode returned to the low voltage or B+ supply of the receiver. The anode is likewise connected to terminal 66 of the sweep transformer through a B boost condenser 67 so that the B supply of the receiver may be augmented in the usual way to energize a B boost bus of the power supply.

A voltage regulator is also provided in the power supply so that the unidirectional operating potentials developed are maintained at substantially constant values in the presence of normal variations of load on the power supply even though those potentials may experience a decrease in value in the presence of abnormally large variations in

5

load which exceed the regulating capabilities. This voltage regulator is shown as a triode vacuum tube 70 having an anode connected to the high voltage bus HV and a cathode connected to the low voltage or B+ supply as shown. The control electrode of tube 70 is returned to its cathode through the parallel combination of a condenser 71 and a resistor 72 and is further connected to the B boost bus through a resistor 73. Resistor 73 is also a portion of a voltage dividing network having additional resistors 74, 75 and 76 connected in series between the B boost bus and a source of negative potential minus B. The junction of resistors 73, 74 is connected to ground through a resistor 77.

The video-frequency channel of the receiver, specifically the luminance channel including luminance detector 14, amplifier 33 and image reproducer 21, constitutes a load on the power supply, being connected thereto by means of the usual coupling through which excitation potentials are established on the tubes thereof from the power supply. As already indicated, both amplifier 33 and reproducer 21 have control electrodes which control an operating characteristic of the luminance channel; in particular, they control the brightness characteristic of the reproducer since amplifier 33 is conductively connected to the cathodes of the electron guns of reproducer 21 to serve as a direct current amplifier. The brightness of the reproducer may, accordingly, be varied as a function of the bias potential applied to amplifier 33 which, at the same time, serves to vary the load that the luminance channel imposes on the power supply.

The bias circuit for amplifier 33 is indicated through the expedient of breaking away a part of block 33 to show the final video amplifier tube 80. There may be preceding stages of amplification but it will be assumed that D.C. coupling is employed from the load circuit of luminance detector 14 to the connection with the cathodes of electron guns 24-26. The bias potential for the control electrode of tube 80 is developed in the power supply 20 and is derived by utilizing resistor 75 of the power supply as a potentiometer and connecting the movable tap thereof through a resistor 78 to the grid of tube 80. Since amplifier 33 is a direct current amplifier, adjustment of the tap of potentiometer 75 in effect establishes the brightness level or operating level of the input circuit of reproducer 21. This may be adjusted to achieve the desired brightness under normal operating conditions.

So long as the received signal causes only normal variations in beam current and therefore only normal variations of load imposed by the luminance channel upon the power supply, the operating potentials developed by the power supply and delivered to the receiver stages remain at substantially constant values. For these conditions, the control electrode of regulator tube 70 is negative with respect to its cathode by a controlled amount since the grid of this tube returns to the junction of resistors 73 and 77 the values of which are selected to make this point negative with respect to the B supply to which the cathode returns. The conductive condition of this tube in conjunction with the load imposed upon the power supply by the several stages of the receiver to which it is connected determine the normal value of the operating potentials delivered. If the load should increase slightly, the magnitude of the flyback pulse developed in the horizontal transformer during retrace tends to decrease which tends to reduce the level of the B boost bus. This, in turn, causes the control electrode of the regulator tube 70 to assume a more negative potential with respect to its cathode than it previously had and thereby causes the regulator tube to become less conductive. Reducing the conductivity of the regulator tube, in effect, reduces the load on the power supply to the end that the operating potentials which it delivers remain substantially constant. In other words, for normal variations in load, the conductivity of regulator tube 70 adjusts the effective load condition as required to maintain constant values of operat-

6

ing potentials and this condition persists so long as the changes in load fall within the capabilities of the regulator tube 70.

Occasionally, the receiver may experience a marked change in load which regulator tube 70 is not, in the absence of the present invention or other auxiliary protective measures, able to accommodate. This may come about, for example, if there is an excessive modulation permitted at the transmitter during the commercial announcement of a telecast in an effect to increase the image brightness for the benefit of the commercial. In the face of a severe increase in load which regulator tube 70 is not able to adjust or accommodate, the voltage developed by the rectifiers of the power supply system decreases; specifically, the B boost bus undergoes a reduction in voltage level. As a consequence, the voltage level falls a corresponding amount along the voltage divider composed of resistors 73-76. As the potential level of resistor 75 drops, the bias applied to the control electrode of amplifier tube 80 become more negative which is a change in bias in a sense tending to compensate the load variations that provoke the decrease in operating potential. In other words, the change in load has been assumed to be the result of an increase in brightness of the reproduced image and the variation in operating bias of amplifier 80 has the net effect of reducing the direct-current component of the television signal to reduce the brightness and restore the operating conditions of the system to represent an effective load for which regulator 70 is able to re-establish and maintain desired constant values of excitation potential.

The described arrangement is an extraordinarily simple protective device which avoids defocusing and blooming without adding in any material way to the complexity or cost of the receiver. It has been convenient to show the control as a bias adjustment on the control electrode of the luminance amplifier although one could certainly apply the same technique to the control electrodes of the image reproducer 21. Since it is necessary to have separate circuits for the control grids of guns 24-26 in a color tube, it is more convenient and practical to resort to varying the operating bias of the grid of the D.C. amplifier as a brightness control in the described manner.

The described variations in operating conditions may manifest themselves in the operation of monochrome receivers as well as color receivers because of abnormally large variations in load upon the power supply. The described arrangement may be employed in either case to compensate for such variations and, in effect, extend the protection of the voltage regulator. The specific disclosure has been directed to a color television receiver for the reason that such receivers undergo the most severe and undesirable changes in operating conditions in the presence of abnormally large variations in load.

While a particular embodiment of the invention has been shown and described, it will be obvious to those skilled in the art that changes and modifications may be made without departing from the invention in its broader aspects, and, therefore, the aim in the appended claims is to cover all such changes and modifications as fall within the true spirit and scope of the invention.

I claim:

1. A television receiver comprising: a power supply, including a voltage regulator, for developing unidirectional receive-operating potentials maintained at substantially constant values in the presence of normal variations in load on the power supply but subject to experience a decrease in value in the presence of abnormally large variations in load and for developing a bias potential likewise having a substantially constant value in the presence of normal variations in load on the power supply but subject to change in value upon the occurrence of and in an amount determined by the magnitude of said abnormally large variations in load; a video-frequency channel including an amplifier device and an image-re-

producing device at least one of which devices has a control electrode effective to control the brightness characteristic of said reproducing device and further to vary the load represented by said channel as a function of applied bias potential; means for connecting said channel as a load on said power supply; and a bias circuit, effective during both normal and abnormal variations in load on said power supply, connecting said control electrode to said power supply for impressing said bias potential on said control electrode with a polarity to control said brightness characteristic in a sense to oppose and thereby compensate said abnormally large variations.

2. A television receiver comprising: a power supply, including a voltage regulator, for developing unidirectional operating potentials maintained at substantially constant values in the presence of normal variations in load on the power supply but subject to experience a decrease in value in the presence of abnormally large variations in load and for developing a bias potential likewise having a substantially constant value in the presence of normal variations in load on the power supply but subject to change in value upon the occurrence of and in an amount determined by the magnitude of said abnormally large variations in load; a video-frequency channel including a video-frequency detector, an image-reproducing device and a direct-current amplifier conductively connected to said detector and to said reproducing device and having a control electrode effective to control the brightness characteristic of said reproducing device and further to vary the load represented by said channel as a function of applied bias potential; means for connecting said channel as a load on said power supply; and a bias circuit, effective during both normal and abnormal variations in load on said power supply, connecting said control electrode to said power supply for impressing said bias potential on said control electrode with a polarity to control said brightness characteristic in a sense to oppose and thereby compensate said abnormally large variations.

3. A television receiver comprising: a power supply, including a voltage regulator, for developing unidirectional operating potentials maintained at substantially constant values in the presence of normal variations in load on the power supply but subject to experience a decrease in value in the presence of abnormally large variations in load and for developing a bias potential likewise having a substantially constant value in the presence of normal variations in load on the power supply but subject to change in value upon the occurrence of and in an amount determined by the magnitude of said abnormally large variations in load; a video-frequency channel including an image-reproducing device and a direct-current amplifier conductively connected to said reproducing device and having a control electrode ef-

fective to control the brightness of said reproducing device and further to vary the load represented by said channel as a function of applied bias potential; means for connecting said channel as a load on said power supply; and a bias circuit, effective during both normal and abnormal variations in load on said power supply, connecting said control electrode to said power supply for impressing said biasing potential on said control electrode with a polarity to control the brightness of said reproducing device in a sense to oppose and thereby compensate said abnormally large variations.

4. A color television receiver comprising: a power supply, including a voltage regulator, for developing unidirectional operating potentials maintained at substantially constant values in the presence of normal variations in load on the power supply but subject to experience a decrease in value in the presence of abnormally large variations in load and for developing a bias potential likewise having a substantially constant value in the presence of normal variations in load on the power supply but subject to change in value upon the occurrence of and in an amount determined by the magnitude of said abnormally large variations in load; a video-frequency channel including an amplifier device and a color-image reproducer, said reproducer having a plurality of electron gun structures having a common cathode and said amplifier being conductively connected to said common cathode and having a control electrode effective to control the brightness of said reproducer and further to vary the load represented by said channel as a function of applied bias potential; means for connecting said channel as a load on said power supply; and a bias circuit, effective during both normal and abnormal variations in load on said power supply, connecting said control electrode to said power supply for impressing said bias potential on said control electrode with a polarity to control the brightness of said reproducing device in a sense to oppose and thereby compensate said abnormally large variations.

References Cited in the file of this patent

UNITED STATES PATENTS

45	2,371,897	Knick	Mar. 20, 1945
	2,752,526	Taylor	June 26, 1956
	2,832,823	Rhodes	Apr. 29, 1958
	2,897,262	Rogers	July 28, 1959

FOREIGN PATENTS

50	548,485	Belgium	Oct. 1, 1956
----	---------	---------	--------------

OTHER REFERENCES

RCA Model 21-CT-8785(U), Chassis No. CTC5F; mfr. No. 274; Service Date 1957 No. T8.